A CONTEXTUAL ANALYSIS OF FLOOD HAZARD MANAGEMENT IN PENINSULAR MALAYSIA

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ABSTRACT

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A contextual analysis of flood hazard management in Peninsular Malaysia

This research seeks to explain the creation and perpetuation of flood hazards in Peninsular Malaysia in terms of a 'hazard response-in-context' model. Socio-political (socio-cultural and political economy) and institutional contexts are found to be central to understanding hazards as essentially socially-created phenomena superimposed onto a physical process system through which hazards are transmitted.

Malaysia is an ex-colonial, newly-industrialising country. The pace of social, economic and political change is fast, as is the pace of technological change. Other things being equal, these are the contexts in which flood hazards are magnified. Contexts are changing, and changing physical systems have given rise to increased flood risk, exposure and vulnerability. Other contexts, largely structural, such as persistent poverty, low residential and occupational mobility, landlessness, and ethnic culture have also contributed to increased vulnerability to flood hazards.

The situation, behaviour and response of individual floodplain occupants in Peninsular Malaysia are found to be heavily influenced by macro socio-political contexts. These are also termed contextual forces and they are fundamentally 'structural'. Macro contexts also 'condition' institutions (meso context) and influence their approach to hazard management including their effectiveness. Institutions (including organisations) were found to be largely inadequate in their management and reduction of flood hazards, and can be improved to create positive influences on flood hazard reduction as well as help individuals (micro context) cope more effectively. Both socio-political and institutional contexts were found to be important as they amplify hazards or fail to adequately address and reduce them. The pioneering of what is termed 'segment analysis' to analyse links between contexts at various levels is an important contribution in this research.

The research concludes that the hazard response-in-context model is appropriately applied to Peninsular Malaysia as it handles both structural and institutional contexts and individual management of flood hazards effectively.

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LIST OF ABBREVIATIONS

AUSTEC	-	Australian Engineering Consultants
BCA	-	Benefit-cost analysis
CBD	-	Central Business District
CHOGM	-	Commonwealth Heads of Government Meeting
cm	-	centimetre
DAP	-	Democratic Action Party
DDRPC	-	District Disaster Relief and Preparedness Committee
DID	-	Drainage and Irrigation Department
EIA	-	Environmental Impact Assessment
EU	-	European Union
FDRPC	-	Federal Disaster Relief and Preparedness Committee
FELCRA	-	Federal Land Consolidation and Rehabilitation Authority
FELDA	-	Federal Land Development Authority
FTZ	-	Free Trade Zone
FWES	-	Flood warning and evacuation system
GDP	-	Gross Domestic Product
GIS	-	Geographic Information System
GNP	-	Gross National Product
ha	-	hectare
IADP	-	Integrated Agriculture Development Programme
IDNDR	-	International Decade for Natural Disaster Reduction
IGU	-	International Geographical Union
JICA	-	Japan International Cooperation Agency
km	-	kilometre
KEMAS	-	Community Development Authority
KESEDAR	-	South Kelantan Development Authority
m	-	metre
MCA	-	Malaysian Chinese Association
MDRPC	-	Mukim Disaster Relief and Preparedness Committee
MIC	-	Malaysian Indian Congress
MIDA	-	Malaysian Industrial Development Authority
mm	-	millimetre
MMS	-	Malaysian Meteorological Service
MNC	-	Multi-National Companies
NDP	-	National Development Policy
NEP	-	New Economic Policy
NIC	-	Newly industrialised country
NRA	-	National Rivers Authority
NSC	-	National Security Council
OPP2	-	Outline Perspective Plan 2
PAS	-	Parti Islam SeMalaysia
PCFC	-	Permanent Commission on Flood Control
PWD	-	Public Works Department
RISDA	-	Rubber Industry Smallholder Development Authority
S46	-	Spirit of 46
SDRPC	-	State Disaster Relief and Preparedness Committee
UMNO	-	United Malays National Organisation
VDRPC	-	Village Disaster Relief and Preparedness Committee
UK	-	United Kingdom
US	-	United States

LIST OF MALAYSIAN WORDS

Adat	-	custom
Air	-	water
Air itam	-	black water
Air terjun	-	waterfall
Alam	-	surrounding/realm
Alam sekitar	-	environment
Allah	-	God
Angin	-	wind
Atap	-	dried palm leaves used for roof tops
Bahasa Malaysia	-	Malaysian language (the national language)
Bandar	-	city
Barisan Nasional	-	National Front
Baru	-	new
Batu	-	mile
Besi	-	iron
Bukit	-	hill/mount
Bumiputra	-	'sons of the soil' (an ethnic grouping which denotes the indigenous peoples of Malaysia)
Bunga	-	flower
Burong	-	bird
Daerah	-	district
Desa	-	rural
Gotong-royong	-	mutual help (usually at the community level)
Hari Raya	-	Islamic/Malay New Year
Hujan	-	rain
Ilmu Alam	-	geography
Jabatan	-	department
Jabatan Pengairan dan Saliran	-	Drainage and Irrigation Department
Jajahan	-	the Kelantanese equivalent of the 'daerah' or district
Jalan	-	road/street
Kajian	-	research
Kak	-	sister
Kampung	-	village
Kedai	-	retail shop
Kenduri	-	feast
Ketua kampung	-	village head
Kongsi	-	shared
Kota	-	township
Laporan banjir	-	flood report
Lembaga Kemajuan Kelantan Selatan	-	South Kelantan Development Authority
Makcik	-	aunty
Majlis Keselamatan Negara	-	National Security Council
Mas	-	gold
Monsun	-	monsoon
Mukim	-	an administrative area between the district and the village
Negeri	-	state
Padang	-	field
Padi	-	paddy

Pakcik	-	uncle
Pantai	-	beach
Pantai dalam	-	interior beach
Paya	-	swamp
Pasir	-	sand
Pasir Mas	-	golden sand
Penghulu	-	village head/head of a group of village heads
Pekan	-	town
Permatang	-	beach ridge
Pertanian	-	agriculture
Pondok	-	hut
Pulau	-	island
Puteh	-	white
Reliabiliti	-	reliability
Relong	-	a traditional Malay areal measurement (1 relong approximates 0.53 hectares)
Rezeki	-	one's share of food and worldly goods
Riba	-	usury
Ringgit	-	Malaysian currency
Rumah rakit	-	raft house
Sahabat	-	friend
Sains	-	science
Sampan	-	canoe
Sekolah	-	school
Semenanjung Malaysia	-	Peninsular Malaysia
Sharia	-	islamic penal law
Sungai	-	river
Surau	-	muslim place for prayers
Tanjung	-	cape
Teluk	-	bay
Timur	-	east
Timur-Laut	-	northeast

NOTES ON MALAYSIAN SPELLINGS, CURRENCY, ETHNICITY AND POVERTY

1. The spellings of place-names in the thesis is in accordance with current Malaysian government policy to use the Malaysian rather than the colonial place-names. For example, the English name for Penang is now officially Pulau Pinang.

2. The currency $ referred to throughout this thesis is the Malaysian Ringgit. In April 1995, $1 Malaysian Ringgit approximates £0.23 Sterling (i.e. £1 = $4.38).

3. In Peninsular Malaysia, Malays (comprising 55.3 per cent of the total population) are considered the indigenous people. Together with the 'orang asli' (aborigines) such as the Sakai, Negrito, Jakun, Senoi and other indigenous minority groups, they are collectively known as 'bumiputeras' or 'sons of the soil'. The orang asli is a minority group (0.6 per cent of total population) largely inhabiting the jungles of the hilly interior and are not included in this research. In contrast, Chinese (33.9 per cent of total population) and Indians (10.2 per cent of total population) were previously immigrant communities and are classified as 'non-bumiputeras'. However, since aborigines are not researched, the terms 'Malays' and 'non-Malays' (mainly Chinese and Indians) are used throughout this thesis for socio-economic and other comparisons instead of the commonly used 'bumiputeras' and 'non-bumiputeras'.

4. In Peninsular Malaysia, the 'poverty line' is defined as the monthly household income level which generates a minimum level of food and other necessities. At 1989 prices, it is estimated to be a household income of $350 per month, and the 'hard-core' poverty line is defined as a monthly income of $175 (Utusan Malaysia 20.6.89). These are the two figures used in framing the questionnaires at the beginning of this research in 1991 and subsequently in the field survey in 1992/93. They, therefore, form the basis on which income analyses are made throughout this thesis. However, whenever necessary, reference is made on price fluctuations over the duration of the research. Adjusted according to the consumer price index, the corresponding figures at 1993 prices are approximately $394 (poverty level) and $194 (hard-core poverty level) per month respectively.

1 AIMS

1.1 Introduction

This research seeks to explain the creation and perpetuation of flood hazards in Peninsular Malaysia in terms of a 'hazard response-in-contexts' model. Response at the individual (household) level is analysed in the context of socio-political[1] (national/international) and institutional[2] (organisational) forces[3].

After more than half a century of hazards research, social scientists (especially geographers) have evolved a considerable understanding of natural hazards from the viewpoint of human ecological adaptation. Early deterministic views of natural hazards (White 1935) were replaced by behavioural-oriented 'hazard response' models developed by North American hazard researchers and dominated the field in the 1960s and 1970s (Burton et al 1978). Towards the end of the 1970s, radical critiques of these dominant models, and new findings and interpretations especially from the Third World, led to the emergence of the 'structuralist' view of hazards which emphasised socio-political reasons for the creation and perpetuation of hazards in poorly developed countries (Hewitt 1983a). Hazards may be viewed as essentially socially-created phenomena superimposed on to a physical process system through which hazards are transmitted (Blaikie et al 1994; Varley 1994). Recent critical philosophical and theoretical development in hazards research has built on the structuralist interpretation and has projected thinking towards a broader contextual view of hazards (Penning-Rowsell et al 1986; Mitchell et al 1989; Palm 1990; Penning-Rowsell Forthcoming). This view makes socio-political, institutional and other contexts central to understanding of hazards.

The current intellectual challenge in hazards research is to conceptualise the links between

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[1] In this research, the 'socio-political context' includes the socio-cultural and political economy contexts. These terms are elaborated in subsequent chapters.

[2] The 'institutional context' refers to legislation, organisational structures, attitudes and sub-cultures, and policies and instruments relating to flood hazards. These are examined in detail in subsequent chapters.

[3] These are contextual forces closely linked to the contexts from which they originate. The term 'forces', when mentioned in relation to the socio-political and institutional contexts, is used throughout this thesis to refer to contextual forces.

the various models and this research attempts this through the development of a particular 'hazard response-in-contexts model'. This is an extension of the contextual model of Mitchell, Devine and Jagger (1989) and incorporates both the behavioural and structural paradigms. While previous hazards researchers have concentrated on parts of this 'model', this research emphasizes the role of 'contexts' as central to understanding the flood hazard in Peninsular Malaysia. Thus, the situation, behaviour and response of individual floodplain occupants in Peninsular Malaysia is conceptualised as being heavily influenced by and in some cases even driven by socio-cultural, political economy and institutional contexts. For instance, individual flood hazard responses are often influenced and heavily constrained by institutional contexts which either amplify hazards or fail adequately to address and reduce them. This view leads to a critical analysis of institutions and the influences which they create, both positive and negative. In turn institutions, as well as individuals and communities of individuals, are subject to socio-political contexts which 'condition' them, 'condition' vulnerability to hazards, and influence their approach to hazard management including its effectiveness. These socio-political contexts are also termed 'structural'[4] forces and they also lead to 'failures' to adequately address hazards.

Malaysia is an ex-colonial, newly-industrialising country, with a high economic growth rate and rising standards of living in recent years (Figure 1.1)[5]. The pace of social, economic and political change is rapid, as is the pace of technological change. Other things being equal, these are the conditions in which we can expect flood and other hazards to be magnified simply because rapid economic change can have dramatic effects on natural and social processes (e.g. the hydrological cycle, floodplain development etc.). However, they are also conditions which produce opportunities for flood hazard reduction. As well as economic development, Malaysia is pursuing goals of sustainable development and social progress embracing ethnic equity (largely in terms of income) and poverty reduction. Flood hazard reduction has an important role to play in achieving these goals and may also benefit from

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[4] In this research, 'structural' forces refer to societal forces operating at the local, national or international level. They include socio-cultural and political economy forces. The structural paradigm/perspective is largely based on the influence of these forces. In contrast, the terms 'structural' approach/measures/methods/schemes are concerned with flood defence and refer to the technological/engineering approaches.

[5] Malaysia comprises Peninsular Malaysia (previously Malaya before achieving independence from the British on 31st August 1957) and East Malaysia (comprising the two states of Sabah and Sarawak on the island of Borneo). This research concerns only the former.

Figure 1.1: Peninsular Malaysia: Political Divisions of States and Districts (Inset - The State of Pulau Pinang).

their achievement, and a critical assessment of flood hazard reduction policies and achievements is therefore required. Two potential strategies of reducing flood hazards are 'flood warning and evacuation systems' and 'income equity', and these are examined in some depth. These two strategies are important issues in the country's development and are viewed as 'segments' of Malaysian society. They provide an ideal focus for examining the links between macro socio-political contexts, institutions and individuals. Their investigation can inform us not only about their current effectiveness in relation to flood hazard reduction, but also about the influence/constraints which macro contextual forces, institutions and individuals have on one another.

1.2 Broad research questions

This research aims to examine the following broad questions:

1 How important is the flood hazard and its effects in Peninsular Malaysia?

2 What are the important contexts responsible for the creation and perpetuation of flood hazard, and vulnerability to flood hazard in Peninsular Malaysia?

3 How and to what extent do the contexts of 'socio-cultural' and 'political economy' forces affect the creation and perpetuation of flood hazards, and condition the flood hazard responses of individuals, communities (groups) and institutions?

4 As part of the context, how adequate are current strategies and policies of the Malaysian government in managing the flood hazard, and to what extent do institutions and organisations affect flood hazard response and how effective are they?

5 How do individuals perceive and respond to the flood hazard, and what are the important factors that affect such perception and response?

6 To what extent do (a) formal flood warning and evacuation systems and (b) official policies on income equity address the flood hazard problem in Peninsular Malaysia, and how can their analysis inform us of the importance of context upon individual flood hazard responses?

1.3 Structure of the thesis

The thesis is divided into nine chapters. Chapter 1 identifies the aims and the focus of the research. Chapter 2 is an introductory chapter presenting an overview of the importance of the flood hazard and its effects in Peninsular Malaysia, the trends and factors contributing to increasing flood risk, exposure and vulnerability, and a detailed discussion of the research methods. Chapter 3 presents a critical review of existing hazards research literature, with special emphasis on flood hazard research. It briefly traces the development of hazards research with contributions from geography as well as from other fields. Various perspectives, paradigms and models of hazards research are examined and a flood hazard 'response-in-contexts' model is conceptualised for Peninsular Malaysia. Key contexts and their facets affecting the flood hazard in the peninsula are also identified. Chapter 4 is an empirical chapter. It analyses in detail the ways in which the two key contexts of socio-cultural and political economy affect the creation and perpetuation of flood hazards. Chapter 5 examines in detail the influence of the key institutional context and its facets on the flood hazard. A 'criteria approach' is employed to evaluate the effectiveness of flood hazard institutions and organisations in managing flood hazards. Results of a questionnaire survey of government officers and private practitioners dealing with the flood hazard are used in this evaluation.

Chapter 6 investigates the reasons for persistent occupation of floodplains, especially those influenced/constrained within contextual forces. It examines individual choice of settlement and the constraints faced by floodplain occupants in choosing to move/migrate when faced with flood hazards. Chapter 7 analyses flood hazard perception and response at the individual level. Results of a household questionnaire survey are discussed. The chapter analyses the significant factors influencing flood hazard perception and adoption of reduction strategies of floodplain occupants. Chapter 8 focuses on what is termed as 'segment analysis'. Two key segments representing key issues in Malaysian society relating to flood hazards are selected. They are the flood warning and evacuation segment and the income equity segment. Both segments are employed to examine the links between contextual forces and individuals, and to demonstrate how contextual forces at various levels can affect overall flood hazard response. Finally, Chapter 9 discusses the main findings and conclusions from this research.

2 BACKGROUND AND METHODS

This chapter presents the background to this research. It comprises an overview of the flood hazard in Peninsular Malaysia focusing on aspects of the natural and human use systems that have contributed to increased flood risk and human exposure and vulnerability. It further examines the extent of flood losses, critically reviews contributions to flood hazard literature, and presents a discussion of the research methods.

2.1 Background to flood hazard in Peninsular Malaysia

2.1.1 Introduction

In Peninsular Malaysia, the flood hazard is caused by a combination of natural and human factors. Malaysians are historically a riverine people as early settlements grew on the banks of the major rivers in the peninsula. Coupled with natural factors such as heavy monsoon rainfall, intense convection rain storms, poor drainage and other local factors, floods have become a common feature in the lives of a significant number of Malaysians.

Floods are the most common natural hazard[6] faced by the inhabitants of Peninsular Malaysia. The peninsula is located in a tectonically stable region between the Sunda and Sahul Shelves. It does not experience intense earthquakes, volcanoes or other forms of earth movements, although landslides are fairly common on a local scale. Furthermore, the peninsula is not in the path of hurricanes or cyclones which can cause disaster. On the national scale, the flood hazard accounts for almost the entire reported annual cost for disaster preparedness, mitigation, relief and rehabilitation.

Compared with the floods in England and Wales which are typically mild and mainly associated with damage to property rather than to loss of life (Neal 1989), or the floods in Bangladesh which can be catastrophic in nature and result in the loss of thousands of lives and major damage (Aysan 1993 p6), floods in Peninsular Malaysia lie somewhere between these two cases. Floods occur annually in the peninsula causing damage to properties and loss of life. It is useful to distinguish between 'normal' from 'major' flood events. 'Normal

[6] The term 'natural hazard' has given rise to much debate. In the context of this thesis, it refers to an event based in nature such as an earthquake, a flood, a drought, a volcanic eruption etc. For a detailed definition see Appendix G.

floods' are seasonal floods which occur annually during the Northeast Monsoon Season between November to March. During these floods the waters do not normally exceed the stilt height of traditional Malay houses. Thus, people living in stilt houses[7] in the rural areas in the East Coast[8] are well adapted to normal floods. It is the major floods, which are 'unusual' or 'extreme' events that render them helpless. 'Major floods' also have their origins from seasonal monsoon rains but statistically occur once every few years (although the historical records show that they can occur in consecutive years, for example in 1970 and 1971 in Pekan). These floods are extensive[9], severe and unpredictable and result in significant loss of life, damage to crops, livestock, property, and public infrastructure (Winstedt 1927). In a major flood, people's coping[10] mechanisms are totally ineffective and they rely on government relief for recovery. During major floods, a flood depth of 3 metres is not uncommon and hundreds of thousands are often evacuated (see Table 2.2). Other classifications such as 'flash flood', 'tidal flood', 'river flood' and 'monsoon flood' may be grouped as normal or major floods depending on the severity (see Appendix G).

[7] In many parts of rural Peninsular Malaysia floodplain inhabitants live in stilt houses, a form of traditional flood proofing. See Figure 2.8 and Chapter 7 for an in-depth examination of the role of stilt houses in individual flood hazard management.

[8] Peninsular Malaysia may be divided into two distinct regions, viz. East Coast and West Coast which are separated by a central mountain range (see Appendix F, Figure F.1). Comparatively, the East Coast is largely undeveloped resulting from a century of colonial neglect, deficient in natural resources and highly flood-prone due to its exposure to the annual seasonal Northeast Monsoon winds. In contrast, the West Coast is highly developed, resource rich, and contains the bulk of the peninsula's economic activities, population, cities and infrastructures. It is seldom affected by monsoon floods except during 'extreme' events. However, because of its rapid development and highly urbanised nature, it is affected by flash floods.

[9] It is not uncommon for a major flood to affect an entire state. For example, the 1971 major flood was described as 'nation-wide' affecting almost every state in the peninsula (see Appendix I).

[10] 'Coping' may be defined as 'the manner in which people act within existing resources and range of expectations of a situation to achieve various ends' (Blaikie et al 1994 p62). In the case of floodplain occupants, it involves managing resources and choosing defence mechanisms (flood reduction strategies) to survive and recover from flood hazards/disasters.

2.1.2 Natural conditions and the flood hazard

The monsoon winds have a profound influence on many aspects of life in the East Coast of Peninsular Malaysia (Monteiro 1962). While the winds bring forth the much needed rains for agriculture, particularly wet rice cultivation, they are also largely responsible for the seasonal occurrence of floods. Floods can be viewed as an extreme event which is both a blessing as well as a curse or as Parker (1991a) puts it:

> 'An interesting characteristic of extreme natural events is that they may be productive resources and hazards at the same time'.

Flooding in the peninsula is both considered a hazard (loss of life and property) and a resource (deposition of fertile alluvium on floodplains).

Peninsular Malaysia experiences a hot, wet humid equatorial climate regime in which the most distinguishing feature is its heavy year round rainfall ranging from 1,500 mm to more than 3,500 mm annually (Figure 2.1). More significantly, however, is the occurrence of sustained heavy rain spells (sometimes for several weeks) during the monsoon season from which a total rainfall of 610 mm within 24 hours is not uncommon (Malaysian National Committee 1976 p561). Being located in the southernmost tip of the Asian Mainland, the Malaysian peninsula is directly in the path of the seasonal monsoon winds. In particular, the East Coast states of Kelantan, Terengganu, Pahang and Johor (see Figure 1.1) are exposed to cold surges of northeasterly winds between November to March (Cheang 1987; Chan 1989). During these months the monsoon winds which originate from the Asian interior bring heavy rains to the entire East Coast as they are moisture-laden after crossing the South China Sea and the Gulf of Siam (Figure 2.2). The seasonal floods in the East Coast are therefore a natural consequence of these heavy rains occurring over a short period of time. Furthermore, when the prevailing easterly winds cross the central mountain ranges of the peninsula, they occasionally cause a 'spill-over' effect bringing heavy rains and subsequent flooding to the West Coast as well. Sooryanarayana (1988) attributes the geographic location of the East Coast states as the main reason for the occurrence of floods as they face the South China Sea and are therefore exposed to onshore cold surges and monsoon disturbances which bring heavy rainfall to the coastal belt and foothill regions. During these Northeast Monsoon months, a monthly rainfall total of 500 mm is not uncommon (Figure 2.3).

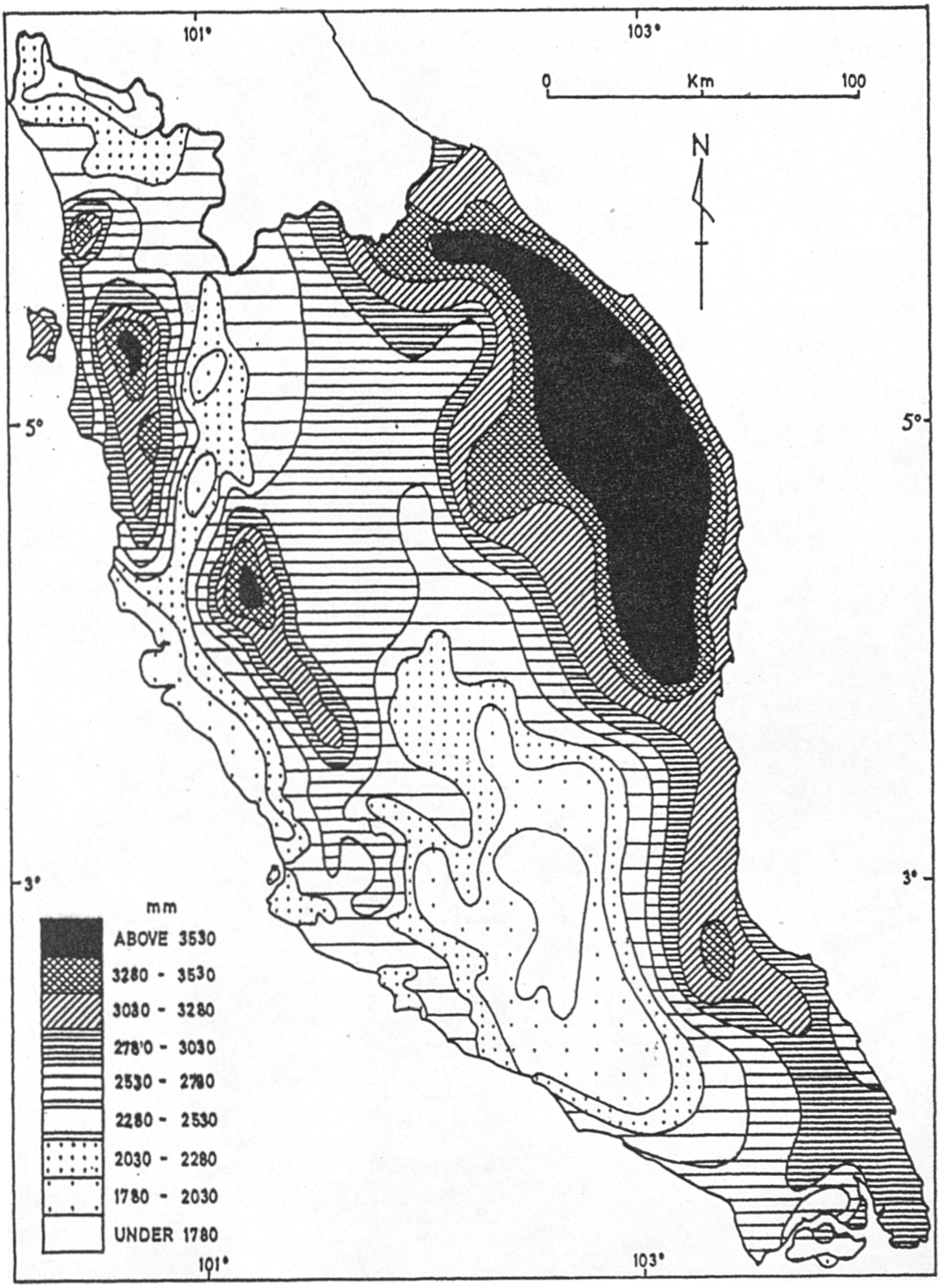

Figure 2.1: Distribution of mean annual rainfall in Peninsular Malaysia (After Dale 1974)

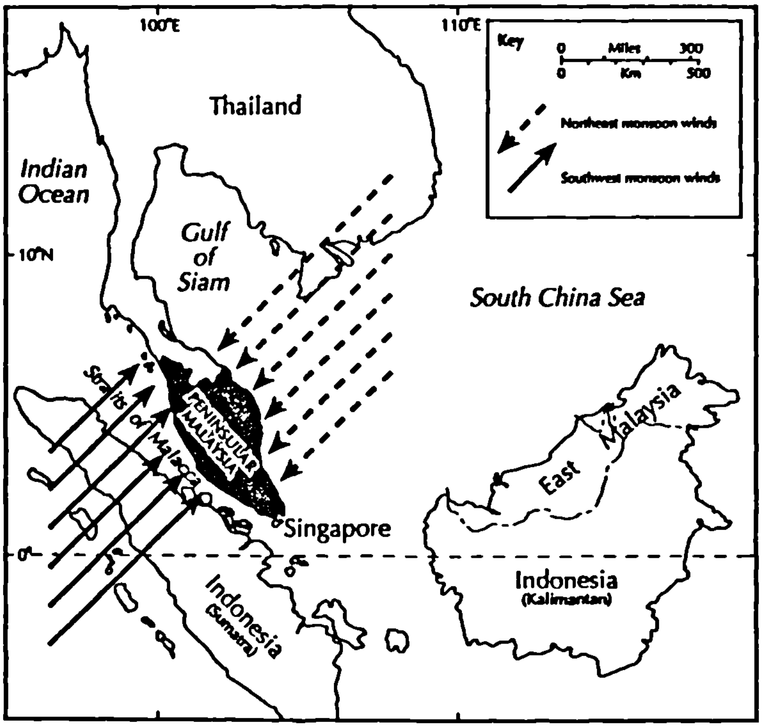

Figure 2.2: Location of Peninsular Malaysia in relation to Monsoon Winds in Southeast Asia

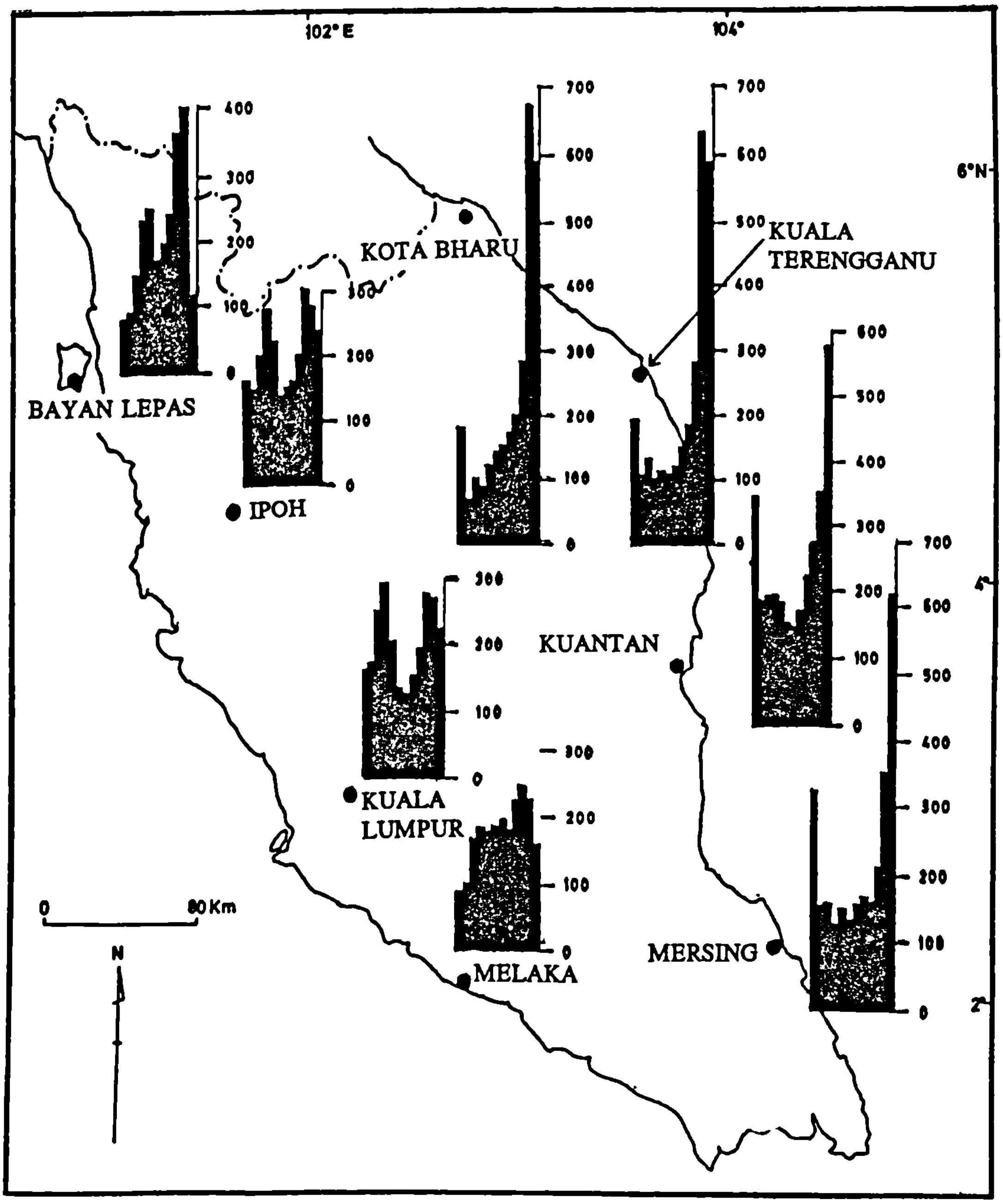

Figure 2.3: Mean monthly rainfall distribution (mm) at selected places in Peninsular Malaysia for the period 1951 to 1987

In general, while localised flooding[11] is mostly due to convectional rain storms, most of the extensive and severe floods in Peninsular Malaysia are associated with the onset of the monsoon seasons. Seasonal floods caused by heavy rains during the Northeast Monsoon period are termed 'monsoon floods'. Consequently, it is not surprising that in terms of flood frequency and magnitude, the four East Coast states are the most susceptible to flooding, each experiencing various magnitudes of flood occurrence almost every year (Table 2.1)[12]. Figure 2.4 illustrates the concentration of the flood events during the Northeast Monsoon months from November to March.

While the Northeast Monsoon is largely responsible for the extensive floods in the East Coast of the peninsula[13], the occurrence of the same phenomenon in the west coast is more localised and associated with the Southwest Monsoon Season (May to September) and two relatively short transitional periods known as the Inter-monsoon Seasons (April and October). During the Southwest Monsoon Season, south westerly winds coupled with small intense and short-lived squalls called 'sumatras' bring rains to the west coast plains, particularly the west coast of Pulau Pinang and the coastal areas of Kedah and Perlis (Chan 1990a). However, the Indonesian island of Sumatra acts as a barrier and these winds do not normally cause large scale floods (Malaysian National Committee 1976 p561) although floods occurring during this period may also be termed 'monsoon floods'. The latter two inter-monsoon seasons are prone to torrential rainstorms. During these two transitional periods when the monsoon winds change directions, light winds and predominantly calm atmospheric conditions coupled with hot and abundant sunshine give rise to intense convection currents which culminate in heavy thunderstorms in the late afternoons (Chan 1990b). These thunderstorms have been shown

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[11] Localised floods are usually flash floods in which the hydrograph shows a rapid attainment of the peak flow (flood peak) over a short period. This could be due to a number of reasons such as accelerated runoff as a result of land use changes, constricted river channels caused by siltation and intense rainfall events such as convectional thunderstorms. Such floods are usually of relatively short duration.

[12] Table 2.1 is an arbitrary classification of flood types by the DID. According to DID staff involved with compiling the annual flood reports (from which the table is constructed), no fixed criteria are applied. Thus, the DID has no systematic definition of 'minor', 'moderate', 'major' and 'flash' floods and this ultimately limits the usefulness of this table.

[13] During extreme events, the Northeast Monsoon may generate 'spill-over' effects across the central mountain ranges on to the West Coast. A good example is the 1971 flood which inundated the Federal Capital and other parts of the West Coast (see Appendix I).

Table 2.1: Flood frequencies of different magnitudes in various states in Peninsular Malaysia (Source: Drainage and Irrigation Department (DID) Malaysia. Definitions of flood magnitudes are based on DID's estimate of the extent and severity of each flood)

State / Year	Kedah	Perlis	Pulau Pinang	Perak	S'gor	Pahang	T'ganu	K'tan	Negri Semb.	Melaka	Johor	Fed. Terr.
1925	-	-	-	*	***	-	-	-	-	-	-	-
1926	***	-	-	***	***	***	***	***	-	-	-	-
1931	-	-	-	***	-	-	-	***	*	-	-	-
1936	-	-	-	*	*	-	-	-	-	-	-	-
1947	*	*	-	***	-	-	*	-	-	-	-	-
1948	-	-	-	*	*	-	-	-	-	-	-	-
1949	*	-	-	-	-	-	*	*	-	-	-	-
1950	-	-	-	*	-	-	-	-	-	-	-	-
1951	-	-	*	*	*	-	*	-	*	-	*	-
1952	*	-	*	*	*	-	-	-	-	*	*	-
1953	-	-	-	*	*	-	-	-	-	-	-	-
1954	*	-	*	*	-	*	***	*	***	***	***	-
1955	-	-	-	*	*	-	-	-	-	*	-	-
1956	-	-	-	*	*	-	*	-	*	-	*	-
1957	-	-	-	*	***	-	**	-	-	-	*	-
1958	-	-	-	*	*	*	-	*	-	-	-	-
1959	-	-	*	*	*	*	*	*	*	-	*	-
1960	*	*	*	*	*	*	*	*	*	*	*	-
1961	*	*	-	*	*	*	*	*	*	*	*	-
1962	*	*	*	*	*	*	*	*	*	-	*	-
1963	*	-	*	*	*	*	-	*	*	-	*	-
1964	*	*	*	**	*	*	-	-	*	-	*	-
1965	*	*	*	**	*	*	***	***	*	*	*	-
1966	*	*	*	**	*	*	*	*	*	*	*	-
1967	**	*	*	***	*	***	***	***	*	*	***	-
1968	-	-	-	-	*	*	*	*	*	*	-	-
1969	-	-	-	*	-	*	*	*	-	-	***	-
1970	*	-	-	*	*	***	**	*	-	-	-	-
1971	**	-	***	*	***	***	**	**	***	-	***	-
1972	*	*	*	**	*	**	**	***	-	***	-	-
1973	*	*	-	**	*	***	***	***	F	-	F	-
1974	*	-	F	*	F	-	**	***	*	-	-	-
1975	*	-	*	*	*	*	*	***	*	-	*	-
1976	*	-	**	-	F	-	*	**	-	-	*	-
1977	*	-	*	-	F	*	-	*	-	-	*	-
1978	*	-	*	-	F	*	***	*	-	-	***	F
1979	-	-	-	-	-	***	***	***	-	-	**	-
1980	-	-	-	-	-	-	-	*	-	-	*	-
1981	-	-	-	-	-	-	-	**	-	-	*	-
1982	-	-	-	-	-	*	**	**	-	-	*	-
1983	-	*	-	-	-	**	***	***	-	-	*	-
1984	*	-	F	*	*	*	-	**	*	**	*	F
1985	F	-	*	-	*	-	-	-	*	*	*	F
1986	F	*	F	*	*	*	***	***	-	-	***	F
1987	-	-	-	*	*	**	**	**	-	-	***	-
1988	***	***	-	-	-	***	***	***	**	*	**	F
1989	-	*	***	*	-	-	***	***	**	*	**	F
1990	**	*	**	*	-	-	*	**	-	-	*	-
1991	-	-	F	-	F	*	*	*	-	-	**	F
1992	*	*	F	-	-	*	-	**	-	F	***	F
1993	*	-	F	-	-	**	***	***	*	*	***	F

Key:	
*	minor flood
**	moderate flood
***	major flood
F	flash flood

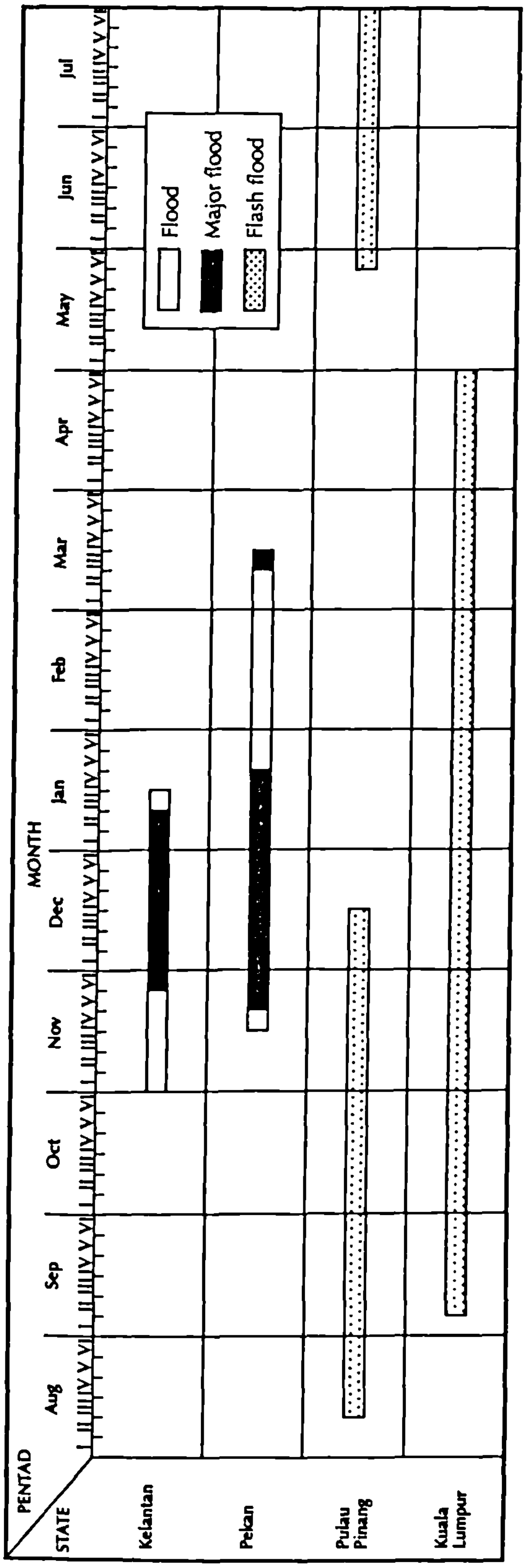

Figure 2.4: Temporal distribution of floods in various states in Peninsular Malaysia (After Sooryanarayana 1988)

to be responsible for 'flash floods' in Kuala Lumpur (Water Resources Committee 1971), Pulau Pinang (JICA 1990), Melaka (Leigh and Low 1983), Kedah (The Star 12.11.90) and Perak (The Star 15.4.91).

Other than the usual monsoon and flash floods, lowly located coastal areas in the peninsula are also susceptible to 'tidal floods'. These occur twice a month during neap tides and are fairly predictable and mild. Consequently, they are not as serious as the former two types of floods. However, tidal surges coinciding with heavy rainfall during the monsoon season can exacerbate both flash and monsoon floods but the flood type is usually categorised as the latter two categories and not tidal. In their accounts of flood causes in the peninsula, the Malaysian National Committee (1976), Leigh and Low (1978) and Sooryanarayana (1988) neither made any mention of tidal flood nor tidal surge. On the whole, the effect of tidal surges do not appear to be significant in Peninsular Malaysia. However, sea level rise is a global phenomenon and is a potentially important factor in assessing possible trends in flood risk. Recent research on the Kelantan river basin, using the Goddard Institute for Space Studies '2 x CO_2' scenario, suggests that change associated with a mean temperature rise of about 3-4 degrees celsius could generate an increase of about 9.0 per cent in river flood peaks (Parry et al 1992). This research, which is based upon the analyses for the Intergovernmental Panel on Climatic Change (IPCC) (1990), also indicates that the effects on sea level rise and tidal flooding in Peninsular Malaysia could be significant. Considering the fact that 50.0 per cent of the country's population live along the coastal zone, with several key cities and industries, tidal flooding caused by sea level rise could become significant (Ch'ng 1993). However, future temperature and sea level rise will depend upon international action in reducing the input of greenhouse gases into the atmosphere and this remains uncertain (Chan and Parker Forthcoming).

Finally, the topography of the peninsula accentuates flood problems. The presence of broad alluvial plains both to the east and west of the central mountain range results in most river profiles with a typically flattened appearance. Furthermore, Quaternary changes in sea-level and progressive sedimentation by the overloaded rivers have raised their base-levels (Malaysian National Committee 1976 p562). This results in rapid runoff in the catchment region and although flood flows are short-lived in the upper reaches, they increase in duration considerably towards the coastal plains (Leigh and Low 1978 p49). Furthermore, the alluvial plains on both the East and West Coasts of the peninsula comprise large expanse of tidal, mangrove and freshwater swamps which are gradually being filled by heavy clay carried down by the rivers. The low-lying swampy topography has resulted in drainage impedance and this leads to frequent flooding. Thus, low-lying topography is as much a contributory factor to frequent flooding in the coastal riverine areas as is heavy rainfall.

Flood-prone areas in Peninsular Malaysia have been mapped by the Drainage and Irrigation Department (DID) on the basis of the extent of past floods. Figure 2.5[14] shows the approximate distribution of flood-prone areas in the peninsula. Most of the extensive flood-prone areas are located along the East Coast.

2.1.3 Flood losses

As a result of seasonal floods occurring almost annually in one part of the peninsula or another, flood losses in terms of loss of life and damages to properties are substantial. The annual costs incurred by the Malaysian government in flood disaster preparedness, rescue and relief operations, and post-flood rehabilitation of victims and public utilities are substantial (Chan 1993 p195). While loss of life due to flooding in the peninsula is not as severe as in Bangladesh or some other countries, it is nevertheless significant (Table 2.2). Flood damages are based on crudely estimated damage to crops and livestock, public structures and properties, and interrupted activities and rescue and relief. The damage figures shown are substantial and would be much higher if damage to private properties is included. Smith (1985) has shown that potential flood damage in large urban centres such as Kuala Lumpur can be high. The Japan International Cooperation Agency (JICA) estimated that the average annual flood damage potential in the whole peninsula is about $72 million at 1982 prices (approximately $92.2 million at 1993 prices) (JICA 1982 pP-14).

During past floods, few estimates have been made of damage to private properties, businesses and industries. Survey results from the current research on actual flood losses of individuals, private properties, businesses and industries reveal that they can be substantial (Appendix K). Such losses comprise both direct and indirect losses as well as tangible and intangible losses. The average losses per flooded household for the most recent and worse floods experienced are $1,393 and $1,837 respectively (both at 1993 prices). These may not appear to be high figures but bearing in mind that 46.9 per cent of households in the survey had

[14] It is not known whether the mapping of flood-prone areas has been accurate and therefore the identified flood-prone areas should be regarded as estimated and approximate ones.

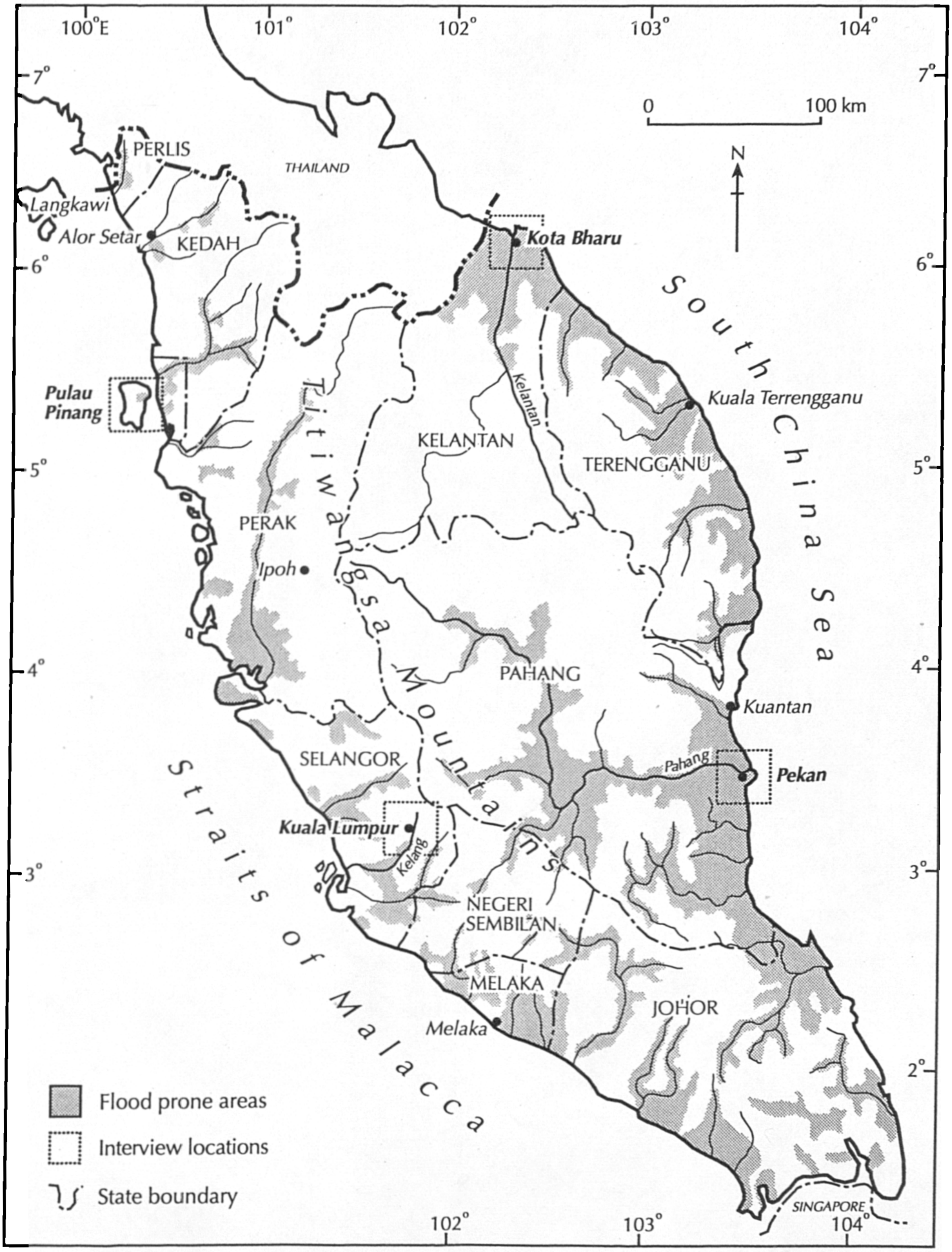

Figure 2.5: Distribution of approximate flood-prone areas in Peninsular Malaysia and interview locations (Source: DID Malaysia)

Table 2.2 : Official flood loss estimates for selected floods in Peninsular Malaysia

Flood Event (Year)	(Place)	Damage ($ million at 1993 prices)	Deaths	Persons Evacuated
1967	Kelantan R. Basin	199.3	38	320,000
1967	Perak R. Basin	154.5	0	280,000
1967	Terengganu R. Basin	40.2	17	78,000
1971	Pahang R. Basin	93.1	24	153,000
1971	Kuala Lumpur	84.7	24	NA
1979	Peninsular Malaysia	NA	7	23,898
1982	Peninsular Malaysia	NA	8	9,893
1983	Peninsular Malaysia	NA	14	60,807
1984	Batu Pahat R. Basin	20.3	0	8,400
1986	Peninsular Malaysia	NA	0	40,698
1988	Peninsular Malaysia	NA	37	100,755
1988	Kelantan R. Basin	33.0	19	36,800
1991	Peninsular Malaysia	NA	11	NA
1992	Peninsular Malaysia	NA	12	NA
1993	Peninsular Malaysia	NA*	22	17,000

NA = Not Available
* In the state of Kelantan, a total of 200 schools were closed during the 1993 flood resulting in 113,000 students missing school for a total of between 6 to 11 days.

(Source: DID Malaysia and Malaysian National Security Council) monthly incomes below $500, these losses are significant. In the business damage survey, all businesses suffered some form of losses. 58.9 per cent of businesses suffered losses more than $1,000 during their most recent flood. Of more significance is the fact that 9.3 per cent suffered losses greater than $10,000. Industrial flood damages are also considerable as production shifts had to be stopped or run at less than full capacity, and there was damage to goods and machinery. The current study on industrial damages reveals that damages vary between $10,000 to $500,000 per factory, depending on the type and size of industry. A detailed discussion of flood losses of households, businesses and industries based on survey results of this research may be found in Appendix K.

2.2 Human use of floodplains

The lure and attractiveness of the floodplain as a place of occupancy is well documented (White et al 1958; Parker 1976; Smith 1992 pp230-1; Alexander 1993 p131). In Peninsular Malaysia, it has been estimated that approximately 2.5 million people[15] live in floodplains and are vulnerable to flood of varying probabilities (JICA 1982 pP-14). Floodplains are also regions where a significant proportion of the peninsula's population and much of the economic activity are concentrated (Leigh and Low 1978 p49). Table 2.3 indicates the extent to which populations have settled on urban centres in the floodplain regions in the peninsula. The three largest urban centres in the peninsula are located on floodplains and are susceptible to frequent flooding. In addition, five of the top ten urban centres and more than half of all urban centres are located on flood-prone areas. Urbanisation may well accelerate in the near future as Malaysia pushes further towards goals of rapid development and income equity. The Malaysian economy has grown by over 8.0 per cent per year from 1988 to 1993 and indications and projections point to it at least maintaining that momentum over the medium term (The Economist July 1994 p61). With such a rapid growth rate existing urban areas will expand and many rural areas will be transformed. Also, the government's policy for greater income opportunity and equity amongst the various ethnic groups may well force the predominantly rural Malays to abandon their traditional padi[16] (paddy) farms and to move

[15] Based on the country's annual average rate of population increase of 2.5 per cent between 1982 and 1993 (Government of Malaysia 1991a p28), the total floodplain population would be 3.3 million in 1993. This figure is expected to be higher if rural-urban and international migration (mostly Thais and Indonesians) are taken into account.

[16] Padi is the main food crop cultivated in Peninsular Malaysia. From it comes rice, which forms the staple diet of Malaysians from all ethnic groups.

Table 2.3: Rate of increase in the population of major urban centres located on the banks of major rivers in Peninsular Malaysia between 1957 and 1990

Centre	River	1957 Population	1990 Population	% Increase
Kuala Lumpur(1)*	Kelang	316,200	919,600	190.8
Ipoh(2)	Kinta	125,800	293,849	133.6
Georgetown(3)	Pinang	234,900	248,241	5.7
Johor Bahru(4)	Johor	75,100	246,395	226.6
Kelang(6)	Kelang	75,600	192,080	154.1
K. Terengganu(7)	Terengganu	29,400	180,296	513.3
Kota Bharu(8)	Kelantan	38,100	167,872	340.6
Kuantan(11)	Kuantan	23,100	131,547	469.5
Melaka(12)	Melaka	69,900	87,494	25.2
Alor Setar(15)	Kedah	52,900	69,435	31.3
Muar(16)	Muar	39,100	65,151	66.6
Batu Pahat(17)	Batu Pahat	40,000	64,727	61.8
Keluang(20)	Mengkibol	31,200	50,315	61.3
Teluk Intan(21)	Perak	37,000	49,148	32.8
Sungai Petani(22)	Merbok	22,900	45,343	98.0
Dungun(29)	Dungun	12,500	28,903	131.2
Kulim(31)	Kulim	17,600	26,817	52.4
Kemaman/Cukai(43)	Kemaman	NU	15,952	NA
Kuala Kangsar(45)	Perak	15,300	14,539	-5.0
Mersing(48)	Mersing	NU	13,888	NA
Pasir Mas(50)	Kelantan	NU	13,402	NA
Tangkak(52)	Tangkak	NU	13,251	NA
Kota Tinggi(53)	Johor	NU	13,056	NA
Ampang(54)	Kelang	NU	12,987	NA
Kuala Krai(57)	Kelantan	NU	12,607	NA

NU = Non urban NA = Not Applicable
* Figures in brackets indicate the ranked position of urban centre in terms of total population.

(Source: Karim 1990 p78-9)

into jobs in urban centres. According to Mahathir Bin Mohamad (1970 pp107-14), the current prime minister, the Malays must be urbanised and encouraged to migrate to urban centres (mostly dominated by Chinese), to stand any chance of catching up with the other ethnic groups.

All of these impending developments will undoubtedly lead to further swelling of urban population, thereby exacerbating the pressures for floodplain encroachment in urban centres located on or adjacent to floodplains. The rate of urbanisation in the peninsula has increased more than four fold from 10.7 per cent in 1911 to 44.7 per cent in 1990, and the number of urban centres has also increased more than eight fold (Table 2.4). For example, the federal capital of Kuala Lumpur is expected to merge with the nearby urban centres of Petaling Jaya, Shah Alam and Kelang into a continuous conurbation stretching the entire length of the Kelang River valley by the year 2020 (Figure 2.6). It is expected that the total urbanised area in the Kelang valley would be about 44.0 per cent in the year 2005 but the middle section of the valley around this conurbation would be 80.0 per cent urbanised (JICA 1989 pD-17).

There are many reasons why floodplains have been preferred locations for early settlements. The peninsula comprises numerous rivers and a central mountain range flanked by flat marshy swamp-land near the coastline. The early settlers must have found the floodplains between the mountain range and the marshy swamps suitable for agriculture and easily accessible by river. As a result, early Malay settlements grew rapidly on the banks of rivers, particularly at their confluences and estuaries (Plates 2.1 and 2.2). It is not surprising, therefore, to find that most of the major cities and towns in Peninsular Malaysia are located near to or just beside the major rivers (Figure 2.7).

Despite susceptibility to frequent flooding, floodplain occupation has progressively increased. This is because the social, economic and other benefits of inhabiting and using floodplains are often perceived to outweigh the negative effects of flooding (Alexander 1993 p131). Floodplain encroachment has become more and more difficult to control. Floodplains are continually enriched with deposits of fertile alluvium and soil moisture for agriculture, most notably for padi. Such alluvium is impermeable and ideally suited for wet padi cultivation. Furthermore, as floodplains are never too far from rivers the availability of irrigation is an added bonus for agriculture. Irrigation has enabled padi to be cultivated twice a year (Chan 1991a). In the early days of settlement when roads were few and far between, communicating through the thick equatorial forest between settlements was difficult. Consequently,

Table 2.4: Increasing rate of urbanisation in Peninsular Malaysia, 1911 to 1990

Year	Total Population	Percentage Urban	Number of Urban Centres
1911	2,339,000	10.7	8
1921	2,907,000	14.0	14
1931	3,788,000	15.1	16
1947	4,908,000	15.9	20
1957	6,279,000	26.6	36
1970	8,810,000	28.7	49
1980	11,473,000	37.5	68
1985	12,968,000	41.1	NA
1990	14,605,000	44.7	NA

NA = Not Available

(Source: From Ooi 1979 and International Law book Services 1991)

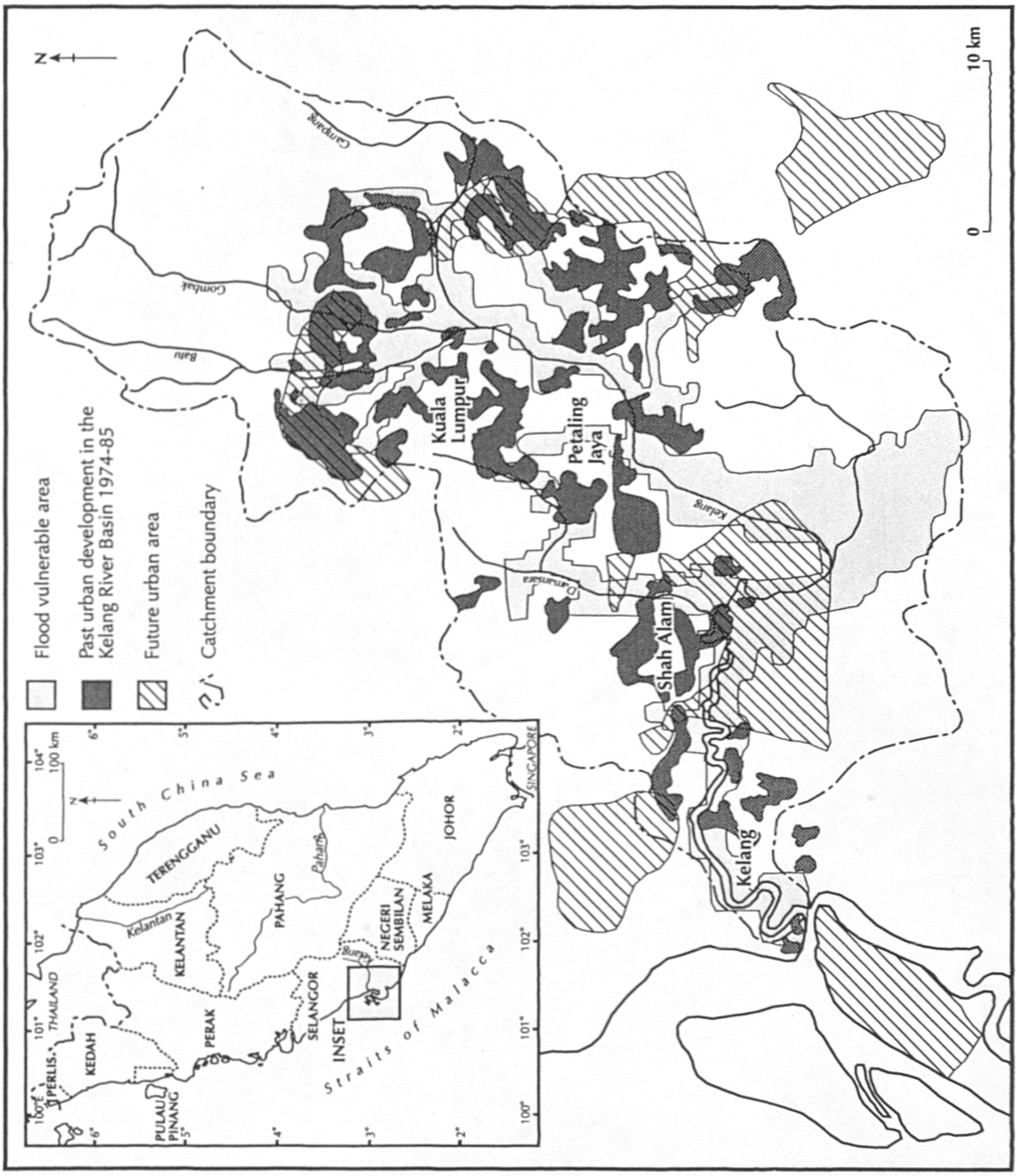

Figure 2.6: Future expansion of urbanised areas in the Kelang River Basin (After JICA 1989)

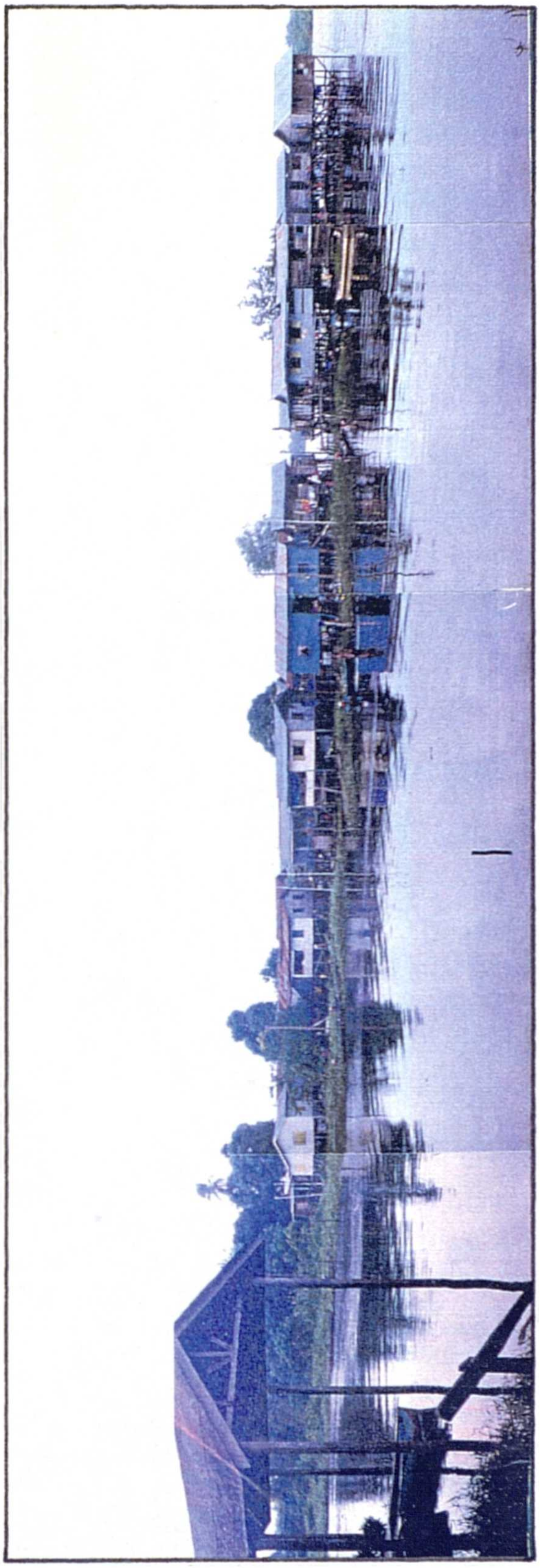

Plate 2.1: Location of Pekan Town (foreground) on the southern bank of the Pahang River and that of Pulau Pekan Baru (background) in the shallow waters of the same river

Plate 2.2: Top: The federal capital of Kuala Lumpur was founded at the confluence of the Gombak and Kelang Rivers. This area is now the Central Business District of the city. Bottom: A lower section of the Kelang River showing embankment of the channel

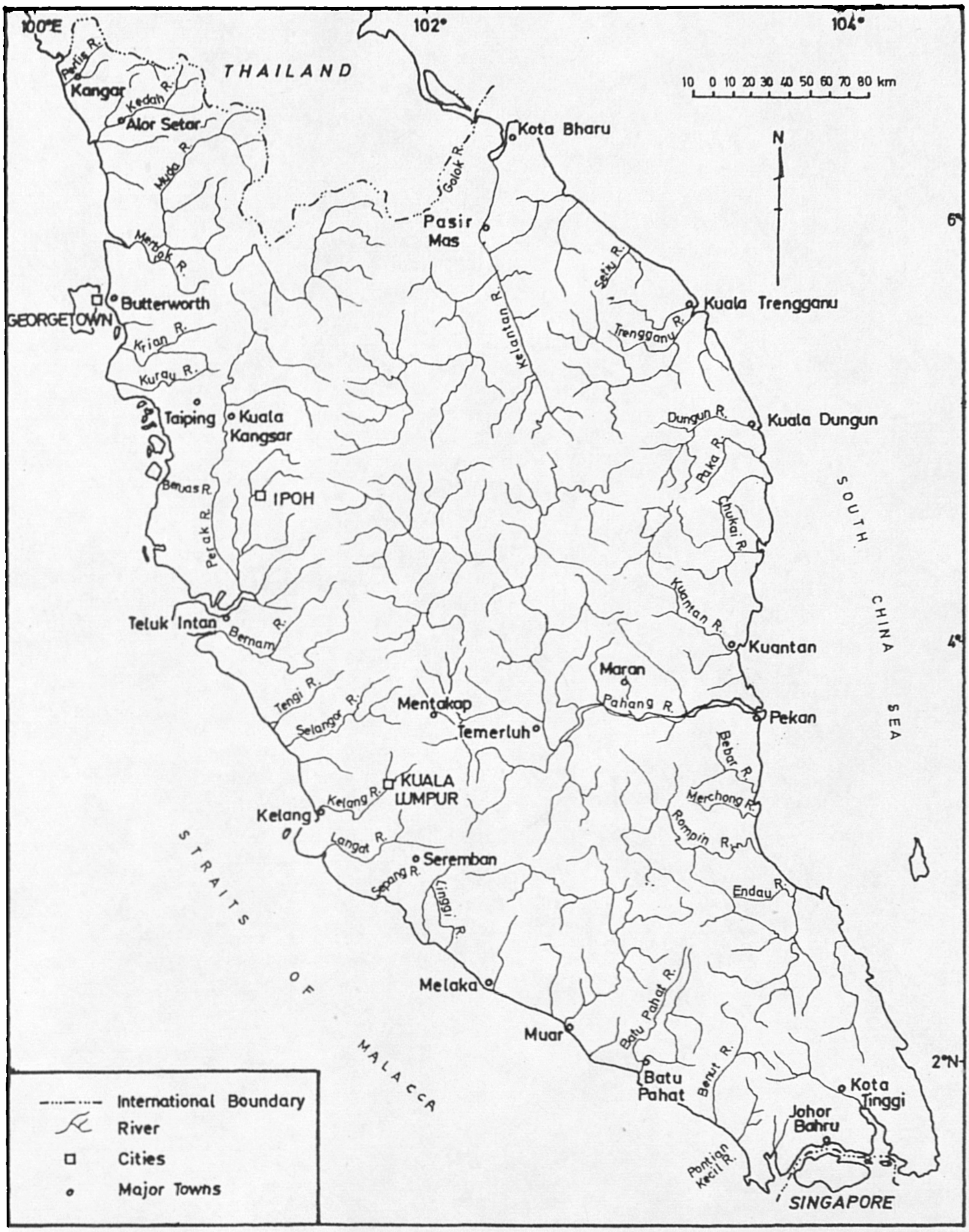

Figure 2.7: Distribution of cities and major towns in Peninsular Malaysia in relation to river systems

settlements flourished beside the major rivers because of the ease of riverine communication and transport. Today, although river communication has declined considerably due to the vast improvement in roads and railways, many rural settlements still depend on it. Rivers also serve as the main source of domestic water supply. The headwaters of many rivers in the peninsula are used as catchment areas and many are dammed as reservoirs. Some examples are the Kelang gates Dam on the Kelang River and the Kenyir Dam on the Terengganu River. Rivers also provide a basic form of rich protein from fisheries and edible freshwater plants. As padi farming usually involves only two months of intensive work during the year, farmers are left with plenty of time to get involved in supplementary income generating activities. Fishing is one such activity.

Towards the mid-19th Century tin mining became an important economic activity in the peninsula. It was also an activity which exacerbated the flood hazard as forested land was cleared for mines, the disposal of tailings caused siltation of rivers, and abandoned mines increased rates of erosion (Leigh and Low 1978). Miners discovered that many floodplains of the peninsula, notably the Kinta and Kelang Valleys contained rich deposits of alluvial tin[17] washed down from the foothills. This created a 'tin rush' which sparked an influx of immigrants, notably Chinese into the peninsula. Not only did the immigrants build settlements on the floodplains but also around the mines. In fact, some of the major urban centres in the peninsula today originated as mining towns. They include the two largest cities Kuala Lumpur and Ipoh, and Seremban, Taiping, Ampang, Kampar and others. Some properties adjacent to riverine areas may also command high property values because of their locational values. Such is the case of properties in and around the confluence of the Kelang and Gombak Rivers in the heart of Kuala Lumpur. Finally, in much of the peninsula a combination of population pressures (due to population increase and rural-urban migration) and rapid development in urban centres has forced many people to inhabit the more hazardous zones not previously occupied on the floodplain.

To the indigenous Malays whose ancestors have lived on the floodplains for centuries, floods have become an integral part of their history and culture. This is especially so in the case of rural Malay peasant farmers and fishermen who regard seasonal flooding as something to be expected and as part and parcel of their life. Living on floodplains is second nature to them

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[17] It was the discovery of rich alluvial tin deposits in the early 19th century that triggered off 'in-migration' of the Chinese from China and later of the British intervention in the Malay peninsula which led to almost three-quarters of a century of British colonial rule.

and cohabiting with the flood risk for long periods has made them well adapted to the flood hazard. A good example of the traditional 'natural style' adaptation to floods that has evolved through the centuries amongst Malay society is the 'stilt house' (Figure 2.8). Living in stilt houses enables most families to cope reasonably well with 'normal floods', i.e. those with flood depths below the height of the stilts. It is this, amongst other reasons, which largely accounts for their reluctance to leave the flood-prone area and relocate elsewhere, despite encouragement by the government (Chua 1972).

The above discussion demonstrates that a combination of natural flood-producing mechanisms and human-use of floodplains has resulted in increased risk and exposure to floods in Peninsular Malaysia. While 'risk' may be defined as the probability and other physical characteristics of hazards, it is essentially a product of hazard and vulnerability as 'there is no risk if there are hazards but vulnerability is nil, or if there is a vulnerable population but no hazard event' (Blaikie et al 1994 p21). Heavy monsoonal and convectional rainfall, flat topography on both coasts, heavy siltation of rivers, and human activities have all contributed to high flood risk. Risk is increasing because flood characteristics are changing due to rapid urbanisation of catchments (Yaziz and Sulaiman 1985; Friends of Penang Hill 1991; Hamirdin 1992). Deforestation and other environmentally damaging human land uses have also significantly altered hydrological parameters. Research has revealed that significant water yield increases occur after deforestation (Abdul Rahim 1988, 1990; Abdul Rahim and Harding 1992), and that commercial logging resulted in significant increases in storm flow volume and initial discharge (DID 1986). Other human activities such as tin mining have also contributed to flooding. Climatic change inducing sea level rise may also be an important flood inducing mechanism which can increase future flood risk (Parry et al 1992). Flood reports for the period 1925 to 1992 (see Table 2.1) also suggest that flooding has become progressively more frequent, with flash floods mainly affecting the federal capital and Pulau Pinang. Flooding magnitudes have also appeared to have increased since the 1970s (a period of rapid economic development) in the East Coast states. The physical contexts of floods have, therefore, changed. Together with greater exposure and vulnerability of human populations (see below), it has contributed to increased flood risk.

'Exposure' is a measure of the population at risk. As the peninsula's major cities grew they spilled onto floodplains progressively increasing flood exposure (Chan and Parker Forthcoming) and flood damage potentials (Figure 2.9). Some prominent examples are the rapid development of the Kuala Lumpur-Petaling Jaya-Shah Alam-Kelang conurbation and

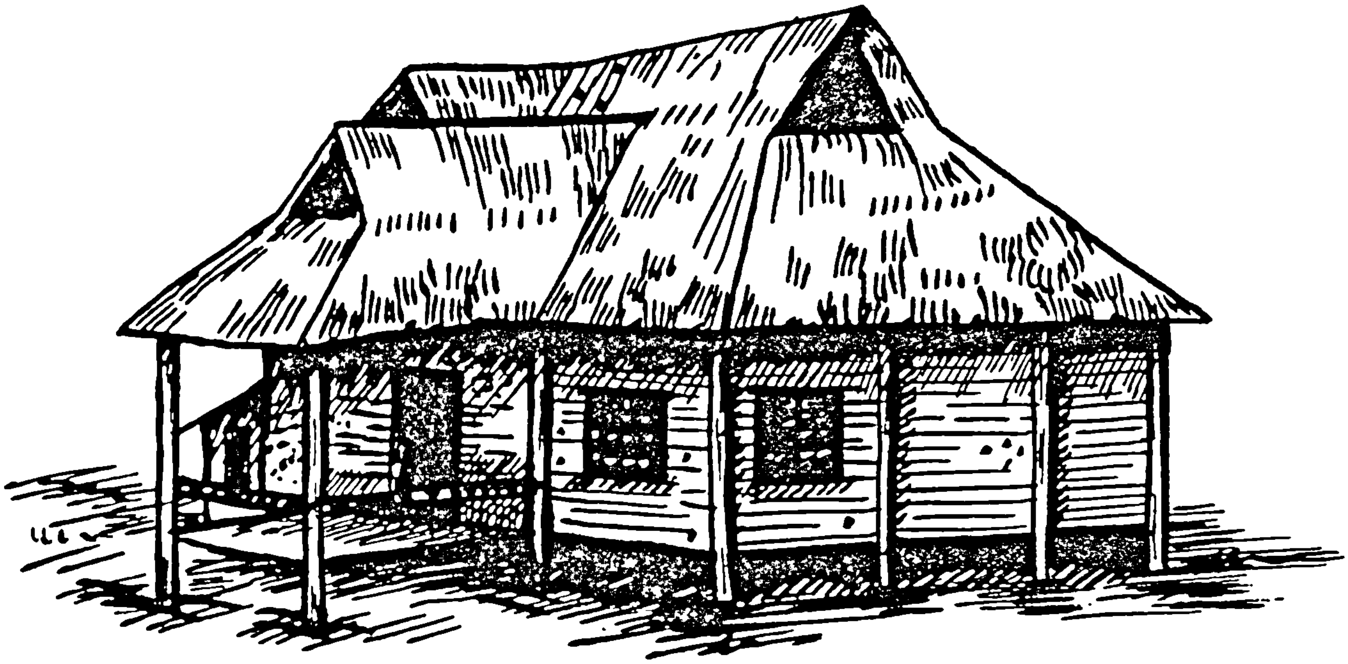

Figure 2.8: A typical stilt house in Peninsular Malaysia

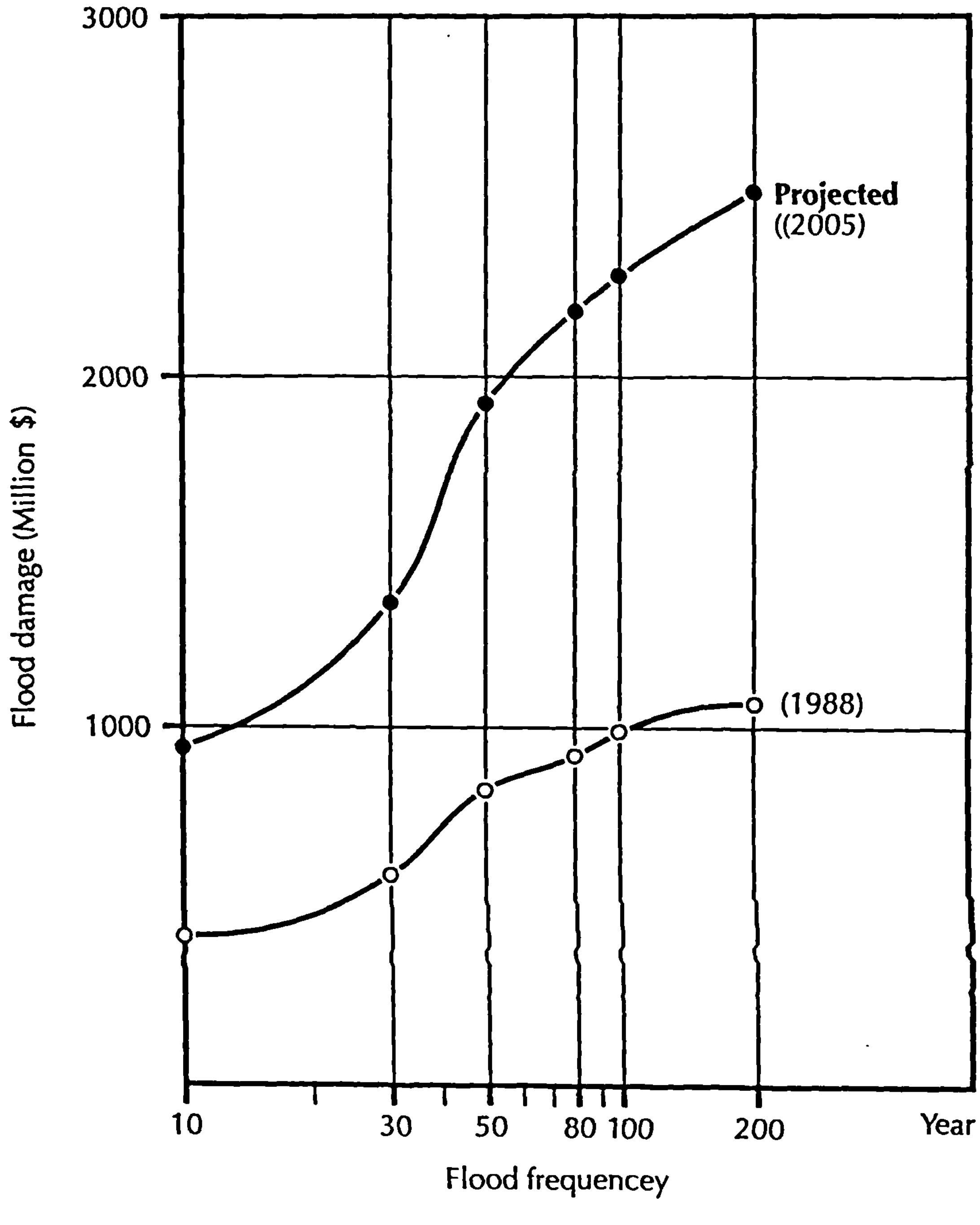

Figure 2.9: Projected flood damage potentials for Peninsular Malaysia (After JICA 1989)

rapid industrialising Georgetown. Expansion in existing urban areas (the majority of which are already on floodplains) due to population expansion and rural-urban migration have also forced people to inhabit the more hazardous parts of existing floodplains. A 'classic' result of urban encroachment of floodplains is the growth of a large squatter population in the major urban centres (Wan Abdul Halim 1982).

If 'vulnerability' is defined as 'the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural disaster' (Blaikie et al 1994 p9), then Peninsular Malaysia is a prime example where increased vulnerability is found. The outstanding feature of the peninsula is its wide disparity in regional development (mainly between the East Coast and West Coast states) and its extremely variegated ethnic mix which also exhibit significant differences in incomes. Those who find it hardest to recover from a flood disaster and reconstruct their lives are the most vulnerable, and these are generally the poor. And because those who occupy floodplains are the poor (comprising peasant farmers and fishermen in rural areas and squatters in urban areas), they are the most vulnerable (see Chapter 6). Thus, the poverty syndrome is directly related to vulnerability (Davis 1978 p11, 1981 p14). Increased vulnerability to flood hazards in Peninsular Malaysia, therefore, is caused fundamentally by poverty and is persistently reinforced by increased flood risk and exposure. Vulnerability, however, should not be simply equated with poverty. There are other causes such as class, caste, gender, ethnicity, disability, and age or seniority, and vulnerability is produced by a combination of these factors and the economic resilience (i.e. access to resources and poverty) of people (Blaikie et al 1994 p9; Cannon 1993; Cannon 1994 p27). Nevertheless, many would agree that, in practice, it is the poor who suffer the most in a disaster (Cuny 1983; Davis 1984a; Varley 1994), and flood disasters may be found at the interface between flood hazards and vulnerable conditions (Davis 1984b p6). A detailed examination of how the natural and the human use systems have contributed to increasing flood risk and human exposure and vulnerability in four selected study areas in the peninsula may be found in Appendix E.

2.3 Methods

This research adopts the triangulation strategy by engaging a combination of complementary research methods which includes the 'cultural insider' observer approach (i.e. by the author), historical analysis, institutional analysis using the 'criteria approach', quantitative and qualitative surveys and case studies. The 'cultural insider' approach involves asking research questions as an 'observer-participant'. It is employed in the analysis of government, institution and individual response to the flood hazard. Historical analysis is used to study how broader socio-political contextual forces have created and perpetuated the flood hazard. Institutional analysis is based mainly on the criteria approach but some observer participation was also used in evaluating flood hazard institutions and organisations (both quantitative questionnaires and qualitative interviews are administered to government officers). The case study method is employed to study individual/household perception and response. In this method, both quantitative and qualitative surveys are used within each of four selected case studies. The merits and demerits of each method are outlined in Table 2.5 and examined below.

The employment of more than one research method to approach a research question, or 'triangulation', is becoming increasingly common (Fordham 1992 p88). Triangulation is now a preferred research strategy and is recommended in the literature because of its advantage of possessing the merits of all methods adopted while simultaneously reducing the demerits inherent in them (Frankfort-Nachmias and Nachmias 1992 p197; Denzin 1970; Marshall and Rossman 1989). In this way, triangulation contributes to the overall effectiveness of the study. The various research methods adopted are complementary rather than contradictory because different areas/objectives in the study are better tackled by some research methods than others.

2.3.1 Perspective and interpretation as a 'cultural insider'

It has been said that 'all social science research begins and ends with observation' (Frankfort-Nachmias and Nachmias 1992 p199). The observational method, whether an insider or not, is often used in social science research such as social anthropology (Spradley 1980), sociology (McCall and Simmons 1969; Jorgensen 1989) and psychology (Ekman 1957; Weick 1985). Ethnographic fieldwork requires the researcher to live and work in the communities being studied. The researcher has to participate in activities, ask questions, eat strange foods, learn new languages and watch ceremonies. In geography, although direct observational methods are indispensable to physical geographers, human geographers have not used them extensively. This is true of the sub-branch of natural hazard studies in geography which has been criticised as overly dependent on the quantitative questionnaire survey (Torry 1979a p369). However, some hazard researchers have employed observational methods as a supplementary to basic questionnaire survey. For example, Ramachandran and Thakur (1974)

Table 2.5: Principal research methods and their main merits and demerits

Method	Qual/ Quan.	Merits	Demerits
Perspective and interpretation as a 'cultural insider'	*	-Supplementary to social survey -Familiarity and knowledge of society, institutions and official procedues -Language skill -Indepth cultural understanding -Directness -Natural settings, reduces artificiality -Easy to be participant observer -Informal interviewing -Familiarity with study area -Easy access to official data and official interviews -Part of the official set-up when undergoing attachment	-Not suitable for large populations -Not suitable for studying causal relationships -Not suitable for studying abstract phenomena -Cultural 'blindness' -Penalties of being too critical in Malaysian society -Constraints in ethnic sensitivities -Constraints of being a government servant
Case study	* o	-Indepth analysis -Can be exploratory, descriptive and explanatory -Can be quantitative -Possesses explanatory power -Comparative studies possible	-Lacks quantification -Cannot generalise findings -Not rigorous
Historical analysis	* o	-Easy access to recorded materials -Can be done mostly in libraries and archives -Suitable for studying countries with a historical background that influences present conditions -Provides the background without which a thorough understanding is impossible -Some degree of quantification	-Accuracy depends on accuracy of historical records -Biasness of western historians -Anti-colonial feelings of local writers and historians -Some official records are classified -Slow and tedious -More qualitative
Institutional analysis using 'Criteria Approach'	* o	-Easy to conduct study as part of the official set-up -Flexibility -Easy to manage -Indepth analysis -Minimal travelling cost	-Lacks objectivity -Qualitative nature -Constraints and penalties of being too critical -Classified information not released -Suspicion on the part of employees leading to non-cooperation
Social survey/ questionnaire interviews	* o	-Flexibility in questioning -Control of interview situation -Additional information possible -Quantitative -Scientific approach -Predictive ability -Sampling facilitates less work and saves time and resources -Findings can be applied to a larger population -High response rate -Collection of supplementary information	-Preoccupied with causality -Focus on individual unit of analysis -Results can be erroneous -High cost -Inaccessibility of remote areas -Interviewer bias -Lack of anonymity -Low speed
Unstructured interviews	*	-Flexibility without rigid questionnaire -Can be supplement to social survey -Indepth analysis -Offers respondent a pressure-free atmosphere -Low cost	-Too dependent on expertise and objectivity of interviewer -Open to biasness of interviewer -Too qualitative in nature -Non-predictive tool -Sample size too small -Haphazard and uncontrolled sampling
Segment analysis	*	-New and innovative -Able to research a problem through various contexts -In large populations main segments can be identified for study -Indepth analysis of single segments possible	-No literature for reference -Not all segments can be studied -Qualitative in nature -Highly dependent on expertise of researcher

* - Qualitative
o - Quantitative

used a research strategy combining careful field observation with intensive interviewing to study flood response in India. Heijnen and Kates (1974) also drew on observations when the former spent several years of intensive work and study in Northeast Tanzania.

In this research, familiarity and deep understanding of Malaysian culture in terms of its history, politics, government set-up, and its multi-racial society is a methodological strength brought by the author. In the interpretation of events and response to the flood hazard, the author does so, not just as a member of Malaysian society, but also a government officer drawing upon seventeen years of experience in government service. This experience serves well as a vehicle of access to many government reports, interviews with senior government officials and other avenues. Attachment at the federal DID, various state DIDs and the Malaysian Meteorological Service (MMS) also helped in many ways in the collection of data and the evaluation of each organisation. The author was attached to the federal DID in Kuala Lumpur for two months and in the Kelantan, Pulau Pinang and Pahang state DIDs for shorter periods ranging from two weeks to a month each. He was also attached to the MMS for a month. The aim of these attachments was to observe and study each organisation. As the author was treated as a member of staff (albeit on a temporary basis) he can observe the functioning of each organisation. Of more significance are the casual discussions with staff of middle and lower management during coffee and lunch breaks. These discussions usually bring out revealing responses from the staff as they are more open to talk about their grievances and opinions of their organisation and other related organisations. There is simply no fear of being victimised by their superiors. Under the constraints of an official interview, responses from them are bound to be rather subdued and thus do not represent the real scenario. First hand experience and observation was also gained when the author spent three months living in a Kampung Tendong, a remote village near the Kelantan river from November 1992 to January 1993 during which time flooding occurred twice. Other than these advantages there are other merits in using the observation and interpretation of a cultural insider.

One important merit is that the cultural insider's conception of reality is not directly accessible to aliens, outsiders, or non-members, all of whom necessarily experience it initially as a stranger (Schultz 1967). It is not possible to acquire a small section of the cultural world of the insider until one has learned the language and understood the culture. This is the greatest merit of the insider approach. Without insider knowledge, the researcher has to go to great lengths before beginning to study the insider's world. Davis (1981 p21) recognised the dangers of cultural detachment which face research workers from western developed countries working in the Third World. These researchers often fail to grasp the realities of local cultures and are too ready to project western values, often resulting in a vast gulf in terms of academic elitism, language barriers, geographical remoteness and income levels of consultants vis-a-vis local families. Cultural collisions between upper class disaster workers and lower class disaster victims have also been noted by Oliver (1981). To overcome this problem, outsiders have to study the local culture before embarking on the research proper. For instance, Hayano (1982) had to learn to play poker and later become a professional poker player as part of his participant observational investigation of poker players. Another researcher, Douglas became a nude beacher in order to study the nudists but later reversed his role when he participated as a member of the home owners's association opposed to the nude beach (Douglas et al 1977). In the case of the current research, there is no such problem. As an informed member of the culture under study the author uses this advantage to effect in the analysis of many aspects of the flood hazard in the contexts of the historical, socio-cultural, political economy and institutional forces. Living amongst the flood victims certainly helped to deepen his understanding of how individuals in the peninsula perceive and response to the flood hazard. This 'observer-participant' role is made more relevant in the context of this research as it draws upon 20 years of academic experience with numerous publications on hazards research and a Masters thesis *on the drought hazard in Peninsular* Malaysia (Chan 1981a).

Another important merit of the method is its directness, which makes it possible to assess behaviour as it occurs. During a flood event, people's behaviour actually occurs in real life, that is in their natural settings. The method is also ideal for certain groups of people who are unable to give responses to interviews satisfactorily, either through physical handicaps, lack of verbal skills, shyness or failure to understand the questions asked. This is the case in many of the kampung (village) areas where many of the respondents are the aged who have hearing, verbal and other physical communication disabilities. In Kelantan, the local dialect is profoundly different from the Bahasa Malaysia (Malaysian national language) spoken in other parts of the peninsula. This becomes a major constraint during interviewing[18].

Familiarity with the local area is also an added advantage for the cultural insider. This

[18] In Kelantan, the author took nearly a month to get familiar and conversant in the Kelantanese dialect although he already has a good command of Bahasa Malaysia. Naturally, the interviewers employed in the Kelantan study area were Kelantanese.

familiarity makes it easy to gain accessibility to the most remote 'kampungs' (villages) which are not accessible by modern transport. For instance, the biggest problem when interviewing remote kampung folks is not refusal but the difficulty in which their houses could be reached. For example, the areas in and around Kampung Tendong (Kelantan) can only be reached by bicycle and motor-cycles or on foot. Another case is Kampung Pulau Pekan Baru (Pekan) which is only accessible by boat. Without knowledge of the local area it would be difficult to gain access into this kampung.

The insider method is, however, not without demerits. One which is commonly stated is that such a form of research is not suitable for studying large populations, which is better addressed by quantitative surveys (Jorgensen 1989 p13). The method is also not suitable for evaluating causal relationships between variables, especially if multiple variables are studied and testing the hypotheses require some form of statistical functions. Furthermore, if abstract variables such as perceptions or attitudes are studied, observation is almost impossible. In such cases it is necessary to include one or more other research methods such as a quantitative survey or an experiment to supplement the qualitative observations of the insider.

Perhaps one of the more common demerits of the insider that can blur the phenomenon studied is 'cultural blindness'. Often, the insider can be 'blinded' by prejudiced opinions, rigid ways of doing things, over-zealous feelings for the organisation in which he/she is a part of and others. Certain aspects of the insider's culture could be taken for granted, as he/she may not quite appreciate their significance because of being too close to the subject. Consequently, his/her views may not be as objective as that viewed from outside, as for example that of an outsider's. One example is the issue of equity in which the Malaysian government is practising a policy of 'positive discrimination' in order to bring the standard of living of Malays and other 'bumiputras' (see notes on pxx) up to the level of the other ethnic groups, notably the Chinese and Indians. As this issue is taken for granted and discussion or debate prohibited (except amongst the component parties of the National Front within closed doors), the insider may not appreciate its significance when evaluating flood hazard responses. When the insider is from the group discriminated against, then the effect of cultural blindness can be more pronounced. Furthermore, the insider can be from any one of the ethnic groups and must avoid any prejudice towards the other groups if the study is to be free from cultural bias.

Another demerit of the insider method is the constraints on the insider when attempting to evaluate the organisation in which he/she is a part of. While constructive criticism can be good for the organisation, it can also be misconstrued as damaging and the insider can be penalised for it. Within this constraint of fear of reprisals the insider is unlikely to be as open as would an outsider in his/her critique of the organisation. Observing and assessing an organisation without the organisation's knowledge may pose ethical problems. It is a question of professional ethics to let the organisation know about the insider's intentions and 'observing without telling' can be treated as a serious offence of which the insider can be penalised.

Finally, constraints in ethnic sensitivities also prevent the insider from openly criticising government policies related to ethnicity as this may stir up animosity amongst the various ethnic groups. The May 1969 racial riots were the result of the explosion of such sensitivities. To prevent such a tragedy from ever repeating itself, the government amended the Internal Security Act (1960) in 1969 to ban open discussion and debate on sensitive ethnic issues.

2.3.2 Historical analysis

Almost all geographical research uses historical analysis in one way or another. This is not just because history affects the present but also because historical data such as census records, existing land use maps, published reports, government files, and the existing literature are all used to some extent in research. There are basically three approaches to historical analysis: historism, historicism and historicalism (Harvey 1990 p215). While historism approaches history as essentially factual and ignores the role of the interpretative researcher, historicism and historicalism see history as an interpretative process[19]. Critical historical analysis is, therefore, not just a matter of reconstructing history by digging through archives or libraries to locate the facts and events of history, but is an active interpretative process whereby existing archival material and other historical evidence[20] are assessed and evaluated in relation to the present. This second approach is adopted in this research.

[19] 'Historicism' sees the past as being reconstructed from the standpoint of the present. 'Historicalism' argues that past and present mediate one another (Harvey 1990 p215).

[20] Both primary historical records/archives as well as their secondary versions (ie reports derived from original primary records) are used in this research.

Torry (1979a p369) has advocated that historical reconstructions exhibit some first rate discussion illuminating the social adjustments to hazards that various societies have made in the past. Much of the work on historical analysis in hazards research takes after the Marxist approach. In his analysis on 'Capital' Marx (1887, 1894), has adopted what is essentially a 'structural historicism' approach. Coincidentally, the emergence of the structural paradigm in hazards research saw researchers employing this approach. For instance, Watts (1983) used a historical analysis to research the case study of drought hazard in northern Nigeria. His analysis revealed the importance of the historical perspective in understanding Hausa peasant society as significant cultural and artistic forms of the hazard are reflected in praise epithets, folk tales, fables and historical anecdote. Furthermore, the history of Nigeria is closely tied to colonial influence which not only exploited and impoverished the economy but more significantly also changed modes of production and in the process increased vulnerability to drought. Admittedly, colonial integration eroded pre-capitalist elements in the economy and changed the adaptive capability of Hausa communities to such an extent that they became less and less capable of responding to and coping with drought. This study has shown that the drought hazard along the West African desert (at least in northern Nigeria), can only be understood from the historical perspective and is an important pointer to understanding flood hazard in Peninsular Malaysia.

There are many merits of historical analysis. It is an important investigative method in hazard models of the structural paradigm and those relating to hazards-in-context, especially in developing countries with a culture closely tied to a particularly hazard and an economy previously under colonial exploitation. In terms of hazards-in-context, although much is known about the endogenous aspects of hazard systems (factors linking hazard components such physical processes, human exposure, perception, adjustments and losses), there is a dearth of research on contexts of hazard that are created by the interaction of exogenous factors and hazard components. Exogenous factors such as indigenous cultures, pre-colonial production systems, colonial exploitation and other historical perspectives are best approached via historical analysis. Easy access to archival records, census data, government reports and other published materials is another merit. Besides, such a method allows the researcher to work in libraries and archives which are open to the public.

One demerit is that the accuracy of the analysis depends on the accuracy of the historical records. There is no sure way of telling when a certain record is true and when it is not. History is written by different people with different background, ideology and even loyalties.

Thus, an English writer is unlikely to severely condemn British exploitation of Malaya's economy as a Malaysian writer would, even though impartiality on the part of academics is advocated. This bias of western historians against the anti-colonial feelings of their local counterparts can distort analysis to a considerable degree. The culture of confidentiality in many government departments may also become a disadvantage as official records are classified and made unavailable to the researcher. Examining archives and historical records is an arduous task demanding the greatest patience. The process is tedious and slow. For instance, the Malaysian Archives allows a researcher to order only four documents at any one time. A certain amount of time is also wasted as there is a time lapse before the documents are located and brought to the researcher. Although quantitative data are obtained and used in historical analysis, there is no denying that the method is inherently qualitative. In this respect, it cannot derive objective statements or inferences on predictive characteristics in the way quantitative methods can.

2.3.3 Institutional analysis

The role of flood hazard institutions is vital in flood hazard management. In the United Kingdom, researchers have developed institutional analysis to study their effectiveness (Penning-Rowsell et al 1986). Although several methods or approaches can be used in the assessment of the adequacy of flood hazard institutions, the criteria approach is common. This method of evaluating the adequacy of institutions (flood hazard or otherwise) based on multiple criteria was originally used in assessing water institutions in the 1960s and 1970s (Fox and Craine 1962; Craine 1969). Other general water management studies which have used the same approach include Mitchell (1971), Barr (1973), Okun (1977), Porter (1978), Parker and Penning-Rowsell (1980), Sewell et al (1985) and Parker and Sewell (1988). In assessing the adequacy of flood hazard institutions. Penning-Rowsell et al (1986) and Parker and Penning-Rowsell (1991) have also used the approach.

The criteria approach is based upon a number of predetermined criteria which are perceived by the investigator as the best representation of the 'fitness' or 'purpose' of institutions. The criteria chosen are based on a priori expectations of institutions. There are no hard-and-fast rules about the number of criteria, although generally, the greater the number of criteria the more thorough and rigorous is the evaluation. For instance, in evaluating water institutions in England and Wales, Parker and Sewell (1988) used nine criteria or what they termed 'evaluative themes'. In another study, Penning Rowsell et al (1986) used ten evaluative criteria in their evaluation of British flood hazard institutions. And, in evaluating water resource management institutions in twenty countries, the Organization for Economic Cooperation and Development (1989) has used a total of thirteen criteria.

The criteria approach is inherently judgemental rather than data-led. It relies upon accumulating knowledge of the strengths and weaknesses of institutional arrangements as revealed through case studies (Parker and Penning-Rowsell 1991). It is also a basically qualitative research method in which the outcome hinges as much on the skills of the investigator as it does upon an understanding and perception of the institutions. In this thesis, much of the information used in evaluating flood hazard institutions in Peninsular Malaysia is gathered through in-depth interviews with officers at various levels/departments within the federal and state government hierarchies. Flood hazard organisations are also studied in detail. Information such as mission statements, future visions, institutional objectives, policies, organizational set-up, plans, jurisdiction, staffing (numbers and qualifications), and other data are used in the evaluation (see Chapter 5).

2.3.4 The case study approach

The large extent of floodplains in Peninsular Malaysia and the absence of data on the total floodplain population necessitates the use of case studies. The 'case study approach' is used in the selection of sample areas within which both quantitative and qualitative methods are employed. This includes the use of structured questionnaires administered by interviewers; long, unstructured interviews (all carried out by the author); self-completion postal questionnaires; and group discussions. Telephone interviews are also used when direct interviews were not possible. This section discusses the merits and demerits of the case study method. The development of the survey questionnaires and sampling strategies is discussed in detail in Appendix F and the full questionnaires presented in Appendix A, B, C and D.

The case study approach has been criticised for insufficient precision (that is, quantification), objectivity, and rigour (Yin 1989 p10). Another criticism is the limited degree to which findings based on case studies can be generalized. Yet in recent years, more and more social science researches have used this technique of inquiry as a result of refinement and improvement in the method. For example, in a perusal of forty illustrative researches using the case study approach, Yin (1989) has discovered amongst the authors a distinguished group of scholars (including a few who have served as heads of their respective professions). This serves to underline the growing importance and application of this approach in social science research. Case studies provides in-depth insight not available otherwise and are selected, not for their typicality (as quantitative sampling dictates) but for their explanatory power (Mitchell 1983).

Although case studies have in the past been mostly used as a preliminary phase of a more detailed survey (for instance, as an exploratory study or reconnaissance survey), it is now increasingly being used as the main method of inquiry in deeper research. There are now exploratory, descriptive or explanatory case studies (Yin 1981a, 1981b). One popular definition of a case study is given by Schramm (1971):

> '...the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result.'

This definition cites 'decisions' (as in floodplain manager's decision to adopt certain flood mitigation adjustments) as the focus of the case study but it could well have been 'institutions' (as in institutional responses to flood hazard mitigation), 'events' (as in a flood event), 'processes' (as in flood flows in rivers), etc.

Yin (1989) offers a more detailed and 'technical' definition which states that a case study is an empirical inquiry that:

(a) investigates a contemporary phenomenon within its real-life context; when

(b) the boundaries between phenomenon and context are not clearly defined; and in which

(c) multiple sources of evidence are used.

This definition can be used to differentiate between a survey and a case study. While a survey can be used to study a phenomenon and its context, its ability to investigate the context is rather limited.

A case study is not synonymous with qualitative research although the very nature of a case study makes it seem more qualitative than quantitative (Schwartz and Jacobs 1979; Van Maanen et al 1982). Case studies can be quantitative if quantitative evidence is used. By the same token, surveys can also be qualitative when certain questions (such as those seeking categorical rather than numerical response) are applied in the questionnaire. On the whole, despite their limitations case studies continue to be used extensively in social science research, including the traditional disciplines such as psychology, sociology, anthropology, political science, history, economics and geography. In hazards research, researchers working within the behavioural paradigm have employed this method (Kates 1962, 1963). Based on case studies, hazards investigators from different parts of the world researched different hazards in an international collaborative effort (White 1974). Multi-disciplinary disaster studies have also used this approach widely (Davis 1975, 1981 pp151-74). More significantly, however, case studies form the basis on which advocates of the structural paradigm carry out their researches (Hewitt 1983a; Watts 1983; Susman, O'Keefe and Wisner 1983). Recently, researchers working within the 'hazards in contexts' view have also used the method (Mitchell et al 1989; Palm 1990; and Cutter 1993). In the United Kingdom, the Flood Hazard Research Centre has used case studies extensively (Parker et al 1987; Neal and Parker 1988; Fordham 1992). In fact, many researchers have argued that the applicability of case studies is no longer in question. Case studies do have a distinctive place in evaluation research (Patton 1980; Cronbach et al 1980; Guba and Lincoln 1981; Yin 1989; Fordham 1992).

2.3.5 The social survey/quantitative interview

The survey questionnaire is the single most important research tool used by geographers working within the dominant paradigm of the North American School (see Chapter 3). So preoccupied were these early hazards researchers with the structured survey questionnaire that a single cross-cultural and cross-hazard questionnaire was used in the study of all types of natural hazards ranging from floods to avalanche and in cultures as diverse as the industrialised American and the Usambara farmers of remote Tanzania (White 1974). Predictably, the use of this single questionnaire has been extensively criticised in the hazards literature (Wadell 1977) but none so vividly as that by Torry (1979a). Yet, despite these criticisms and the emergence of new research methods the survey questionnaire remains an important research tool in hazards study.

The survey questionnaire entails personal interviewing and the flexibility by which questioning may be done is one of the merits of this method. Although a structured questionnaire is used in most instances, it still allows an experienced interviewer great flexibility in the wording, structure and clarity of questions. Furthermore, potentially the interviewer is in a position to control an interview. He/she can re-phrase questions, clarify questions, coax the respondents (but not to the extent of eliciting a biased response) and even probe for additional information and details that are relevant. For instance, many unique flood experiences of respondents in this research were recorded during the structured questionnaire interview (Appendix H). Also, the interviewer can ensure that the interview is conducted in private and that others in the household such as the spouse or other family members do not influence the respondent in any way.

Survey questionnaires are used extensively in hazards research in geography for two reasons. First, they enable direct contact with people and human processes being investigated. Second, and more significantly, is their 'quantitative' nature. A central theme common to all quantitative researches is the employment of a sound scientific methodology which proceeds along a route with well defined stages: problem, hypothesis, research design, measurement, data collection, data analysis and generalization (Frankfort-Nachmias and Nachmias 1992). While this line of inquiry is unchallenged in natural science research, much has been disputed about its applicability in social science researches, particularly those involving the measurement of social phenomena. According to the 'Verstehen'[21] tradition, the natural and social sciences are distinctive bodies of knowledge resulting from their divergence and the nature of their subject matter. Thus, it follows that natural and social scientists must inevitably employ different methodologies of research, quantitative research being the domain of the former and qualitative research being the domain of the latter. In contrast to this tradition, however, is the view of the 'logical empirists' who believe that despite their distinctive humanistic nature, the social sciences can still achieve objective knowledge in the study of the social world. To the empirists, both the natural and social sciences can be researched by the same quantitative methodology.

Because of its quantitative nature, researching a sample of a statistically derived size allows the researcher to infer findings on to a larger population. This saves time and resources and makes it possible for large populations to be studied. In many cases it is also impossible or unnecessary to study an entire population when a sample would suffice. In some cases the population size may be unknown or infinite and quantitative sampling is probably the best solution.

Another merit is the high response rate which may be obtained through direct interviewing as compared to mailed questionnaires or telephone interviews. This, however, depends on how the interviewer presents himself/herself, sample characteristics, the purpose of the survey and other factors.

[21] Verstehen is German for 'empathy'.

While it is obvious what quantitative research has to offer hazards research, it is not without demerits. One is its preoccupation with the laws of causality. Yet, researches based on the survey method may at best bring about simple levels of association and correlation and 'correlation does not imply cause' (Bryman 1988). Another limitation is the focus of quantitative research on the individual unit of analysis and its subsequent aggregation of all the individuals studied. Society should not be viewed as an 'aggregation of disparate individuals' (Blumer 1948). Furthermore, it has been argued that quantitative research does not allow for in-depth analysis of social phenomena which is also inherently difficult if not impossible to quantify. Social behaviour and culture have taken centuries to evolve and it is not possible completely to understand such phenomena by merely administering a questionnaire survey (although not all social science quantification is by questionnaire). Advocates of qualitative research have also claimed that people are more alike than they are different. As such, there is no need to conduct large-scale surveys and statistical analysis. This point may have been wrongly claimed in the case of many population surveys (such as census enumeration) but there is certainly some truth in the study of small closely-knitted communities. The erroneous results of many market researches and some opinion polls such as the 1936 literary poll in the United States[22] and the opinion polls conducted during the British General Elections of 1987 and 1992 (Butler and Kavanagh 1988 p127) are proof that survey research is not infallible.

2.3.6 The unstructured interview

The unstructured interview is essentially a qualitative research method used primarily in reconnaissance or pilot surveys. It involves interviewing a respondent without a rigid questionnaire structure but with certain aims or key questions in mind. Increasingly, this method is now being used to complement the quantitative survey questionnaire which is unable to record details and in-depth accounts of the events being studied. In this research unstructured interviews are employed in the insider method, historical analysis, institutional analysis and as a supplement in the questionnaire survey.

[22] In 1936, the Literary Digest Poll which interviewed 2.4 million people predicted a victory for Landon by 57.0 percent to 43.0 percent. Yet, the actual results of the presidential election gave Roosevelt a huge landslide victory of 62.0 percent to 38.0 percent (Freedman et al 1978 p302-7). It was later discovered that the error was in the construction of the sampling frame. The questionnaires mailed were all based on telephone directories and most of the poor did not have telephones.

There are many advantages in the unstructured interview that have made it an important research tool. Perhaps the most important is its ability to probe deeply into the subject. Detailed accounts and reconstruction of events are all possible with this method. In hazards research, respondents can be urged to narrate and account their hazard experience to the greatest detail. As questions are not structured, respondents sometimes produce answers that prove unexpectedly invaluable. The material obtained from a non-directive interview (e.g. an in-depth interview) also enables the researcher to diagnose the motivations that are operative and this further allows for possible interpretations. Thus, new aspects of the research can surface and this further adds to new research questions which make the research even more comprehensive.

Often respondents will not tell the truth in a doorstep interview, much less in a mailed questionnaire survey[23]. A structured survey questionnaire may give an impression of 'officialdom'. Respondents may feel under pressure and may provide answers that will not incriminate themselves. Spontaneity may be lost. On the other hand, an articulate interviewer may be able to avoid the impression of an interview. If a relaxed atmosphere is created respondents can be encouraged to talk and respond freely. It is believed that non-directive interview methods are more likely to reveal the truth, since people are unwittingly revealing themselves.

Some researchers have claimed that since people are more alike than they are different, there is no need to have a large sample as in a questionnaire survey (Schlackman 1989). Therefore, the number of unstructured interviews can be small reducing the cost of interviews.

However, the unstructured interview also has its disadvantages. Results depend on the expertise and objectivity of the interviewers. Interviewers may inject bias. There is also the possibility interpreter bias of the data. The method may be considered too qualitative and subjective and unscientific. Related to this is the criticism that because the method is non-quantitative, it cannot be truly predictive, limiting its usefulness. Sample sizes may be too small to make reliable statements about the total population. Sampling can be criticised for

[23] Whether or not the respondent tells the truth in an interview may depend on the topic of inquiry. If the topic is about personal income (therefore with tax implications) or something personal which may implicate the respondent, then it is not likely that the whole truth will be revealed. On the other hand, if the topic is about general perception or views without any implications, then the interviewer may expect a reasonably truthful answer.

being haphazard and uncontrolled in the selection process, possibly generating bias and statistical error. Finally, it is argued that it is not possible to classify sub-sections of the sample to get segmentation analysis, because the sample may be much too small.

As a qualitative method, the unstructured interview has gained popularity coinciding with a major shift in emphasis to qualitative research. In the past, the quantitative survey and the unstructured qualitative interview have been seen as alternatives. However, recent advances in qualitative research have improved its standing in the research community (see Robson and Foster 1989; Yin 1989) and increasingly researchers now use a judicious combination of both methods in their researches (Fordham 1992).

2.4 Segment analysis

A central aim of this research is to examine and understand the links between the socio-cultural, political economy and the institutional context and how these contexts affect individuals in terms of flood hazard response. A method of analysis is therefore devised so that the links between various contexts can be analysed. This method is called 'segment analysis'. Many segments may be identified within the sphere of influence of contextual forces on the individual (Figure 2.10). For instance, the researcher can take the 'flood warnings and evacuation' segment and trace the links between the macro level contexts of socio-cultural and political economy, meso level institutional context and the micro level individual. In this way, flood warning and evacuation effectiveness can be analysed using evidence from all three levels. More significantly, shortcomings can be identified at each level.

Segment analysis is an attempt at innovatory approach to the study of hazards. Its strength is that it allows phenomena to be examined across contexts. Hitherto, contexts have been analysed in isolation although hazards are perceived to occur within a variety of contexts (Mitchell et al 1989; Penning-Rowsell Forthcoming). Focus on one segment at a time enables in-depth analysis. A segment may be further broken down into sub-segments for more detailed analysis. For instance, flood warning and evacuation can be divided into sub-segments of flood forecasting, institutional procedures of warning between flood hazard organisations, warning dissemination to the public and final evacuation.

In this research two segments are selected for analysis. These are the 'flood warnings and

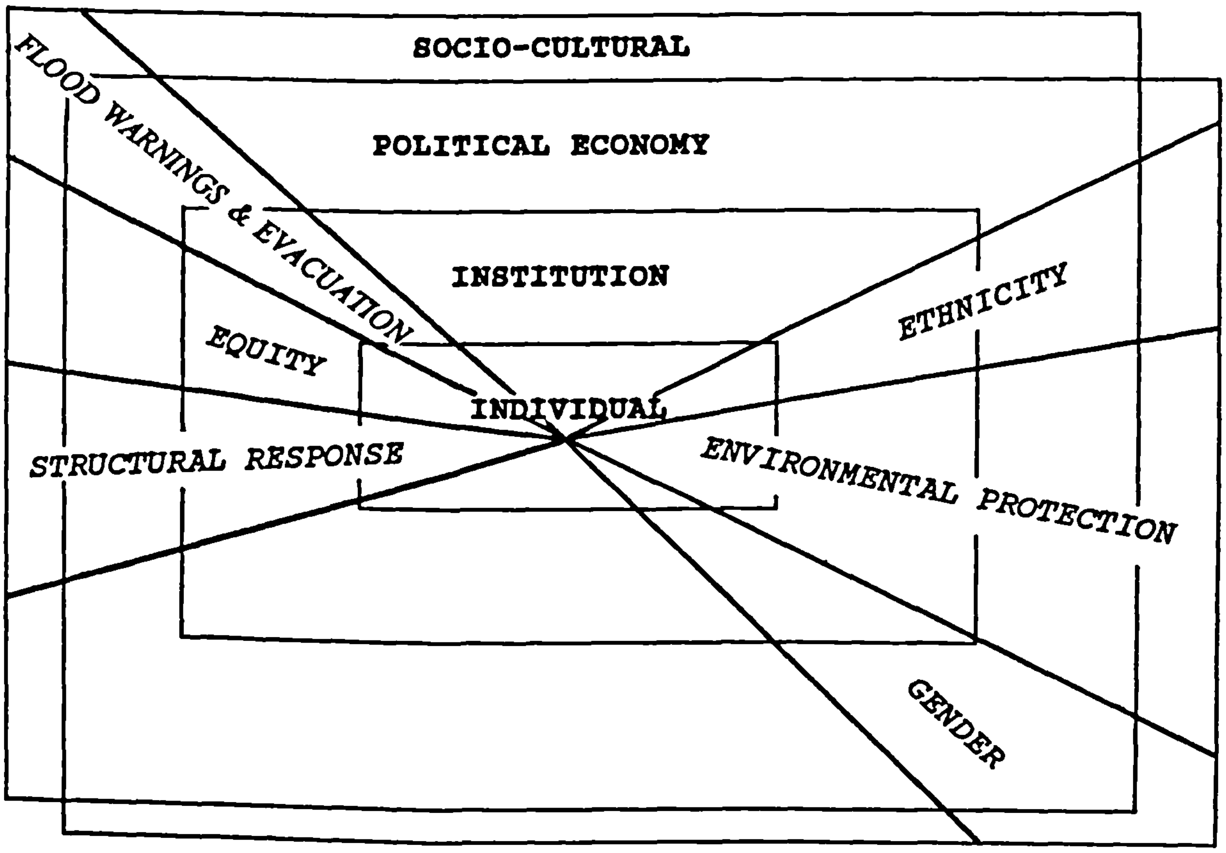

Figure 2.10: Examples of segments within the influence of contextual forces on individual response to the flood hazard in Peninsular Malaysia

evacuation' and the 'income equity' segments. The former is selected because of its significance and potential in flood hazard reduction in Peninsular Malaysia. The latter is selected because it is a central issue in Malaysian society. Segment analysis is qualitative in nature and dependent upon the expertise of the researcher. Although historical and other published data are used, much depends on interpretation.

2.5 Conceptual model

Conceptualisation is an important research methodology. One of the early tasks was to develop a flood hazard response-in-context model for Peninsular Malaysia. This model is based upon a variant of the behavioural hazard response model of the 'dominant North American School' (see Chapter 3), but one nested within the current contextual view of hazards. Based on this model, the extent to which contexts pervade and influence the flood hazard in the peninsula is analysed. Also, the model is used to analyse individual perception and response to the flood hazard and how contexts affect them. This model is discussed in greater detail in Chapter 3.

2.6 Case studies and surveys in the current research

Four case study areas are selected. The selection of the case study areas is based on criteria which include geographical location, flood magnitude and frequency, flood type, urban or rural environment, presence or absence of formal flood warning systems, and ethnicity (Appendix F discusses the sampling rationale in detail). Selected case study areas showing sampling sites, numbers of respondents interviewed, and approximate flood-prone areas are illustrated in Figure 2.11 (Pulau Pinang), Figure 2.12 (Kuala Lumpur), Figure 2.13 (Kelantan) and Figure 2.14 (Pekan).

Within these four case study areas, households are sampled for the main survey. This survey is based on a quantitative method of stratified random sampling using cadastral maps and street maps to select properties (Figure 2.15, Figure 2.16 and Figure 2.17). In remote kampungs where such maps are not available, sketch maps of house layout within the kampungs are used (Figure 2.18).

To supplement the quantitative survey, detailed flood experiences of individual households in each study area were recorded using the unstructured interview method. This serves to

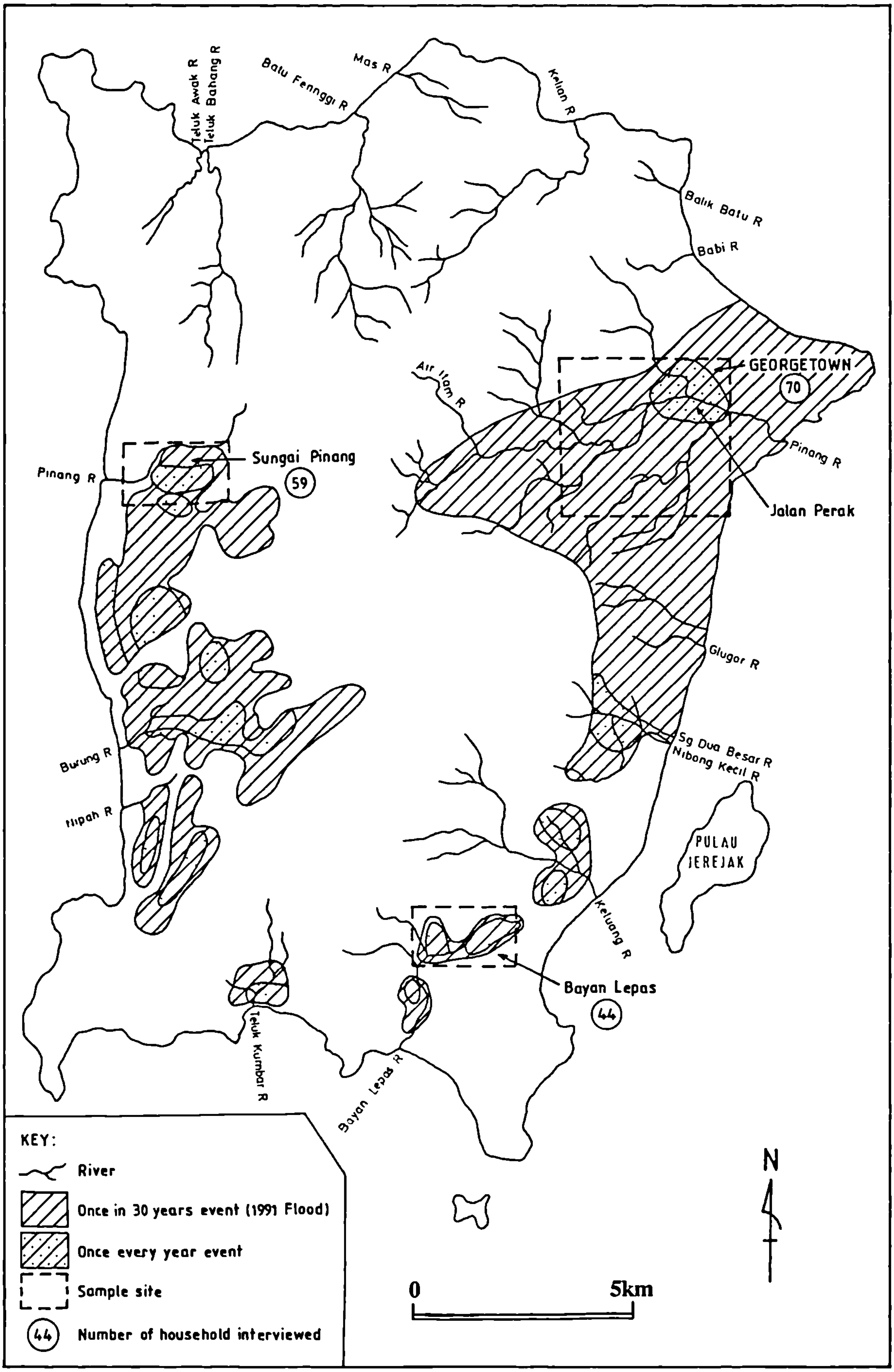

Figure 2.11: The Pulau Pinang case study area showing sampling sites, numbers of respondents interviewed, and approximate flood-prone areas

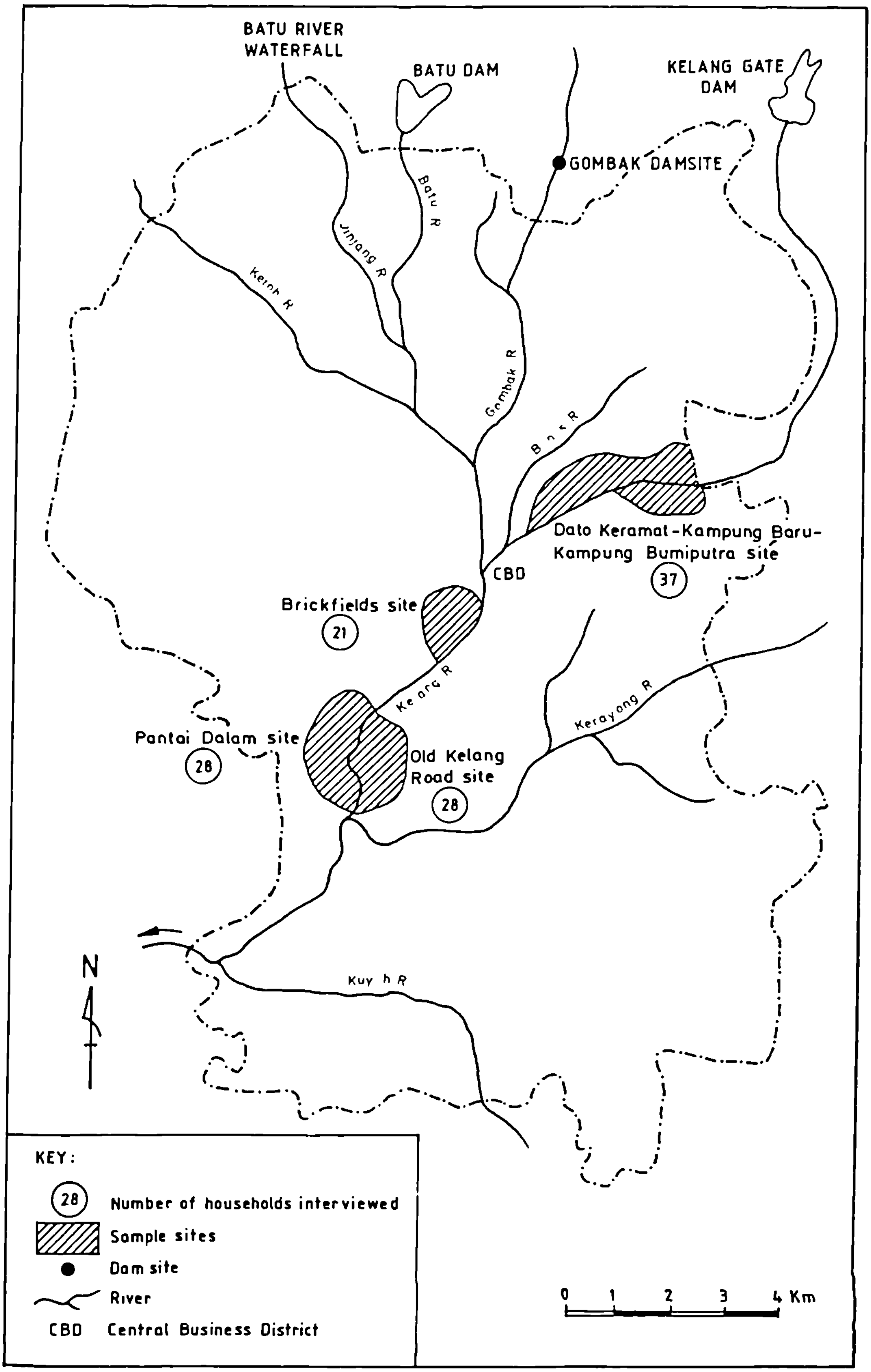

Figure 2.12: The Kuala Lumpur case study area showing sampling sites and numbers of respondents interviewed. Sampling areas coincide with approximate flood-prone areas

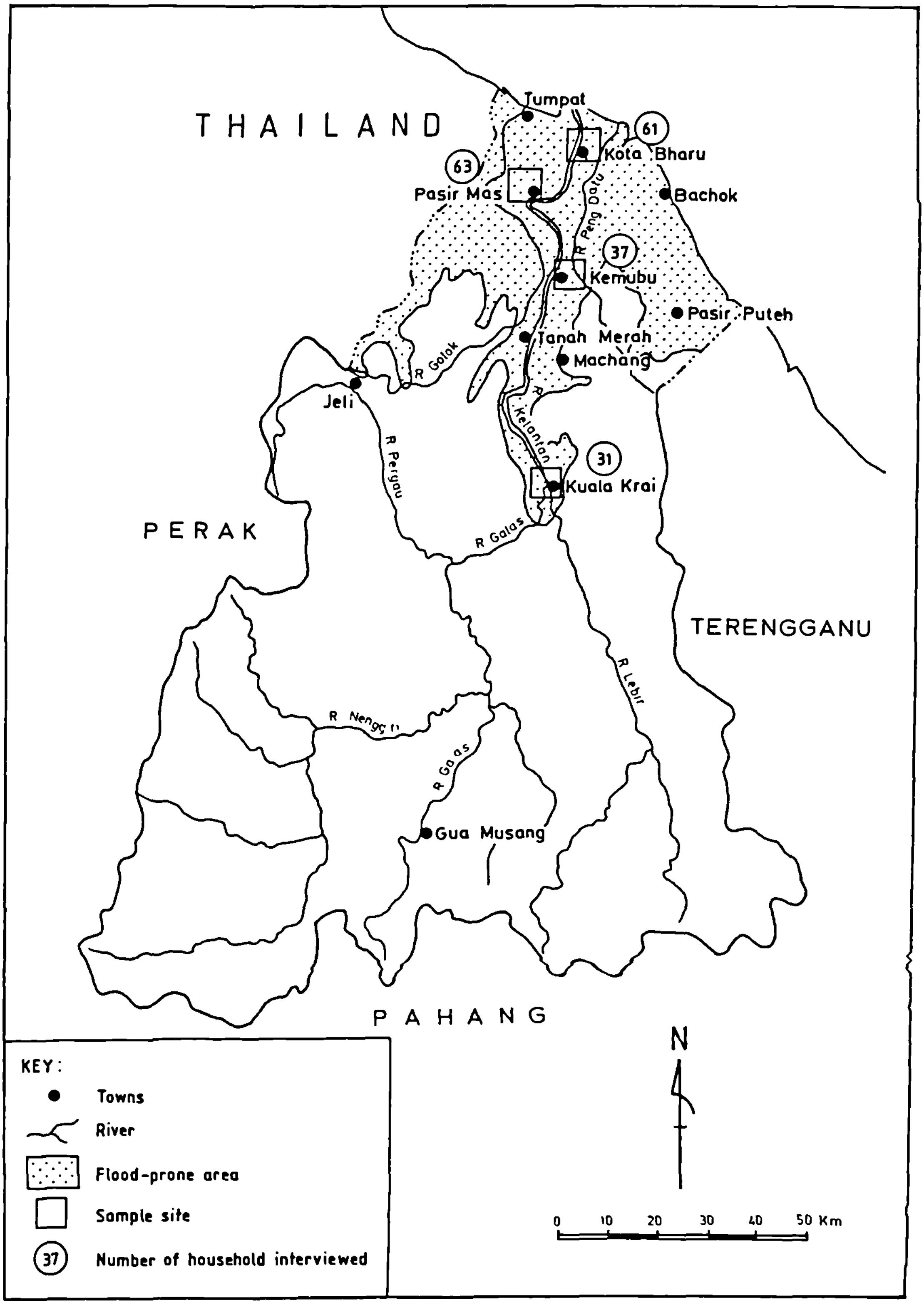

Figure 2.13: The Kelantan case study area showing sampling sites, numbers of respondents interviewed, and approximate flood-prone areas

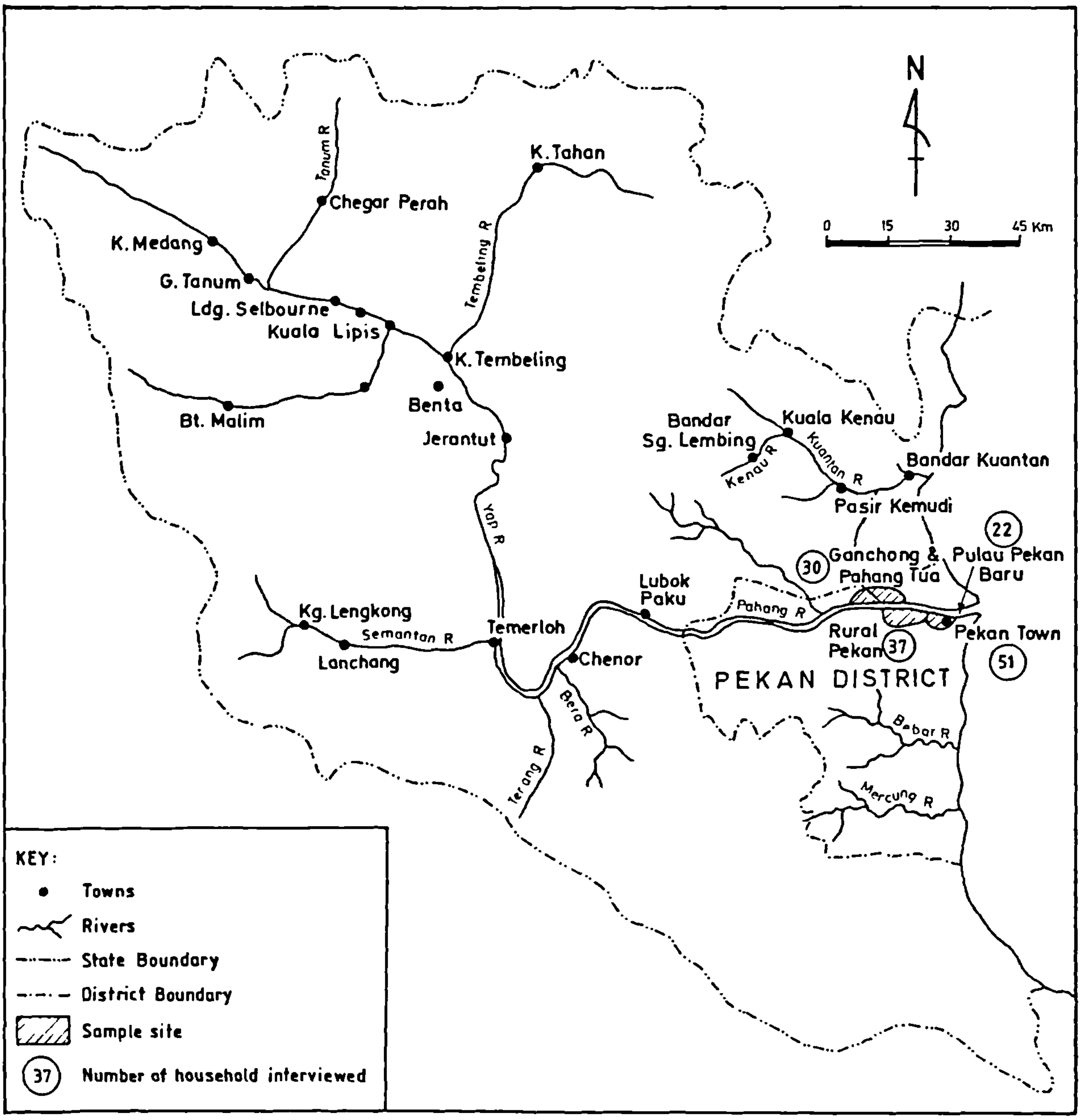

Figure 2.14: The Pekan case study area showing sampling sites and numbers of respondents interviewed. The entire study area is located on the Pahang River floodplain

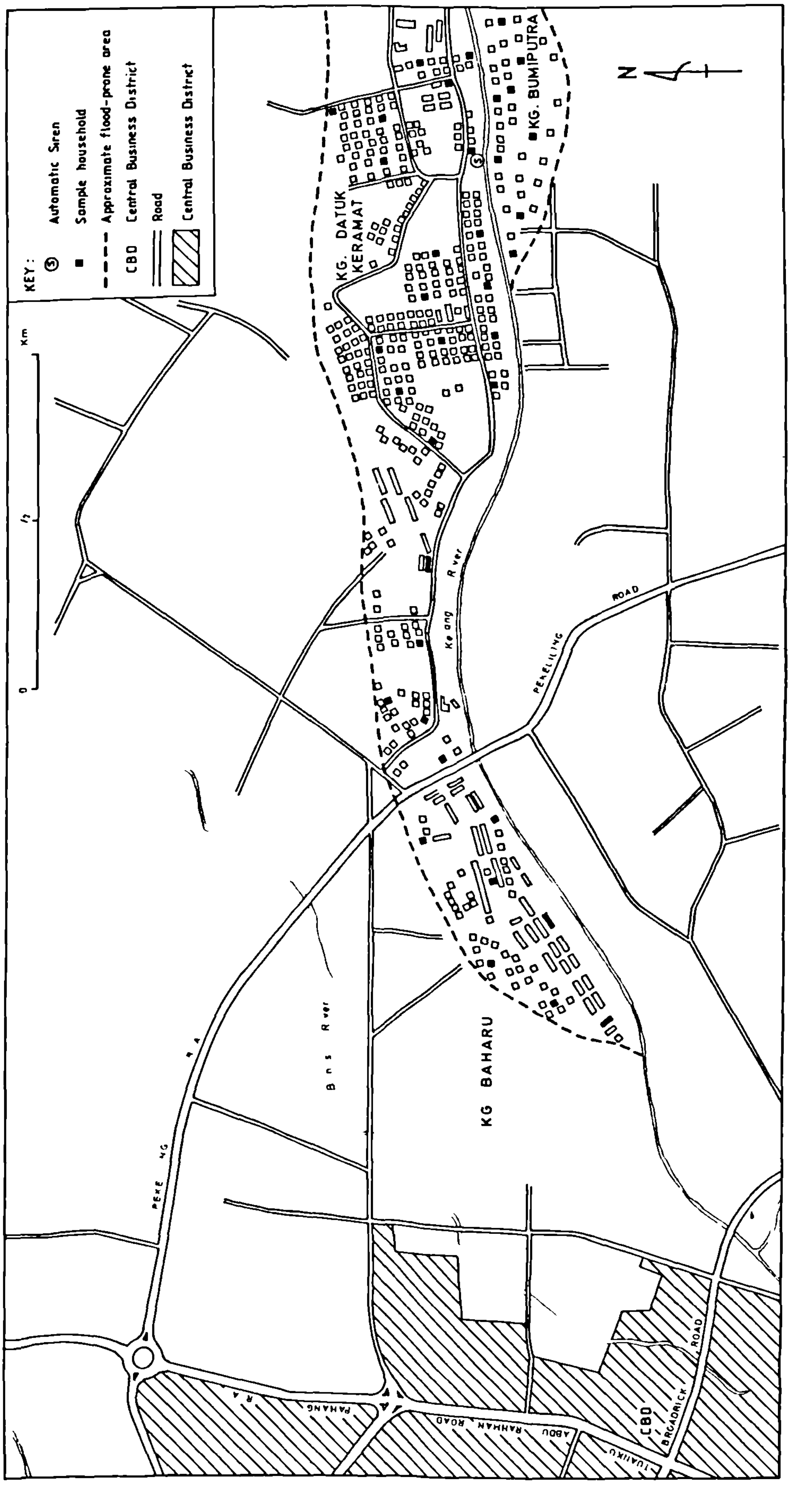

Figure 2.15: Street map of the Kampung Baru and Kampung Datu Keramat sample sites in Kuala Lumpur showing the location of households interviewed (Based on Director of National Mapping, Malaysia 1982)

Figure 2.16: Street map of the Georgetown sample site in Pulau Pinang showing the approximate location of households interviewed (Based on Director of National Mapping, Malaysia 1982)

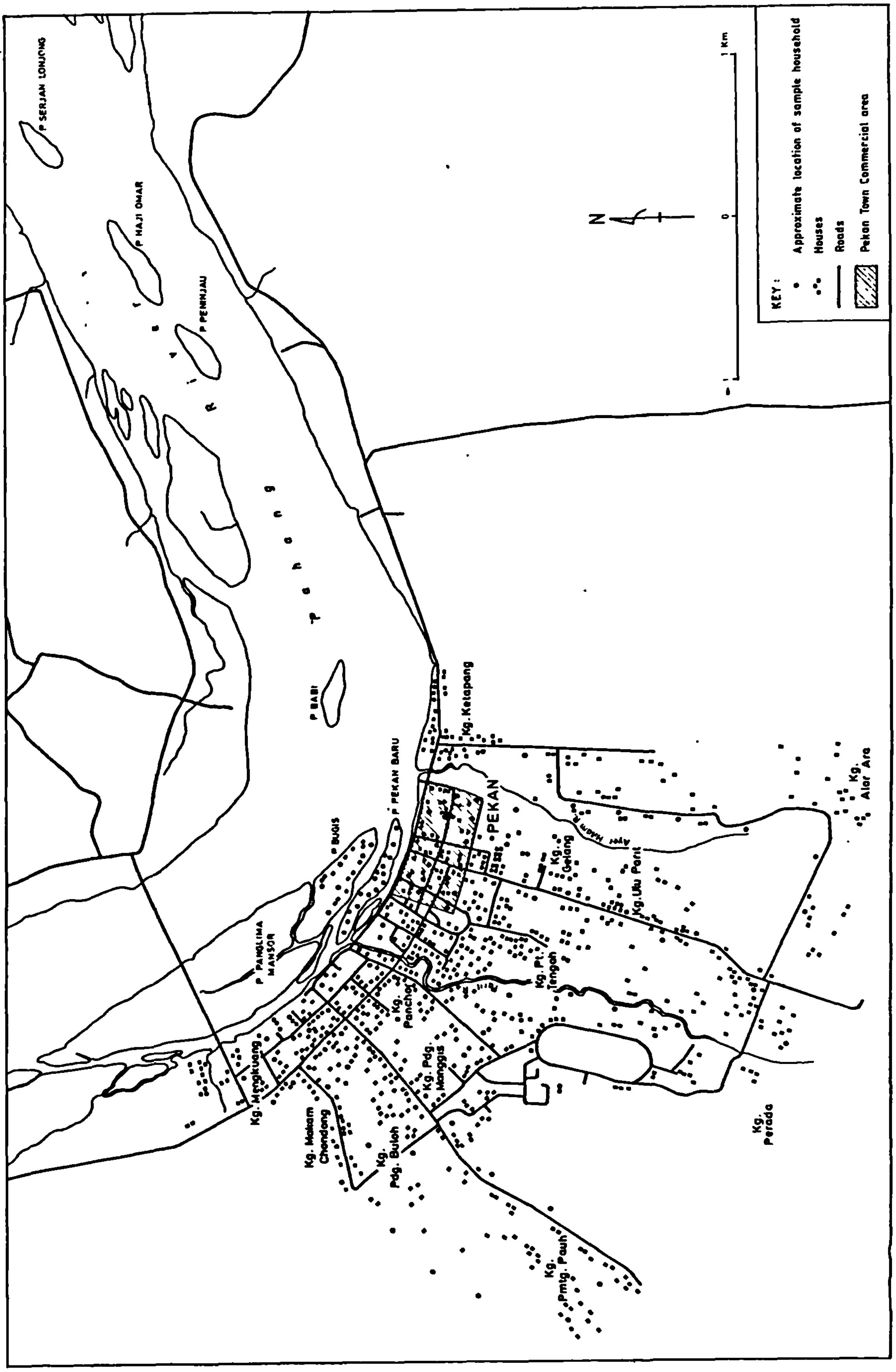

Figure 2.17: Approximate location of households interviewed in the Pekan town sample site based on topographical and street maps of the mukim of Pekan

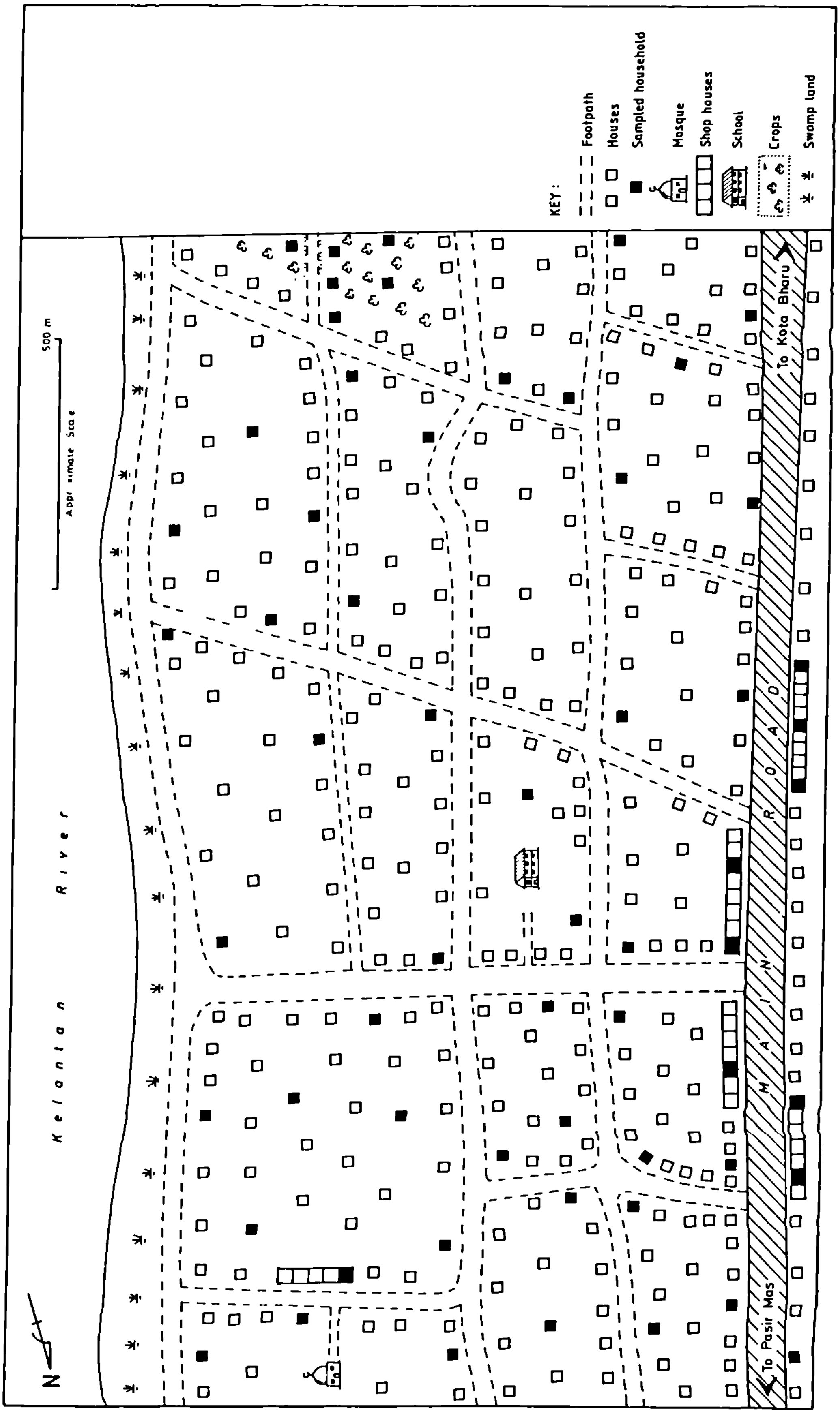

Figure 2.18: Sketch map of approximate location of sampled households in relation to the distribution of houses in the Kampung Tendong sample area in Pasir Mas, Kelantan

give a more detailed insight into the flood hazard which is not captured by the quantitative survey. Of the total 618 households surveyed, 172 were from Pulau Pinang, 192 from Kelantan, 114 from Kuala Lumpur and 140 from Pekan. Of the total, 336 households were residential, 145 were farming, 96 were commercial and 41 were fishing.

In order to put into perspective the extent to which the flood hazard affects floodplain occupants, a supplementary quantitative survey on flood damages to business establishments was also carried out in each of the four study areas. This was a brief record of actual flood damage to property, goods, business and other related flood losses. Hitherto, as far as the author is aware, no such survey has been done in the peninsula. In this research, a total of 273 business establishments were surveyed, with 52 in Pulau Pinang, 76 in Kelantan, 55 in Kuala Lumpur and 90 in Pekan.

A supplementary questionnaire survey of government officers, academics, consultants and workers of voluntary organisations was also carried out. This survey also employs the quantitative questionnaire design but some detailed flood experiences of the respondents based on the qualitative research methodology was also used. Interviews in the four study areas were conducted by the author. Respondents from other states outside of the study areas were posted mailed questionnaires to complete (a self addressed and stamped envelope was attached for the return). The author also carried out qualitative interviews with individual respondents and had group discussions with employees of some organisations. Telephone interviews were carried out only when respondents were not available for direct interview. A total of twenty-one respondents was interviewed and twenty-eight mailed questionnaires were returned, making a total of forty-nine respondents.

Finally, the criteria approach based on selected evaluative criteria is used in the evaluation of the adequacies of flood hazard institutions. The evaluation of flood warning and evacuation systems is based partly upon 'observer-participation'. While in England, the author spent two months (February and March 1992) on attachment at the National Rivers Authority's flood forecasting and warning section in Waltham Cross in order to study advanced forecasting system and warning procedures. During the fieldwork in Peninsular Malaysia, the author also spent two months on attachment at the DID and the MMS (September and October 1992), and visited several other flood hazard organisations to study and evaluate the forecasting systems, warning dissemination systems, evacuation procedures and the preparedness, relief and rehabilitation programmes. Detailed interviews (both quantitative and qualitative) regarding all aspects of the flood hazard were also held with top level government officers in the various flood hazard organisations.

This chapter has examined the background to the flood hazard in Peninsular Malaysia, demonstrated the ways in which flood risk, exposure and vulnerability are increasing, and discussed the methods employed in this research. The next chapter critically examines the development of hazards research, hazards theory and concepts, and develops a model of flood hazard response for Peninsular Malaysia.

3 CONTEXTUAL HAZARDS THEORY IN CONTEXT

This chapter critically examines the dominant hazards paradigms[24]. It focuses on how geographical concepts have been applied in the study and development of hazards research[25]. It also highlights some of the more prominent work on hazards from other fields, particularly in the English speaking world. A 'hazard response-in-context' model is conceptualised for Peninsular Malaysia. This model forms a basis of this thesis and is tested for its applicability in the Malaysian context in following chapters.

3.1 Theoretical evolution of modern hazards research

Much of the early work on hazards research, predominantly on natural hazards, was by geographers. The theoretical foundations of hazards research, and the roots of the dominant paradigm of hazards research, lie within the sub-branch of behavioural geography. Because of this, much of the early literature and current understanding of hazards[26], and indeed of flood hazards in particular, have their origins in geography. Geographers' interest in man-

[24] In this thesis the terms 'perspectives', 'paradigms' and 'models' are viewed to occupy a place on a hierarchical structure ranging from 'the most general' to 'the most specific'. In this hierarchy, a perspective would occupy one end marking the most general and a model would occupy the other end marking the most specific. A paradigm occupies an intermediate position. In terms of hazards research, a good example of a perspective would be 'the geographic approach to natural hazards study'. Because of this, perspectives on hazards research may be viewed as 'approaches' or as 'schools of thought' (Alexander 1993 p12). On the other hand, the two commonly noted paradigms in hazards research are 'the behavioural paradigm' and 'the structural paradigm' (Smith 1992 p40-45). Finally, a good example of a model in hazards research would be Kates's (1971) 'general system model of hazard response'.

[25] The term 'hazards research' (also commonly known as natural hazards research) is adopted throughout this thesis to refer to 'the totality of factors which generate, sustain, exacerbate, or mitigate those characteristics of natural and man-made environments that threaten human safety, emotional security, and material well-being' (Mitchell 1984).

[26] While the study of the flood hazard has been carried out all over the world, it is not within the scope of this dissertation nor is it the intention of the author to do an exhaustive literature review of global flood hazard studies. This section presents a critical review of the more salient developments of flood hazard research in particular and natural hazards research in general in the Anglophone literature.

environment[27] relationships has stimulated research on the relationship between humans and hazards. This has led to development of the behavioural paradigm (also known as the natural hazards paradigm, see below) which has its roots in human-ecological adaptation rather than orthodox environmental determinism (Semple 1911). While determinism portrays humans as helpless in the face of environmental hazards, human ecology focuses on the variety of adjustments open to humans.

This fundamentally ecological viewpoint was initially advocated by Harlan Barrows (Barrows 1923) who influenced much of the later work of Gilbert White. The theme of human ecological adaptation to natural hazards is subsequently exemplified in the works of White (1945), Kates (1971) and Burton et al (1978, 1993). During the great depression of the 1930s, soil erosion and floods were significant hazards. The United States government largely sought to control floods through engineering means. During this period, almost the entire literature and work on flood hazard research in the United States was contributed by engineers and hydrologists who viewed technological response (such as dam and levee construction) as the principal answer to flood damage reduction. It was at this time that Gilbert White pioneered early geographic flood studies in his research on 'Human Adjustment to Floods' (White 1945)[28]. This initiated geographic influence in flood hazard studies, and indeed in the broader field of natural hazards studies. He demonstrated that United States federal increases in expenditure on structural flood prevention did not have the desired effect of reducing flood losses. Instead, flood losses continued to rise as a result of floodplain encroachment which was encouraged by increased structural protection of floodplains. As a solution, White proposed that it was more important to investigate the whole range of human response to floods and identify the available alternatives for flood loss reduction.

At about the same time, the study of natural hazards was conducted in disciplines and professions that worked to a considerable degree in isolation from each other and from the public (Burton 1986 pix). But the 1960s saw a move towards a broader inter-disciplinary approach to the study of natural hazards. This was seen in the development of natural hazards

[27] The 'man-environment' theme is one of the established core geographic traditions. In the context of this theme, the masculine terms 'man' and 'his' are accepted terminologies in geography and should not be misinterpreted as sexist language. In the context of general usage, however, non-sexist terminologies are adopted throughout this thesis.

[28] According to Kates and Burton (1986 p10), 'Human Adjustment to Floods' may well have been the most influential dissertation in US geography.

research in geography (Kates 1962; Burton and Kates 1964; White 1964) and disaster research in sociology (Dynes et al 1964; Barton 1969; Drabek 1969) and anthropology (Lessa 1964; Tonkinson 1968; Anderson 1968; Torry 1979b[29]).

In the 1960s and 1970s, White collaborated with two of his research students Ian Burton and Robert Kates at the University of Chicago and developed what became the dominant behavioural paradigm in hazards research. This paradigm is based on human ecological adaptation within a theory of rational decision making. Subsequently, similar work was extended to the University of Colorado, the University of Toronto, Clark University, and (recently) Brown University. Much of the North Americans' work was centred around the individual's response to the flood hazard. This hazard response model was then extended to research different hazards in different parts of the world in an international collaborative programme (White 1974). The culmination of a decade of natural hazards research was then published in their much criticised volume of 'The Environment as Hazard' (Burton et al 1978). The White-Burton-Kates School of natural hazards (also known as the Chicago School or the North American School) had significant effects and influence on geographic research. According to Gold (1980 p211), a notable by-product of the school was the stimulus it gave to behavioural geography. Furthermore, the school is highly influential at the national and international level, is heavily and consistently funded, and has published extensively. As such, it represents conventional geography's outstanding success story in the academic-government arena (Emel and Peet 1989 p62).

Thus, from the early formative years of hazards research in the 1940s until the 1970s, the dominant behavioural paradigm strongly influenced the research direction and focus. As a result, other researchers tended to be rather orthodox and worked mostly within the confines of the dominant paradigm. They tended not to challenge its theoretical base, preferring to make incremental changes within the paradigm (Fordham 1992 p14). And because the dominant paradigm of the 'North American School' stressed the individual unit of analysis as its basis of explanation, group and community response, institutions, and socio-political and economic processes, were under-researched. Furthermore, the emphasis on the individual unit of analysis also favoured quantitative measurement techniques. Although this is not necessarily a weakness, it curbed the usage of qualitative techniques within case studies,

[29] Torry (1979b) presented an overview of the development of anthropological studies in hazardous environments, notably that of natural hazards/disasters from the 1950s to the end of the 1970s.

ethnography, content analysis, observation and participant observation.

Other than the geographic literature, researchers from other disciplines working outside the North American paradigm have also contributed, notably in disaster research and emergency planning for disaster. Beginning in the late 1970s, the adequacy of the traditional behavioural paradigm was questioned, both from within and outside geography (Waddell 1977; Torry 1979a). Radical critiques exposed the limitations of the dominant paradigm and generated new interpretations of hazards. By the mid-1970s, dissidents of the dominant paradigm argued that human perception and response to hazards were subject to cultural, social, economic and political forces (Torry 1979b). More significantly, researchers based in Third World countries discovered that broader structural forces (local and national) were more powerful and pervasive in deciding the outcome of hazards and disasters (Waddell 1983; Hewitt 1983b). This radical view which went beyond the conventional geophysical cause of hazards became known as the structural paradigm. More recently, the recognition that structural forces at the international level can strongly affect local vulnerability has resulted in an expanded version of the structural paradigm, known as the 'political economy paradigm' or the 'political ecology perspective of hazards' (Watts 1983; Cuny 1983; Marston 1983; Davis 1987; Winchester 1992; Blaikie et al 1994[30]; Varley 1994). This essentially 'structuralist' view links social relations to the environment, and is rooted in Marxist political economy.

Another view by the sociologist Mary Douglas is mainly concerned with how culture affected cognition and behaviour with reference to response to hazards (Douglas 1986). While working within the dominant paradigm, British researchers also discovered the importance of institutional forces in floodplain management. In the United Kingdom, local planning authorities and hazard institutions hold the key to hazard mitigation as individual action is rather limited and constrained. This stimulated the development of institutional analysis in hazards management (Penning-Rowsell et al 1986) in which institutions are viewed within a

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[30] Although basically a social/structuralist perspective of hazards emphasising vulnerability and lack of access to resources, Blaikie et al (1994) avoid using: (1) a purely deterministic approach rooted in political-economy; (2) notions of equating vulnerability with poverty or some other specific conditions; and (3) definitions of vulnerability that focus exclusively on the ability of a system to cope with risk or loss. They advance the political economy perspective by explaining vulnerability as a progression from 'root causes' to 'dynamic pressures' and 'unsafe conditions', which, when coincide with hazards, lead to disasters.

political economy context and are important factors in explaining failure or success of flood hazard management policies. In a similar manner, sociologists, anthropologists, engineers, epidemiologists, and those working in development studies and disaster medicine and others made contributions to the literature of hazards research and formed their own interpretations and perspectives on hazards (see Section 3.3).

Beginning in the 1980s, critical philosophical and theoretical development of hazards research projected thinking towards a contextual view of hazards (Oliver 1981; Penning-Rowsell et al 1986; Mitchell et al 1989). This view emphasises the importance of varying contexts on the occurrence of hazards. Focusing on the contexts of societal and political forces in relation to hazards is an advancement of the conventional human-ecological view (behavioural paradigm) and the structuralist view (structural paradigm). In the contextual view, social, institutional, political, cultural and economic contexts are central to understanding of hazards as essentially phenomena created by society and superimposed onto a physical process system through which they are transmitted. Contexts are multi-layered. They may be looked at from different 'scales' (micro - individuals or households; meso - institutions and organisations; and macro - the state), 'space' (individual property; village; district; state; and country) and 'time' (before, during and after hazard occurrence). Some of the recent examples using this new line of approach are the works of Mitchell et al (1989) on wind storm hazard in southern England, Palm (1990), Palm and Hodgson (1992) on earthquake risk in California and Penning-Rowsell (Forthcoming) on non-structural flood alleviation in Argentina. The current work of the Disasters and Vulnerability of Megacities Study Group of the International Geographical Union is also modelled after the contextual view (Parker 1994).

3.2 The evolution of the geographic perspective

Although the geographical perspective on hazards is exemplified by the early pioneering work of White (1945) and the subsequent development of the North American school, its roots originate from the human-ecological tradition within geography and may go back to Darwinian thinking (Barrows 1923). Humans and their environment are seen to interact to produce either resources or hazards. As such, the geographical perspective may be viewed from both the physical as well as the human angle. While the former is based on the premise that geophysical extremes are the main cause of hazards, the latter focuses on human-ecological adaptation, thus recognising the important role played by humans in the human use system (Kates 1971; Burton et al 1978, 1993). Geographers tended to emphasise the spatial and temporal distribution of hazards and their impacts. Thus, much of the early work focused on mapping the location of extreme geophysical events and human occupancy in the hazard zones. Case studies are widely used to identify similar patterns of risk, perception and response to hazards. Social science methods of survey are widely used. A cross cultural questionnaire has been applied to research hazards in a wide range of physical and social environments (White 1974).

3.2.1 The behavioural paradigm and its development

The traditional 'behavioural paradigm' originating from the North American School of hazardologists is one of two main paradigms in hazards research (Smith 1992). It is developed from models and concepts of the geographical perspective and is considered by many as the 'dominant' paradigm in hazards research.

Early hazard response models, mostly developed by geographers before the 1950s were based on the assumption that choice of floodplain occupants was essentially one of economic optimization. This later became known as the 'Model of the Completely Optimizing Man' (White 1973 p199). It assumed that individuals living in places of hazard would:

(a) have relatively complete knowledge of the particular hazard and its occurrence; and

(b) seek to make those adjustments which would represent an optimal resolution of the costs and benefits from each of the adjustments open to them.

However, the model is an ideal that is never achieved in real life. Firstly, it would be impossible, if not naive, to expect floodplain occupants to have complete knowledge of the floods and their occurrences although public education strategies aim to improve knowledge. Furthermore, each flood is distinctly different from the next due to spatial and temporal variations. Secondly, it assumes that humans only think along economic lines and that choice of adjustment is solely based on economic consideration of cost and benefit. This may not necessarily be true. For instance, illiterate padi farmers of the far eastern Third World countries may not have occupied floodplains because of their 'attractiveness' and 'economic lucrativeness'. Such farmers could have been forced into these 'marginal' areas simply by social and political factors such as poverty, landlessness and political policies. Furthermore, choice of adjustment may not necessarily be traced to economic considerations. For instance, building houses on stilts in rural Malaysia is as much a necessary structural response to the flood hazard as it is a distinct Malay culture (see Chapter 7).

The inadequacies of the completely optimizing man prompted researchers to look for an alternative. Thus, a second model called the 'Subjective Utility Model' was developed. This model was essentially modified from the model of the completely optimizing man. It assumed that man:

(1) would still seek to optimize economically as far as possible;

(2) would perceive and assess the flood hazard as well as make decisions in the choice of response based on incomplete knowledge of the hazard.

This second model was thought to be better equipped to handle people's actions and response. For instance, it was more 'real' in real life situations in the floodplains where occupants rarely have complete knowledge of the flood hazard. Nevertheless, it still maintains the notion that humans are always looking for economic optimization and is therefore still subjected to the same limitations as those of the first model.

The above models were tested in the field by White (1973 p200) who found that neither seemed to explain much of the behaviour of floodplain occupants. For instance, although floodplain occupants were fully aware of the danger of a recurrence of the hazard, they readily moved back into their houses once the flood had subsided. Floodplain occupants were also unaware of the valuation in property although they were aware of the difference in hazard potential on a spatial basis. Limitations of the models led geographers to search for new models of hazard response. Simon's (1956) 'Model of Bounded Rationality' was adopted.

Bounded rationality suggests that imperfect knowledge of humans of the world around them results in 'satisfactory' choices rather than the ideal optimum. This model was generally used for a variety of management decisions involving firms and organisations. In this respect, the 'behavioural theory of the firm' (Cyert and March 1963) was a logical extension of the theory of bounded rationality in business organisations. The geographer Robert Kates also tested the model in his study of the behaviour and perceptions of floodplain occupants in Lafollette (Kates 1962). The results of this study indicated that humans are largely rational in decision-making and that they make choices from a range of available alternatives based on individual knowledge.

Based on the model of bounded rationality and human ecological adaptation along the lines of the dominant paradigm, Kates (1971) developed a comprehensive model of decision-making known as the 'General Systems Model of Human Adjustment to Natural Hazard'

(Figure 3.1). This model is considered the dominant conceptual model in hazards research (Fordham 1992 p37). It is described in some detail because of its fundamental importance in hazards research and also because it is being extended into a model of flood hazard perception and mitigating adjustment at the individual/household level (see Section 3.5).

In Kates's (1971) model, hazard perception is a function of expectation of future occurrence and personal vulnerability which was claimed to be independent of socio-economic indicators. In terms of the hazard, the most important characteristics were hypothesized to be frequency, magnitude, duration and temporal spacing. In terms of personal experience, it was recency, frequency and intensity of an event. Finally, in terms of personality, it was fate control, differential views of nature and tolerance of dissonance-creating information. Choice of adjustment is influenced by four critical features of the hazard, viz. frequency, magnitude, suddenness of onset and ecological setting. Awareness of adjustments is hypothesized to be a function of access to communications network and differences in awareness due to factors controlling access to information.

On the whole, the model can, at best, only represents a subset of all possible factors affecting perception and adjustment. As such, critics should consider whether it includes the most important factors rather than all relevant factors (Whyte 1986 p252). It has also been argued that the Kates model approximates to a closed system where problems are analysed only with reference to its internal structure and not its external environment (Fordham 1992 p41). Advancement in research and theory has since shown that 'external forces' are intricately linked with individual choice (Hewitt 1983a). In terms of the flood hazard factors such as land use, environmental preservation, individual power to choose, institutional influence, political ideology, colonial history, economic and socio-cultural background etc. all affect the final choice of individuals.

Despite many justifiable criticisms (see Section 3.2.2), the model simplified the complexity of the problem area and was a bold initial step which served to at least create a focus for a critical response (Fordham 1992 p39). It has been found to reveal more explanations of human behaviour (both individual and group) in a flood event than previous models. Its simplicity was attractive and widely acceptable to researchers working in the field. Kates's model has been widely used to investigate not only the flood hazard but also to study other natural hazards (White 1974; Sarre 1976; Kirkby 1973; Burton et al 1978, 1993). Despite its limitations, the basic elements of the model have been generally accepted as useful. In the

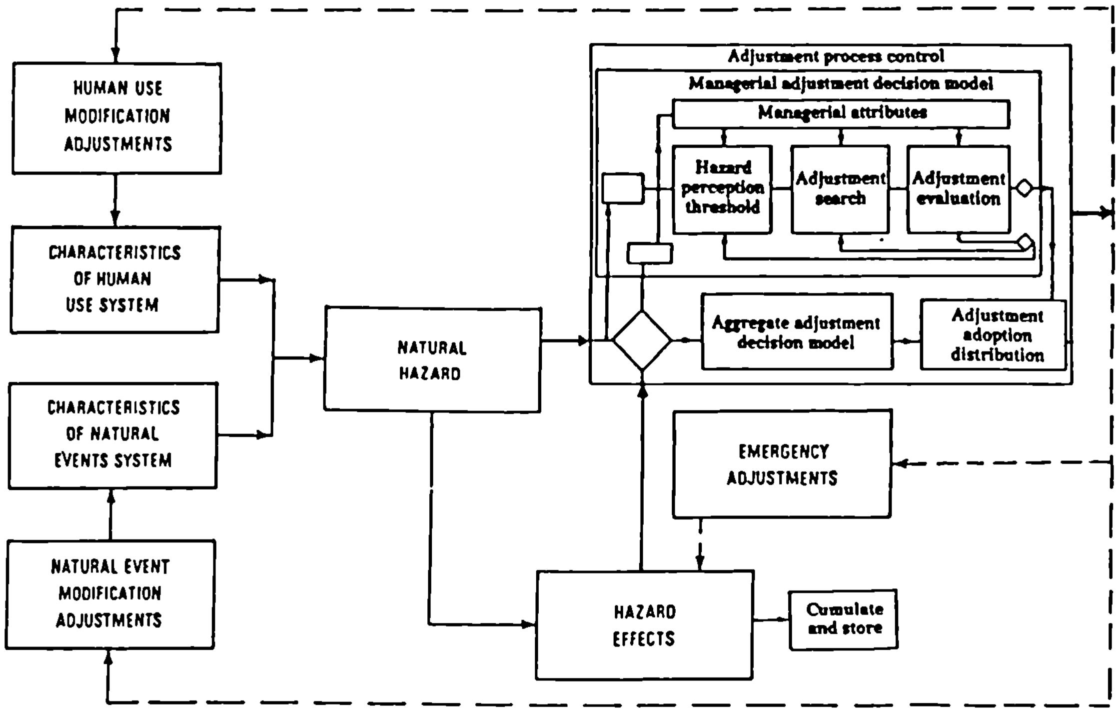

Figure 3.1: A General Systems Model of Human Adjustment to Natural Hazard (After Kates 1971)

United Kingdom, the model was imported almost unchanged into British geographical research in the 1970s (Penning-Rowsell 1972; Harding and Parker 1972, 1974; Parker 1976; Parker and Harding 1979). Even in the 1990s, the model is still being adapted in hazards research (Fordham 1992).

Burton, Kates and White extended Kates's (1971) model into their so-called 'Choice Tree of Adjustment model' (Burton et al 1978). The human use system interacts with the natural use system to produce hazards, which humans recognise, consider how they might deal with them, and choose options that seem to them available (Burton et al 1993 pp31-65). Human response to hazards are considered ecologically based and classified into 'biological adaptation' and 'cultural adaptation'. Emphasis is then placed on how individuals and agencies response to the large range of choices available when faced with a hazard. The theoretical range of choice of response encompasses all the ways (immediate, temporary and long term) in which society may act to reduce the effects or increase the benefits of a hazard. Because this model is a direct extension of Kates's model developed within the confines of the North American School, much of the criticisms are essentially the same.

3.2.2 Critiques of the dominant paradigm

While the dominant paradigm has been widely used and still provides a useful theoretical framework in hazards research, especially that at the individual level of analysis, it has been severely challenged and criticised (Waddell 1977; Torry 1979a; Hewitt 1983a; Penning-Rowsell et al 1986).

One criticism is its inherent over-emphasis on the role of the individual in hazards management, either as a decision-maker or as a victim. Individual choice and action may seem effective in the free-enterprise system of the United States but the impoverished and deprived in Third World countries are helpless in the face of disasters. Because of this focus on individuals, community level response are modelled in the crudest forms by Kates (1971) who simply sum the aggregate response of all individuals within the community. Even in the case where individual responses are deemed important, society cannot be viewed just as an aggregation of individuals. Often, there is a high degree of dependence on community response to flood hazards (Harding and Parker 1976). Also in some countries such as the United Kingdom, flood hazard management appears better explained via a 'model of community hazard response' (Penning-Rowsell et al 1986). This limitation is, however, corrected to some extent in later work by Burton et al (1978) but individual response still remains one of the prominent features of the dominant paradigm, although the authors (in a second edition) recognised the importance of differential vulnerability to hazard between and within communities, conditioned by social group, economic class or livelihood system (Burton et al 1993 pp250-2). A further critique is the fact that an individual's response may be constrained if not severely curtailed by institutional forces. Thus, in many western societies, response to hazards is better analysed and understood through institutions and government. For example, researchers in Britain have found that institutional and political forces often override whatever little choice floodplain individuals may have (Penning-Rowsell et al 1986).

Another criticism centres on the almost entirely western oriented approach used by early hazardologists working within the behavioural paradigm. Much of the work on which models and theories is based is from the United States and Canada, and other western developed countries. Thus it was argued that the behavioural paradigm is a narrow view based on western interpretation of hazards and disasters. It is also deeply rooted in materialism and capitalism and described by its critics as an optimistic, deterministic evaluation which reflects undue faith in technology (Smith 1992 p42). Waddell argues that the dominant paradigm was a product of, and relevant to, a particular type of society:

> '..a western, urban-industrial, capitalist state characterised by a resolutely anti-environmentalist ideology, a population that both is massively mobile and has lost most of its sensitivity to the natural world, and a central government whose responsibility for managing environmental problems is ill-defined' (Waddell 1977 p73).

The use of a common cross-cultural questionnaire across all hazards (White 1974) has been another weakness of the behavioural paradigm. Lewis (1976) has pointed out that research methods developed within the North American continent cannot be applied to other parts of the world, especially those of 'less-developed' or 'under-developed' countries. Similarly, the same set of questionnaire cannot be used interchangeably in two widely differing societies with different cultures, values and literacy. Also, what is applied to one hazard cannot be applied en bloc to another as hazards differ substantially in their origins, time, space and other attributes .

Geographers working within the dominant paradigm have also been accused of paying scant attention to the cultural aspects pertaining to hazard response although they are aware of its importance (Walker 1979 p113). In their employment of the standard survey instrument, researchers working within the paradigm have also been accused of holding culture and social organisation constant. This is untenable as the influence of culture on risk perception of hazards is well documented in the sociological literature (Douglas and Wildavsky 1983; Douglas 1986). Elsewhere, Davis (1978 pp15-19) has underlined the importance of understanding the local culture when planning response (e.g. the provision of shelter/housing) to disasters.

According to Hewitt (1983b p6), the dominant paradigm is characterised by research in three main foci: (a) emphasis on field monitoring and scientific explanation of geophysical processes aimed at modelling and prediction; (b) commitment to physical and managerial control aimed at controlling nature through technological solutions; and (c) emphasis on disaster plans and emergency measures, especially relying on military-styled operations during and after a disaster. Because of the above foci, the paradigm has been criticised as being too 'technocratic' (Hewitt (1983b p8). Others have found that hazard-loss reduction strategies cannot rely on technological solutions alone but must involve some adjustments within human societies (Jones 1993 p165).

To others, especially anthropologists and sociologists, the dominant paradigm shows scant regards for important sociological factors in community hazard response, particularly with reference to cultural, social institutions and organisations that have been shown to strongly influence behaviour (Torry 1979a; Douglas 1982). In fact, Torry (1979a) has claimed that geographers have tended to concentrate on the physical properties of land and weather that make societies hazard-prone, but neglected the benefit of 'a coherent social systems frame of analysis'.

The paradigm has also been criticised for its association with human ecology. For instance, it has been argued that hazards research is different from human ecology. While the former seeks to understand individual human adjustment to environmental extremes, the latter seeks explanations for collective human adjustment (social units) to the environmentally routine (Mileti 1980 p328). Torry (1979a) noted the 'absence' of an ecological perspective in hazards research, even though the dominant paradigm is based on human ecological adaptation. Smith and Tobin (1979) have also noted that environmental attitudes, values and imperatives are lacking in the dominant paradigm.

The paradigm presents a traditional, highly compartmentalised view of hazard which focuses on hazard agents, thereby emphasising the differences rather than exploring the similarities of hazards (Jones 1993 p163). In addition, there is still a tendency to perpetuate certain misconceptions about hazards by over-emphasising conspicuous, high energy events which have large-scale impacts, death tolls, the unpredictability of 'natural' events, and the value of the technocentric approach (Jones 1991).

Finally, structuralists contend that the dominant paradigm is inappropriate, especially with reference to the Third World where individual response is severely constrained within the cultural, economic, political and social milieu (Waddell 1977; Torry 1979a). Thus, structuralists contend that vulnerability to hazards in human populations is more determined by socio-political and economic forces than by individual response.

3.2.3 Strengths of the behavioural paradigm

Despite many criticisms levelled against it, the behavioural paradigm has stood its ground, most notably during its peak in the 1970s. Even as new developments and findings surfaced in the 1980s, the traditional paradigm was never displaced. Instead, major critiques are merited with the credit of enriching it with fresh ideas, demonstrating that hazard research is an open-ended scientific enquiry in which its critics are as much a part of the evolving research as its early innovators (Burton et al 1993 p243). The paradigm is, therefore, not static but dynamic and capable of absorbing new knowledge and growing with time. This is only natural as an ever changing world necessitates new knowledge, models and paradigms. To prove its worth, the traditional paradigm is still being employed in a combination with other paradigms in many current researches (Penning-Rowsell et al 1986; Fordham 1992).

Within the confines of geography, research into natural hazards has evolved steadily over time within a unified paradigm, viz. the behavioural paradigm. The ability of the behavioural paradigm to bind together natural hazards research of cross-cultural dimensions is in itself a strength. Because of this, natural hazards research benefited from the considerable advantages of a coherence and integration that contrasts markedly with other areas of behavioural geography (Gold 1980 p202).

The behavioural paradigm is policy-oriented and therefore has wide applicability on government agendas. When it was discovered that in spite of the United States government's increased spending on flood prevention, flood damage had actually risen sharply, researchers working within the paradigm soon gained the attention of the government. This was reflected in the substantial funding that has been made available for natural hazards research. Subsequently, this applicability extended into the international arena whereby the International Geographical Union (IGU) were involved in a collaborative effort working within the dominant paradigm.

Although its focus on the individual is criticised as a limitation, it is this feature that has perpetuated the popularity of the behavioural paradigm in hazards research. The simplicity of analysing individual response to hazards enables the researcher to tackle many complex research problems which are otherwise difficult to approach. Individual response should be treated as a first step in an ascending hierarchy towards the understanding of hazards. It should not be perceived as the final and ultimate end product of a research. Thus, knowledge gained from individual response can then be researched within a more comprehensive and wider spectrum by including influences from institutional, socio-political and economic forces. In fact, the situational attributes affecting individual response can be modelled in the contexts of historical, socio-political, economic, institutional and other forces. This is what is being attempted in the current research.

The dominant paradigm reveals more explanations of human behaviour in hazard events than previous research. Its assertion that human response to hazards is boundedly rational (although this concept was originally borrowed from sociology) is well documented (Burton et al 1978, 1993). Thus, if the behaviour of floodplain occupants is formed on the basis of inadequate knowledge, then flood reduction policies should include educating them. This is indeed how the National Rivers Authority (NRA) in Britain operates (Fordham 1992 p31). Because of this, the dominant paradigm has wide practical applications to the reduction of hazards. This has been proven in terms of substantial research grants such as in the collaborative international research programme in the 1970s sponsored by the IGU (White 1974; Burton et al 1978). Thus, it commands the recognition of the international community. Currently, the United Nation's International Decade for Natural Disaster Reduction (IDNDR) is run along the lines of the traditional paradigm focusing on physical risks and the role of natural science and engineering in the hazards policy arena (Mitchell 1990; Varley 1994).

In western developed countries where capitalism and freedom of choice prevails, individual response can be significant. Notwithstanding the influence of wider forces affecting the individual, he/she is nevertheless largely free to choose. In such a situation, the behavioural paradigm which emphasises individual choice, whether in the selection of settlement location or the adoption of adjustment can be appropriate.

Although the use of a quantitative questionnaire design has been severely criticised (Lewis 1976; Waddell 1977), the basic research design of the dominant paradigm is actually based on an examination of occupance of hazard-prone areas, hazard perception and the adjustment choice process, the range of possible adjustments to hazard events and the effects on response of varying public policy (White 1974). That such a research design is a strength is testified in the enduring effect it has on much hazards research, as even up to the present day many researchers still employ it albeit with additional research tools such as qualitative methods (Fordham 1992 p32). The quantitative questionnaire has remained popular largely because its core structure has proved to be sufficiently reliable. In fact, refinement and improvement of other research methods (especially in qualitative research) has strengthened the research design as quantitative and qualitative methods are used to complement one another. Related to this is the extensive use of the case study approach exemplified in the collaborative research programme (White 1974). Hazard researchers working within the dominant hazards paradigm have largely employed the case study approach and have contributed substantially to the refinement and popularisation of the technique. This then, is a strength of the dominant paradigm.

The simplicity but coherent approach adopted by the dominant paradigm is attractive and widely acceptable to researchers working in the field. Kates's model has been widely used by many researchers all over the world to study not only the flood hazard but also to study other natural hazards as well (White 1974). Despite its limitations, the behavioural model is useful as it is still being adapted to hazards research (Fordham 1992; Burton et al 1993). Related to the above point is that the paradigm has a cross-cultural dimension. Cross-hazard and cross-cultural comparisons may have their limitations but it provides an insight to the extent of hazards and disasters, and their effects on human populations in the world.

3.3 Complementary perspectives and paradigms

After five decades of hazards research, many disciplines have made contributions to the field. And despite the dominance of the behavioural paradigm, the field of hazards study has not integrated into a common discipline but has disintegrated because of increasing specialisation. As a result, many complementary perspectives or 'schools of thought' can now be identified

(Alexander 1993).

Of all the other perspectives in hazards research **the social and political perspective** comes closest to challenge the dominant behavioural paradigm. It contends that social and political systems lead to the creation and reinforcement of hazards. It was initially developed by sociologists and some human geographers (Hewitt 1983a). This perspective centres on the vulnerability of floodplain communities. Social and political systems in Third World countries generated by decades of colonial exploitation have increased vulnerability. Consequently, these countries are poorly equipped to handle or cope with floods. High incidence of poverty and deplorable living conditions (accompanied by grossly inadequate housing facilities) have forced 'squatting' on the potentially hazardous floodplains (which contain swampy low-lying land which would otherwise be left alone). Such poverty stricken communities would be most vulnerable in the event of a flood occurring as they neither have the experience nor the resources to cope. For example, the lack of suitable farm land due to overcrowding and population pressures in Bangladesh has forced landless farmers to progressively occupy 'marginal' areas for agriculture. Winchester (1992) has shown that decades of poverty and colonialism has increased the vulnerability of some communities in South India to natural disasters. The process of 'marginalization'[31] of the rural peasantry has no doubt added to the increase in flood hazard potential as more and more farmers have occupied flood-prone areas. According to Susman et al (1983 p279), the international division of labour and market forces within the poor underdeveloped countries have caused the poorest of the poor to live in the most dangerous places. The process of marginalization in relation to the flood hazard is shown in Figure 3.2. Poverty, vulnerability and militarization may also coincide with the occurrence of 'natural' disasters leading to a vicious 'poverty-repression-militarization cycle' which brings about mortality, famine, refugee migrations and the destruction of homes and livelihood (COPAT 1981; Turton 1991). More recently, Varley (1994) and her co-authors have demonstrated how socio-political forces such as the inadequate planning for, and response to disasters, are the real cause of human suffering from disasters. Similarly, Blaikie et al (1994) stress the significance of the human factor in disasters. The authors demonstrate that the social, political, and economic environment is as much a cause of disasters as the

[31] The term 'Marginalization' has been used to refer to poor countries where the rural peasantry, due to neglect, repression and deprivation has progressively been forced into marginal or peripheral lands which are normally considered too hazardous to be farmed. This has the effect of making such poor peasant societies extremely vulnerable and the hazard more severe (Blaikie 1985)

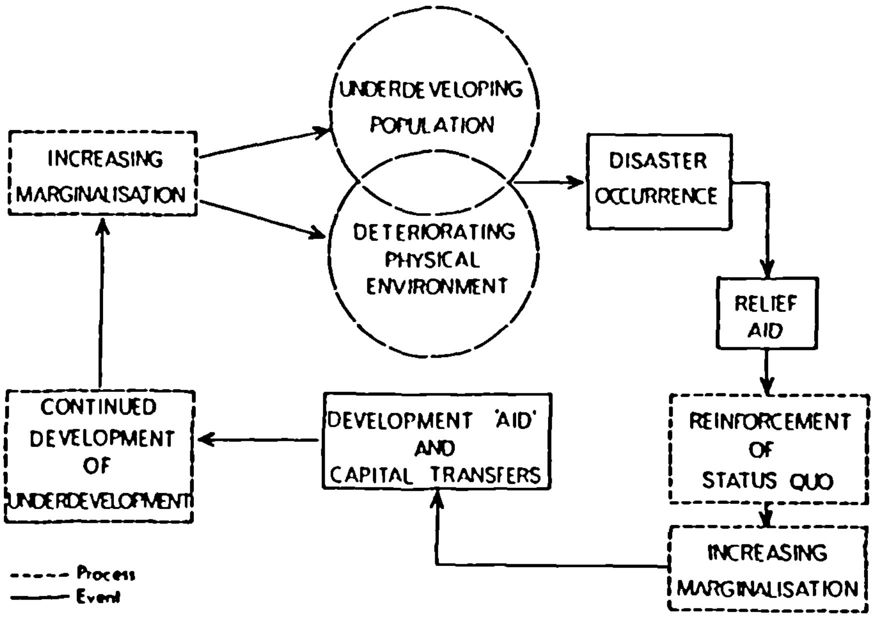

Figure 3.2: The process of marginalization and the relationship to disaster (After Susman et al 1983)

natural environment. Because of this, effective disaster mitigation is rooted in human society and humans have to understand vulnerability in terms of their own society in order to take effective action.

Over the years, the social and political perspective has evolved to become known as the 'structural paradigm'. It is based on the assertion that underdevelopment and economic dependency of Third World countries have increased their vulnerability to hazards and disasters. Structuralists view the occurrence of disasters as a product of the global economy, colonial exploitation, capitalism and marginalization of the poor rather than as a product of extreme events in nature. Underdevelopment in Third World countries breed impoverishment which is perpetuated by technological dependency and vulnerability to hazards. As a result, disaster reduction is seen to lie in the redistribution of wealth rather than on the use of science and technology. This can lead to a Marxist view of disasters.

According to Smith (1992), the structural paradigm challenges the behavioural paradigm at several key points. Firstly, it asserts that natural hazards are not uniquely dependent on geophysical extremes. Increased vulnerability may be the result of poverty, colonialism, marginalization, militarization and landlessness. As a result, increased vulnerability is related more to human exploitation rather than the forces imposed by nature.

Secondly, it asserts that some Third World countries are by nature hazard-prone and that disasters in such countries are not unusual phenomena. Third World countries are more susceptible and vulnerable to disasters largely because they lack the resources to respond effectively.

Thirdly, it asserts that since the roots of Third World disasters lie in the everyday social order, effective hazard management would depend on structural changes in society rather than technological solutions. Because of this, a clear understanding of the local social order is of more importance in hazard management than imported technology. Furthermore, effective hazard management is best achieved from within, by changing the existing economic, social and political conditions rather than by importing external help. Finally, technical aid and disaster relief are seen as short-term temporary measures which may do more harm in increasing dependency rather than reducing vulnerability of such countries in the long term.

Fourthly, it asserts that disaster victims are not to blame for their own misfortunes.

Structuralists do not view disaster victims as lacking in hazard perception, unaware of what they are doing, or engage in irrational, hazard-inducing behaviour. They are of the opinion that disaster victims lack time and access to resources to respond and combat disaster effectively.

The structural paradigm is not without criticism. One commonly mentioned limitation is that it is mostly applicable to Third World countries. Because of this, its usefulness as a research tool for hazard management in the developed countries is limited. However, it has been argued that the structural paradigm may be applied to developed countries because of regional/and local variations in wealth. For instance, the majority of the 6,500 people who were evacuated when a sea wall collapsed in Towyn, North Wales in 1990 were elderly pensioners who could not afford property insurance (Welsh Affairs Committee 1990). Here, the effects of floods were magnified by the limited resources of recovery which elderly people could call upon. Furthermore, the paradigm may be applied to developed countries on the premise that all individuals are to some extent constrained and influenced by the institutions, economic and social circumstances in which they find themselves (Smith 1992). And that these institutions are influenced by macro scale economic and political processes which operate at international level. Another weakness is that it does not offer a framework for practical hazard mitigation. All it does is to offer a theoretical perspective with limited world application. Finally it must be pointed out that the structural paradigm is also open to all the same sociological criticisms arising from scant regard being given to social organisations, values, culture and other societal forces in hazard management as does the behavioural paradigm.

The natural science perspective is essentially the natural scientist's explanation to the occurrence of hazards. It is sometimes referred to as the 'technical approach' (Alexander 1993 p14). It focuses on how natural processes in the 'Earth-Atmosphere System' create hazards and takes into account the importance of society in altering the physical processes. Hazards are principally attributed to the natural causes. As such, it is of paramount importance to monitor and understand the natural processes. It is also important for the natural scientist to measure and monitor these processes in order to classify them. The natural processes can also be modified by humans and this makes it more complicated and difficult to study. Natural scientists often believe that natural processes can be controlled by technological solutions. This perspective is strongly advocated by natural and physical scientists who employ seismology, volcanology, geomorphology, hydrology and engineering approaches to hazard management. Some good examples of the natural scientist's approach to hazards are Harding (1972), Ward (1978), El-Sabh and Murty (1988), and the United Kingdom (UK) flood studies report (Institution of Civil Engineers 1967).

The natural science perspective is essentially a 'tech-fix' approach, although in recent years it has incorporated ecological, biological, environmental and 'sustainability'[32] considerations (a good example is the NRA in Britain as exemplified in the work of Gardiner [1991]). Because of its emphasis on technology as a means of alleviating hazards, it has often been criticised as being too narrow an approach. No field of science can predict the occurrence of hazard events with any level of certainty. Furthermore, artificial structures with high protection levels may still be *'over-topped' by an extreme event. For instance, a 100-year* flood protection embankment may still be over-topped by the 101-year event. Furthermore, this 'technocentric' approach tends to assume that human ingenuity is sufficient to overcome hazards, either by modifying them or making the environment 'safe'. This is certainly a misconception as the number of hazards and their impact on people and property have continued to increase and the environment becoming increasingly hazardous (Aysan 1993 p2). Studies by others have also shown that disasters occur because of other factors such as the misapplication of technology, institutional ineffectiveness, warning ineffectiveness, and hazard generating socio-political systems (Turner 1978; Penning-Rowsell et al 1986; and Winchester 1992).

The organisational perspective was originally an approach used by organisational analysts in explaining hazards. It focuses upon the ways in which organisations such as government agencies, private companies and voluntary bodies deal with hazards. Many scientists such as economists, economic geographers, system analysts, planners, sociologists and those who are concerned with 'collective behaviour' or rather 'collective decision-making' have been responsible for this perspective (Turner 1978; Handmer and Parker 1991; Parker 1992). The role played by such agencies and bodies cannot be underestimated because any action taken by any such body may have widespread effects on the occupants of hazard zones. The basis for organisational explanations to hazards is that organisations may contribute in one way or another to the creation or worsening of hazards.

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[32] 'Sustainability' is both a controversial and ill-defined concept. In terms of 'sustainable development', the following definition by the Brundtland Commission (1987) has been adopted: 'development that meets the needs of the present, without compromising the ability of future generations to meet their own needs'.

Turner (1978) studied a number of hazards arising out of organisational inefficiencies and listed reasons for the creation and aggravation of hazards. Reasons may include inherent organisation inefficiencies within the organisation and outside the organisation (interaction with other organisations); the existence of organisational 'sub-cultures' which leads to 'collective blindness' to the hazard; using the 'decoy' (for instance, an agricultural organisation will highlight the benefits of clearing virgin forest for agriculture in terms of productivity and employment but will disregard or pay less attention to the potential of floods created by such an activity); the tendency for 'organisational exclusivity' (some organisations tend to disregard the advice and warnings of other quarters, especially from scientists and environmental preservation pressure groups); information dissemination difficulties (large companies or governmental bureaucracies tend to complicate the process of passing on information. As such, the information received at lower ranks could well be distorted and therefore not the real information); difficulties dealing with floodplain occupants who are 'strangers' to a company's or agency's instructions; failure to comply with regulations; failure to minimize emergent danger (or failure to admit imminent danger by raising an alarm); and failure to organise safety procedures (for evacuation or relocation) in the event of flood occurrence. Elsewhere, Handmer and Parker (1991) have documented the tendency for organisations to 'groupthink', thus narrowing options. They further noted that there is a high level of secrecy amongst the bureaucracy of government organisations in Britain, all of which hinder emergency planning.

The organisational perspective's usefulness tends to be limited to the scale of the organisation in tackling problems associated with hazards. In many parts of the world, especially western industrialised countries, the role played by organisations in generating and mitigating hazards is very important (Parker 1992 pp10-16). For instance, in the United Kingdom, the role of the NRA in flood hazard management is vital. Similarly, in Peninsular Malaysia, the role of the DID is crucial in flood hazard mitigation (see Chapter 5).

The anthropological perspective is centred on 'humans' and 'the community'[33] as the fundamental unit of disaster analysis. The anthropologist views disaster studies as distinctively and solely within the realms of cultural anthropology. According to Torry (1979a), the anthropologist is concerned about what influences disasters have on social processes in a three

[33] Torry (1979a) has defined the term 'community' as politico-territorial units ranging from towns to entire nations and including localised ethnic enclaves such as tribal populations.

dimensional viewpoint, viz. holistic, developmental and comparative. In the first viewpoint, it is the community that is the ultimate object of study. In the second, it is mechanisms that govern social change and evolution. In the final viewpoint, it is the cross-cultural investigation of principles that underpins social integration and change. Anthropologists have focused on the role of disasters in guiding the socio-economic evolution of populations, in dispersing them and in causing the destruction of civilisations (Alexander 1993 p13, Torry 1979b). Anthropologists have also studied the 'marginalization syndrome' (Oliver-Smith 1979) as well as looking at threshold points beyond which communities can no longer withstand hazards. In many ways, the anthropological perspective may overlap with the social and political perspective.

The sociological perspective in hazards research can be seen in much of the work of Dynes, Quarantelli, Mileti, Sorensen, Drabek, Douglas and others. It focuses on the socio-cultural aspects of disasters. Some examples are hazard vulnerability and impacts in terms of patterns of human behaviour, the effects of disasters upon community functions and organisation (Quarantelli 1978; Dynes 1970), the stress factor in disaster research (Glass 1970), disasters in relation to bereavement (Church 1974) and the 'disaster syndrome' (Wallace 1956). It also focuses on human behaviour during times of disaster (Mileti 1984), their perception of risk (Mileti 1989), disaster warning systems and general hazard and disaster studies (Mileti et al 1975;), emergency planning (Sorensen et al 1984) and public warnings of disasters (Sorensen and Mileti 1986; Mileti and Sorensen 1988; Sorensen and Mileti 1989), disaster warning responses (Drabek and Stephenson 1971), social impacts of disasters (Drabek and Boggs 1968), and the sociological aspects of extreme environments (Mileti et al 1975). Douglas emphasised the influence of culture on risk perception (Douglas 1986). Her contention is that perception of risks is encoded in social institutions and that culture and social organisation determines decision-making. Douglas and Wildavsky (1983) are of the opinion that the selection of particular single issues as environmental hazards is culturally determined. In what they call a 'cultural theory of risk perception', they contend that people's concept of hazards should not be taken at face value but that it reflects certain forms of social organisation, morals, economic, political or other value-laden factors.

The sociological perspective is a diverse one in that all aspects of society in relation to hazards are studied. However, its apparent relevance in disaster research is weakened by the fact that individual, institutional, economic and political responses are considered far less important in the creation and perpetuation of hazards. Furthermore, the perspective does not acknowledge the importance of structural or engineering solutions to protect society from environmental hazards. Its sociocentric view of hazards and disasters (focusing on cultural or social organisations) inevitably inhibits its very scope and applicability .

Other than the perspectives mentioned above, there have been recent additions in the field of hazards research. One is the **development studies perspective** which evolves around problems created by the aftermath of hazards. These include the provision of aid, relief and shelter, hazard victim relocation, refugee management, health care and the avoidance of starvation. Because the most critically affected by hazards are poverty-stricken developing countries, much of this perspective is centred on the Third World countries. Some examples of the development studies perspective on hazards research are Davis (1978, 1981), Chen et al (1980) and Knott (1987). Finally, a new field in disaster medicine has created what is known as the **disaster medicine and epidemiology perspective**. This perspective focuses on the management of mass casualties, the treatment of severe physical trauma and the epidemiological surveillance of communicable diseases resulting from a disaster (Beinin 1985).

3.4 Recent developments in the geographic perspective

3.4.1 Hazards-in-context

The hazards-in-context model enables researchers to examine hazards and disasters differently from traditional views developed by previous generations of hazard researchers (e.g. Burton et al 1978; Hewitt 1983a). Contexts may be temporal (historical), spatial, political, economic, socio-cultural, environmental, institutional, organisational, etc.. According to Mitchell, Devine and Jagger's (1989) 'A Contextual Model of Natural Hazard', a natural hazard system consists of two parts: a subsystem of hazard components and a subsystem of hazard contexts (Figure 3.3). The former contains four interacting components which modify one another through seven endogenous links (a human-ecological approach). On the other hand, the later contains exogenous factors that interact with and modify hazard components but are largely independent of them (a structuralist approach). Exogenous factors are highly variable and because of this, contexts are likely to change. This poses a challenge for researchers attempting to identify and analyse contexts in their search for commonalities amongst hazards and disasters.

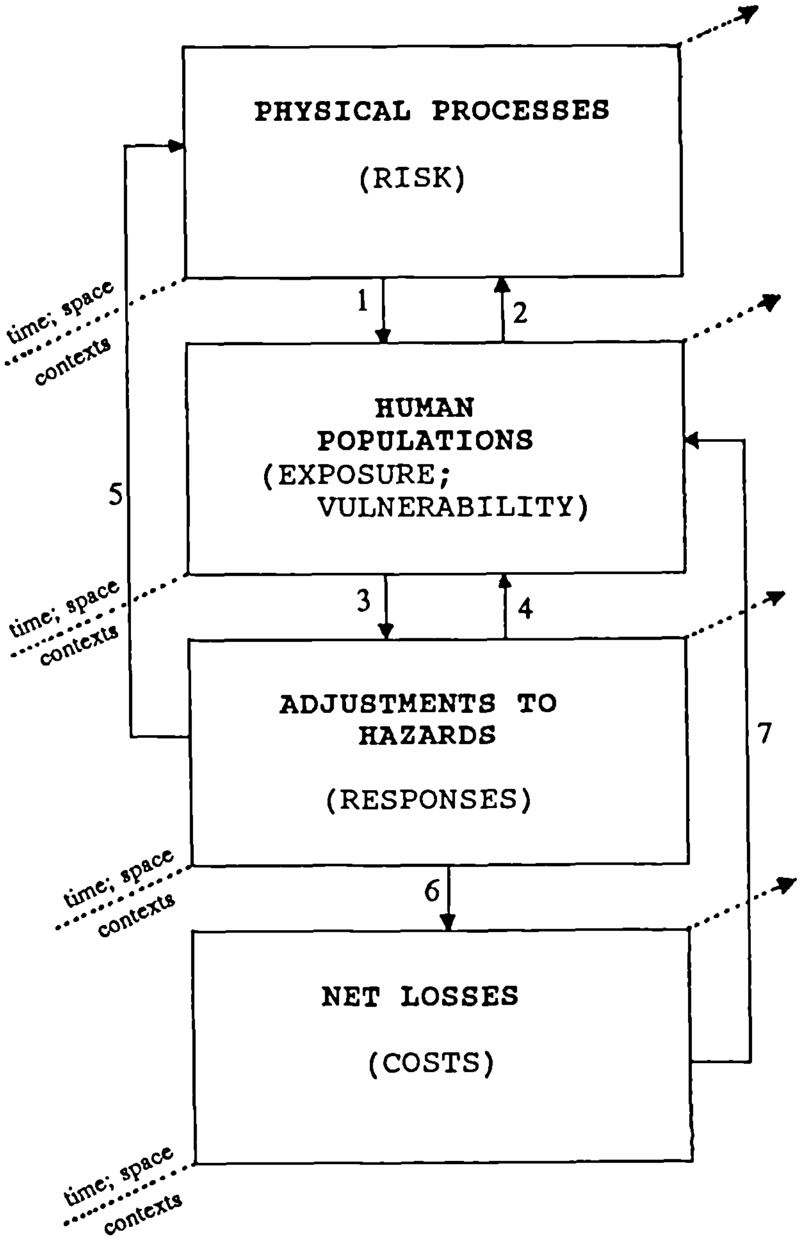

Figure 3.3: A basic Contextual Model of Natural Hazard (After Mitchell, Devine and Jagger 1989)

3.4.2 Strengths and limitations

Hazards-in-context is a relatively new perspective in hazards research and it offers researchers a new and dynamic approach in viewing hazards. Its focus on hazards as being more influenced by contextual socio-political forces rather than strictly human-ecological ones is appropriate in the current state-of-the art in hazards research. In this new approach, hazards are analysed in terms of the contexts affecting human populations. Vulnerability and impacts are therefore placed in perspective. Each context affecting a hazard can be studied individually as well as in combination. In the case of the latter, comparisons between contexts enables the researcher to identify the most influential context within specific time and space frames. This will then enable policy makers to target strategies and policies of hazard reduction against the identified context. Hazards are by nature highly changeable in time and space. So too are contexts. This is not a problem as the analysis of hazards-in-context is highly versatile and takes into account such changes. Modelling changes in contexts over time and space enables the researcher to monitor the effects of such changes on hazards. Unlike the behavioural paradigm which is only appropriate in western capitalist societies, or the structuralist paradigm which is largely applied in the Third World (although it can be used to study poor sections of western societies), the hazards-in-context approach may be applied to both developed and undeveloped countries. Finally, no standard research method is specified in this approach. Researchers can employ both quantitative and qualitative methods, and historical analysis and other secondary data sources can be used.

A limitation with the hazards-in-context approach is that there is a dearth of research on contexts of hazards as it is a relatively recent development (Mitchell et al 1989 p406). More specifically, much hazards research in the past and that currently under way seeks to measure hazard components such as physical processes, risk and vulnerability of human populations, adjustments to hazards and the net losses from hazards. Less is known about the exogenous factors or contexts between which hazard components interact to produce the final outcome. Thus, there is a scarcity of literature on contexts. Because of the multitude of contexts influencing any hazard, the analysis of all contexts is inherently complex and poses problems. Analysing each context separately may be a solution but contexts may be intricately related and affect one another. To further complicate the picture is the fact that contexts are dynamic and change through time and space. Thus, until the researcher can identify the key contexts influencing a specific hazard, it is unlikely that any meaningful analysis can proceed.

3.5 Developing a flood hazard response-in-context model for Peninsular Malaysia

3.5.1 Flood hazard research in Peninsular Malaysia

In Peninsular Malaysia, much of flood hazard research reflects a technocentric approach which strongly emphasises the use of structural/engineering methods, and to a lesser degree on non-structural methods in solving flood problems. As a result, the bulk of the literature on flood studies in Peninsular Malaysia is concentrated within the field of engineering and hydrology. Some notable examples are Charlton (1964), Volker (1971), Water Resources Committee (1971), Banks (1973), Bidwell (1979), DID (1973a, 1974, 1976), JICA (1980, 1982, 1989, 1990), and Syed Mohammad et al 1988). This approach is central to the 'Society over Nature' school of thought, or technocentricism. Although technology plays an important role in flood hazard management, it is a fallacy that it can provide the means of total protection against all floods. Conversely, it has been observed that technology can increase vulnerability (Jones 1991 pp37-8).

Flood hazard research in the social sciences, mostly involving geographers, has so far proceeded along the line of the dominant North American paradigm. One of the earliest research is Winstedt's (1927) report on the 'great flood' of 1926. Chua (1972), Leigh and Low (1972), Abdul Samad and Tohardi (1973), Sham (1973), Abdul Samad (1974), Leigh and Low (1983), Jamaluddin and Ismail (1983), Jamaluddin (1985) have variously studied human response to the flood hazard. Leigh and Low (1978), Lim (1988) and Chan (1993) have researched government and public policies on flood management while Low (1983) and Sooryanarayana (1988) have investigated the physical aspects of flooding. Some parts of the peninsula are affected by droughts (a minor hazard) and this phenomenon has been researched by Chan (1981a, 1981b, 1985, 1987, 1988a, 1988b, 1991b). A summary of the principal findings of past research is given in Appendix J.

3.5.2 The conceptual flood hazard response-in-context model

The application of the flood hazard response-in-context model for Peninsular Malaysia is an attempt to advance hazards theory. Malaysia is one of the 'Tiger economies' of Asia, experiencing profound and rapid physical, political and socio-economic changes. Such changes are likely to affect both the nature of flood hazards as well as human responses to them. The hazard response-in-context model is dynamic and takes into account such changes, and enables the researcher to explore the influence of macro socio-cultural, political economy and other societal contexts, and meso institutional contexts on micro level responses of the individual. More significantly, it seeks to identify the links between contextual forces of different levels/scales and seeks to analyse how they interact and influence one another.

The conceptual flood hazard response-in-context model for Peninsular Malaysia is a hybrid model reflecting both the behavioural and the structural paradigms, in addition to the current perspective of hazards-in-context (Figure 3.4). Individual response can be effectively studied via the behavioural paradigm, which also takes into account geophysical forces generating the seasonal floods. The structural paradigm explores the influence of local, national and international structures on local vulnerability to flood hazards. Local and national structures are manifested by poverty, low residential and occupational mobility, low educational attainment, customs and traditions, equity and communal/ethnic issues, federal-state politics and development policies relating to flood hazards. On the other hand, international structures are manifested by colonialism, neo-colonialism, dependency, and globalisation of the world market system. All these structural contextual forces can lead to the creation and perpetuation of flood hazards (see Chapters 4, 5 and 6).

There are a number of contexts in which flood hazards and flood hazard response are located. Contexts are exogenous factors which often deeply pervade flood hazard creation, perpetuation and response. Thus, they often determine the course of development of the flood hazard, vulnerability to the hazard, and the form, extent and successfulness of hazard response. The challenge in this research is to conceptualise the links between contexts at the socio-political level through the institutional level down to the individual level where hazard impacts are felt. Thus, a '*flood hazard* response-in-context *model*' is conceptualised (Figure 3.5).

In this model, individual and institutional management of flood hazards are conceptualised as being heavily influenced by macro socio-political contexts. These macro contexts comprise socio-cultural and political economy forces which 'condition' individuals and institutions and influence their approach to hazard management including its effectiveness. They also 'condition' and often 'determine' human vulnerability to hazards. These socio-political contexts are also termed 'structural' forces and they in themselves may lead to 'failures' to adequately address hazards. In turn, the behaviour and response of individuals are also influenced by meso institutional contexts which sometimes amplify hazards or fail to

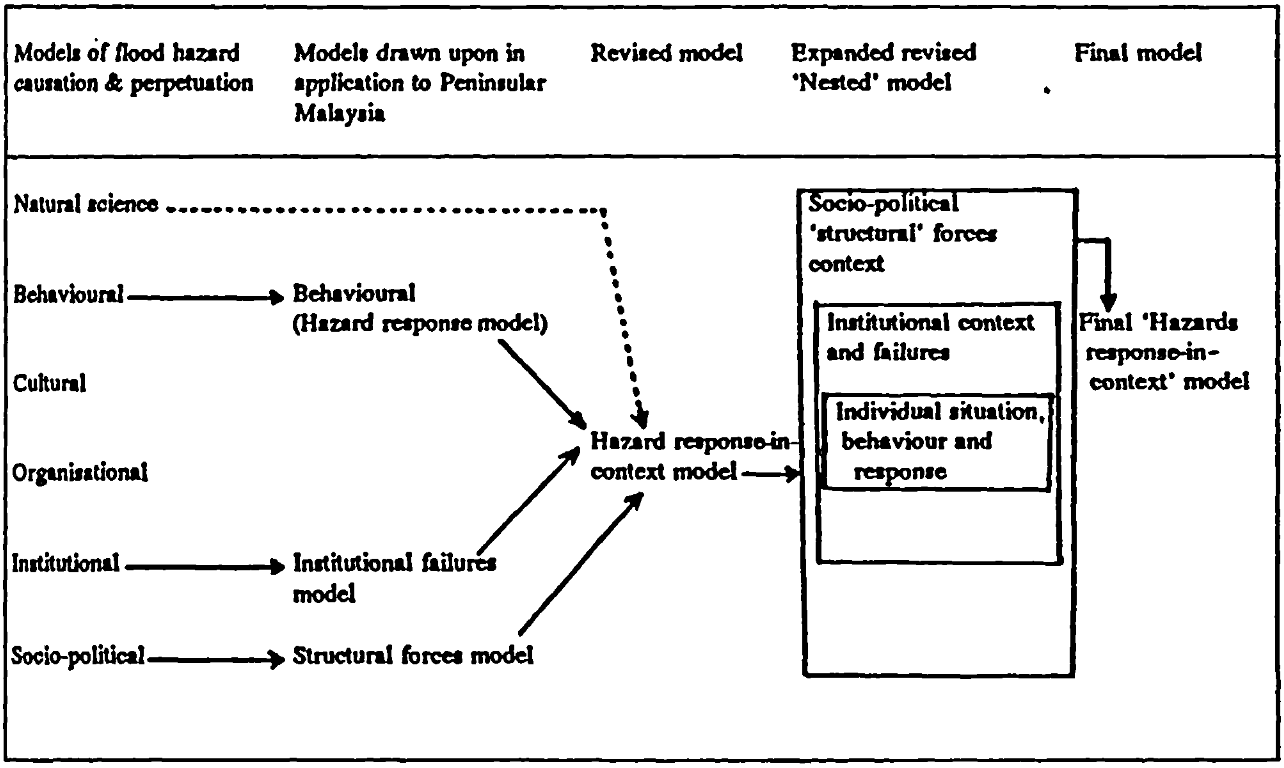

Figure 3.4: Principal 'Strands' of thinking in developing a 'Flood hazard response-in-context model' for Peninsular Malaysia

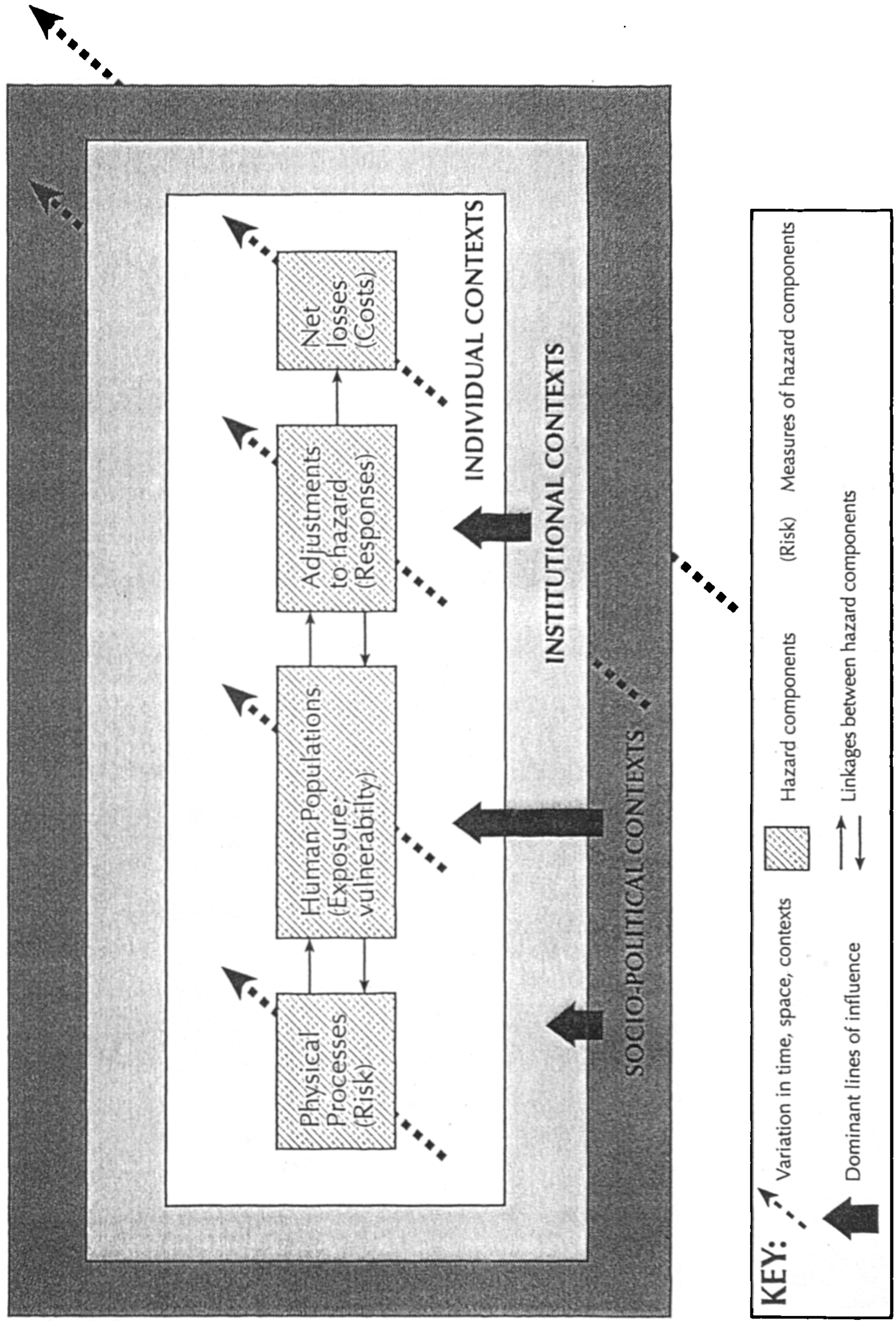

Figure 3.5: A 'Flood hazard response-in-context' model for Peninsular Malaysia

adequately address and reduce them.

Within the broader influence of socio-political and institutional contexts, individual/household perception and response to the flood hazard is based on an initial conceptual 'Model of flood hazard perception and response at the individual/household level' (Figure 3.6) which is an extension of Kates's (1971) model. In this initial model, interaction between the human use system and the physical process system creates an objective level of flood hazard. The level of the hazard depends on (i) human use such as the type of land use, building characteristics and the amount of damageable material wealth; and (ii) the geophysical characteristics of the locality (mostly relating to flood characteristics). The two systems are dynamic and modifications to either (by way of feedback mechanisms) may alter the level of the hazard.

Individual perception of the flood hazard is hypothesized to influence the degree and form of adjustment. This perception is complex and is dependent on the individual's situation which is determined culturally, politically, economically and socially (amongst other factors). In terms of culture, variables such as ethnicity, religion and beliefs, and values in life are hypothesized to affect perception. In terms of politics, the individual's perception is envisaged to be influenced by attitudes towards government, publicity of flood mitigation schemes, attachment to political parties and government policies. Economic well being largely determines an individual's resilience towards the flood hazard. Finally, social characteristics (including flood experience) and attitudes/beliefs towards the environment, education, gender and others can also have an effect on perception. There are, however, other situational characteristics that may have an effect on perception as well.

If, however, the flood hazard is not perceived (irrespective of whatever the actual level of the hazard), then response is unlikely. If the flood hazard perception threshold is reached, then the search for adjustment begins. Thereafter, the adjustment is evaluated for final decision-making as to whether it will be adopted. The same factors that influence perception are also hypothesised to affect the evaluation of adjustments.

Finally, broad socio-political and institutional contextual forces are hypothesised to influence the evaluation process as well. The process does not end after an adjustment has been adopted because any adjustment adopted will eventually have feedback effects on both the human use system as well as the natural event system.

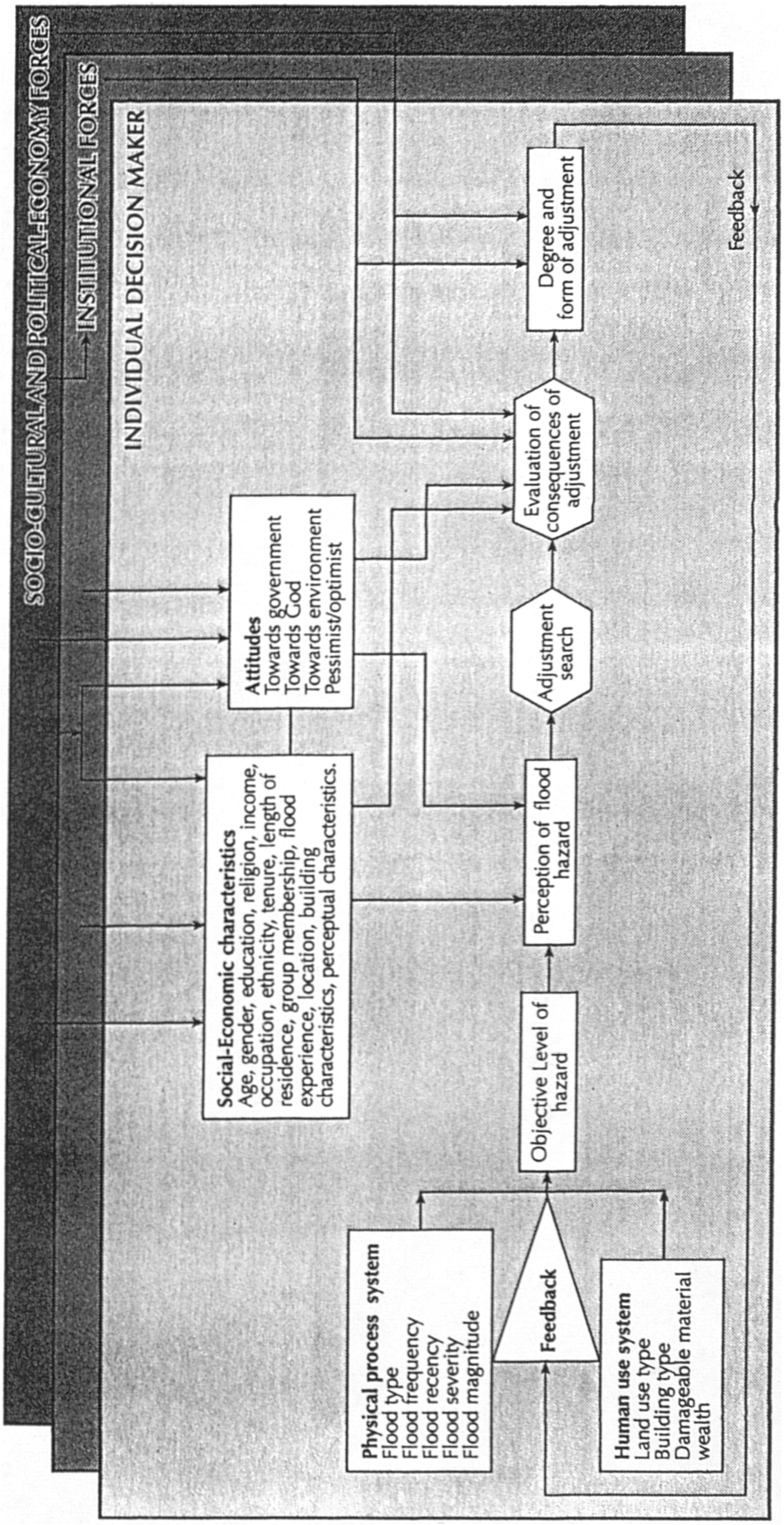

Figure 3.6: Model of flood hazard perception and mitigating adjustment at the individual/household level (After Kates, 1971)

3.6 Key contexts affecting flood hazard response in Peninsular Malaysia

This section identifies the 'key contexts' considered to be most important for analysis of flood hazards and flood hazard response in Peninsular Malaysia (Table 3.1). It examines in a general way how each key context and their 'facets' can influence both the creation and perpetuation of the flood hazard as well as the perception and response of individuals and organisations to floods in Peninsular Malaysia. It sets the scene against which these contexts will be analysed empirically in detail in Chapters 4 and 5.

Extending Kates's (1962) key observation, when analysing floodplain 'managers', that individuals are 'prisoners of their experience', in a similar way they are also prisoners of their contexts. Thus, contexts are important in any analysis of flood hazards and response to them, and the argument extends from individuals to include organisations which are influenced by, and reflect, the political economy context. Focusing on contexts should, therefore, add weight and penetration to analysis. The principal problem in exploring contexts and demonstrating their significance is methodological, and is examined in more detail in Chapter 2. The historical method and the use of examples (case studies) are two ways in which contexts may be approached.

3.6.1 Socio-cultural context

Many facets of the socio-cultural context are responsible for the creation and perpetuation of flood hazards in Peninsular Malaysia. In the early years of settlement, a combination of socio-economic factors have led to the settlers to occupy floodplains. Malays are basically a riverine race and have, therefore, always preferred floodplains as their homes. Consequently, flooding has gradually become an integral part of their culture. Flooding is seen as an acceptable hazard in their lives. Interestingly, generations of experience with the flood hazard has made the people resilient to it. They have developed traditional modes of adjustments and can cope fairly well with normal floods[34]. It is the major flood that renders them helpless with the majority unable to recover sufficiently for the next planting season. The 'kampung way of life', the stilt house and traditional warning and evacuation mechanisms are cultural adaptations that have evolved from living with floods (see Chapters 6, 7 and 8). Malay culture is profoundly different (in many ways it is in direct contrast) to Chinese or

[34] See Section 2.1 for definition of normal and major floods.

Table 3.1: Key contexts and facets which affect the flood hazard in Peninsular Malaysia

Key context	Facets of context
Socio-cultural	Historical settlement *Colonialism* Ethnic culture (ethnicity, values, beliefs, attitudes, religion, customs, tradition, the 'kampung way of life', land ownership and inheritance, outlook in life, etc.)
Political economy	Neo-colonialism Economic development policies Flood hazard policies Federal-state politics Post-colonial communalism Equity and poverty eradication
Institutional	Laws Organisational structures Attitudes, values and culture Policies and instruments

Indian cultures. The majority of Malays live a quiet and sedentary life in rural kampungs contented with religious pursuits while immigrant Chinese and Indians engage feverishly in business and other material pursuits in the cities[35]. Consequently, the ways in which each ethnic group perceive and respond to flood hazards can differ. Ethnicity is an important facet affecting flood hazard response.

The facet of colonialism has profound influence on flood hazard response in Peninsular Malaysia. British colonial rule for more than three-quarters of a century in the peninsula is reflected in many spheres, including the economic (as in exploitation of the Malayan economy, uneven regional development favouring resource-rich states, neo-colonialism and imperialism), political (as in political systems modelled after colonials), institutional (as in hazard institutions set up by colonial powers or modelled after colonials) and social (as in the practice of communalism and the immiseration of peasant farmers). In the hazards literature, researchers such as Susman et al (1983) have demonstrated that many catastrophes in the Third World are due to structural imbalances and maladaptations to the new economic system introduced via colonialism which displaced more resilient indigenous systems of production. Consumerism and the western market system break down the traditional way of life via the injection of such western cultures into them (Said 1991). Marxist interpretations of colonialism have stressed its negative dimensions (Marx and Engels 1976; Brett 1973; Cardoso and Faletto 1979). In Peninsular Malaysia, Hua (1983) has highlighted the mechanisms of perpetuating oppression that maintain the conditions responsible for Malaysia's economic subordination to metropolitan capital despite having achieved independence for more than three decades. This negative effect of core-periphery relations has determined the way in which many aspects of the Malaysian economy has developed.

3.6.2 Political economy context

In this research, the political economy context covers those facets associated with political, social and economic systems which can amplify or attenuate flood hazards. For example, 'Neo-colonialism' is a facet through which developed western economies exploit the economies of developing countries. It usually leads to dependency problems which reinforces 'core-periphery' relations (Brett 1973; Fong 1989). Consequently, the developing country's

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[35] The first Chinese and Indian immigrants came to the peninsula with only one aim, i.e. to make their fortune. Hence, their almost total involvement with commerce and business.

economy is weakened through this exploitative process and has less resources to deal with hazards, thereby becoming more vulnerable. A country's development policies (including flood management strategies and policies, government aid and relief, formal/official warning and evacuation systems) are translated from political ideology. Ill-conceived policies can amplify hazards and also contribute to increased flood risk, population exposure and vulnerability. The Malaysian government's emphasis on using technological solutions may prove ineffective and can lead to increased vulnerability. Equity and poverty eradication are key political ideologies preached by successive Malaysian governments since independence. The extent to which these two facets are resolved can have significant effects on flood hazard reduction. For example, if rural income levels are raised vis-a-vis urban incomes, and poverty levels are significantly reduced, then vulnerability would be reduced proportionately. Better off rural peasants (mostly floodplain dwellers) will be able to recover faster from flood impacts. Communalism is a common ideology practised amongst the majority of political parties in Peninsular Malaysia (Mahathir Bin Mohamad 1970). The colonialists have used it effectively to segregate the various ethnic groups, culminating in immigrant Chinese and Indians becoming rich citizens and indigenous Malays (mostly floodplain dwellers) remaining poor. Communalism has now taken on a new dimension in that there are sections of all communities being left behind in economic progress. While previously there are mainly poor Malays in remote kampungs, there are now poor Chinese in new villages[36] and poor Indians in rubber estates. Related to communalism is the process of differentiation (in terms of income and opportunity) and marginalization (in terms of social allocation whereby peasants are being forced to occupy marginal land) which lead to the immiseration of rural peasants (Nonini 1992). Impoverished peasants are therefore most vulnerable to flood hazards. Finally, the urban version of rural peasants are the landless and homeless 'squatters' the majority whom are rural peasants who have migrated into the cities to look for a better living. Inevitably, high land prices and rents in cities have driven the migrants to inhabit hazardous zones, most notable of which are flood-prone riverine areas. Combined with poor education and low occupational mobility, urban squatters are forced to persist in these areas and become very vulnerable to flood hazards.

[36] The Chinese 'new village' was created during the 'Emergency' (1948-60), a period when Malaya faced the threat of communist terrorists operating under the Communist Party of Malaya (CPM). It is a nucleated type of rural settlement surrounded by barbed wires employed by the British, ostensibly, to stop rural Chinese from giving supplies to the communists (who operated from the Malayan jungle). Thousands of these new villages were created during the emergency. However, it is a dual-purpose strategy employed to segregate the different ethnic groups as well as to suppress the MCP (see Hua 1983 pp94-9).

3.6.3 Institutional context

In Peninsular Malaysia, flood hazard management is almost an exclusive responsibility of the government. As in many other countries, floodplain management is an activity occurring within an institutional context. Although general development policies are formulated by the federal government (at the political economy level), the formulation of flood hazard policies, their implementation and enforcement, action during floods, and day-to-day operations are vested in flood hazard institutions. Management of the flood hazard is done either directly or indirectly by flood hazard institutions set up by the government and government owned flood hazard organisations such as the DID, MMS, Police Department, Welfare Department and others. The government, therefore, interacts with the public through institutions. Institutions form the link between socio-political contexts and the individual. Within such a scenario, flood hazard reduction then largely depends on how effective flood hazard institutions are. Flood hazard institutions can either reduce flood hazards through effective management or amplify them through mismanagement or failures.

There are four facets of the institutional context which can determine the outcome of flood hazards. **Legislation** is a key factor in effective flood hazard management. Laws, regulations, administrative jurisdiction, enforcement powers, duties and responsibilities, and interventionary powers are important tools for the government to control and enforce flood reduction programmes. Flood hazard management will be effective if all the above 'tools' are adequately legislated and vice versa. **Organisational structures** demarcates the responsibilities, functions and powers of an organisation. Thus, organisational objectives largely determine the way in which flood hazard management will be undertaken. Within this framework also lies administrative structures, administrative discretion, duplication of responsibilities, fragmentation and administrative flexibility, all of which influence the effectiveness of the organisation and therefore the extent to which the flood hazard can be reduced. **Attitudes and sub-culture** are developed over the life time of an organisation. Organisations can develop specific values, attitudes, customs and sub-cultures amongst its corporate structure which in turn influence decision-making. **Policies and instruments** are other 'tools' employed by institutions in the management of flood hazards. To a large extent, policies determine the degree to which the flood hazard can be alleviated. Ill-defined policies can lead to the amplification of flood hazards. A policy embracing 'sustainable development' will help reduce flood hazards but such a policy is often viewed by developing countries as a hindrance to rapid economic development. In a developing country such as Malaysia, a balance must be sought between the need for rapid economic development and the achievement of sustainability in the long run. 'Equity' and 'poverty eradication' are policies pursued by the federal government. They should also be policies embraced by institutions (not necessarily concerned with flood hazard) as success in both will undoubtedly bring about more balanced regional development and more equitable income distribution amongst the people. Rural inhabitants with better incomes can then recover faster from hazard impacts and respond more effectively with better means of adjustments. However, if institutions *do not* embrace and implement such policies, it can only increase vulnerability resulting in more severe impacts.

This chapter has critically examined the dominant hazards paradigms, identified key flood hazard contexts and developed a 'hazard response-in-context' model. The next chapter focuses on the socio-cultural and political economy contexts, two key contexts that have contributed significantly to the creation and perpetuation of flood hazards in Peninsular Malaysia.

4 THE SOCIO-CULTURAL AND POLITICAL ECONOMY CONTEXTS OF FLOOD HAZARD RESPONSE IN PENINSULAR MALAYSIA

In Chapter 3, key contexts and their facets affecting the flood hazard were identified. This chapter focuses on the socio-cultural context and political economy context and their facets. This is an empirical chapter in which a combination of historical analysis, qualitative and quantitative analysis, and the insider approach is employed to analyse the creation and perpetuation of the flood hazard within the influence of the above two key contexts. The institutional context is analysed in Chapter 5.

4.1 Socio-cultural context

4.1.1 Historical patterns of settlement

The early settlers chose to live on floodplains near the major rivers for a number of reasons such as water supply, agriculture, communications and transport, fishing and tin mining. Historical records indicate that the first major Malay settlements were in the floodplains of Kedah and other northern or north-eastern states (Mahathir Bin Mohamad 1970 p21). Abundance of land and geographical considerations have made the Malays 'people of the lowlands'. Land was plentiful in the more accessible river valleys and floodplains for everyone. The hills and jungle in the interior were never necessary for cultivation or permanent settlement. Furthermore, rice is the stable food of the Malays and padi farming is their main occupation. As the padi plant needs water-logged soils and flat land, floodplains are the ideal locations for extensive cultivation. Hence the early Malay settlers became primarily plainsmen, padi farmers and fishermen who lived on the banks of rivers. The rivers became their principal means of communication, source of fish and other aquatic food supply, and ironically also their sewerage system. Gradually, small settlements grew into towns and those that are located near the confluences (which commanded both inland and sea communications) soon became the capitals of local chiefs or rulers.

According to Kennedy (1967 p123), the geography of the peninsula was the principal factor that determined the pattern of settlement in Malaya. The typical Malay kingdom was based on settlements along a major river valley. Usually, the capital lay near the river estuary so that the ruler could control the movements of people and goods in and out of the state, organise defence against enemy attacks, and levy tolls and taxes on imports and exports. The river served as the main, and often sole means of communication, while the jungle, swamps and mountains which form the hinterland acted as natural barriers. Some examples of such settlements are the royal town of Kuala Kangsar on the banks of the Perak River (where the residence of the Perak Sultan is located), Pekan on the Pahang River (where the residence of the Pahang Sultan is located), Kuala Terengganu on the Terengganu River, Alor Setar on the Muda River, and Kota Bharu on the Kelantan River. As a result, the majority of present day cities and towns in the peninsula are located adjacent to or near rivers, giving rise to a large flood-prone population and a high damage potential (see Figure 2.7).

The growth of large settlements were mostly on fertile river valleys and delta regions where flat land and rich alluvial soils were found. Some of the early padi settlements which have survived until the present day include the Kedah Plain (on the Kedah and Muda Rivers), the Kelantan Delta (on the Kelantan River), the Seberang Prai Region (on the Muda River Delta), the Krian Region (on the Kerian River), and the Terengganu Plain (on the Terengganu River). In the present day, these areas are no longer solely made up of padi fields but are all densely populated with compact built-up areas. For instance, Kota Bharu and Kuala Terengganu are capital towns located on the Kelantan Delta and Terengganu Plain respectively. Because of their location, these are vulnerable areas as they are subject to seasonal flooding as well as flash flooding. Those located on river estuaries and deltas are also subject to tidal floods. As padi farmers are one of the poorest income groups in the country (Chan 1991a p35), they are also one of the most vulnerable communities to flood hazards. It has been estimated that 57.7 per cent of farmers were living below the 'poverty line' (see definition on pxx) in 1991 (International Law Book Services 1991 p234). In the current study, the 95 farmers surveyed yielded an average monthly household income of $346, well below the 1993 poverty line of $394 per month. The farming community, therefore, has one of the highest incidence of poverty in the country. This implies that the majority of farmers will find it financially difficult to cope with flood hazards, and to recover and rehabilitate. Hence their high vulnerability to flood hazards.

Fishing was an indigenous occupation amongst the Malays, long before the British came to Malaya. According to Winstedt (1951), fishing was a significant form of indigenous economic activity. A significant proportion of indigenous Malays are specialised fishermen who live in fishing villages dotted along all major river estuaries and river banks. The long coastline of the peninsula is also ideal for fishing activities. These are all areas which are highly vulnerable to the flood hazard not just by virtue of their proximity to rivers and seas, but also their low-lying topography and the threat of the monsoons (particularly those settlements on the East Coast). When the weather is good and there is demand for fish, padi farmers are sometimes enlisted as part-time fishermen. In fact, a significant number of padi farmers engage in part-time fishing and other economic activities during the season immediately after transplanting and harvest. This is the period when they have the most free time. In 1951, Winstedt (1951 p122) estimated that there were about 50,000 Malay fishermen (mostly on the East Coast) and another 10,000 Chinese fishermen (mostly on the West Coast). In 1992, Keng (1992) estimated that there were 115,000 fishermen of which Malays comprised nearly 90.0 per cent and Chinese 9.0 per cent. The fishing community is also one of the poorest groups in Malaysian society. In 1991, it was estimated that 27.7 per cent of fishing households were below the poverty line (International Law Book Services 1991 p234). In the current study, fishermen had the lowest average household incomes ($325 per month) of all income groups surveyed. Thus, 57.2 per cent of fishing families have monthly incomes below $350, and are, therefore, poor. Although the fishing community is well attuned to normal flooding and nature in a way that others are not (76.2 per cent of fishermen interviewed are aware of flood hazards), they remain one of the most vulnerable to major floods because of their low income. Fishing settlements have not developed and prospered in the way mining settlements have. They remain a permanent feature of the rural Malaysian landscape. For example, present day fishing settlements are found in the coastal parts of Kota Bharu, Kuala Terengganu, Kemaman, Pekan, Kelang, Teluk Intan and others. Because of the high poverty rate within the farming and fishing communities vis-a-vis other communities, income equity is a central issue in Malaysian society that needs to be addressed (see Chapter 8, Section 8.3).

Finally, mining towns have also evolved significantly in the peninsula. Although tin has been mined for local use and export (mainly to China) since the Melaka Sultanate in the 16th Century, it was not until the industrialisation of the west in early 19th Century, particularly with the rise of the tin canning industry, that the tin rush began in the peninsula. The early Chinese miners settled close to the major rivers wherever large deposits of alluvial tin were found. Thus, the federal capital of Kuala Lumpur was founded at the confluence of the Kelang and Gombak Rivers because of tin (Gullick 1983; Kuala Lumpur Municipal Council 1959) (see Plate 2.2). Other big settlements to have a tin origin were Ipoh (on the Kinta River), Kampar (on the Kampar River), Taiping (on the Krian River), Sungai Lembing (on the Lembing River), and Sungai Siput (on the Perak River). The mining settlements were also located near rivers because Chinese gravel and hydraulic pump methods necessitated the use of water from the rivers. Because the settlements were near to rivers, they were easily subject to periodic seasonal flooding. Also, mining exposed the land surface to erosion. This leads to more rapid and higher rates of runoff, a shorter time lag between rainfall and flood flow, and greater flood peaks. According to Leigh and Low (1972, 1978), mining activities are one of the major factors leading to increased flooding in the major tin producing areas of the country. The breaking of bunds which prevented the water from mining ponds to flow into adjacent low land where settlements are located is another threat of flooding (see Appendix I, 1963 flood). There were several cases of such localised flooding in Ipoh in the late 1970s (DID undated a).

4.1.2 Colonialism

A brief historical background is necessary as a prelude to the analysis of the influence of colonialism on the flood hazard in Peninsular Malaysia. Although western colonial influence began with the Portuguese capture of the port of Melaka (then Malacca) in 1511, it was the British who most deeply influenced much of the peninsula's history. The British first colonised and set up trading posts at the ports of Pulau Pinang (then Penang) in 1786, Singapore[37] in 1819 and Melaka in 1824. When the British signed the Treaty of Pangkor with a Malay ruler in 1874, it marked the beginning of British colonial rule in the region which was to last more than three-quarters of a century.

Although direct influence of colonialism on the flood hazard in Peninsular Malaysia can be seen in flood policies during the colonial and post-colonial periods, its 'indirect' influence is more profound in terms of colonial exploitation of the economy, development policies, communal ethnic policies, agriculture policies, rapid economic development, and the introduction of cash cropping. Each of these points are analysed in detail in the following sections.

(a) Colonial flood policies and their influence on current flood management approach

Early flood management policies and strategies were developed by the colonialists and the current approach is modelled after them. The DID, the agency now responsible for flood management in Malaysia, was initially set up in 1932 by the British. As a result, much of its

[37] Singapore was part of Malaysia until 1965 when it elected to be an independent republic.

organisational structure and the way it functions, especially its emphasis on agricultural interests (mainly drainage and irrigation) via the engineering approach, is modelled after the British. Thus, it is no coincidence that the prime responsibility of flood alleviation and land drainage in Britain rests with the Minister of Agriculture, Fisheries and Food. Consequently, British flood alleviation and land drainage policies emphasise agriculture interests based largely on the skill of the engineer (Penning-Rowsell et al 1986 p172). Before the formation of the DID, river conservancy was the responsibility of the Public Works Department (PWD), another agency set-up by the British which focuses on engineering solutions. During the 1920s, a number of flood mitigation schemes were undertaken by the PWD, notably in Kuala Lumpur and Ipoh situated on the Klang and Kinta Rivers respectively. In these two schemes, only engineering solutions were used as the two rivers were canalised, embanked and shallow sections dredged periodically (DID 1973b pix). This essentially British culture of employing engineering solutions, a 'tech-fix' approach, continued right through independence until today. This is proven by the continued employment of British firms in many of the country's hydrological and flood management schemes. A recent notorious example is the construction of the Pergau Dam (a multi-purpose dam incorporating flood control features) in which British firms were guaranteed contracts worth millions of ringgit (Davidson and Rufford 1994).

Although post-colonial governments in Malaysia have reportedly adopted a more comprehensive multi-disciplinary approach in flood management (Water Resources Committee 1971), flood problems continue to be predominantly approached by structural or engineering solutions (JICA 1982). Since 1971, flood management became the official responsibility of the DID. It adheres strictly to engineering solutions of 'flood control' and is largely dominated by engineers (see Chapter 5). This is very much a British culture as flood management in Britain has mainly been the responsibility of the predecessors of the National Rivers Authority (NRA), organisations largely dominated by engineers. The NRA is an organisation dominated by engineers and its approach to flood management has been based on structural/engineering methods. In recent years, however, the NRA has moved on and adopted a multi-disciplinary approach to flood management, but their Malaysian counterparts such as the DID have failed to follow suit and are still predominantly employing the engineering approach. Because of this, structural measures of flood control is the norm and non-structural measures are under-developed. The comprehensive analysis in Chapter 5 demonstrates this point effectively.

The hallmark of British bureaucracy is its 'culture of secrecy' which impedes the free flow of information to the public (Parker and Handmer 1992 p258-65). According to the authors, such a culture is one factor that sets the conditions which encourage the perpetuation of hazards and the occurrence of accidents, emergencies and disasters. Such a culture is also practised in the Malaysian administrative bureaucracy for national security reasons, but as shown in Britain, it can lead to ineffective hazard management. The bureaucratic infrastructure of the Malaysian administrative system was originally created by the British. It was the British who set up district offices and land offices so that they (the governing body) could extend their rule to the most remote parts of the peninsula (International Law Book Services 1991 p92). Although many changes have been made since independence, the bureaucratic nature of doing things from one administrative level to another (e.g. from the federal level down to the mukim [the lowest official administrative unit] level) or between government agencies still prevails until today. In terms of the flood hazard this can be seen from the inability of different government departments to cooperate and work effectively to manage the flood hazard. For instance, the DID often has difficulty convincing other agencies not to develop certain floodplain regions.

(b) Colonial exploitation of the Malayan economy

Various theories on the reasons for western imperialism in countries in the far east have been expounded. In the case of Malaya, the most prominent is that of economic gains based on the Marxist perspective (often the sole reason given) (Hobson 1961; Sinclair 1967; Badriyah Haji Salleh 1990). Others like Fieldhouse (1966) are of the opinion that British intervention resulted from the initiative and private interests of individuals (mostly British officials). Yet, others, notably the British themselves, have claimed that the main reason for British intervention in the affairs of the Malay states during the late 19th Century (subsequently leading to colonisation and rule over Malaya) was to bring law and order to the region so that trade could be carried out without disruptions caused by Malay feudal disputes and Chinese secret societies scuffles (Kennedy 1967 pp156-7). Whatever the reason, it is undeniable that without economic gains (the British had already considerable interests in the three Straits Settlements of Penang, Malacca and Singapore prior to intervention), they would not have set foot in the Malay peninsula.

However, this section is not about the reasons which brought about intervention. Rather, it is about how the colonial government differentially exploited the peninsula's resources, drained its revenues (both through over-subscription to Imperial defence and other contributions as well as through profits channelled out of the country via British and other European enterprises). They failed to develop the rural economy which led to large sections of the population, as well as large parts of the peninsula, remaining poor and thereby becoming vulnerable to the flood hazard. They also laid the basis for today's rapid urbanization in the West Coast states which in itself is a force generating increased flood risk and exposure (This is examined in Section 4.1.2 f).

Li (1982) criticises the British for overly exploiting 'one of the richest colonies of the 'British Empire'[38]. The effect of British colonial rule on Malaya's economy can be seen in two areas. First, although tin and rubber made the economy prosper, this prosperity was seldom enjoyed by the masses. Much of it went to large British and European companies. The majority of the masses, especially the indigenous Malays, remained poor. Second, because the colonial government's interest and focus was almost entirely on tin and rubber (and other cash crops), it paid scant attention to rural development and almost totally neglected padi farming[39]. This resulted in vast regions of the country being undeveloped and large sections of the population being impoverished.

Tin and rubber are the two stalwarts on which the economic history of Malaya has evolved. Although the rise of the latter as the single most important export during the first quarter of the 20th century can be described as nothing short of sensational (Li 1982 p62), tin has had a much longer history. From 1898 to 1905, Malaya was the world's largest tin producer, supplying more than half of the world's output. Tin was the single most important factor leading to British intervention and subsequent formation of the four 'Federated Malay

[38] At the turn of the century, the colony which came closest to British Malaya in terms of revenue was Ceylon (now Sri Lanka) which for 1899 had a revenue of £1.7 million as compared to £2 million for British Malaya. However, while the former had a population of more than 3.3 million, the latter had a population of only 1.2 million. Thus, in per capita population terms, the British government in Malaya was probably three times richer than its counterpart in Ceylon (Li 1982 p13).

[39] Although it is unrealistic to expect British capitalists to invest money in the padi farming industry which at best could yield only meagre profits, it is a moral responsibility of the colonial government to do so. That it did not goes a long way to prove that the latter also had its mind firmly set on exploitation of rich resources and not on the welfare of the people.

States'[40] in 1895. The British neglected the 'Unfederated Malay States' which were not rich in tin deposits contributing to their under-development, impoverishment and vulnerability to the flood hazard (see Section 4.1.2 c). Before the British came the Chinese were the main producers of tin in the peninsula but the British with larger investment capitals and superior mining techniques soon replaced and 'marginalized' the Chinese miners. For instance, Chinese share of the tin production fell from 78.0 per cent in 1910 to 32.0 per cent in 1937 while British share rose from 22.0 per cent in 1910 to 68.0 per cent in 1937 (Li 1982 p66). By 1960, three years after independence, the European (mostly British) share of production was still 60.0 per cent, and the returns from the tin industry played a major role in keeping the sterling area afloat (Karim 1990 p134).

However, it was not just the free enterprise system that defeated the Chinese miners. It must be mentioned that the British capitalists were supported and favoured in many ways (as in the issuance of mining licences and concessions for example) by their own government. Official policies and favouritism were the factors that killed off Chinese competition as a series of enactments established official control over the industry. According to the enactments, the most important criteria for the granting of a mining licence was the amount of capital a firm could raise and because of their larger capitals, British firms were naturally favoured. The corruption of the Mines Department was also notorious, even before the sensational trials of a number of high-ranking officers in 1940 (Thompson 1943 p71; Li 1982 p67). As if such factors were not enough to eliminate Chinese competition, a series of international tin agreements or schemes to control tin *production (thereby stabilising tin prices) during* the 1930s finally removed even the most resilient of the remaining Chinese mines. The effect of the agreements favoured large producers (British) as when the tin quota was low, they could easily pool their resources and fulfil it without the help of the small mines. As such, small mines had to close or stay idle during times of low quotas. It was during times of high quotas when the large mines could not fulfil them that the small mines had a chance to produce, thus making them 'marginal producers'. Gradually, a combination of the use of tin dredges (British and other European) and the closure of small mines (Chinese) led to the unemployment and impoverishment of thousands of Chinese miners. For example, before the

[40] The Federated Malay States comprising Perak, Selangor, Negri Sembilan (all on the West Coast) and Pahang (on the East Coast) were formed in 1896 with the Resident-General's headquarters in Kuala Lumpur and a resident in each of the four states. In the case of Pahang, only its western part, largely comprising undulating topography suitable for rubber cultivation, was developed by the British.

quota system on production was introduced in 1931, the average total labour force was about 100,000 men but by 1937 it had dwindled down to only 49,000 (Thompson 1943 p75). Finally, the British also controlled and monopolised the tin smelting business in Malaya and the world. The control of Malaya's tin industry is evident of Britain's almost total domination and exploitation of its economy.

In terms of rubber production, Europeans were able to wrest large areas in concessions from a predominantly British Civil Service who, directly or indirectly, were in control of the whole country. According to Badriyah (1990 p260), the colonial government clearly favoured British and other European investors in the rubber industry. This is evident not only in the liberal allocation of land and the charging of low rentals for new estates but also in the government's direct involvement in bringing in foreign labourers (most notably Indians) to work in them. By 1953, Europeans owned 83.0 per cent of rubber estates covering some 0.65 million hectares (Puthucheary 1960 p27). In contrast, the Chinese owned smaller estates amounting to 14.0 per cent of the total hectarage and the Malays were mostly smallholders (plots of less than 40 hectares). Other than the direct control in the rubber industry exerted by their dominant hectarage, the colonial government also employed rubber restriction schemes to limit production levels of smallholders, thereby reducing their competition.

In commerce where most of Malaya's economic activity were in the production of exports and the distribution of imports, British control was almost total. Practically all the import-export houses in colonial Malaya were British or at least European and they were protected by the colonial government without any need for legislation (Mahathir Bin Mohamad 1970 p48). European companies did not merely control the major share of both tin and rubber production but also in their exports as well. For instance, the Dunlop Organisation, apart from owning extensive rubber estates in the country, was also one of the world's most important supplier and manufacturer of rubber products. Because of this, European companies also controlled much of the trade in Malaya. About 60.0 per cent of exports in 1953 were done by the producers and manufacturers themselves (Puthucheary 1960 p62). The import of highly specialised machinery and other products needed by European companies was also dealt by themselves. And the bulk of the imported goods was handled by large European companies. Imported goods from these large companies were then distributed to smaller intermediary companies (mostly European and Chinese) which then re-distributed them to the Chinese middleman who usually owns a 'kedai' (retail shop) in the town or village. The kedai is not an indigenous feature of pre-colonial Malay culture but was introduced by Chinese immigrants during the colonial period. Its intrusion into the kampung represents the first introduction of capitalism into the subsistence economy of the indigenous Malays. More significantly, however, it played an important role in breaking down the self-sufficiency of the traditional economy rendering it more vulnerable to the flood hazard. Throughout this distribution process, the Malays are not involved at all and therefore gain no benefit from the trade. They not only remained as peasant farmers and fishermen but because of the rapid change from a subsistence economy to a capitalistic one, they grew more dependent on the kedai for goods (the traditional ones which they previously produced and new goods from other states or imported goods). As a result, their resilience and coping mechanisms with regards to the flood hazard were weakened if not lost completely. And they became more vulnerable to floods, especially the severe floods.

In other areas of the economy, the British also controlled the whole of the banking business as well as the shipping sector. In the former, British banks were patronised by British mining and rubber companies and other concerns. Initially, the banks were set up to deal largely with the financing of the import-export business, especially that connected to tin and rubber but later branched out to include other businesses. In the latter, almost all ships plying the international routes had British or European firms as their agents in Malaya. With this grip on shipping, the exclusion of local firms from the import and export business was complete. Finally, British firms also had a firm grip on the lucrative government contracts for construction and supplies as they were naturally favoured by the British run government. Major construction works such as roads, bridges, public buildings, and dams had ready contractors in British firms. Not surprisingly, major colonial government contracts for construction and supplies were often a closely guarded monopoly of British firms. According to Mahathir Bin Mohamad (1970 p49),

> '..So institutionalized was the doling out of contracts to the British firms, that the brass plaques on foundation stones which were put on all Government buildings often carried the name of the British firm or the contractor himself, a practice which is unthinkable today.'

Finally, British colonial exploitation of Malaya's economy must be seen in light of the large amount of funds contributed by Malaya to the home government in Britain for military and other imperial expenses. Apart from expenditure on railway, roads and other public works, a large amount of the annual revenue of the peninsula was consumed by military expenses. This was rather odd as prior to the 2nd World War, British Malaya was not involved in any war. According to Li (1982 p28), this was largely due to Malaya's own wealth as the home government in Britain was not slow in casting a covetous eye on Malaya's rich resources. To help fund its imperial defence, Britain wanted Malaya to contribute the highest possible amount for local and imperial expense. For instance, from 1890 to 1895, the Straits Settlements were ordered by the Colonial Office to pay £100,000 annually for military expenses. This was then fixed at 20.0 per cent of the Colony's revenue in 1899 which totalled $1.9 million[41] (Emerson 1964 p309). In 1931, the local government managed to persuade the home government to fix the annual contribution at $4 million. Apart from the above 'regular' contributions to imperial defence, Malaya was also generous in military contributions known as 'special circumstances'. For example, in 1899, it contributed $65,000 to the Boer War (Parliamentary Debates, 19th July 1923, V166, p2618). Its contribution towards the Imperial War Exchequer during World War I was at least £15 million (Annual Report of the Straits Settlements for 1916). Malaya also contributed towards the construction of a battleship named 'Malaya' (part of the Imperial fleet) at a cost of £2.25 million. Another £2 million was given for the construction of the greatest naval base in the far east (Parliamentary Debates, 13 May 1914, V62, p1088). It is estimated that from the end of World War I to 1938, Malaya contributed no less than £22.25 million to imperial defence (Parliamentary Debates, 24 June 1942, pp1992-3).

It would not be difficult to imagine how the Malayan economy, and indeed flood hazard management might have benefited if all the resources exploited by the colonialists were not channelled out of the country but into the development of these two areas. The above point is reflected by Leigh and Low *(1978 p53), who stressed that the prevention of major floods* in the 1940s was beyond the capability of the Malayan government because of inadequate financial resources. Whilst vulnerability to the flood hazard during the colonial period may in large part be attributed to all the above reasons brought about by colonial rule, the inheritance of a much exploited economy in 1957 meant that such vulnerability would continue, at least until all the problems created by the colonialists could be overcome. This may take a long time as the economy of post-colonial Malaya (at least during the first few decades after independence) was still very much dominated by British and European interests, with Chinese interest increasingly taking a stronger foothold. Thus, the Malayan economy may not be in a position to spend on flood hazard reduction strategies as much as it would need to. Consequently, flood hazard vulnerability perpetuated, especially in the traditionally

[41] This amount was only second to personal emoluments totalling $2.9 million paid out to the elaborate bureaucracy. Here again, as the top flight government officers were British, a significant percentage of this amount were channelled back to Britain.

impoverished areas.

(c) Colonial policies of uneven regional development

Although British colonial rule is largely responsible for developing much of Malaya, it also gave rise to wide disparities in regional development. The colonialists were only interested in states that were either rich in tin or rubber. Thus, the Federated Malay States were rapidly developed to facilitate the increased exploitation of both commodities while the other states were neglected and lagged further and further behind. Consequently, this has led to wide disparities in regional economic development within the peninsula. Paying a visit to Malaya before World War II, Li (1982 p24) remarked that:

> '..one could not but be impressed with the fine government buildings, good roads, comfortable travel by rail, schools and medical services in the Federated Malay States and the Straits Settlements. The situation was not as good in the Unfederated Malay States.'

Wide regional development disparities, therefore, developed between the Federated and Unfederated Malay States. For instance, during the early decades of the 20th century, the state of Perak (one of four Federated Malay States under British rule) was much more developed than Kelantan which was virtually untouched by modern economic development and thereby retaining its Malayan backwardness. And the Straits Settlements were even more developed than the four Federated Malay States due to their early colonisation. In 1936 total revenue for the four Federated Malays States was $68 million (averages about $17 million each) as compared to only $3.2 million[42] for Kelantan. This is precisely where the problem lies. Because the British were only interested in exploiting tin and rubber they concentrated on developing the Federated Malay States. Of the four Federated Malay States, Perak and Selangor were the richest in terms of revenue, and were therefore developed more rapidly than the other two states of Negri Sembilan and Pahang which lagged a long way behind (Kennedy 1967 p197). In fact, Pahang (an East Coast state) was the least attractive to the British. It neither had any large reserves of tin nor was it suitable for rubber. Thus Pahang was the least developed and had the poorest communications and other infrastructures. And since it was in the East Coast and therefore exposed to the Northeast Monsoon winds, its population living on floodplains was very vulnerable to the seasonal floods. Other than the

[42] This figure is for 1937 (from Annual Reports of the Federated Malay States and Kelantan).

Federated Malay States, the three Straits Settlements were the most developed as they were all ports which handled the flow of almost all goods in and out of the country. The least developed were the Unfederated Malay States, notably Kelantan and Terengganu on the East Coast and Kedah and Perlis in the northeast[43]. Of these, Kelantan and Terengganu are the least developed and therefore the most vulnerable to floods as both are exposed to the Northeast Monsoon winds.

Undeniably, colonial contextual forces are at least partly responsible for disparities in incomes and development between regions (up to independence). In other words, such forces are responsible for the creation of 'cores' and 'peripheries' in relation to each other. According to King and Parnwell (1990 p1), core areas are economically well developed, where the inhabitants are generally richer, and have greater access over the peninsula's material resources. They are also usually highly industrialised and urbanised, and have good infrastructure and essential services. On the other hand, peripheral areas are those which do not have the above mentioned attributes of core areas. In Peninsular Malaysia, cores and peripheries can be identified in terms of states (as in Kuala Lumpur being the core and Kelantan being the periphery) or regions (as in the West Coast being the core and the East Coast being the periphery).

Because of the existence of core and peripheral areas, there are also disparities in the coping capacities of regions, states, and people during floods. Consequently, perpetuation of peripheral areas is one of the reasons why certain regions are more vulnerable to the flood hazard than others. For instance, although East Coast states are generally well adjusted to 'normal' floods, poor states such as Kelantan and Terengganu cannot cope with major floods and take a much longer period to rehabilitate and recover. Because of this disparity, the current federal government is obliged to help the poorer states during flood emergencies. Every year, a significant amount of money is spent on flood hazard preparedness, relief and rehabilitation (Majlis Keselamatan Negara 1992).

As a result of more than three-quarters of a century of colonial rule, rigidly set policies have

[43] Perlis replaced a Siamese advisor with a British advisor after the Anglo-Siamese Treaty in 1909. Johor, because of its close proximity to Singapore, had British influence since the latter was founded in 1819 but a formal British advisor was only taken in 1914. Terengganu was given British protection in 1910 and accepted a British advisor in 1919. Finally, Kedah had British advice and assistance since 1910 but only formally accepted a British advisor in 1923.

reinforced and deepened economic disparities between states and regions. Certain states and regions have been so neglected that it may take many decades for them to catch up with the developed states and regions. Such disparities are still very prevalent in the country today. In fact, the disparities are so large that post-colonial governments have not been able to effectively reduce them. In many areas, the disparities are increasing. Credit, however, must be given to post-colonial governments for realising such disparities and introducing development policies to redress the situation, although the efforts have been largely ineffective as richer states have forged even further ahead of those lagging behind (Faaland et al 1990). Thus, it would not be entirely wrong to suggest that flood hazard vulnerability in the poorer states and regions of post-independent Malaya was largely contributed by colonial development policy.

(d) Colonial communal policies of ethnic segregation

British policy in Malaya was based on the colonial ideology of harmony and consensus combined with a policy of 'Racial divide and rule' in which the various ethnic groups are segregated (Abraham 1976). Hirschman (1985) offers the interpretation that 'racial divisions' in the peninsula are largely a product of British colonial practices. Although the British encouraged large scale immigration of Chinese and Indians, the immigrants were not thrown into contact with Malays, but were segregated geographically, economically and socially from the local population. Thus, Malays continued to live in rural areas (mostly on floodplains as they were farmers), the Chinese in mining towns and other urban centres (as they were mostly miners and businessmen) and the Indians in rubber estates and towns (as they were mostly rubber tappers, traders and government labourers who worked on roads and railways). It was largely a result of this policy that led to the immiseration of the Malays (mostly peasants during colonial rule) on one hand and their marginalization and proletarianization on the other (Nonini 1992). And because of this policy, the Malays have largely remained trapped in their farms on the floodplain even until today. Although Malay peasants are quite well adjusted to 'normal' flooding as the majority live in stilt houses and have developed many coping strategies (see Chapter 7), they are the poorest and most vulnerable group to severe flooding in the peninsula and are likely to remain so.

British colonialists perceived Malay peasants as most suitable for padi cultivation, fishing and other rural economic activities and should therefore remain subsistence producers. This official view became an obstruction for peasant economic mobility as it discouraged peasants from moving into other jobs (in the towns) and plant cash crops. The colonialists simply wanted them to remain in rural areas in order to sustain the food supply for the Chinese (who worked in mines, cities and towns) and the Indians (who worked in the rubber estates). The Malays were never encouraged to go into business, mining or other economic activities. A small proportion of the educated Malays were encouraged to go into government service but the majority remained in the traditional agrarian sector. Furthermore, Malay entry into the rubber industry as smallholders was severely curbed and controlled by the British who did not want competition to their estates. Although many Malays eventually planted rubber in smallholdings and became a threat to British interest, their efforts were soon stifled by various government schemes such as the Stevenson Scheme in 1922 and the International Rubber Regulation programme in 1934 (Nonini 1992 pp85-102). These rubber restriction schemes were organised by agreements between large capitalist producers and colonial states, of which the British were the foremost advocate. In Malaya, the British were able to implement both schemes to great effect, restricting smallholder production and thereby eliminating competition from them. This has the effect of suppressing rural Malay standards of living but more significantly it prevented the Malays from moving out of their flood-prone farms into the better drained foothills where the rubber plant thrived. Thus, continued impoverishment and geographical immobility perpetuated and exacerbated the flood hazard amongst the Malay peasantry.

On the other hand, the Chinese were encouraged by the British to go into mining, business and other commercial activities. In fact, large scale immigration of the Chinese from China was encouraged if not induced by British colonial policy. In his book 'The Malay Dilemma' in which he described the reasons leading to Malay poverty in comparison to other ethnic groups in Malaysia, Dr. Mahathir, the current prime minister of the country, accuses the colonial government of a loose immigration policy which resulted in the influx of a 'hardened, adventurous and resourceful' immigrant Chinese population which subsequently dominated the Malaysian economy (Mahathir Bin Mohamad 1970). The other main ethnic group, the Indians, was also encouraged by the colonial government to migrate to Malaya in large numbers, mostly to work in rubber plantations owned by the British. Many Indians, however, were also involved with trading, money lending, wholesaling and other commercial activities. Economically, the Indians are also better off than the Malays although they still lag behind the Chinese. Current figures show that the ratio of mean monthly income between Malays and Chinese is 58.8 per cent while that between Indians and Chinese is 75.9 per cent. The ratio of mean income between Malays and Indians is therefore 77.5 per cent

(Government of Malaysia 1991a p11).

Tunku Abdul Rahman (Far Eastern Economic Review, 21 July 1988, p17), Malaysia's first prime minister, sums up the Malays' plight just after independence:

> 'The Malays required help in raising their standard of living, so in the first five year development plan we agreed on extensive development because the people of the kampungs had been completely neglected by the British.....'

(e) Colonial agriculture policies favouring the plantation sector

Malay peasants were impoverished not just by colonial policies of ethnic segregation which reduced their occupational mobility. Related to the above point is the fact that the colonial government's preoccupation with plantation agriculture had severe negative effects on peasant agriculture. Despite the introduction of land alienation, credit service and the provision of agricultural and marketing facilities by the colonial government, they were found to be inadequate as peasant interests continued to be neglected. Thus, Lim (1977 p225) remarked that:

> 'It would not be an exaggeration to say that the colonial government's activities favouring the plantation sector were often tantamount to an anti-peasant policy and stunted peasant development during a period when conditions were conducive to growth'.

The government's inability to provide effective measures to bring peasants into the main stream of economic development is largely responsible for the latter's perpetuation within a subsistence level of existence. Because of government neglect, Malay peasants have largely remained poor. Thus, at the end of the 1930s, many Malayan peasants were hard-pressed by indebtedness, low productivity, unfavourable marketing arrangements and insecurity of tenure. And most of these problems, claimed Lim (1977 p225), could have been averted had there been a government more genuinely committed to the social and economic progress of its people. It was largely because of such immiseration that rural Malay peasants are perpetually the most vulnerable to major and extensive floods which obliterate much of rural floodplains, most notably in the East Coast. Such was the case in 1926 when the country suffered from widespread floods at the height of which the Pahang and Perak Rivers rose from 23 to 34 metres above their normal levels resulting in the surrounding land resembling a vast inland sea (Lim 1977 p159). Other than its toll on human life and suffering and property damage, large areas of kampung and padi land (including crops) were destroyed

(Winstedt 1927). In Kuala Kangsar (Perak) alone, more than 4,000 hectares of padi were destroyed (see Appendix I).

(f) Colonial influence on rapid economic development

The exploitation of tin and rubber by the colonialists also significantly modified the hydrological cycle and contributed to the exacerbation of flood hazards, especially flash floods on urban floodplains on the West Coast. The opening of tin mines not only involves the clearing of forested land but the exposure of the land surface, as mines are left exposed for long periods of time. Even when the mines have stopped operations, the land was not replanted with vegetation. Natural regeneration on mining land takes a long time as the soils are poor due to excessive leaching. Mining activities have been pointed out as a contributory factor to increased flooding in the peninsula (Leigh and Low 1972, 1978 p49-52). Similarly, replacing forested land with rubber trees also result in increased surface runoff, siltation of rivers, and decreased lag time between rainfall and peak flow (Daniel and Kulasingam 1974; Zulkifli and Abdul Rahim 1991). The building of railways and roads to facilitate transportation and the growth of towns and other settlements all add increased incidence of floods. Finally, rapid development of urban areas in the major towns have led to floodplain encroachment and the growth of a large flood-prone population. In this way, the more developed West Coast states are subject to flood problems, especially those relating to flash floods (Jamaluddin 1985).

(g) Changing production systems and loss of traditional coping mechanisms

In hazards research, a central critical point about colonialism is the introduction of foreign (exogenous) methods which are ill adapted to local conditions in the colony. The failure of early American settlers to overcome drought hazard on the Great Plains was largely due to the transference of farming methods best suited to the humid conditions of the east coast of the continent. Few farmers who formed the wave of movement westwards recognised or understood the climatic adversities of the Great Plains which was subject to periodic and often chronic arid conditions (Warrick 1983 p68). In the African continent, there are many instances where colonialism has increased hazard vulnerability through the introduction of alien farming methods, resulting in the disappearance of traditional coping mechanisms and adjustments (Watts 1983). More significantly, however, is the change in the production system brought about by colonialists. Thus, the transition from producing use-values for local consumption (including a variety of food crops), to growing cash crops reduced the ability of the population to cope with environmental stress. Consequently, nutrition suffered and the population became more vulnerable (O'Keefe and Wisner 1975; Richards 1975; Susman et al 1983).

In Peninsular Malaysia, the introduction of cash crops such as rubber, coffee, tea, cocoa, oil palm and others transformed the production system from one of subsistence food cultivation to that of market-oriented cash cropping. Although subsistence agriculture remained important in the East Coast, the lucrative returns from these cash crops, most notably rubber, induced the majority of peasants to cultivate them in smallholdings. And although many farmers did retain part of their land for padi cultivation, there were many who completely abandoned it and went into full time rubber cultivation. The extent of peasant involvement in the rubber industry is reflected in the fact that one third of the total area in 1930 was under smallholder cultivation and smallholders contributed two fifths of the peninsula's production (Karim 1990 p117). This change in the production system is more pronounced in western Peninsular Malaysia where colonial influence is greatest and the physical environment more suitable for rubber. As a result of moving into a cash oriented production system, farmers were integrated into the world market, making them vulnerable to external market forces beyond their control or understanding. If they were previously already vulnerable to the flood hazard, they were now more vulnerable than ever as their traditional padi crop which served as a buffer for recovery was now not there any more. For instance, the aftermath of World War I brought on a major recession on the colonial economy in the early 1920s. This sent the price of rubber down sharply and although its effects were initially felt across the board by all producers from the large estates to the smallholder, the introduction of the Stevenson Scheme (1921 -1928) by the colonial government protected the large European estates from price fluctuations but added further misery and hardship to peasant smallholders as their production was curtailed (Nonini 1992 pp85-88). Thus, the effects of the 1926 widespread flood were badly felt by peasant rubber smallholders and padi farmers alike. In the case of the latter, at least part of their rice surplus from the previous year could help them recover sufficiently for the next season's planting. In the case of the former, replacing padi with rubber meant that there is the loss of indigenous coping farming methods such as the use of flood resistant padi varieties. Furthermore, although rubber trees were not destroyed in the flood, tapping the trees had to be stopped for a period of a few weeks to more than a month, thus reducing income to almost nil and they had no rice surplus to fall back on. When other factors such as the restriction of production by the Stevenson Scheme, exploitation by Chinese middlemen and fluctuating market prices are taken into consideration, all will add up to increased hazard vulnerability amongst farmers. Similarly, peasant coconut cultivators (cocoa and coffee are usually inter-planted between coconut trees as they need the shading from the taller coconut palms) were subject to a worse fate as smallholdings were too small to provide a reasonable standard of living and flooding damages the trees resulting in low yields (Lim 1977 p198).

(h) Summary

'Core-periphery' relations between Britain and Malaya can be explained by the classical Marxist position which argues that the impact of the relationship is profoundly ambivalent; that it tends on the one hand to create exploitation and subjugation while on the other it produces new forces in colonial societies through the elimination of their own backwardness (Brett 1973). Certainly, in the case of Peninsular Malaysia, the Marxist view seems most appropriate. It is an undeniable fact that without British colonial influence, the natives would still be trapped in their traditional mode of production, the Chinese and Indians would not have migrated to the peninsula in such numbers and overall development would have been much slower. Conversely, it is also true that core-periphery relations between Britain and the peninsula have largely been in favour of the former.

That the colonialists developed many parts of the peninsula (notably the West Coast states rich in tin and rubber) and contributed in no small measure to Malaysia's modern development is a fact that cannot be refuted. It would be wrong to condemn colonial rule as solely having negative effects on the country. Much of modern Peninsular Malaysia, particularly with regards to communications (roads and railways), the ports, the economy (plantation agriculture, mining, etc.), the development of towns, health and education, and a sound public service amongst others are a reflection of British colonial heritage. But that is not the point. That it has exploited the country's rich resources, significantly drained its revenues, created wide disparities in regional development and incomes amongst the ethnic groups, fostered communalism resulting in the immiseration of Malay peasants, suppressed rubber smallholders and Chinese miners, influenced flood hazard policies, exacerbated flood hazards by inducing rapid development in the West Coast, changed indigenous modes of production and destroyed traditional flood hazard coping mechanisms are pertinent issues that have significantly contributed to the creation and perpetuation of flood hazards as well as increased vulnerability amongst certain sections of the country's population.

4.2 Political economy context

The condition of human society is a function of political economy. The way in which society is structured in relation to access to resources and wealth, is a central explanation of hazard and disaster (Wisner et al 1976; Hewitt 1983a; Blaikie et al 1994). Parker and Handmer (1992) found that hazard management and emergency planning are fundamentally affected by a matrix of 'pervasive influences', of which political economy is a predominant influence. Political and economic ideologies are translated into policies which pervade government agencies and institutions. It is such policies (whether for economic development or hazard management) that can either reduce hazards and disasters, or amplify and exacerbate them. Much socially-created hazards and disasters have been shown to be generated and reinforced by political economy forces (Hood and Jackson 1992). Blaikie (1985), from a neo-Marxist perspective, demonstrated that soil erosion in Third World countries are contributed by political economy contexts, notably class relations and imperialism.

4.2.1 Neo-colonialism

Neo-colonialism, or imperialism[44] as it soon came to be known, is the modern form of colonialism. With the achievement of independence by their ex-colonies, colonial powers sought to control the economies of their ex-dependencies through trade, 'multinational companies' (MNCs) owned by nationals of the colonial powers, arms deals, provision of aid, and other means. Although such imperialistic domination is not immediately associated with the flood hazard, a deeper analysis would soon reveal that a dependent economy (often impoverished) will have little resources to manage the flood hazard. Neo-colonialism can also have a more direct effect on the flood hazard when developed countries transfer technology (flood forecasting, warning, basin management) or grant aid (relief, food, money) to their dependencies. In Malaysia, the British have mainly provided such expertise but since the 1980s, the Japanese have taken over this imperialistic role by transferring their expertise in flood hazard management via the Japan International Cooperation Agency (JICA 1982, 1990).

There is a vast literature on neo-colonialism and imperialism condemning the exploits of

[44] There are many definitions for the term 'imperialism'. In this research, imperialism is taken to mean the direct or indirect domination and exploitation of Peninsular Malaysia, in the political, economic or social spheres by other countries, notably those of the Western developed world but in recent decades also by developed countries in the East, notably Japan.

western imperialists (see Hobson 1961; Nadel and Curtis 1964; Gudeman 1978; Hua 1983; Cheah and Abu Talib Ahmad 1990; Nonini 1992). However, it is not within the aim nor scope of this research to conduct a comprehensive review of them. Rather, this section has the modest aim of highlighting the existence of such a literature, and more significantly it seeks to ascertain the extent to which neo-colonialism is affecting post-colonial Malaysia, in relation to the creation and perpetuation of flood hazards.

Undoubtedly, the present day Malaysian economy is still as dependent on foreign capital and trade for its products as in the past. Although the country achieved political independence in 1957, it did not acquire the same status economically. Economic links with western imperialists and the global economy, or neo-colonialism, is strong and is responsible for Malaysia's subordination to metropolitan capital (Hua 1983). Immediately after independence, Malaysia was the world's largest producer of tin and the second largest producer of natural rubber but both products were dangerously exposed to the vagaries of widely fluctuating world commodity prices. For instance, the price of rubber fell sharply during the period between 1963 and 1972 causing widespread hardship amongst rubber smallholders. The International Tin Agreement signed initially in 1931 restricted tin production in 1958 to 43.0 per cent of the peninsula's potential. This resulted in the closure of 255 mines and 12,807 miners lost their jobs (Ooi 1979 p390). Over-exploitation during the colonial period led to depletion of surface tin deposits in many of the traditionally tin-rich areas. Subsequently, such areas could only be mined profitably by mechanised tin dredges, for which only western firms had the capital resources to use. Thus, exploitation by Europeansin the tin industry continued well after independence (Europeans produced 60.0 per cent of the peninsula's tin in 1960). Between 1980 and 1986 a total of 655 mines were forced to close and tens of thousands lost their jobs (Karim 1990 p134).

The over-dependence of tin and rubber made the post-independence Malaysian economy extremely vulnerable to global forces beyond its control, which is why successive governments since independence have aimed at diversifying the economy. For instance, the drastic fall in commodity prices in the early 1970s severely curtailed the growth of the Malaysian economy. The gradual decline of both products has also severely affected the Malaysian economy. As a result, the 1971 flood was more severely felt, not just because of its magnitude (a 1 in 100 year event) but also because there was an economic depression. Both public and private resources could not deal with the flood as well as they would have if economic conditions had been better. Consequently, the recovery capacity was lower.

Those who suffered the most were the unemployed miners, retrenched rubber tappers and rubber smallholders. This was one of the reasons why the 1971 flood (declared a national disaster) was more severely felt in the West Coast than in the East Coast, the former being heavily dependent on tin and rubber while the latter on traditional padi farming and fishing.

Post-colonial Malaya has enjoyed economic success, despite its subjection to neo-colonial forces and the world market. The mid-1970s onwards were boom years, with an average Gross National Product (GNP) growth rate of approximately 7.0 per cent per annum. The moving away from its traditionally based primary sector into manufacturing was the main impetus, although diversification programmes into other commodities such as oil palm, timber, pepper and cocoa further strengthened the economy. The discovery of major oil fields in Sarawak, Sabah and Terengganu then became the driving force which further advanced the country's surge towards recognition as a Newly Industrialised Country in the 1980s. Although a minor hiccup was experienced in the mid-1980s due to world-wide recession, the country recovered sufficiently within a couple of years and has since surged even faster ahead in economic development. Between 1988 and 1994, the country's economy grew at an average rate of 8.0 per cent per annum (The Economist 1994 July p61). This then, provides the perfect scenario for the advocate of imperialism to champion its positive effects. However, such a mechanistic straight forward Marxist conclusion is not completely correct as there are negative neo-colonial effects on the economy.

In a televised speech across the nation on the 31st of August 1985 (Independence Day), the prime minister Dr. Mahathir warned against the threat of neo-colonialism. He stressed that independence would be meaningless if the country was still threatened by neo-colonialism (The Star 1.9.85). The prime minister's warning is not without basis as many fields in the country are still under the control of rich foreign countries. For example, the country's economy is largely dominated by foreign based 'multinational companies' (MNCs) (mostly in manufacturing and oil/natural gas mining and processing), and its primary (oil palm, rubber, tin, oil) as well as secondary products (processed and manufactured goods) are mostly sold to the developed world. A significant proportion of its needs are also imported from the developed world. And foreign shipping and insurance companies dominate the two sectors. The national debt is also increasing. The country's dependence on western banks resulted in a total debt of approximately $50 billion in 1984. In the same year, foreign companies and banks raked in profits totalling $4,806 million, and foreign shipping and insurance companies took in profits amounting to $2,279 million. In another analysis, Hua (1983 p186) noted that the outflow of investible income continued unabated. In 1974 and 1975, the outflow was $600 million and $550 million respectively. The figures did not include repatriation of income in the form of royalties, patent fees and other services of which the figures for the two years were $1,341 million and $1,061 million respectively. In 1980, repatriation of profits rose to $1.8 billion. In 1981, the net cash outflow in freight and insurance was $2 billion. In 1990, foreigners owned a quarter of the total $109.8 billion in share capital in Malaysia. Given this volume of ownership and the economic boom in the last five years, the foreign companies are expected to reap significant profits. Consequently, the amount of repatriated funds flowing out of the country is expected to rise in tandem with rising profits. All these have certainly substantially decreased the country's resources which are needed for development, and this has disastrous effects on flood hazard commitments, noting that it already has a low salience on government agendas.

In an analysis of the ownership of share capital of limited companies in Malaysia, Jomo (1990) noticed that although the share of foreigners is decreasing, it still remains substantial. For example, foreign ownership totalled $2,909 milli n (62.1 per cent) of the total share capital in 1969. In 1988 this figure was $24,082 million (24.6 per cent) and in 1990 foreigners owned $27.6 billion (25.1 per cent) (Government of Malaysia 1991a p14). In a comprehensive analysis on the politics of imperialism in Malaysia, Hua (1983) demonstrated the extent to which imperialistic domination has facilitated the Malaysian economy's continued subordination to metropolitan capital. He identified imperialistic control in the forms of the international finance markets, sub-contracting, technological dependence, aid granting, managerial and other 'invisible' ties, which siphon off surplus value. A good recent example of the 'conditional' nature of aid and its neo-colonial implications is the Pergau Dam[45] affair. The exposure of this controversy implicated the British government's promise of aid (in building the dam) in return for Malaysia's agreement to buy arms from Britain (Davison and Rufford 1994). Such neo-colonial forces have considerably weakened the Malaysian economy. In the context of hazards and disasters, it has made the country more vulnerable.

Another example of neo-colonialism is the overwhelming dependence of the Malaysian

[45] This is a multi-purpose dam built on the Pergau River in the State of Kelantan. The British donated £234 million in aid to the project, but it was later accused of being linked to the Malaysian government's decision to buy £1.3 billion-worth of arms from British companies (The Sunday Times, UK 27.12.94).

economy on the global economy and the 'protectionist strategy' of developed countries (Fong (1989). This is a structural weakness as the economy is dependent on the industrialised countries for investments and technologies, markets for its commodities and manufactured goods, and has to fight protectionist strategies such as the European Union (EU) and others. Global economic pressures have been demonstrated to affect vulnerability to disasters in developing countries (Blaikie et al 1994 pp39-41). Malaysia is therefore extremely vulnerable to global economic conditions, as demonstrated again by the world recession in 1985. As a result of decline in commodity prices and the reduced demand for its manufactured goods, the Malaysian economy experienced a negative growth rate of 1.0 per cent in Gross Domestic Product (GDP) - the first in its modern economic history. As a result, unemployment rose to about 10.0 per cent (it is currently about 6.0 per cent). Fortunately, only minor floods occurred across the country in the two recession years of 1985 and 1986. Nevertheless, the later flood was severe in Terengganu as damages totalling $3.26 million were estimated (see Appendix I).

Exports make up a significant proportion of the Malaysia's GDP. For instance, the country's exports made up 48.3 per cent of GDP in 1985. The corresponding figure in 1990 was 78.6 per cent and it is projected to be about 73.4 per cent in 1995 (Government of Malaysia 1991a p18). Thus, reduction on export earnings, whether in terms of export volume or price fluctuation, will have disastrous effects on the economy. The collapse of the tin industry serves to illustrate this point. As one of the major producers of tin in the world (Malaysia produced 28.0 per cent of the world's supply in 1985), it suffered when global prices fell sharply during the global recession in the mid-1980s. It has been estimated that 80.0 per cent of tin mines went out of operation in 1985 (Far Eastern Economic Review 7 November 1985 p115). In the case of rubber, falling prices and competition from synthetic rubber produced by developed countries have forced many smallholders out of production. The total hectarage shrunk from approximately 2.0 million hectares in 1985 to about 1.8 million hectares in 1993[46] (Government of Malaysia 1991a p92). The production figures also dropped from 1.47 million tonnes in 1985 to about 1.3 million tonnes in 1993. Recession and uncertainty in the world market has also affected other commodities in Malaysia. In 1985, falling oil prices meant that Malaysia had to drill 50.0 per cent more in order to maintain its oil revenue (Pant 1987 p103). It is becoming increasingly apparent that developed countries are using the

[46] This shrinkage is in part due to the conversion of rubber to oil palm and also due to the abandoning of smallholdings with an uneconomic hectarage of old rubber trees.

world recession to their advantage. The case of oil palm in Malaysia perhaps exemplifies the extent to which developed countries (via neo-colonialism) have the economies of developing countries at their mercy. The prices of oil palm went down from US$740 a tonne in 1985 to US$235 a tonne in 1986. The cause of the price crash in oil palm was the strategy of developed countries to subsidise the production and export of soya bean in the United States and rape-seed oil in the European Union (Pant 1987 p104). Although the prices of both soya bean and rape-seed are both higher than oil palm in 1985, the manipulations of protectionalism and imperialism have denied oil palm from Malaysia and other developing countries markets in the EU and the USA. The above discussion has two effects on the flood hazard in the peninsula. First, lower revenues from tin, rubber and other exports reduces the government's ability to spend on flood management. And second, rubber smallholders, tin miners and those employed within the two industries become marginalized and thereby more vulnerable to flood hazards.

Another area where neo-colonialism is draining the Malaysian economy of vital resources is the flow of profits out of the country via foreign investments, notably that of multi-national companies (MNCs) (see Japanese MNCs below). According to Mehmet Sami Denker (1994), MNCs evade tax in Malaysia by an accounting process called 'transfer pricing' whereby prices of manufactured goods (usually partly finished) are deliberately depressed. These goods are then sent to a branch of the company located in a tax haven to be finished and exported at a huge profit there. MNCs started to invest in the peninsula in the 1970s and began building their factories in 'Free Trade Zones' (FTZs), many of which are located in floodplains. For example, FTZs in Petaling Jaya and Shah Alam (Selangor) are located in the Kelang River floodplain, part of the Bayan Lepas FTZ are periodically flooded (Pulau Pinang)[47], and Pasir Gudang (Johor) is sited adjacent to the Johor River. These FTZs have not only increased the flood damage potential of their own infrastructure and properties but have inadvertently resulted in the growth of small townships around them which serve their work force. For example, the township of Bayan Baru prospered and grew because of the Bayan Lepas FTZ.

In the mining of petroleum and natural gas, Petronas the national oil corporation of Malaysia, owns the entire oil and gas resources in the country. But, as a new comer to the field, it

[47] In Pulau Pinang alone, scores of multinational companies such as Intel, Advanced Micro Devices, Motorola, Hitachi, Philips, Thompson and Sony dominate the state's FTZs in Bayan Lepas and Seberang Prai.

depends heavily on the technical expertise of foreign giants such as Shell, Esso, British Petroleum, British Gas, Gulf, and others. At the end of 1988, there were 32 foreign oil companies in operation in the country (Karim 1990 p139). In agriculture, foreign based companies such as Guthrie, Harrison & Crossfield, Sime Darby and others are responsible for converting hundreds of thousands of hectares of virgin forest into rubber and oil palm plantations. This has increased runoff by at least 10.0 per cent and contributed to the exacerbation of flood hazards (Leigh and Low 1978 p50). The power of MNCs (in foreign capital and ownership), has given rise to the universally accepted truth that developing nations are locked into a subordinate relationship with advanced capitalist power (The Economist 15.3.94 p73). The strong presence of the MNCs and continued inflow of foreign investment from developed countries gave rise to many negative effects. By virtue of their size, international expertise and economies of scale, MNCs effectively killed off small and medium local enterprises. This not only led to the absence of domestic entrepreneurship but also the over-reliance on foreign capital. Local enterprises were largely confined to medium and small scale low technology areas such as retailing, wholesaling and traditional agriculture; further accentuating the 'foreign dominance-domestic dependence' structural weakness of the economy (Fong 1989 p291). According to Hua (1983 p188), MNCs also exploited cheap labour in developing countries. In Malaysia, women were the ones generally most exploited as they form the bulk of the work force in the FTZs. In terms of the flood hazard, women are the most vulnerable as they have to look after the children during evacuation and tend to them during the entire relocation period.

On the whole, from Peninsular Malaysia's viewpoint (a developing country), neo-colonialism exploits its economy in the same way as colonialism has in the past. Control of the economy by MNCs and other foreign based agents denies the home country access to vital resources. At the same time, it also denies the local population of access to wealth which could have raised standards of living and increased the ability of households to cope with and recover from flood hazards. Thus, both country and people are made more vulnerable to flood hazards by neo-colonial forces. Elsewhere, studies have shown that lack of access to resources or wealth have led to diminished ability to deal with various hazards (Blaikie et al 1994) and that vulnerability can be increased for particular groups who are being incorporated into a world system of capitalistic production relationships (O'Keefe et al 1977; Hewitt 1983a).

Malaysia's 'Look east' policy have often been suggested as anti-western and hence antiimperialistic. However, this cannot be further from the truth as in the last decade, the Japanese have taken over the major imperialistic role which the British have held in the past (Jomo 1994a p5). Amongst the older generation of Malaysians to have survived the Second World War, the majority would have much to say about Japanese imperialism. In present day Malaysia, Japanese imperialism is manifested in several ways. Major building contracts in the 1980s were won by Japanese firms, even though some bids were higher than domestic bids (Jomo 1994a p7). The yen appreciation in the 1980s reduced Japanese price competitiveness in the world market, resulting in the internationalization of Japanese capital. This was felt strongly in Malaysia as Japanese investments have also dominated the Malaysian economy in the last decade. While this appears good for the Malaysian economy in the short term, their impact on the long term is undesirable as there has been little technology transfer and enhancement, and they appear to stifle domestic investments (Anuwar Ali 1994 p124). For example, MNCs dominate much of the FTZs, many of which, as mentioned earlier, are located in floodplains. *Japanese MNCs such as Mitsubishi, Sony, Nissan, National, Toyota* etc. are not too different from their predecessors of the likes of Barlow Estates, Harrison and Crossfields, Dunlop, Guthrie Corporation, etc. Their brand of imperialism is no different from that of the British (Gann 1984). The most prominent exploitation of the Malaysian economy is that of Mitsubishi Motor Corporation which monopolised the production of Malaysia's national car, the Proton Saga (Jomo 1994c). This prestige project has been costly to the Malaysian government but Mitsubishi was the principal beneficiary despite installing an obsolete plant in Malaysia producing a second-class vehicle which was a deliberately downgraded Mitsubishi Fiore (Bartu 1992 pp76-7). Bilateral trade with Japan has also largely favoured the Japanese. In 1991, Malaysia suffered a trade deficit of -$11,347.8 million with Japan (Bank Negara 1991).

Since the 1980s, Japanese flood consultants (mainly through JICA) have also been employed to work together with the DID on all aspects of flood management in the country. The Japanese experts JICA has since published many reports on various flood mitigation strategies for different river basins in the country (JICA 1980, 1982, 1989, 1990). But an analysis of these reports revealed that Japanese strategies of flood management are predominantly structurally based. Although some sections of JICA reports involve non-structural measures, they are not stressed sufficiently, presumably there is not much money to be made in non-structural projects such as squatter relocation and improvement of warning systems[48]. On the other hand, structural engineering projects can total billions of ringgits. For instance, in the proposed flood mitigation schemes for the states of Perlis, Kedah, Pulau Pinang and Perak structural measures such as river improvement, dam construction, floodways, and polders dominate the proposals. Non-structural measures were only proposed as minor or secondary 'back-up' measures as they covered only two pages of the 44 page report on the National Water Resources Study of Malaysia (JICA 1982 pp213-4). Finally, Japanese influence has contributed to exacerbating environmental problems relating to flood hazards in their major role in Malaysia's deforestation (Jomo 1994b).

4.2.2 Economic development policies

'Rapid economic development' is a policy pursued by successive governments since independence. Through its '2020 Vision', Malaysia aims to become a developed country by the year 2020 and so far, indications are that it is right on course (Government of Malaysia 1991b; The Economist 16.7.94 p61). According to the current prime minster Dr. Mahathir Bin Mohamad, '...In our unrelenting drive for growth....our goal of making Malaysia a developed country by the year 2020 will become a reality' (Government of Malaysia 1991a pvi). In its pursuit of the 2020 objective, a combination of shrewd planning and the discovery of off-shore oil and gas deposits has made Malaysia's economy one of the fastest growing in the world (Thillainathan 1992). During the 5th Malaysia Plan period (1986-1990), the country achieved an average annual GDP growth rate of 6.7 per cent of which the 1990 growth rate was about 10.0 per cent (Government of Malaysia 1991a p7). In the 6th Malaysia Plan period (1991-1995), the Malaysian economy is expected to grow even faster at an average rate of 7.5 per cent per annum in real terms. To maintain such a high growth rate, the rate of deforestation, agriculture, and industrialisation (most of which takes place on densely populated floodplains) is expected to keep pace. Other things being equal, the flood hazard is expected to be amplified both in terms of the hazard as well as the damage potential. Chan and Parker (Forthcoming) have demonstrated that rapid urbanization and development have

[48] Personal communication with government officers who feel that foreign consulting agencies always emphasise structural flood mitigation schemes because of the large capital investment involved and the fact that there is a lot of money to be made. By comparison, there is no great financial benefits of relocating squatters and foreign based agencies do not want to get involved with the politics of their host country. Similarly, land use control, forecasting and warning systems and other non-structural measures are not as profitable as a flood control dam or the channelling of a major river.

significantly contributed to increasing flood risk, exposure, damage potential and vulnerability (amongst certain sections of Malaysian society).

To stay within the 2020 objective, the main thrust of the current 6th Malaysia Plan (1991-1995) is to sustain the growth momentum achieved over the last three years of the 5th Malaysia Plan (1986-1990) in which the GDP grew at an annual rate of more than 8.0 per cent. This means that efforts at industrialisation, agricultural development and expansion (in terms of opening more land schemes), improvements in infra-structure (transport and communications), tourism, and other areas of development will continue at a rapid rate (Government of Malaysia 1991a). The rapid expansion of all these sectors is expected to change the hydrological regime leading to the exacerbation of the flood hazard, especially in the areas chosen for each development. Not only will the traditionally urbanised areas be subject to more environmental stress but also, rural areas which are being targeted for development are expected to experience an increase in the flood hazard.

During the 5th Malaysia Plan period, industrialisation has provided the main stimulus to the growth of the Malaysian economy. The export-oriented manufacturing sector has been the main focus of industrial development. The manufacturing sector has expanded rapidly during the 5th plan period, making it the leading growth sector in the economy as well as the largest sector in terms of employment creation. The average growth rate of all manufacturing industries during the 5th plan was about 13.9 per cent. In terms of investment in the manufacturing sector, a total of $18,000 million was invested in 1990. At the beginning of the 6th plan, this figure had increased to $58,575 million, involving 3,210 projects (Government of Malaysia 1991a p132). In the 6th Malaysia Plan, the momentum gained in this sector will be sustained, if not increased. A total of $3,187 million is allocated for industrial development and a growth rate of 11.5 per cent is targeted. By the end of the 6th plan, it is estimated that a total of $80,000 million would have been invested. The expansion of the manufacturing sector means that more land will be opened for the spatial location of factories, the building of infrastructure, housing for workers, and other support in the service sector for the industry. More industrial estates (FTZs) will be created and existing ones expanded. This will involve both urban and rural locations. The expansion of rural industries will also be emphasised as this is a vehicle to redress social and regional disparities in incomes. It is expected that rural growth centres will develop from locations with rural industries while urban locations will continue to expand.

However, modernising the rural sector may have eroded traditional social structures based on family, kinship and fellowship in the kampung. These structures were broken down when 'profit-making' became the ultimate motive of many rubber smallholders. Many kampung folks became selfish and 'money-minded'. The traditional 'gotong-royong' (mutual help) spirit became weak. In previous subsistence farming communities, there was a great deal of this spirit amongst the kampung folks. This is crucial during times of flood. One can always count on either relatives or friends for help. The spread of capitalism amongst rubber smallholders has gradually eroded such communal ties. This has made families more vulnerable in times of flood.

The export oriented nature of the economy also had a negative effect on traditional padi farming. As a result, padi farming became secondary in importance. And although self-sufficiency in rice was stressed by the government, padi cultivation never attained the same importance as that of rubber or oil palm. Thus, padi always lost out to rubber and oil palm whenever there was competition in land use. This inevitably led to the occupation of marginal flood-prone land by padi farmers as most of the less hazardous land were planted with rubber and oil palm. More significantly, however, is the fact that the use of these flood-prone land has marginalized padi farmers and made them vulnerable to the flood hazard.

Under the 5th Malaysia Plan, a total of 353,296 hectares of new agriculture land was developed by the Federal Land Development Authority (FELDA) and other agencies. Under the 6th Malaysia Plan, this total has been reduced to 162,708 hectares (Government of Malaysia 1991a p100). Despite this reduction, large tracts of virgin forest will have to be cleared for the new agriculture land. This is expected to significantly affect the hydrological regime in the areas selected for the development.

Tourism has become an important source of revenue for Malaysia. Gross receipts from the industry grew by 24.5 per cent from $1,500 million in 1985 to $4,500 million in 1990 (Government of Malaysia 1991a p234). In the 6th plan, the industry will be expanded and a national tourism plan adopted. This will involve the approved building of new hotels and tourism related projects amounting to $2,602 million. Improvements in basic infrastructure facilities in new tourism locations as well as existing ones are also planned. The national parks of the country, notably Taman Negara which is located in the heart of the Malaysian jungle in Pahang, is expected to be developed with new facilities. Another example is the Bukit Bendera area in Pulau Pinang. It is the only remaining forested area on the island but the Pulau Pinang state government has recently approved a grand plan to develop the area into a tourist resort complete with hotels, cable cars, casino, and other structures. This caused a public outcry as prior developments on its hill slopes have already caused environmental degradation and alleged to have exacerbated flood problems (Friends of Penang Hill 1991). Other examples of tourist destinations to be developed are Pulau Besar Island Resort (Melaka), Desaru Integrated Tourism Complex (Johor) and Tasik Kenyir (Terengganu). The Kuala Lumpur International Airport and Langkawi Airport are to be expanded. Total allocation for improvements of airports under the 6th plan is $997.5 million. The total allocation to expand the tourism industry,however, is about $533.9 million. Under this amount, an allocation of $157.4 million is given under the 6th plan for the building and improvement of roads and other infrastructure to have better access to tourist resorts (Government of Malaysia 1991a p247). All these developments are expected to further amplify flood hazards and increase damage potentials.

In terms of roads, the government plans to expand, upgrade and improve them under the 6th plan. The recent completion of the North-South Highway stretching from Bukit Kayu Hitam at the Thai border to Johor Baru at the Singapore border involved the opening up of tens of thousands of hectares of forest land. Another example is the East-West Highway which links the West Coast to the East Coast. Between 1985 to 1990, a total of 20,030 kilometres of new roads were built. Over the 6th plan period, a total of $8,952.8 million is allocated to land transport improvements, the bulk of which is in the building of roads.

A significant portion of Peninsular Malaysia's economy is also dependent on logging. In the 1960s, extensive exploitation of its forests either through logging, agriculture and other land use have reduced the total forest cover to less than 68.0 per cent of its total land area of the peninsula (Ooi 1979 p369). Since then, agriculture, logging, rural development and other human uses have proceeded rapidly and the current total area under forest is expected to have decreased substantially. In forestry, a total of 29 million cubic metres of sawn logs will be produced in 1995. This represents a decline from 1990 but the amount is still substantially large to cause concern over issues related to flood hazard. Also, the production of sawn timber will be maintained at an annual level of 9.1 million cubic metres over the 6th plan period (Government of Malaysia 1991a p93-95).

The importance of forest cover as a natural form of flood prevention is widely claimed (Shiva et al 1991; Kenyalang 1992, Sahabat Alam Malaysia 1992; Utusan Konsumer 1992; Malayan

Nature Society 1992). The dense evergreen equatorial forest of the peninsula protects the top soil from splash erosion and overland flow through its thick, multi-layered structure, undergrowth and litter layer. Natural forest also absorbs part of the rain water during and after a rain event, leaving only a portion of the rain water into the streams. Finally, interception of the rainfall by the forest canopy, tree trunks, branches, undergrowth and leave litter increases the lag time by which the rain water reaches the streams. All the above factors have significant implications on flood occurrences. For instance, forest conversion and logging of commercial trees have been shown to have disastrous consequences on soils and the hydrological regimes (Daniel and Kulasingam 1974; Kamaruzaman 1990; Friends of Penang Hill 1991; Hamirdin 1992). The DID (1986 and 1989) has also shown that clear-cutting of dipterocarp forest resulted in a water yield increase of 822 mm (470.0 per cent), 793 mm and 476 mm in the first, second and third years respectively. Similarly, Abdul Rahim (1990) found that logging in the peninsula has substantially increased water yield between 55.0 per cent to 70.0 per cent (unsupervised logging) and between 28.0 per cent to 44.0 per cent (supervised logging with conservation measures). Abdul Rahim and Harding (1992) observed that magnitude and rate of water yield depended on the amount of forest cleared, the type of logging and the rainfall regime.

Despite water yield increases through logging, the relationship of deforestation to flooding remains inconclusive. For example, although Zulkifli and Abdul Rahim (1991) found that there is a water yield increase of between 3 mm to 5 mm for every percentage of forest cover cleared, the runoff was usually insufficient to produce noticeable flooding downstream. Nevertheless, uncontrolled and inappropriate techniques of logging have resulted in accelerated soil erosion, landslides and river siltation, resulting in reduced carrying capacity of rivers. Ultimately, this can contribute to increased flooding (Leigh and Low 1978 p50). For example, increased flooding in parts of Pulau Pinang has been attributed to the clearing of forest on the slopes of Bukit Gambier, Bukit Jambu and Paya Terubong hills (Friends of Penang Hill 1991 p96-110).

In recent years, Malaysian development policies are reportedly to take aboard the concept of 'sustainability' (see definition in Section 3.3, Footnote 32) (Government of Malaysia 1991a p5). However, in the light of current rapid growth and the relentless pursuit of the 2020 objective, it is likely that economic and political considerations would be given priority in many development schemes.

4.2.3 Flood hazard policies

In Peninsular Malaysia, notwithstanding the fact that individuals are responsible for their own lives and properties, the responsibility of flood management rests largely with government departments and agencies. Before 1971, flood problems were tackled on an ad-hoc basis. Although a large number of government agencies were involved with flood operations from forecasting to rehabilitation, no specific government agency was solely responsible for overall flood management. Each agency operated within its own jurisdiction. In theory, state governments (through state agencies) received funds from the federal government and are responsible for tackling flood problems in their own states respectively. Because of political, economic, physiographic and other differences, some states may have different policies and strategies in managing floods other than those prescribed by the federal government. As a result, there has been no clearly formulated and comprehensive national policy on flood management (Leigh and Low 1978 p52). Such a state of affairs led to the amplification of flood hazards of which the 1967 and 1971 nation-wide floods were outstanding examples.

Since the 1971 flood, flood management became a formalised responsibility of the government and the DID was given this function. But, as examined in earlier in Section 4.1.2 (a), the DID was more interested in agricultural development than flood management. Not surprisingly, river conservancy and flood mitigation was assigned relatively low priority by the DID (Leigh and Low 1978 p53). Its domination by engineers resulted in its adoption of a lop-sided 'structural/engineering approach' to flood problems. More recently, although many of its schemes incorporate non-structural measures, such measures are usually of secondary importance and often under-funded. For example, funding allocations for non-structural measures are almost negligible when compared with those of structural measures (Figure 4.1). Structural measures continue to feature highly on Malaysian flood management strategies. While the federal government has recognised that high cost structural measures of flood control are either economically unjustifiable or unfeasible, the bulk of the annual allocated flood expenditure still goes to structural schemes.

In the current 6th Malaysia Plan which embodies the National Development Plan (NDP), a central aim is to make science and technology an integral component of socio-economic planning and development, which entails building competence in strategic and knowledge-based technologies, and promoting a science and technology culture in the process of building a modern industrial economy (Government of Malaysia 1991a p4-5). In terms of flood hazard

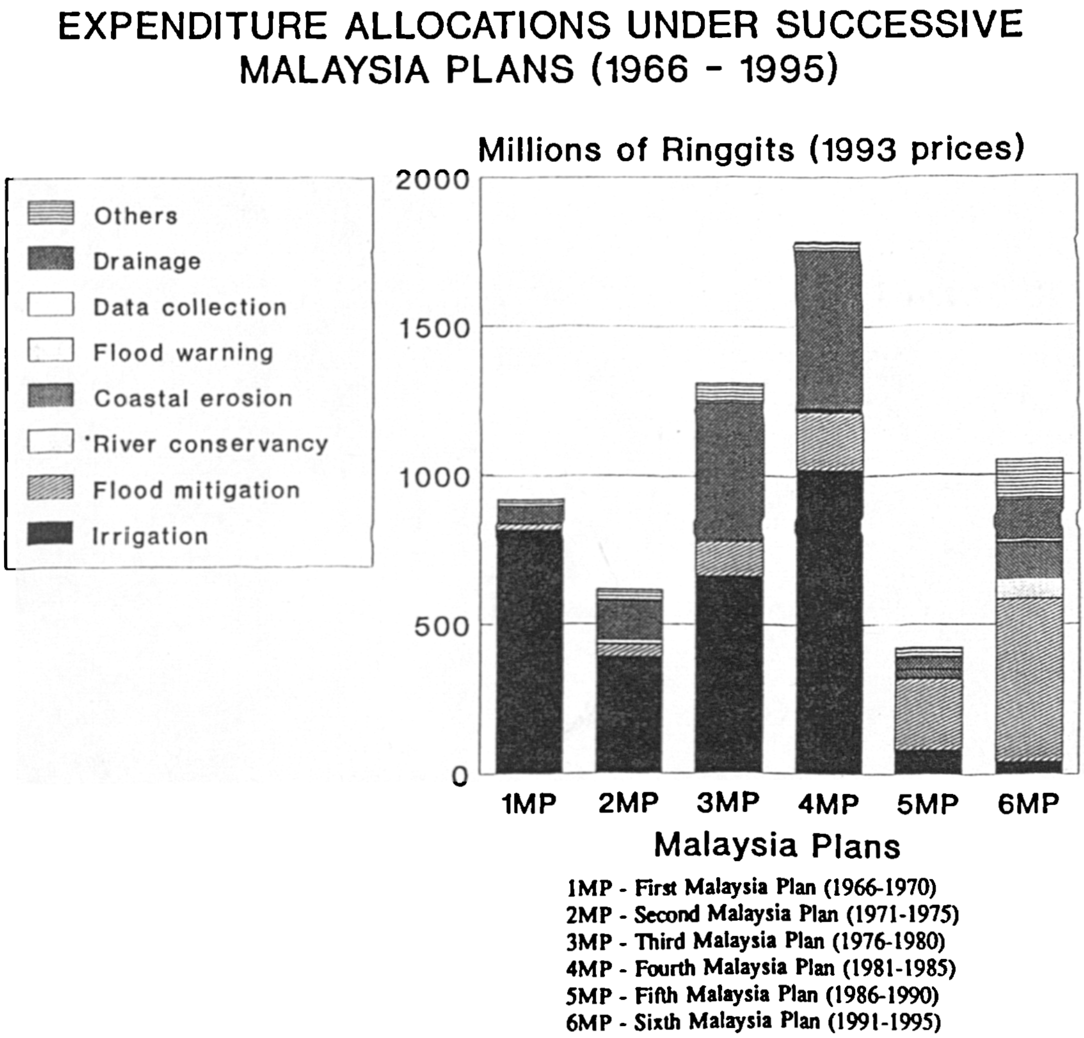

Figure 4.1: Break-down of flood hazard allocations over various Malaysia Plans (Source: DID Malaysia)

mitigation, it is envisaged that the highest affordable technology will be employed in all aspects of flood hazard management such as forecasting, warning, disaster preparedness, disaster relief and recovery. In forecasting and warning, high-tech methods such as satellite imagery, radar measurement of rainfall, telemetric rainfall and river level gauging, automatic sirens and sophisticated telecommunication links will form the basis of future flood hazard management. While the emphasis on high-tech solutions should enhance the accuracy of flood forecasts and increase warning times, they must be complemented by other improvements, notably social and educational programmes aimed at those living in flood-prone areas. Because the NDP over-emphasises structural measures of flood mitigation it promotes an unbalanced flood hazard management strategy. This narrow 'tech-fix approach' brings with it all the associated problems when applied to a public who is not suitably tuned to it. For instance, improvement in forecasting and warning is nullified when there is no corresponding improvement in warning dissemination and evacuation (Neal 1989). While it cannot be denied that non-structural measures such as flood forecasting, warning and evacuation procedures have been improved since 1971, there is still much room for improvement (see Chapter 5). Furthermore, there are many non-structural measures such as flood insurance, legislation, development planning, flood risk analysis, land use change, resettlement, flood proofing, public education and others that are still very under-developed. In order to reduce flood hazards substantially, the Malaysian government needs to change its present emphasis on the deeply rooted structural approach to a more comprehensive one. While recognising the importance of non-structural measures in flood hazard management, there has not been enough effort to translate that recognition into action. The early innovators of this technocentric approach have now recognised the importance of societal forces in hazards creation (Burton et al 1993).

In tandem with rapid development in the country, cities have grown, spilled on to the more hazardous parts of floodplains and progressively increased flood exposure (Chan and Parker Forthcoming). Some examples are the Kelang valley conurbation comprising Kuala Lumpur-Petaling Jaya-Shah Alam-Kelang on the Kelang River floodplain, Georgetown on the Pinang River floodplain and Kota Bharu on the Kelantan River floodplain. As disasters, poverty and urbanisation are closely related (Davis 1978 pp10-5), urban floodplain encroachment caused by rapid urbanisation and poverty (landlessness) is expected to generate a greater vulnerable population. Pursuing the 2020 objective has given rise to an even more rapid development of many already over-populated areas, particularly in most of the major urban centres in the country. Accelerated developments of this type may, on the one hand, be good for the economy but could be disastrous when the already delicately balanced hydrological system is stretched further. A good example is the rapid expansion of the federal capital in the 1960s which led to the disastrous flood in 1971. Similar examples can be found elsewhere. In Britain, the Datchet floodplain development study is a good example (Neal and Parker 1988). To overcome this dilemma, flood management policies must be closely framed with development policies in forestry, agriculture, urbanisation and other forms of human land use. Principles of sustainability and conservation of the environment, particularly with reference to developments affecting the river environment, must be adhered to strictly. Due to rapid developments in recent years, policies which seek to reduce the conflicts between flood hazard reduction and rapid economic development are needed.

4.2.4 Federal-state politics

In Peninsular Malaysia, there are two levels of government: the federal government and the state government[49]. Although the former sets the policies and passes legislation, the latter has enough power in many areas that allow it to act independently. As a result, disputes often arise over issues of land, river, forest, and other resources within a state. Such disputes are often complicated and intensified when the federal government and the state government are not from the same political party.

The varying degrees of the flood hazard in different states in the peninsula are contributed partly by conflicts of interests between the two levels of government and partly by the complicated system of division of jurisdiction with respect to land, river and their management. For example, the division of jurisdiction over land between the federal and the state governments can result in the latter deviating from established federal policies. Land within the boundaries of a state legally belongs to that state. Thus, the development of land (including rivers and land adjacent to them, the rich tropical forest on the land and other natural resources) is a matter of the state government and not that of the federal government. Although the federal government has set laws and regulations for the use of land (to control erosion, flooding, pollution etc.), it is the state government who makes the final decision on the use of its land. As a result, conflicting land development strategies and policies between the two levels of government are not uncommon. For instance, federal policy may dictate a fixed rate of deforestation but since the states control their own forests and need revenue

[49] State governments are further broken down into district offices and mukim offices.

from them, the rate of deforestation may be much higher than that prescribed. This point is discussed in greater detail in Chapter 5 when federal organisations come into conflict with state governments.

In terms of development funding, each state government depends on the federal government for funds to run the state. Funds (for flood management and others) are allocated by the federal government to each state under each 5-year Malaysia plan. Generally, the amount allocated depends on the revenue of the state from its resources such as land, forests, minerals, etc. Once the federal government has come to a decision, the total amount allocated is then broken down on a yearly basis. Each year a certain proportion of the total allocated is given to the state until the end of the fifth year. Other than the allocated funds, state governments can also borrow loans from the federal government to run some of its projects. The amount of such loans depends on the population of the state and the purpose of the loan. Generally, this is how the funding system works but there are exceptions to the rule.

Although floods have always been a significant hazard affecting many parts of Peninsular Malaysia, its salience on the political agenda is probably low. The irony of the flood hazard is that it has become so common in the everyday life of Malaysians, especially amongst the inhabitants in the East Coast and those occupying low-lying riverine areas on the West Coast, that it has not been addressed with the priority in the same breath as other social, economic and political issues. In fact, Malaysians are probably more concerned about the percentage of their taxable income in the next budget than the threat of flooding in the next monsoon. Before the 1971 flood which crippled the federal capital of Kuala Lumpur and affected almost the entire peninsula, flood mitigation was not a significant issue for the government (Chan 1993 p198). It was only after the 1971 flood that a comprehensive flood management policy was drawn up. Even so, budgetary allocations for flood management are very low compared to other allocations. In the Fifth Malaysia Plan (1986-1990), the total expenditure for flood mitigation and river conservancy was $164.1 million. This was only 0.46 per cent of the total development expenditure of $35,300 million over the period. In the Sixth Malaysia Plan (1991-1995), $367.9 million has been allocated for urban drainage which include most of the major flood mitigation schemes in the country. This amount represents only 0.67 per cent of the total development allocation of $55,000 million (Government of Malaysia 1991a p62). The low priority given to flood management on political agendas results in many of the flood related problems not being addressed adequately. Consequently, it is one of the reasons why the flood hazard has continued to occur in many parts of the peninsula.

Qualitative interviewing of top government officers in flood hazard organisations and other government departments in the current research has revealed some interesting results. In Peninsular Malaysia, politics play an important part in funding allocations. Almost all development projects funded by the federal government are politically determined. For instance, the building of the Pulau Pinang Bridge (connecting the island to mainland Peninsular Malaysia) has been on the drawing board since the beginning of the 1980s but it was many years later before it was finally approved and built in 1987. Pulau Pinang has always been a problem state for the federal government because of the strong support of the opposition Diplomatic Action Party (DAP) by its people. The bridge was a strategy employed by the federal government to woo voters during each election. It was finally approved when growing discontent amongst Penangites appeared to swing the vote towards the DAP. This case illustrates how politics and the control of it can determine funding and the approval of important projects. It is certainly the prerogative of the ruling party to use every strategy (within the law) to enhance its political position. Certainly, there is nothing illegal about the Pulau Pinang bridge issue. There are many other similar incidents employed by the federal and state governments but suffice to say, one is enough to demonstrate the point.

Since politics determine funding, it is only logical that (other things being equal) the federal government will allocate more funds to states which support it and less to those that do not (unless it is of the opinion that funds may improve its support). Kelantan is often described as the poorest state in the country (The Star 24.8.94) and by coincidence also the most vulnerable to the flood hazard because of its exposure to the Northeast Monsoon Winds, its flat terrain and the densely populated floodplains where the majority of its people inhabit (New Straits Times 25.12.84). Under the 6th Malaysia Plan, $80.2 million were allocated to the state for flood management (DID undated b). This sum is substantial considering the fact that many other states got much less. However, during the subsequent general election in 1990[50], the ruling National Front lost the state to the Parti Islam SeMalaysia (PAS), an opposition Islamic party. Since then, funds allocated under the 6th Malaysia Plan has been flowing much slower into Kelantan. This is a fact that is confirmed by official figures and the government officers interviewed. No reason is given for this slow down. The passing of

[50] In Peninsular Malaysia, seats are contested for both the Parliamentary and State constituencies. In Kelantan, there were a total of 13 Parliamentary Seats and 36 State Seats. In the 1990 general election, the UMNO led National Front (which forms the federal government) did not win a single Parliamentary or State Seat. The majority was won by PAS, which then formed the Kelantan state government (Information Malaysia Yearbook 1994 p437-41).

a state law to introduce the Islamic 'sharia' penal system by the PAS state government in November 1993 (The Economist 27.11.93 p83) aggravated relations with the federal government as it challenges federal policy (the rest of the country's legal system is based on British law)[51]. With PAS seemingly getting a stronger and stronger grip on the state government, it is not expected that flood management funds will be increased in the next Malaysia plan, unless the federal government uses it as a strategy to win back the voters. At the present moment, it is likely that flood management schemes in Kelantan will continue at a slow pace. Thus, other things being equal, flood hazards are likely to continue undiminished as flood management funds are curtailed and schemes delayed from completion.

4.2.5 Post-colonial communalism

Communalism is a sensitive word seldom uttered in Malaysian circles. Yet, it is practised subtly for practical reasons by political parties, institutions and other groups in Malaysian society. Historical, colonial and cultural reasons have given rise to the pronounced pluralistic Malaysian society where deep rooted demarcations permeate the population structures and locations, political organisations, economic activities and religious beliefs (Section 4.1). That such demarcations still exist today is largely reinforced by political forces. In a multi-ethnic country where competition and sensitivities are unusually high amongst the various ethnic groups, communalism is practised by respective political parties which represent them. Thus, while pluralists are inclined to attribute ethnic diversities to ethnic origins and cultural background, a more acceptable reason is the result of deliberate segregation by first, the colonial rulers and then, since independence, by successive post-colonial governments. Communalism worked well for the British whose 'Divide and Rule' policy prevented ethnic unity against them. Post-independence communalism, however, has taken on new dimensions. It would appear surprising that communalism would exist in a multi-ethnic country striving for ethnic equity. Yet, according to the current prime minister Dr. Mahathir Bin Mohamad (1970 p174), although all political parties in Malaysia advocate non-communalism, they are in fact all communal in their set up. He argues that economically, the Malays who have lagged considerably behind the other ethnic groups, have to depend on 'racialism' (communalism) to sustain themselves. Communalism and racial politics when used

[51] The federal government is worried that Kelantan would turn into an islamic state. This would not only exacerbate ethnic problems but also frighten foreign investors. The Economist (27.11.93 p83) reported that Chinese organisations throughout the country are upset over the passing of the law.

constructively as tools to achieve ethnic equity (in sharing the wealth of the country) are therefore justified. The emergence of a new Malay middle class testifies to the practicality of communalism (The Economist 6.11.93 p89).

The most notorious of communal parties are the opposition political parties such as the DAP (Chinese), PAS (Malay) and S46 (Malay). These parties champion the cause of each ethnic group they represent. Often, opposition parties take advantage of common issues relating to the flood hazard and distort them into communal ones. For instance, squatters living in a flood-prone area along the Pinang River in Pulau Pinang refused to be relocated to make way for flood mitigation works carried out by the state government (formed by the ruling Barisan Nasional Party) in 1991. The opposition parties then seized the opportunity and made the issue into a communal one as the majority of the squatters supported them. This led to long delays in the implementation of the flood *mitigation works resulting in the perpetuation of the* flood hazard in the area.

Discrimination in access to resources is a dynamic pressure leading to increased vulnerability of specific ethnic groups to disasters (Blaikie et al 1994). In Peninsular Malaysia, ethnic segregation generated by communalism has also led to such discrimination. Communalism, during and after the colonial period, has left the Malays way behind the Chinese and Indians in terms of economic well being. Until today, poor Malay peasant farmers still occupy flood-prone padi land throughout much of the East Coast and along riverine areas on the West Coast. These are areas most susceptible to the flood hazard. The poorer section of the Chinese and Indian communities are not spared either. As many cannot afford the luxury of legitimate housing, they squat on river banks where the threat of flooding has deterred development. It is by no means an unusual discovery to find that the poor are worse hit and most vulnerable to the flood hazard. Rather, the world's poor are hit hardest by natural disasters and are most vulnerable because of having to live in the most dangerous, hazard-prone areas (Wisner et al 1976; Davis 1978; Burton et al 1993). Poor Malay farmers have found it difficult to relocate or move into towns (mostly dominated by Chinese). Similarly, poor Chinese from new villages and Indians from rural rubber estates have been faced with the same problem. Even when the poor migrate into townships, they inevitably end up living in the most hazardous zones such as river banks and other flood-prone areas. The most vivid examples are squatter settlements found along flood-prone stretches of rivers such as along the Pinang River (Pulau Pinang), the Kelang River (Kuala Lumpur), the Kelantan River (Kelantan), the Kinta River (Perak) and others (see Chapter 6). In a way, such communities have become marginalized and impoverished through communalism, a force generated by the political economy context.

Since the 1970s, more positive efforts have been made by the government to encourage Malays to move into the commercial, business and professional sphere. Invariably, this has led to an influx of rural migrants into the cities where such opportunities are ample. The younger generation, better educated and aware of the opportunities and the attractions of city life tended to leave their farmer parents to seek their fortune in the cities. This has created a massive problem for the government in that there is currently a shortage of labour in the rural farming sector. More and more, old farmers are beginning to leave their farm land unfarmed (also known as 'idle land') because farm size are uneconomical (due to fragmentation) and they no longer have the energy nor the desire to farm (Fong 1989 p294). Most of them now receive contributions from their children who work in the cities. Although damage to crops may be reduced because many farmers have stopped farming, the risk to people may have increased as households are now largely comprised of old couples (Chan 1991a). As a result, 'old' farmers and other rural inhabitants continue to be the most vulnerable people affected by the flood hazard.

While Malays in urban areas have taken advantage of 'special privileges' outlined in the **New Economic Policy (NEP)** (see Section 4.2.6), and have since developed into a working middle class, the position of rural Malays in remote kampungs (in impoverished states) has not improved much (Faaland et al 1990 p150). The authors have also demonstrated that East Coast states of Kelantan and Terengganu have the highest proportion of poor households. Hua (1983 p2) argues that communalism is deliberately being maintained so as to perpetuate the ruling class's (mainly comprising the Malay aristocracy) power and wealth but the Malay masses remain largely poor. The poor states and the Malay peasantry, therefore, remains poor and vulnerable to flood hazards. The majority of Malays continue to live in the rural areas which are traditionally flood-prone. Although rural-urban migration in recent years has substantially increased the Malay urban population (Malays comprise 58.1 per cent of the total urban population), only 35.0 per cent of all Malays are urban (International Law Book Services 1991 p10). Even so, many Malays stay within their own communities in the cities and towns. A significant portion of urban Malays are also living as squatters in urban areas, notably on the banks of rivers which are highly flood-prone. Some examples are Kampung Baru and Kampung Datuk Keramat in Kuala Lumpur and Jalan P Ramlee in Pulau Pinang. As a result, the Malays continue to be the most flood-prone community simply by virtue of living in the hazardous areas, whether in rural farms or squatter settlements beside rivers (Wan Abdul Halim bin Othman 1982). Political economy forces in the form of communal politics have certainly contributed in no small measure to the exclusive nature of current ethnically segregated settlements.

4.2.6 Income equity and poverty eradication

This section introduces the concepts of 'income equity' and 'poverty eradication' and analyses them as facets of the political economy context influencing the flood hazard. In Chapter 8 'income equity' is dissected and examined in detail as a segment which cuts across the socio-political, institutional and individual contexts relating to flood hazards.

Since independence in 1957, Malaysia's economy has grown rapidly. Malaysia is rich in natural resources and the country has developed into a vigorous, dynamic economy where industry has replaced agriculture as the largest sector in both production and exports (but not employment), yielding a per capita income of approximately US $2,000 equivalent (Faaland et al 1990 pv). Yet, beneath this glorious picture lie inequitable social structures which have been planted and reinforced by political economy forces (colonialism and post-colonial communalism) for more than a century. These are income inequality and poverty. By themselves, they are normal problems faced by many developing countries but in Malaysia they are central social and political issues because they take on an extra dimension, that of being identifiable with ethnic group as Chinese are richer than Indians, and much richer than Malays. Faaland et al (1990) have shown that the income disparity between Malays and non-Malays have increased from $1,250 in 1967 to $1,475 in 1985 (in favour of non-Malays). Furthermore, poverty remains high and the majority of poor households are in the traditional rural areas which are almost exclusively Malay.

Equity and poverty eradication are therefore two related issues which successive post-colonial governments have been trying to achieve. That their efforts have been largely ineffective was manifested by the ethnic riots of 13th May 1969. This became a painful lesson which all Malaysians would never want repeated. As a result, equity and poverty eradication became the central concern of government from 1970, and the 20-year NEP (1970-1990) was introduced. Not surprisingly, the NEP's objectives were: (a) to eradicate poverty; and (b) to restructure society. As the majority of the poor were rural Malay peasant farmers, drainage and flood mitigation became important tools towards achieving the first aim. In five Malaysia plans from 1966 to 1990, the government has spent $745 million for drainage and $425 million for flood control respectively. Under the Sixth Malaysia Plan (1991-1995), the corresponding amounts to be spent are $123.3 million and $507.8 million respectively. Partly as a result of drainage and flood control, rural standards of living have certainly improved. The incidence of poverty as officially defined has since dropped from 49.3 per cent in 1970 to 17.1 per cent in 1990 (Government of Malaysia 1991a p120). However, drainage and flood mitigation may have also given rise to a sense of 'false security' in flood protection schemes, resulting in further floodplain encroachment. This has led to denser population densities in floodplains and a higher flood damage potential. The second objective of the NEP aims at restructuring society so that economic function cannot be identified by ethnic group. Until the 1970s, the majority of Malays were in the agriculture sector (padi farmers and rubber smallholders) and the civil service, the Chinese in commercial and mining, and the Indians in agriculture (rubber tappers) and unskilled labour. This was not a healthy situation as resentment arose between the ethnic groups. Thus, the government encouraged Malays to go into business, take up professional jobs, and gave them scholarships to acquire a higher education. And because all these opportunities were in the major urban centres, rural-urban migration became a flood-related problem (see Chapter 6). For instance, Malays only made up 11.2 per cent of the total urban population in the peninsula in 1957. Positive encouragement by successive governments has seen this figure increase to 14.9 per cent in 1970, 37.4 per cent in 1980, and 45.6 per cent in 1990 (International Law Book Services 1990 p10). The rapid increase in the urban population gave rise to a whole range of problems, not least was the increased frequency of flash floods due to over-development of the housing industry at the expense of forested areas, squatting on flood-prone areas, and blockage of free flow of rivers caused by the dumping of rubbish into rivers (Low and Leigh 1972; Pang 1987).

With the end of the NEP in 1990, the government introduced the Second Outline Perspective Plan (OPP2) which embodies the NDP. As with past practice, the NDP also makes use of five-year development plans. The Sixth Malaysia Plan (1991-1995) marks the first phase of this policy under the OPP2. The NDP is not unlike that of the NEP. Its objective is to achieve balanced development in order to create a more united and just society (Government of Malaysia 1991a p4). Its motto is 'growth with equity'. By this, the NDP aims to reduce and ultimately eliminate the social and economic inequalities and imbalances in the country in order to promote a fair and more equitable sharing of the benefits of economic growth by ethnic groups, communities, regions and states. Towards this end, rural areas will again be given priority in development projects, particularly with reference to flood control and drainage. In the urban centres, squatter settlements will either be relocated or provided with flood protection measures. All these measures are aimed at improving the living standards of the poor and eradicating poverty. However, their effectiveness remains debatable. For example, although the NEP has brought about improvements in rural standards of living and significantly reduced poverty levels, it has not reached its targets in both poverty eradication and redistribution of incomes (through restructuring society). Malays have only attained approximately 20.0 per cent ownership of the country's wealth, well short of the 30.0 per cent target of the NEP (Faaland et al 1990 p233). Although poverty in its worst form is gradually diminishing in the country, approximately 619,400 families in rural areas, mainly Malays, are still in poverty. Of this total, 143,100 families are the hard-core poor (Government of Malaysia 1991a p12). Thus, these families are still highly vulnerable to flood hazards as most are located in the traditional rural sector where farming on floodplains or fishing near estuaries and the coasts are the major occupations. There is thus still a long way to go before both equity and poverty eradication can be achieved. As such, these facets of the political economy context have important implications of population vulnerability and flood hazard reduction. The nearer the government gets to achieving these two targets, the less vulnerable the people would become and the more flood hazards would be reduced.

4.3 Other contexts

In theory, there can be an unlimited number of contexts in which the flood hazard can occur. Contexts are likely to differ if the same area is flooded by two different events (temporal contexts). Likewise, contexts are also likely to differ when two different areas are flooded by the same event (spatial contexts). It is not within the scope of this thesis to discuss all contexts, just as it is impossible to describe all flood events in the peninsula. The above discussion only serves to outline the main contexts which are conceptualised to have an important impact on the creation and perpetuation of the flood hazard in Peninsular Malaysia. However, when describing specific flood events other contexts which are deemed important and which are not previously explained will be discussed.

4.4 Summary

This chapter has demonstrated that flood hazards occur in specific contexts and have deeper origins than their present or current manifestations. The contextual analysis on the two key contexts of socio-cultural and political economy has demonstrated the importance of macro forces on the creation and perpetuation of flood hazards in Peninsular Malaysia. More significantly, it has illuminated the importance of both the elements of time and space in the occurrence of flood hazards. Both elements are manifested by the influence of both key contexts on the flood hazard.

In terms of the time element, the notion that 'the past is the key to the present' is probably best illustrated by the influence of the socio-cultural context. Its three facets of early historical settlement, colonialism and ethnic culture are forces that have been shaped in the past. Yet, so profound are their influences on the flood hazard that these forces are felt until the present day. All three facets mould the current pattern of floodplain settlements in the peninsula, influence flood hazard policies, and strongly affect traditional responses to flood hazards, all of which largely determine the outcome of flood hazards. More specifically, the colonial legacy has also deep-rooted influence on the current status of the Malaysian export-oriented economy and its sub-ordination to metropolitan capital/neo-colonialism. On the other hand, the time element of the political economy contexts is best reflected by the influence of post-colonial government policies on rapid economic development, flood hazard management, and its social, economic and political policies (viz. federal-state politics, equity, poverty eradication, communalism, etc.). These facets have not only perpetuated the flood hazard in many parts of the peninsula but also reinforced flood vulnerability within a large section of the population.

In terms of the spatial element, the most distinct manifestation of flood hazard variability is between East Coast and West Coast (there are of course intra-region variabilities as well). Wide disparities in incomes and development exist spatially between the two coasts and this is attributed to both the socio-cultural (mainly as a result of colonialism but also to a lesser extent from ethnic culture) and political economy (mainly via post-colonial government policies) contexts. This has created an East Coast which is relatively underdeveloped, deeply entrenched in the traditional agrarian sector, impoverished and therefore very vulnerable to flood hazards. On the other hand, rapid development of the West Coast has also caused problems associated with increased erosion, rapid runoff, shortened lag time between rainfall and flood flow, and is likely to have contributed to increased frequencies and magnitudes of flooding. Research has indicated that many densely developed urban floodplains are highly susceptible to flash flooding (Huan et al 1982; Jamaluddin 1985; Friends of Penang Hill 1991; Hamirdin Ithnin 1992).

Socio-cultural and political economy contexts, however, do not stop short of merely affecting the creation and perpetuation of the flood hazard. More significantly, they also have profound influences on how institutions and organisations deal with flood hazards, and the way individuals (as floodplain occupants and as government officers) perceive and respond to such hazards. The ways in which both contexts affect institutions and organisations is examined in detail in Chapter 5, and the extent to which they affect individual response analysed in Chapters 6 and 7.

Thus, while this research accepts the important role of individuals in response to the flood hazard (a key finding well documented by North American hazard researchers such as White (1945), Kates (1962, 1971), and Burton et al (1978, 1993), it is also well aware of the influence of macro contextual forces on individuals (key findings of researchers working within the structural paradigm such as Wisner et al (1976), Hewitt (1983a), and more recently Blaikie et al (1994) and Varley (1994). This research also takes into consideration the important role of institutions and organisations, which themselves subject to macro socio-cultural and political-economic forces, strongly limit and constrain the actions of individuals (in terms of flood hazard reduction) (Penning-Rowsell et al 1986). So far, this research has managed to demonstrate the importance of macro forces in the creation and perpetuation of flood hazards. It has still to demonstrate the significance of institutional forces and the important role of individual response in flood hazard reduction. But, the biggest challenge, is to analyse the links between the macro forces, through institutional constraints, right down to the individual response (Chapter 8). This is where the current research aims to advance hazards theory as much as it aims to contribute to a better understanding of flood hazards in Peninsular Malaysia.

This chapter has demonstrated how the socio-cultural and political economy contexts have significantly influenced the creation and perpetuation of flood hazards in Peninsular Malaysia. The next chapter focuses on how the institutional context affects the outcome of flood hazards in the peninsula via an evaluation of the adequacy of flood hazard institutions and organisations.

5 THE INSTITUTIONAL CONTEXT OF FLOOD HAZARD RESPONSE

5.1 Introduction

Socio-cultural (mainly colonial influence) and political economy contexts (mainly government policies) have generated and created institutions[52] as vehicles to control and manage flood hazards. Although these are the broadest forces influencing the creation and perpetuation of the flood hazard, it is the institutional context which profoundly affects overall policies and trends and their day-to-day operation. In Britain and many other developed countries, flood hazard institutions and organisations[53] have been found to be the key forces which determine the success or failure of policies and strategies in flood hazard reduction. (Penning-Rowsell et al 1986). In the same way, once institutions are established, they in turn influence higher level government policies, and lower level individual response. In terms of flood hazard management, institutions have become an important tool as they form the link between the government and the public (Mitchell 1990).

This chapter aims to demonstrate the ways in which flood hazard institutions affect the outcome of flood hazards in Peninsular Malaysia. It focuses most closely upon current legislative arrangements, organisational structures, attitudinal philosophies and sub-culture, and policies and instruments. Their effectiveness are examined via an evaluation of flood hazard institutions using the 'criteria approach'.

5.2 Macro contexts and flood hazard institutions

Socio-cultural and political economy contexts are macro contexts which have a profound effect on institutions. The ways in which current flood hazard institutions are set up, their current characteristics and how they manage flood hazards are strongly influenced by macro contextual forces such as colonial policies and their heritage, and current government policies

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[52] In this research, the term institutions is broadly defined as comprising components of legislation, organisational structures, attitudes and sub-culture, and policies and instruments.

[53] Depending on the context, the term 'flood hazard organisation' is used in this thesis to refer to a government department or agency which is directly involved with flood management. Some examples are the DID, the MMS, the FDRPC, the Police Department and the Army. A flood hazard organisation can be considered as a component of flood hazard institutions, viz. the organisation structures component.

and ideologies. This section focuses on the extent to which macro contexts influence flood hazard institutions.

5.2.1 Socio-cultural context and institutions

The socio-cultural context affects flood hazard institutions and organisations in many ways. Of the three facets of historical settlement, colonialism and individual culture, it is the colonial facet that has the most profound effect on institutions. Historical settlement is not envisaged to have a profound effect. Neither does individual culture, although the actions of individuals may have a 'feedback' effect on institutions and organisations.

During British rule, laws and regulations on flood control, urban drainage, land use practice and other aspects related to the flood hazard were set up by the British. Much of Malaysia's legal system is based on British Law (The Economist 27.11.93 p83). The bulk of Malaysian lawyers are trained in Britain and the British judicial system is often quoted as an authority. Many laws were also passed during colonial times and have remained more or less unchanged until the present day. For instance, the Waters Enactment of 1920 which outlines the general usage of rivers was passed during colonial rule. Another is the Mining Enactment of 1929 which outlines mining regulations and issues related to erosion and flooding (the effectiveness of these enactments are examined in Section 5.3.2 b). Both the above enactments are still in force in the present day although some modifications and additions have been included over the years.

Chapter 4 has demonstrated the considerable extent to which colonial policies have influenced current flood management approach. To elaborate the point, it must be emphasised that the British were largely responsible for the creation of many flood hazard organisations, amongst them the DID and the PWD. The DID is an organisation not unlike the NRA and its predecessors in Britain. Its main function is to provide drainage and irrigation for agriculture land. Flood alleviation is only of secondary importance. Because of colonial policies, the DID and the PWD are dominated by engineers and predominantly employ the structural/engineering approach to redress flood problems. This technocentric approach has largely benefited small scale urban floodplains in the West Coast (Pang 1987) but is ineffective against large scale monsoon floods in the East Coast (Leigh and Low 1978). Following the major flood in 1971, the main strategy to protect the federal capital has been based on the technocentric approach. According to the then director-general of the DID, the

Kelang Gates Dam would be enlarged and designed to contain flood water of a 100-year event, the probability of the 1971 event (New Straits Times 7.7.79).

In Britain, the Ministry of Agriculture, Fisheries and Food exercises overall coordination of flood alleviation and land drainage, as part of their wider responsibility for agricultural policy and development. Flood hazard alleviation is, therefore, deeply rooted within a 'land drainage' (agricultural) legal context which deeply pervades all institutional arrangements (Penning-Rowsell et al 1986 p58). Likewise, the DID is an organisation functioning under the umbrella of the Ministry of Agriculture. Flood hazard alleviation in Peninsular Malaysia is also deeply entrenched within an agricultural context, viz. that of land drainage to produce more land for agriculture. It is, therefore, hardly surprising that flood alleviation takes secondary importance behind agricultural objectives such as land drainage and irrigation in the DID's objectives. The role and function of flood hazard institutions and organisations are therefore constrained within this 'agricultural force field'.

The British 'culture of secrecy', introduced in Chapter 4, is a characteristic prevalent in Malaysian flood hazard organisations. In most western democracies, the philosophy of freedom of information is usually guaranteed by legislation. Information is more or less publicly available unless it falls into a politically sensitive area such as military defence. In Britain, however, government information is seldom made available to the public. Government officials also frequently feel the need to limit information flow. In a comprehensive examination of the culture of secrecy in Britain, Ponting (1990) concludes that the culture is almost endemic. His analysis shows that there are only about half a dozen statutes that provide for mandatory disclosure of information compared to a hundred or more that prohibit such disclosures. Evaluating emergency planning in Britain, Parker and Handmer (1992 p261) point out that the British government appears to treat information as 'secret' unless it decides to release it, although 'confidentiality' is the word preferred by the British bureaucracy. This culture of secrecy has profound effects on hazard institutions and other emergency planning bodies. Lack of information is often the cause of failures in many disaster situations, as in the 1987 storm in Britain (Mitchell et al 1989) and general emergency planning in Britain (Parker and Handmer 1992).

This culture of secrecy has been passed on by the British to successive post-colonial Malaysian governments. Most government information is being withheld from the public, with the exception of those governing general public safety such as in health and education.

The passing and implementation of flood hazard schemes is usually discussed behind 'closed doors' and information regarding these schemes are seldom released to the public. The laws touching on the prohibition of unauthorised release of information include the Internal Security Act 1960, the Printing Press Ordinance 1971, the Constitution Amendment Act 1971, amongst others. These laws ensure that the culture of secrecy is maintained. Consequently, the public may not know about a scheme until work has begun on it. The official guide book for government departments on flood disaster response procedures (Kerajaan Malaysia 1992) is another example of bureaucratic secrecy. Although information contained in it would benefit flood victims as it would enable them to respond more effectively to the government flood relief machinery (see Figure 5.2), it is classified[54]. In Peninsular Malaysia, institutions and organisations also practice the culture of secrecy for the sake of safe guarding their own interests. During the author's attachment at the federal DID, information in many areas was hard to obtain. For instance, many flood reports, especially on current flood mitigation schemes are classified[55]. Another area in which information was not released to the author was that of the details of funding allocations. Only total allocations (which could be obtained in the Malaysia Plan) were released. This became a problem when assessing the financial resources of an organisation. In terms of flood hazard management, confidential information such as future expansion plans of the DID and the MMS are not made available to one another. This can often lead to the purchase of similar equipment (e.g. of telemetric rain gauges as both agencies run their own network of rain gauges in the peninsula). There may be other areas where organisational secrecy can have a negative effect of the overall effectiveness of flood management.

In a country which hinges on the intricately balanced ethnic harmony, the threat of opposition parties and the press abusing and scandalising any sort of issue may perhaps partly explain why the secrecy trait is perpetuated. Nevertheless, withholding information from one organisation to another and from the public retards the effectiveness of flood hazard reduction measures, whether it be in the selection and location of flood mitigation schemes, relocation

[54] The author went through a great deal of trouble in order to get a copy of this book. He was finally allowed a copy on the understanding that it would only be used for reference in his thesis and under no circumstances was it ever to be released to the press.

[55] Some schemes such as the Sungai Pinang Flood Mitigation Project (JICA 1990) and the proposed construction of the Gombak Dam in Kuala Lumpur (The Star, 29.11.84) involve the relocation of squatters and villagers. This adds a political dimension to flood management and can become problematical.

of floodplain occupants, or in disaster preparedness, relief or rehabilitation.

Flood hazard institutions and organisations are constrained by a multi-tiered administrative bureaucracy set up during colonial rule. Although successive post-colonial governments have made changes to the system, the core administrative bureaucracy remains essentially the same. The administration hierarchy starts at the federal government, the state government, the district office, the mukim committee and finally the village committee. The significance of this hierarchy is that flood hazard management, particularly in relation to preparedness, relief and rehabilitation follows its principle. The federal government (through the National Security Council) runs the annual flood preparedness, relief and rehabilitation programme but it has to depend on the state governments for support at the state level. State governments in turn rely on district offices, and so on. Ultimately, the effectiveness hinges more on the village committee than any other body. It is at this level that lives are either saved or lost. This system has too many levels and information is often distorted or lost along the way. This is true in the case of flood warning dissemination where intended warnings do not reach a high proportion of the flood-prone population (this is discussed in detail in Chapter 8).

Administrative bureaucracy is also an undesirable feature which often hinders the smooth running of flood mitigation schemes. An example is in the relocation of squatter families in the Sungai Pinang area in Pulau Pinang. Construction companies could not start work on the scheme as squatter families refused to move and the bureaucracy of the state government is such that none of the government departments wanted to accept responsibility for moving the squatters. Although the DID is in charge of the scheme it feels that squatters are not within its jurisdiction. The Welfare Department which under normal circumstances look after the squatters sees no reason to interfere. The Police Department does not want to get involved either. This 'passing the buck' syndrome is often the result of too much bureaucracy. Finally, it was the state government which had to act on behalf of the DID but work was delayed for more than a year, during which time flooding occurred several times in the area.

5.2.2 Political economy context and institutions

Flood hazard institutions and organisations are results of policies developed by politicians and civil servants acting within the influential and constantly evolving wider political economy context. A shift in government policies towards a more comprehensive strategy of flood management after the 1971 nation-wide flood saw the creation of many flood hazard institutions and organisations. For example, the DID was officially given the additional function of flood management, a Permanent Inter-departmental Committee on Flood Forecasting between the DID and the MMS was formed, permanent national and state flood committees were formed (these later became the Federal Disaster Relief and Preparedness Committee [FDRPC] and State Disaster Relief and Preparedness Committees [SDRPCs]), and legislation relating to flood control was tightened up.

Political ideologies translated into government policies are political economy forces which can influence flood hazard institutions and organisations. For example, major government policies of poverty eradication and equity seek to increase the incomes of the poor and reduce disparities between ethnic communities. They result in increased funding and emphasis on developing the impoverished traditional agricultural sector which is rural based and mainly concentrated in the East Coast, and are therefore more flood-prone. Since flood hazard reduction can contribute to better incomes (through reduced crop and livestock loss, and other damages), such policies inject more funding and other resources into flood hazard organisations and enhance their capability. On the other hand, although rapid economic development policies can increase incomes, they may also lead to major contradictions as priorities are usually given to development institutions ahead of flood hazard institutions. This can curb the effectiveness of the latter vis-a-vis the former, leading to the exacerbation of flood hazards. A good example is encroachment of urban floodplains in Kuala Lumpur and Georgetown caused by rapid economic development.

Chapter 4 examined the extent to which neo-colonialism can lead to exploitation of the economy by foreign forces. The 'Look East' policy adopted since the 1980s reinforces foreign domination of the Malaysian economy, in this case mainly Japan and to a lesser degree Korea. Transfer of technology from these two countries has resulted in the reinforcement of the technocentric approach to flood problems, resulting in flood hazard institutions and organisations perpetuating such a lop-sided approach. Major flood mitigation master plans for the peninsula and vital regions in the country such as Kuala Lumpur and Pulau Pinang are prepared by the Japan International Cooperation Agency (JICA 1982, 1989, 1990). Although non-structural measures are mentioned, they are relegated to minor importance as all the above master plans strongly emphasise engineering solutions, i.e. where money can be made. Japanese construction companies usually gain major shares of flood mitigation works as they work closely with JICA. Despite the 'Look East' policy, British firms still have considerable interest in Malaysia. This is evident during the Pergau Dam controversy when Malaysia threatened to boycott the allocation of Malaysian contracts to all British firms (The Sunday Times UK, 27 February 1994). Australian consulting companies have also transferred their flood management technology to Malaysia. Both British and Australian firms also advocate the technocentric approach (Davison and Rufford 1994; Australian Engineering Consultants 1974a, 1974b). Tied to this technocentric approach is Malaysia's policy on science and technology as an integral component of socio-economic development, mainly towards becoming a Newly Industrialised Country (NIC) envisaged in its Vision 2020 objective. As flood hazard institutions and organisations are vehicles of the government, they are compelled to follow the technocentric policy and are thus constrained by macro political economy forces.

Malaysia's policy of 'Malaysia Incorporated', introduced in the 1980s, is a system in which the public sector (i.e. the government) and the private sector work closely together to develop the country (Jomo 1989). It aims to make the public/government sector perform like the private sector. Efficiency and maximization of economic benefits are the keys. Tied to this policy is the government's concept of privatization of government companies, public enterprises and public projects. Many public services such as the electricity, water, telecommunications and highway construction have been privatized. Ostensibly, the aim of privatization is to rid the public sector of its lacklustre image[56]. Privatized agencies also relieve the government the burden of funding and once privatized, these agencies survive on their own[57]. In time, they generate profits and this is the ultimate aim of the government. Increased productivity and profit-making are objectives of the privatization campaign.

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[56] The average incomes of government employees lag far behind those of their counterparts in the private sector. In the past, there has been little motivation for government employees who get a fixed rate of increment every year, irrespective of performance. This has led to a rather 'lackadaisical' attitude at work. There was no apparent necessity to speed things up or improve services to the public. It was mainly because of this attitude, that up to the 1980s, flood hazard organisations did not perform as well as they ought to. Since the Mahathir government came into force in the 1980s, the public sector has been improved. Flood hazard organisations as well as their employees are now assessed annually and funding and increments based on performance of the previous year.

[57] During the recession in the mid-1980s, many unprofitable government organisations were disbanded in an attempt to cut cost. Two examples are Majuikan, a fishery organisation and Majuternak, a livestock organisation.

Privatized and economically profitable public companies are therefore given priority in most spheres of development. For example, when a conflict arise between a Local Authority (say the City council) and the DID over the development of a floodplain area, it is the former which will be favoured in the current climate of profit making. Flood hazard institutions are set to lose out to other profit making institutions. Their effectiveness, therefore, are constrained by political economy forces beyond their control.

Related to its profit making motives is the use of benefit-cost analysis[58] (BCA) in the majority of government projects, including flood mitigation schemes. In the case of flood management, BCA considerations inevitably lead to the favouring of densely populated and densely built-up urban areas, viz. the major cities. These are areas where the economic, social and other benefits are greatest resulting from a flood protection scheme. Poor, sparsely populated rural agriculture areas are set to be neglected as they have always been. They will remain largely unprotected although they remain relieved by preparedness, evacuation, rescue and rehabilitation programmes. Flood hazard institutions are, therefore, subject to BCA considerations (a political economy force) in their projects.

5.3 Evaluating the adequacy of flood hazard institutions and organisations

While recognising the important influence of socio-political forces in the shaping and running of institutions and the significance of individual cognition and adaptation to flood hazards, researchers have found that institutions in many countries dominate the outcome of flood hazards (Penning-Rowsell et al 1986; Handmer 1988). The extent to which flood hazards are reduced is a function of the effectiveness of institutional attributes such as legislation, organisational structures, attitudes and sub-culture, and policies and instruments. This section evaluates the adequacy of flood hazard institutions and organisations based on the criteria approach, the rationale being 'The more adequate institutions and organisations are the more effective they are in protecting individuals through the reduction of risk, exposure and vulnerability to flood hazards'.

[58] Benefit-cost analysis is defined as 'an economic technique designed to compare the inputs to measures (costs) and the resulting outputs (benefits)' (Davis et al 1987 p45).

5.3.1 Introduction

In recent years, greater awareness of public accountability[59] and mounting pressures from opposition parties and other pressure groups have forced the federal government to impose more stringent monitoring procedures on its ministries, agencies and departments at all levels. For instance, government departments and agencies responsible for managing the flood hazard have been hard-pressed to 'perform' and 'deliver'. This is because, in the event of a disastrous flood, the blame is usually put on the 'government' without referring to the responsible department or agency.

Despite such developments, there have been few attempts to evaluate the overall adequacy of flood hazard institutions, the exceptions being Leigh and Low (1978) and Hiew and Law (1992). In terms of individual flood hazard organisations, there has been no attempt to assess their adequacies in order to improve their overall effectiveness. What has been done is the evaluation of individual flood protection or mitigation schemes, usually the structural schemes constructed by flood hazard organisations (Australian Engineering Consultants 1974a; JICA 1980, 1989, 1990; Ferng 1988; Government of Malaysia Undated). Also, much of the assessment has been done 'internally' or at most by 'sister' agencies owned by the government. To compound the problem, much of what is going on in government departments and its institutions are often 'classified' and unavailable to the public, one of the relics of British culture. This 'culture' of secrecy and confidentiality is one factor that has hitherto resulted in less independent assessment of public institutions than would have been appropriate. Because of the need to provide greater public protection from the flood hazard, institutions need to perform to meet public expectations. In as much as such institutions need to perform, there is an equally strong need for them to be assessed objectively so that weaknesses and limitations can be reduced or eliminated. In the long run, this will serve to improve the performance and image of these institutions and this has the ultimate effect of benefiting the consumers or customers in terms of better and more efficient services.

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[59] 'Accountability' may be defined as '...the process of participation that insures, through both formal and informal means that beneficiaries influence the content and direction of the activity with reasonable expectations of compliance by those in authoritative positions (Inter-American Foundation 1977, quoted from Ressler 1981 p147).

5.3.2 Using the Criteria Approach in evaluating flood hazard institutions and organisations in Peninsular Malaysia

In the current study, a total of 4 criteria (see Chapter 3 Section 3.6.3) have been selected for use in the evaluation of the adequacy of flood hazard organisations in Peninsular Malaysia (Table 5.1).

(a) The extent to which organisational structures are adequate for effective flood hazard management

Organisational structures for effective flood hazard management refer to the set-up of flood hazard organisations (mission statements, objectives, functions, formal and informal relationships) and institutional arrangements.

Every organisation should have a clearly stated purpose. 'Mission statements' can be expected in the corporate plans of flood hazard organisations. Although the presence or absence of a formal mission statement is the first step in the evaluation, a more important consideration is whether statements are comprehensive. 'Corporate objectives' are elaborations of the mission statements and can be a substitute for them. We should expect frequent review of objectives. 'Functions' should also be clearly defined to enable organisations to manage flood hazards effectively. Functions of one organisation should not overlap with those of other organisations.

Although the Malaysian government's intention is to control floods and provide protection and relief to the people, there are no specific mission statements or objectives indicating this intention. In the Sixth Malaysia Plan which is the government's corporate plan for development in the period 1991 to 1995 (Government of Malaysia 1991a), flood management is only a small section on urban drainage within water resources management.

The **DID** is responsible for flood management and its mission statement is:

> 'To provide efficient, effective and quality service through the planning, implementation and management of works and irrigation, drainage, river engineering and coastal engineering facilities as well as through the interaction and close relation with other departments/agencies and the public towards achieving sustained national development' (Jabatan Pengairan dan Saliran 1992 p3).

Table 5.1: Criteria for evaluating institutions in flood hazard organisations in Peninsular Malaysia

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(a) The extent to which organisational structures are adequate for effective flood hazard management

(b) The extent to which laws and regulations are adequately legislated and enforced for effective flood hazard management

(c) The extent to which attitudes and sub-culture determine the outcome of flood hazards

(d) The extent to which policies and instruments are adequate to achieve equity, environmental protection, and public consultation in decision-making

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The above statement does not suggest flood management as one of the DID's objectives. The DID was initially set up to drain swamp lands and to convert them into productive agricultural land. Therefore, drainage and irrigation are the main emphases. The DID's other functions are river engineering, coastal engineering, hydrology and supporting civil engineering services. Although the DID recently adopted a corporate plan strategy with well defined functions and objectives, flood management was only a minor focus. Furthermore, within its flood management focus, the DID's emphasis on 'flood mitigation', 'improve rivers', 'control of coastal erosion', and 'engineering' suggests a strong technical/structural approach. Alternative non-structural flood measures are not mentioned.

The main objective of the **MMS** is to maintain an efficient meteorological service to serve the people's needs, but it does not yet have a mission statement. Its main function is weather forecasting and the collection and provision of meteorological data. The MMS is in a joint committee with the DID for flood forecasting. The MMS forecasts heavy rain and relates the data to the DID which is responsible for forecasting flood levels at various points on the major rivers. The MMS does not have a direct flood management objective and its role in flood forecasting is secondary.

The **Permanent Commission on Flood Control (PCFC)** is a federal committee made up of officers from different federal government departments. It is headed by the Minister of Agriculture and its members are made up of officers from the DID, the MMS and other government departments involved with the flood hazard. It does not have a mission statement but its broad objectives are to prevent flood from occurring (Lim 1988). Because it focuses on the term 'prevention', its concept of the flood hazard is only a partial one which advocates the 'control' view. This suggests that its diagnosis of flood problems is limited to physical processes. It does not address human causes and human processes contributing to flood problems except where physical processes are modified by human action. Human aspects of flooding, often the main reason for increased flood exposure and vulnerability (Blaikie et al 1994; Varley 1994), are ignored. Its objective is to find short-term measures for flood prevention and research long-term measures for flood mitigation. In the event of unavoidable flooding, its objective is to minimize flood damage in terms of loss of life and property. The commission meets annually to review flood problems and plan strategies for their control. Besides its apparent lop-sided approach to flood hazard reduction, there are other limitations. It meets only once a year or whenever it is necessary (for example when a major flood occurs). It is an advisory body and its effectiveness is limited to suggestions and recommendations of projects for flood control. Its biggest disadvantage is that it is a body made up of individuals from different organisations, some of which may not have compatible objectives. For example, the representative from the Ministry of Agriculture would not readily agree with the DID's representative on land use control.

Another national committee dealing with the flood hazard is the **Federal Disaster Relief and Preparedness Committee (FDRPC)**. This committee is headed by the Minister of Information and has its secretariat at the National Security Council in the Prime Minister's Department (Figure 5.1). The FDRPC does not have a mission statement but its objectives are: to ensure relevant government departments are well prepared for the seasonal monsoon floods; to prepare the public for orderly response action during the event of a flood emergency; to ensure that assistance and aid are provided to flood victims in an orderly and effective manner; and to coordinate all relief operations at all levels (Majlis Keselamatan Negara 1992). The committee meets every year during the month of October, just before the Northeast Monsoon Season and it oversees all preparedness and relief operations for the entire duration of the flood season.

The FDRPC focuses on disaster plans and emergency measures, often relying on military-styled operations to manage flood disasters. Every year, just before the onset of the Northeast Monsoon Season, the FDRPC activates its preparedness programme. Meetings of all government departments involved in flood hazard reduction are called and officers briefed on preparedness, relief and rehabilitation procedures. Getting ready for the flood season is normal, and such preparedness appears positive in the government's aim for flood loss reduction (flood disaster preparedness has probably saved many lives and reduced property damage during past floods but there are no records to substantiate this). However, the preparedness programme has its limitations. What appears to be a comprehensive programme of disaster preparedness is actually only for government officers as the FDRPC concentrates more on the training of government officers to carry out their duties during flood emergencies than on the public. Although the training of government officers is an integral part of disaster preparedness, and can be vitally important, ignoring the training of the public in preparedness programmes can have negative results. Given the best trained officers in a flood emergency, the overall flood loss savings would be minimal if the public fails to response effectively, either due to ignorance (as a result of not being prepared sufficiently) or otherwise. People living in flood zones often do not heed flood warnings and evacuation notices because they

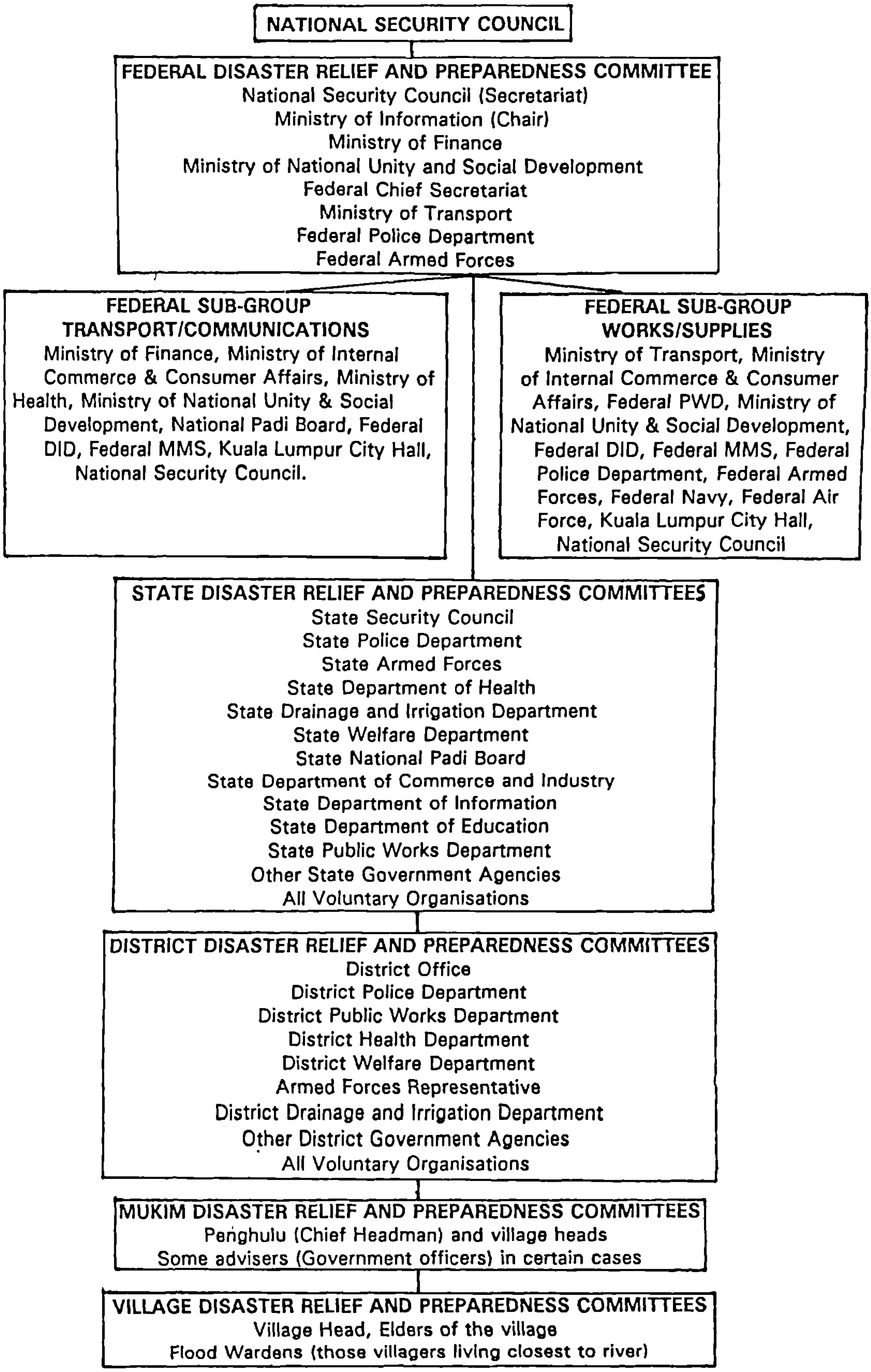

Figure 5.1: The Federal Disaster Relief and Preparedness Committee (FDRPC) and its sub-committees (Source: National Security Council of Malaysia)

are not well prepared or well informed. Floodplain occupants in Peninsular Malaysia generally have a high level of flood awareness (see Chapters 6 and 7), but are less aware of the dangers of floods and government flood reduction schemes because of poor public education programmes. Also, the FDRPC's compulsory evacuation programme often lead to resentment amongst the flood victims. While voluntary evacuation can be a positive asset, compulsory evacuation can retard the recovery process (Davis 1981 p28, 1984a p338).

The FDRPC's annual provision of flood relief and rehabilitation to victims have also led to negative effects. According to one officer, many flood victims gradually get used to such help from the FDRPC and become more and more dependent on government aid. They grow complacent and less independent. The self-reliance and coping mechanisms built up by their ancestors are eroded and they become more vulnerable. Thus, when government help is not forthcoming during a flood, these people are especially hard-hit. Siew, a sundry shop owner from Kuala Krai (Kelantan) laments that the Malaysian Chinese Association (MCA) did not fulfil its duty of looking after the interest of the Chinese community during floods (see Appendix H Case 4). He complains that the government did not provide enough food, shelter, clothing and other help to the Chinese community during the many floods he has experienced while living in Kuala Krai. Such stories are also not uncommon amongst the Malays. Makcik Mabee from Pulau Pinang (Appendix H Case 1) complains that she never received sufficient help from the authorities in times of floods. Being a squatter, she says she has been victimised as flooded residents in nearby Jalan P Ramlee have received aid which she did not. Accumulated flood loss due to frequent flooding has severely taxed Makcik Mabee and her family and made them more vulnerable.

Institutional arrangements between *flood hazard and related organisations*, formal or informal, are part of their organisational structures. Interlocking structures reflect the locus of an organisation within the governmental hierarchy. Informal and formal relationships determine the power of an organisation, the exercise of which will require inter-organisational co-ordination, delegation and bargaining (Penning-Rowsell et al 1986 p26). Figure 5.2 shows the flood disaster response machinery depicting the institutional arrangements between flood hazard organisations involved with flood management in Peninsular Malaysia. This machinery is coordinated by the National Security Council (NSC)[60] but the FDRPC is the body that

[60] The main role of NSC is to maintain national security of all sorts and a widespread flood could threaten national security.

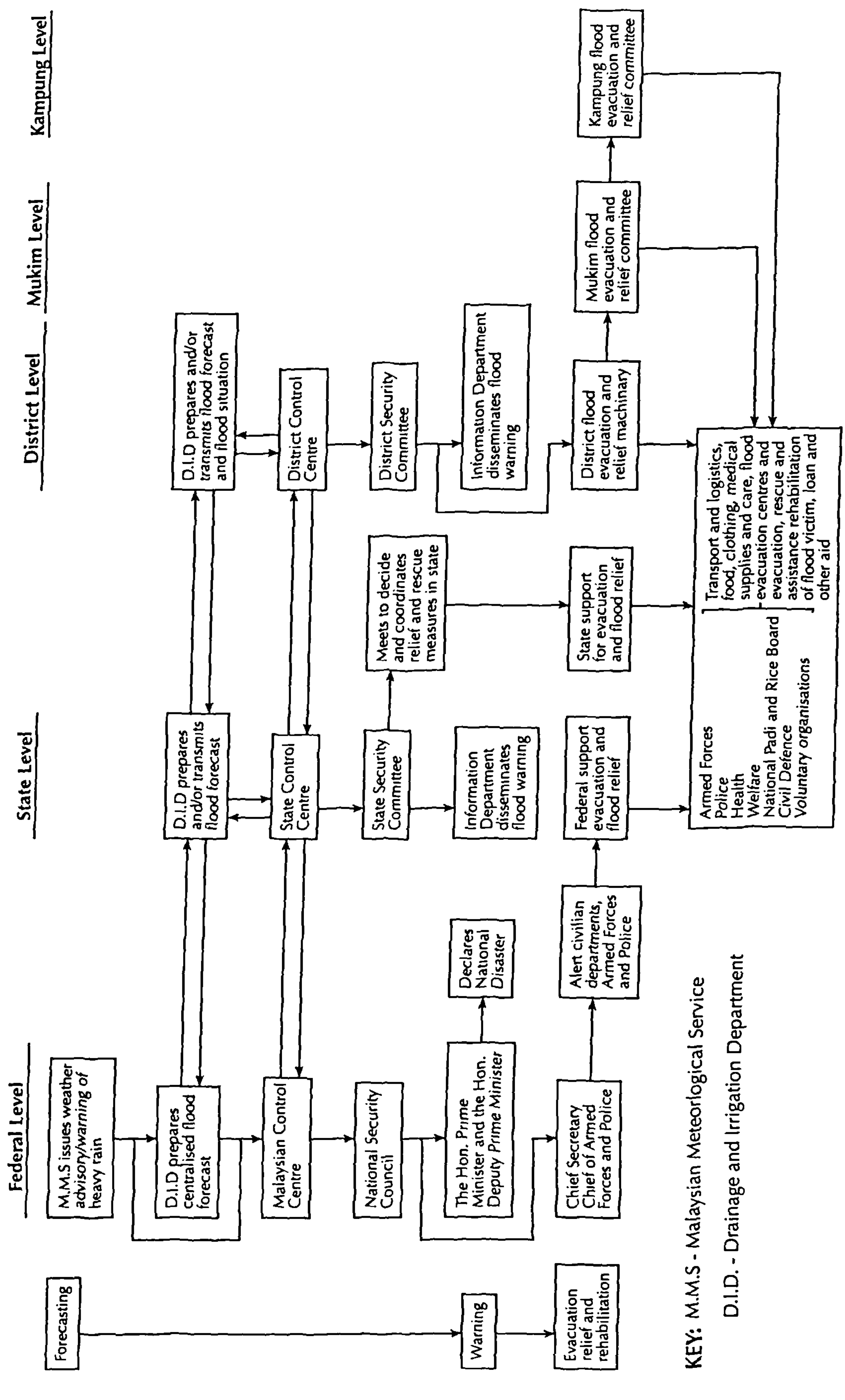

Figure 5.2: The Flood Disaster Relief Control Machinery in Peninsular Malaysia (Source: National Security Council of Malaysia)

runs the machinery. Once the MMS forecasts a heavy rain spell, it transmits a 'heavy rain warning' to the DID. The DID then forecast 'danger' flood levels along the major rivers of the peninsula based on the received rainfall information and data from its own network of telemetric rainfall and river level stations. The forecast is then faxed to the Malaysian Control Centre and various State Flood Control Centres for appropriate action to be taken. When the DID has forecast flood, the machinery is immediately put on alert. During the Northeast Monsoon Season, the machinery is on standby or alert (that is, ready to be activated anytime). The full machinery is activated when floods occur in several states or when a state experiences a massive flood which cannot be adequately handled by the state authorities. In the event of massive and widespread flooding seriously crippling several states (and weather conditions are forecasted to deteriorate), then the NSC will advise the prime minister who may then decide whether or not to declare the flooding as a national disaster.

The NSC is the secretariat for the FDRPC which is the overall coordinating body. The FDRPC is divided into two sub-groups, one for transport and communications and the other for works and supplies. The FDRPC coordinates all operations from the Malaysian Control Centre in Kuala Lumpur. At the state level, there are 11 State Disaster Relief and Preparedness Committees (SDRPC). Under each state are District Disaster Relief and Preparedness Committees (DDRPC). Within each district are Mukim Disaster Relief and Preparedness Committees (MDRPC). Each MDRPC is headed by a 'penghulu'[61]. Finally, there are many Village Disaster Relief and Preparedness Committees (VDRPC) under each mukim. Each VDRPC is headed by a 'ketua kampung'.

The above organisational structure for flood defence appears complex but well designed as a central flood hazard organisation is connected to other sister agencies/departments. However, the flood disaster machinery will only be effective if all involved agencies do their part. The lapses of one or more agencies could disrupt the entire machinery. For example, the June 1991 flood in Pulau Pinang caused havoc in the city of Georgetown as the MMS failed to issue warning of heavy rains and the DID also failed to forecast the flood and was not in a position to issue any warning. As a result, rescue boats could not be transported from their base to the flooded areas in time as the roads were all flooded and jammed by stalled vehicles.

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[61] A penghulu is the Malay term for headman to a group of villages. However, in some areas the term is used synonymously with 'ketua kampung'. Ketua kampung is literally translated as village head, 'ketua' being head and 'kampung' being village.

The flood disaster machinery is closely bound by the FDPRC. Without its co-ordination, the other agencies and departments are mere separate bodies unattached to one another. These organisations work together only during the flood season under the directive of the FDRPC. At other times there is little integration between them. Most flood hazard agencies are independent and work on their own. Increased cooperation and support is needed to improve overall reduction of flood hazards. At the moment, only the MMS and the DID work closely in developing and improving flood forecasting systems. Feedbacks from informal interviews with officers from some of these organisations revealed that there is insufficient teamwork and mutual support between their organisations in relation to flood management. Most of the time, they work independently of one another. For instance, the Health Department could work closely together with voluntary organisations such as the Red Crescent and the St. John's Ambulance Brigade in order to avoid duplication of work as well as provide mutual support whenever necessary. Similarly, the DID and the MMS could also benefit from working closely with academic institutions such as universities and private consultants in the field of flood forecasting and warning.

Duplication of responsibilities between flood hazard organisations is a common characteristic of poorly designed and wasteful organisational systems. However, in the case of disaster emergency/flood emergency planning, it can be deliberately designed as a form of 'fail safe' measure. Duplication and double communication links act as checks as failure of one organisation is counter-checked by another. However, feedbacks from official interviews do not suggest that such duplication in Malaysian organisations are deliberately planned. Consequently, the current overlapping of responsibilities between organisations is non-productive. In the dissemination of flood warnings, for instance, the Police Department is officially responsible but many other agencies also do the job. They include the DID, the Army, the local authorities and others. Uncoordinated, this can be a wastage of human resources resulting in some people being warned many times and others not warned at all. However, with better coordination, some duplication can be retained as checks but others can be eliminated.

The above flood disaster machinery appears to be too rigid which is often a common cause of management failure (Davis 1986a p19). Although it is important that functions and responsibilities are clearly demarcated, there should also be some flexibility in terms of administrative discretion. For instance, the DID does not always have to wait for the MMS for warnings on heavy rains to make its flood forecast. It already has its own network of telemetric rain gauges and river level gauges to rely upon. Also, warning dissemination must have some flexibility. Based on the machinery, the DID makes the initial flood forecast. The message is then relayed to the Malaysian Control Centre which then passes it on to the National Security Council. The latter then advises the prime minister whether or not to issue the warning nation-wide or region-wide. This bureaucratic process takes too long. The DID should have the flexibility to relay the warning to the Police Department (responsible for warning dissemination at the grass-root level) irrespective of whatever happens at higher levels. The police can then quickly warn the people at the village level and even if the flood does not materialise, it would not cause too much commotion and embarrassment as it has not been broadcast over the national radio or television.

In other areas of flood management, it is the view of the author (based on attachment at various agencies) that not enough discretion is given to administrators at different levels of the administration hierarchy to make decisions, implement policies and carry out tasks effectively without having to refer to higher level authorities. Often, effective flood hazard management hinges on the flexibility and freedom of administrative discretion to 'get things done' quickly and effectively without involving too much bureaucracy. The author's attachment at the Kelantan state DID revealed that it took more than two years to get the approval, the funds and then the purchase (includes tendering) and the final installation of three telemetric rainfall stations in the upper stretches of the Kelantan River. According to the officer in charge, there are just too many procedures to follow and too many stages to go through. The current period is even worse as Kelantan is now under the PAS government and the federal government (which allocates the funds) is not in the best of terms with it (The Economist 27.11.93 p83).

Another problem is the lack of consultation and communication between flood hazard organisations. Flood hazard organisations are independent statutory bodies and there is no legal obligation that they should consult or seek approval from other organisations, except in the case where their projects fall into the jurisdiction of another organisation. For instance, when the DID needs to acquire state land for the construction of a dam, only then does it need to seek approval from the state government concerned. As a result, flood hazard organisations do not feel obliged to inform or consult other organisations about its activities. Also, the culture of secrecy and bureaucracy reinforces such non-consultation. Furthermore, some organisations often compete amongst one another and look upon one another as competitors, and some activities may come directly into conflict or infringe upon those of other organisations. For instance, the Forestry Department is not obliged to inform other organisations regarding its logging activities upstream although they affect the river regime downstream. Similarly, the Kuala Lumpur City Hall is not obliged to inform the Kelang Town Council about its development activities even though they have a profound effect on stream flow characteristics downstream (Kelang is situated on the estuary of the Kelang River downstream from Kuala Lumpur). For example, in the implementation of the Kuala Lumpur Flood Mitigation Project, improvement activities upstream of the Kelang River are carried out without any consideration of their effects downstream (Ferng 1988 p4). This lack of consultation and communication is one reason that often leads to mismanagement of the flood hazard and its consequent exacerbation.

Flood hazard organisations in Peninsular Malaysia are typically conservative and do not possess the administrative flexibility to adapt to changes. Results from the survey on government officers and flood hazard experts revealed that 87.8 per cent of those interviewed were of the opinion that the current flood forecasting and warning systems employed by Malaysian authorities did not use 'state of the art' technology. Although some amount of this inflexibility may be attributed to cost constraints, it is not entirely so. The large amount of money spent on structural flood mitigation schemes in the country suggests that there is enough money to get even the best forecasting and warning systems.

(b) The extent to which laws and regulations are adequately legislated and enforced for effective flood hazard management

Flood hazard management may be adequately legislated or under-legislated (Chapter 3). Ferng (1988 p4) emphasised the importance of instituting an unambiguously defined legal framework within the institutional framework in the attainment of comprehensive flood management in Malaysia. It is envisaged that there may be considerable variation in the extent to which different flood hazard organisations at different levels of government in Peninsular Malaysia have adequate legal powers at their disposal to undertake each of the above functions.

In Peninsular Malaysia legislation with respect to flood management is effected indirectly through laws on river use, water, mining and land. For instance, the **Waters Enactment 1920** is the basic law pertaining to river use. It provides that 'the entire property in and control of all rivers in any state is and shall be vested solely in the Ruler of such state'. With respect to flood mitigation, the Waters Enactment contains provisions for:

- prohibiting the construction of buildings and structures in the vicinity of a river or a declared flood channel 'except in a case which may be expressly authorised by any other law' or except in accordance with the terms of a written permission by the state Authority'.
- allowing the Ruler of a state, if he is satisfied that the bed of any river is insufficient to contain flood waters, to declare by notification in the Gazette that the abutting land of such river shall be a flood channel and be subjected to the state's control; and
- empowering the state ruler to put a stop to all illegal acts and interference with the bank of a river.
- a written authorization is required from the Ruler-in-Council for the construction of any revetment or erection of any building or structure within 15.2 metres of a river bank or within any flood channel.

Unfortunately, because the enactment stipulates that river use is the prerogative of the state, clashes of interests often occur between federal and state governments. As a result, federal flood management policies and regulations may not be strictly adhered to. Often, a state may feel that developments on land adjacent to a river may be necessary in view of economic and other considerations. Thus, it is not uncommon to find buildings being built on the edge of river banks in many cities and towns in the peninsula. Even in the federal capital, land pressure and rapid development have necessitated the development of flood-prone stretches of the Kelang River (see Plate 2.2). Some local authorities such as the Kuala Lumpur City Council have often failed to heed the advice of federal agencies such as the DID. For instance, the former had plans involving the beautification of the middle stretch of the Kelang River which flows through the city. Apparently, the council put huge boulders into the river channel to make the water cascade, against the DID advice that it can impede channel flow and give rise to floods[62].

There are other laws relating either directly or indirectly to flood hazard reduction. One is the **National Land Code (1965)** which contains indirect provisions for dealing with flood control, particularly with respect to non-structural measures. Land is the property of the state. As such, the state authority has the right to reserve land for any public purpose by notification in the Gazette. Since flood management is considered a public purpose, certain

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[62] This information was gathered through informal discussion with DID officials in relation to flood management in the federal capital.

flood-prone areas may be set aside as 'reserved land' and thereby not to be developed. This law, in theory, is a kind of land use control to monitor floodplain encroachment. But, unfortunately, federal laws and regulations are often not strictly followed by state governments. The problem lies in the fact that the federal government has no direct control over land matters. The state has absolute power over its land[63]. In practice, usually federal procedures are followed (within certain limits) and state development projects involving drainage and flooding require independent assessment and advice from the DID. But the advice may not be heeded. For instance, housing development on the Paya Terubong Hills in Pulau Pinang (Plate 5.1) has resulted in increased flooding frequencies and magnitudes on the lower stretches of the Air Itam River[64]. Another example is the proposed development of the Penang Hill region, the only forested area left on the island. In this case, the state government's priority in tourism may have outweighed all other considerations.

The **Mining Enactment 1929** imposed restrictions on the siting of mines, retention of slimes and the maximum permitted solid content of effluent discharged. All these are aimed at controlling the siltation of rivers and other drainage networks, thus reducing the risk of flooding indirectly.

The **Drainage Works Ordinance 1954** also has provisions for the regulation of river and land use which has bearing on flood control and mitigation. But in effect, it deals more with the engineering aspects of drainage works rather than flooding.

The **Land Conservation Act 1960** was introduced by the federal government to standardise pre-existing state laws for the control of soil erosion, especially that which touches on the cultivation of short-term crops on steep terrain. Thus, indirectly it also touches on flood control through the regulation of land use. It also has provisions for the regulation of river use.

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[63] Land owners may have rights over their land but even so, they have to relinquish their land to the state when it is needed for the building of public structures (such as a highway). A reasonable price is usually paid by the state for the acquisition of private land.

[64] Information relayed to the author by State DID officers as well as residents in Thean Teik Estate and other flood-prone areas affected by the development.

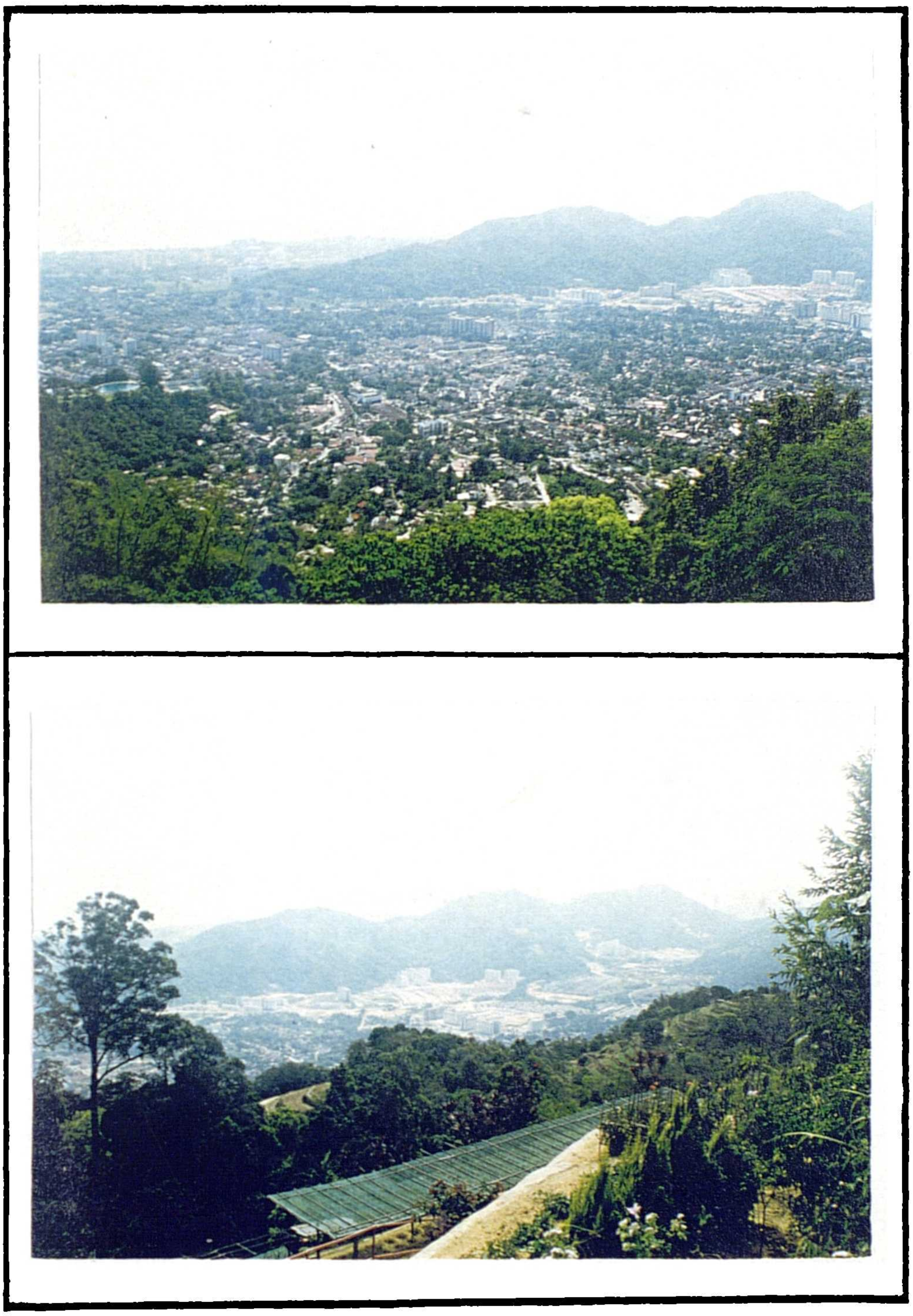

Plate 5.1: Housing development on the hills of Paya Terubong which has been claimed (by respondents, newspapers, and DID officers) to be responsible for increased flood frequencies and magnitudes at the lower stretches of the Air Itam River

The **Municipal and Town Boards (Amendment) Act 1975** empowers local authorities to introduce related by-laws with regard to erosion and sedimentation, which are both closely related to the flood problem (Yaziz and Sulaiman 1985). For example, the Kuala Lumpur City Hall was the first local authority to introduce the Earthworks By-Laws 1975 which has seen some success in controlling erosion and sedimentation of rivers from construction areas in the federal capital (Hj Ahmad et al 1992 p8). The state of Selangor has also introduced its own **Earthwork By-Laws 1991** but other states have yet to follow. These by-laws relating to the control of soil erosion and sedimentation of rivers also have their weaknesses and need strengthening. The main problem is with enforcement. It is difficult to monitor erosion and sedimentation once a contract has been awarded. Developers can submit plans within the requirement of the by-laws but once the contracts are awarded it is often difficult to enforce the regulations. As a result of poor enforcement, soil erosion and land slides are very common in newly developed housing areas, especially those located on hill slopes (Friends of Penang Hill 1991). Furthermore, in the absence of such by-laws in other states, the erosion and sediment problems from development activities will continue to persist (Hj Ahmad et al 1992 p8).

While the above laws governing the regulation of river use have some bearing on flood mitigation, they are not sufficiently clear or forceful enough as measures of flood mitigation. This is because economic development is often given priority over flood reduction. Federal policies are also not strictly adhered to because land and rivers belong to state governments and federal flood hazard agencies only act in an advisory capacity. Furthermore, in the approval of land and river use the term flood mitigation is not clearly spelled out and is often left to the discretion of the authorities concerned. These laws were formulated mainly for the purpose of regulating and managing single sectoral water use. New laws must be passed to enable the authorities to have direct control in all aspects of water use which may affect flooding. This includes laws that clearly specify water rights administration, water resource development, floodplain management and all aspects of flood mitigation (Lim 1988 p8). Alternatively, the existing laws should be updated with a stronger emphasis on flood mitigation.

Laws are only as effective as those who enforce them (Davis 1985 p29). Federal legislation must be enforced at all levels. The present division of power between the federal and state governments often results in the weakening of enforcement. This problem becomes most pronounced when the state government is not ruled by the ruling political party in the federal government[65]. This is exactly the case in Kelantan where the current ruling party is the Pan Islamic Party (PAS). Politicking and non-cooperation on both sides weakens flood hazard management. For example, when the Land Conservation Act 1960 was introduced by the federal government, it was repealed in five states within a few years[66]. Furthermore, even in those states that have retained it, enforcement has been minimal (Leigh and Low 1978 p62). In the light of these developments, differences between the federal and state governments must be ironed out to facilitate the implementation and enforcement of flood management legislation. Potential loop-holes must be plugged and existing legislation should always have a clause capable of being upgraded or reviewed constantly in the case of any such law being circumvented. Such enforcement and review of legislation will ultimately help reduce, if not contain the flood hazard. Examples include effective enforcement of the Land Conservation Act, Waters Enactments and Mining Enactment.

At the local level, enforcing the federal laws lies with the district office, and flood hazard departments such as the DID cannot take independent action even when such laws are violated. The DID must work through the district officer. Thus, the DID has very little control over development within floodplains, even though it is recognised as the authority and expert relating to river use, floods and other riverine aspects[67]. Land development agencies need only consult the DID whenever development plans are related to drainage or flood control. However, there is no need for development agencies to heed the advice of the DID even if the DID views the development plans to be inadequate in terms of drainage, or damaging in terms of high flood risks. As such, while the DID is officially recognised as the authority on all aspects of river use, drainage, flood control and management, its influence does not go beyond that of offering advice. Under the Malaysian Constitution, the states have

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[65] In Peninsular Malaysia, the electorate casts two votes - one for a member of Parliament (in the federal government) and the other for a member of State (in the state government). In some cases, the party that wins the federal elections is not the same as that which wins the state elections. For instance, Kelantan and Sabah are states which have been captured by opposition parties during the last election.

[66] The Act was repealed in the states of Kedah, Pulau Pinang and Perak in 1965, and in Perlis and Terengganu in 1966. In all these states it was repealed under a State Statute Law Revision Enactment, which is described as 'An Enactment to repeal certain obsolete laws' (Leigh and Low 1978 p62).

[67] This situation is similar to that found in Britain where the NRA is the recognised authority in flood defence, but it is the local authorities such as the County and District councils that hold the key to success or failures in hazard management (Parker 1992 pp12-14). The DID's situation is perhaps another case of colonial inheritance.

the right over rivers within their jurisdiction. As such, it is difficult to envisage when they will relinquish this right unless legislation is passed otherwise. At the moment, all the DID can do is to give advice to the state authorities when a certain project concerning a river is proposed. There is even no provision that a state authority needs to seek advice from the DID with respect to developments relating to the river environment. Even if it does, it may not adhere to the DID's recommendations. In the case of municipal and city master plans, there are certain provisions for sufficient drainage and flood control but it is not mandatory for the architect or planner to adhere strictly to the DID's proposals or suggestions. In most cases, when a decision has to be made between development and flood management priorities, it is the former that usually prevails. To ensure that common sense and safety standards are adhered to, the only solution is to give the DID more legislative power. And to ensure that flood mitigation is given due consideration in any project, the DID must be given legislative powers to approve or reject development projects. This would be difficult, as legislation would have to be passed by the federal parliament.

Insurance can be an effective flood loss reduction strategy (Harding and Porter 1969; O'Riordan 1974; Burton et al 1993). Because flood insurance is largely under-developed in Peninsular Malaysia, there is a large scope for developing this aspect of the insurance industry. Unlike many parts of the developed world where publicly subsidised flood insurance is given (e.g. in the USA), there are no such subsidies in Peninsular Malaysia. Currently, there is little legislation on flood insurance and private insurers are shying away from such a market as they consider it too risky. Alternatively, insurers impose a heavy loading on such properties thereby rendering the owners being unable to insure their properties. Insurance companies appear disinterested in developing flood insurance because of the high incidence of flooding in the country. The Persatuan Insuran Am Malaysia (General Insurance Association of Malaysia) could be encouraged to draw up such a scheme and decide upon a reasonable rate of premium to be charged, naturally taking into account the frequency and magnitude of flooding in the area concerned. House-owners should also be made aware that flood insurance policies exist and it is their prerogative to insure their properties. At the moment, flood insurance on private properties is poorly developed. It is precisely because of this reason that the majority of the public is not even aware that it exists (see Chapter 7). In Peninsular Malaysia crops are also not insured. There is simply no such insurance. Farmers have for centuries been at the mercy of the weather.

(c) The extent to which attitudes and sub-culture determine the *outcome* of flood hazards

Organisations often develop their own values, attitudes and sub-cultures which influence those of their individual members. More significantly, these characteristics often influence decisions relating to overall flood policies and strategies.

The concept of collective 'sticking together' could result in individuals making decisions or taking stances which reflect the consensus of an organisation, but which may not necessarily reflect their own convictions or be of benefit to society. While undergoing a placement period at the DID the author found out that it was official policy to recruit only engineers to perpetuate its emphasis on the technical approach to flood management. Within the DID, there are less than a handful of professionals from other disciplines in middle and top management. Consequently, many decisions favour structural/engineering measures to tackle flood problems as this is the area where engineers are most comfortable and adept in. Thus, despite some engineers who are in favour of recruiting professionals with a sociology, geography, disaster planning background, they still stick together to perpetuate the emphasis on engineering. Few are willing to change the culture which has roots dating back to the colonial era. Engineers from the DID seldom see 'eye-to-eye' with academics from the local universities during seminars and workshops for flood management. Suggestions for non-engineering measures are resisted collectively by members of the DID. Collective sticking together is also observed in other agencies. The MMS mainly employs meteorologists, mathematicians, physicists and those with a technical background. And although the police department is largely responsible for warning dissemination, there are no experts on communications in the force.

Flood hazard organisations have also developed distinctive behavioural characteristics reflecting their history, traditions, accumulated experience and collective perception of their roles beyond those laid down officially. Some have developed *perceptions of* their effectiveness amongst its members. For example, the FDRPC is run by government servants. Thus, it has a bureaucratic structure which slows things down. As a disaster management agency it is more inclined to view floods as unavoidable, and only evasive actions and loss reduction are emphasised. This culture pervades through the ranks in this organisation, often resulting in its members having a low opinion of the MMS and the DID in their roles as flood forecasting agencies.

Finally, an organisation may have developed self-sustaining mechanisms designed to perpetuate both the organisation and its members. In the case of the DID, this mechanism is manifested in its recruitment programme and its strong emphasis on engineering. Being under the umbrella of the Ministry of Agriculture, the DID naturally emphasises agricultural land drainage and irrigation in order to maintain its role and perpetuate its life. Neglecting its agricultural objectives may result in its funding being severely reduced and its life threatened.

The above analysis reveals that values, sub-cultures and attitudes can determine the outcome of flood hazards. The DID would be a much more effective agency if its values and cultures were to be brought in line with current approaches to flood management. For example, the NRA in Britain, still largely dominated by engineers, have now embarked on a multi-disciplinary approach to flood management and other water resources issues (Gardiner 1991).

(d) The extent to which policies and instruments are adequate to achieve equity, environmental protection, and public consultation in decision-making

Financial resources is an institutional instrument vital in flood management. The country's expenditure on flood mitigation has increased substantially over the years. From a mere \$17.7 million in the 1st Malaysia Plan (1966-1970), it has shot up to a massive \$541.8 million[68] (for the 6th Malaysia Plan (1991-1995), a 30 fold increase over a 20 year period (see Figure 4.1). However, while the total amount of expenditure has increased, an examination of the breakdown of the expenditure reveals that the total amount spent on non-structural measures has been low. In terms of expenditure on flood forecasting and warning, there was no provision under the 1st Malaysia Plan (1966-1970) and 2nd Malaysia Plan (1971-1975). In the 3rd Malaysia Plan (1976-1980) and 4th Malaysia Plan (1981-1985), a total of \$3.8 million was spent. This represented a mere 0.2 per cent of the total amount allocated to the DID and 1.8 per cent of total flood management works. In the 5th Malaysia Plan (1986-1990) and 6th Malaysia Plan (1991-1995), the respective amounts allocated to flood forecasting and warning systems were \$2.9 million and \$3.0 million. The figures represented 0.8 per cent and 0.3 per cent of total allocation to the DID respectively. In terms of flood management related works, they represented only 1.4 per cent and 0.5 per cent respectively.

Due to the low spending on flood forecasting and warning systems, the current technology

[68] Both sets of figures are calculated at 1993 prices.

of its forecasting and warning systems in Peninsular Malaysia is far from 'state of the art'. Whether or not the MMS and the DID are aware of the current state of the art in forecasting and warning technology is debatable. What is not, however, is the fact that both agencies are using inferior technologies in their forecasting and warning systems. At the present moment, the MMS can forecast heavy rainfall by using satellite and radar imageries but a closer examination at its methodology reveals that it is more of a qualitative rather than quantitative forecast. From its qualitative forecast, what is obtained is information that a certain area will receive heavy rainfall within a certain time span. Such a forecast is not capable of predicting the quantity of the forecasted rainfall which is vital in any flood forecasting system[69]. The MMS may claim that quantitative rainfall may be obtained through its telemetric rain gauges but such 'ground level' information is certainly always too late for flood warnings to be effective. Moreover, the number of such telemetric rain gauges are few and inadequate for any reasonable forecast to be made. On the other hand, the DID can reasonably claim to have in their possession adequately run models of flood forecasting based on the empirical 'Stage Correlation Method' (DID 1988a), the mathematical 'Tank Model' (DID 1990), the 'Black Box Model' (DID 1988a) and others. However, a closer scrutiny of these models showed that the forecasts made are usually of medium to long term duration, that is forecast made for a few days to a week or more. Such forecasts seem to work reasonably well during the Northeast Monsoon Season and presently the Tank Model is used to forecast flood flows in many of the river systems on the East Coast. However, the Tank Model is not suitably adapted to cope with shorter term forecasts such as those involving forecasts of less than 2 hours duration. In many urban areas such as Kuala Lumpur and Pulau Pinang, it is this type of forecast that is needed. Another short-coming of the DID's forecasting system is that there is no quantitative use of radar and satellite forecasted rainfall. Only rainfall received at ground level from telemetric stations and river level gauges are used. As such, the lead time of flood warnings is usually limited, if at all the message is conveyed to the public (see Chapter 8).

Although the total number of telemetric stations for rainfall and river flow in the peninsula seems large enough, a closer scrutiny would expose the inadequacies of uneven distribution.

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[69] 'Real time' forecasting in the UK is currently based on quantitative forecasts of rainfall by radar and satellite which are used as inputs in fully automated flood forecasting computer programmes (see Haggett 1986; Haggett et al 1991; Chan 1994). Given the importance of time in the issuance of flood warning, quantitative forecasting of rain is vital to flood forecasting as it increases the lead time (time between the issuance of a warning and time when a flood occurs).

Most telemetric stations are located in populated areas while the sparsely populated areas, especially highland watershed areas, do not have enough telemetric stations. The MMS and the DID have also not utilised remotely sensed rainfall (radar and satellite sensed rainfall) as an input in its forecasting models. This could have been deliberately overlooked because of the high cost involved but real-time flood forecasting cannot be detached from the usage of such techniques.

Human resources is another important institutional instrument in flood management. The DID is an organisation dominated by engineers. Other than low level supporting staff such as clerks, typists, drivers and labourers, almost the entire managerial staff of the DID have engineering backgrounds. In the entire DID, there is only one member of staff who is specially trained as a flood forecaster. The other staff in the forecasting section are not trained for forecasting work and have to learn from this particular officer. During the flood season, this officer is severely over worked. This is surely inadequate. Even technical staff such as laboratory technicians, technicians for equipment, technicians manning hydrological stations and maintenance technicians must have engineering or related background. The only exception is in administration and finance where managerial staff have backgrounds from economics, accounting and other social sciences. The same applies to the MMS who have top management staff coming from a predominantly mathematics and physics background. As there is a tendency for engineers concerned with floods to think primarily in terms of engineering solutions (Parker and Harding 1978 p50), it is not surprising that the DID's approach to flood management is almost entirely dominated by engineering measures.

In terms of staff adequacy (numbers), the qualitative survey with a number of high ranking DID officers revealed that the DID's staff strength is adequate only for lower level staff from clerical workers downwards. For officers in the A Category (those with degrees) the shortage was about 15.0 per cent and for officers in the B Category (those with diplomas) the shortage was about 10.0 per cent. In the case of the MMS, the shortage was estimated by their officers at 10.0 per cent and 5.0 per cent respectively. This was becoming a serious problem as young graduates were lured into the more lucrative private sector. One DID officer estimated that staff shortage would continue to deteriorate unless the government make it more lucrative for fresh graduates to work in the public sector.

The above discussion again serves to reconfirm the fact that Malaysian flood management policies are too engineering oriented. While it cannot be denied that certain structural methods such as the building of multi-purpose dams and deepening river channels has reduced flooding somewhat, they are very costly in economic and environmental terms. In many cases, such methods may not be feasible, economically viable or environmentally sustainable. Yet, the Malaysian Government has persisted by investing heavily in structural flood mitigation methods. Besides this imbalance between structural and non-structural methods, flood hazard management policies are also lop-sided in that over-emphasis is given to disaster preparedness and relief while not enough emphasis has been allotted to flood forecasting and warning systems. At a time when the government is openly advocating a policy of multi-disciplinary approaches towards flood hazard management, this over-dependence on the structural approach for flood hazard reduction needs to be redressed urgently. More money needs to be spent on non-structural methods in flood management, either as a supplement to structural methods or as a replacement when costly structural methods are not economically viable.

In Chapter 3 and Chapter 4, the analysis and discussion on both the colonial and post-colonial reinforcement of communalism have demonstrated the importance of the **equity** issue in Malaysian society. In fact, the progress and survival of the country hinges on an equitable sharing of its wealth by all ethnic groups. Communalism has created and reinforced unequal share of the nation's wealth, some groups being much better off economically than others. Within the confines of such a scenario, there is always the threat of ethnic resentment and conflict, often leading to undesirable incidents of which the May 1969 riots was the worse. Post-colonial government policies, therefore, more than anything else, have concentrated on this one aspect of equity. From the First Malaya Plan to the current 6th Malaysia Plan, solving the equity equation has been the preoccupation of all successive post-colonial governments. In the 6th Malaysia Plan, the main objective of the NDP is to attain balanced development via a concept of 'growth with equity' (Government of Malaysia 1991a p4-5). To what extent, then, do flood hazard institutions and organisations employ the equity instrument to help attain the government's objective of equitable economic sharing between the various ethnic groups in the country? This section attempts to answer this question[70].

The conventional governmental approach to flood defence is to view them as services to be

[70] This section focuses on how flood hazard institutions and organisations employ the equity instrument in flood management. Later, in Chapter 8, 'income equity' is expanded and used as a segment to analyse links between contextual forces and individuals.

delivered as public goods. This is because flood defence is 'indivisible', and it is rarely possible to protect some and not others. In some countries such as Britain, welfare reasons also demand that flood defence be a part of governmental service to the public (Penning-Rowsell et al 1986). Similarly, flood defence is viewed as a public good to be delivered by the Malaysian government via its flood hazard institutions and organisations. It is largely because of the 'indivisibility' of flood defence that the objective of equity is often not achieved. For instance, it is difficult if not impossible to single out the poor from the rich and give only the former group more protection in order to redress the equity problem. Also, the siting of flood schemes in an area of predominantly one ethnic community may be politically sensitive, and expose the government to criticisms.

The use of economic principles to gain best value for investment is another reason why income equity is rarely tackled by flood hazard institutions and organisations. In Peninsular Malaysia, prudent use of available resources, or the employment of sound economic principles is employed by flood hazard organisations. Recession in the late 1980s has forced the Malaysian government to adopt an 'austerity drive' and tighten its spending. Economic instruments such as BCA are applied to most, if not all new flood mitigation projects. For instance, most of the major river basin mitigation projects in the peninsula have BCA considerations. The JICA has carried out research and consultancy on most of the major river basins for flood mitigation, and BCA has always been featured in its suggestions and plans (JICA 1982, 1990, 1991). Because of the government's objective to maximize benefits within the constraints of its budget, BCA and other economic principles are applied and the result almost always favour the rich. This is not surprising as the poor peasant farmers inhabit sparsely populated rural farm land that does not justify the cost of an expensive flood scheme, since the returns or benefits would be comparatively small. On the other hand, a flood scheme located in a densely populated urban area where property prices are high would be economically justifiable. Although the benefits in a BCA can be classified into various categories such as monetary, social, environmental, political or even aesthetic (as in the case of an archaeological site in a flood-prone area), it is the economic consideration that is most often prioritised. As the majority of government flood schemes (and other projects) must now go through a BCA, it is inevitable that the majority of such schemes are located in the richer and more densely populated areas (JICA 1982). In flood management funding allocations under the 6th Malaysia Plan (1991-1995), it is the federal capital (the single richest, most developed and most densely populated area in the country) that is allocated the largest share. Its total allocation for flood mitigation under the 6th Malaysia Plan is \$103.7 million, or 22.4

per cent of the total $507.8 million for the whole country (DID Undated b). In comparison, the three poorer East Coast states of Kelantan, Pahang and Terengganu are allocated $56.4 million (11.1 per cent), $14.9 million (2.9 per cent) and $0.9 million (0.2 per cent) respectively. Based on current BCA approach, it is unlikely that impoverished rural areas will catch up with their urban counterparts. It is even more unlikely that income equity will be achieved via the flood management sector.

Despite the overall ineffectiveness of flood hazard institutions and organisations in helping to redress the equity problem, those involved with flood preparedness, relief and rehabilitation have done a good job in helping the poor. Every year, thousands of floodplain inhabitants are evacuated and relocated temporarily because of the seasonal monsoon floods. Some are dislocated from their homes for more than a month. For instance, the family of Kak Atikah from Pekan (see Appendix H Case 5) were evacuated to a school hall for more than two months during the 1988 flood. During this flood, the back part of her house (located on shallow waters in the Pahang River off Pekan Town) was washed away. According to her, some of her unlucky neighbours had their houses completely destroyed and these people were dislocated even longer as they took much longer to rebuild their houses. In general, the majority of those relocated are the rural poor, mostly farmers, fishermen and other rural inhabitants in the agricultural sector. The FDRPC provides those affected with temporary shelter, food, clothing and even money to tide them over the flood period. Those whose homes have been destroyed are even given loans to enable them to rebuild their houses. In view of all the above help given by the FDPRC, the annual amount spent on preparedness, relief and rehabilitation is substantial. Some examples of the aid given are shown in Table 5.2.

In a developing country pursuing rapid economic and industrial development, **environmental protection** is an institutional instrument which is much mentioned but under-achieved. Flood alleviation schemes are intended to be beneficial to floodplain occupants, they can also bring about adverse and unintended effects on the environment. For instance, flood alleviation schemes involving agricultural land drainage can impoverish many rich and varied wetland habitats (particularly both fresh water and mangrove swamp forests) as well as irreversibly change the natural landscape. In Peninsular Malaysia, as more and more wetlands are drained (for flood alleviation and agricultural purposes), the ecology and the physical environment is changed and this can have negative effects on both. Flood defence such as the building of dams, artificial embankments and river barriers have potentially disastrous effects on not only

Table 5.2: Total amount of aid given out by the Social Welfare Department to flood victims in Peninsular Malaysia (1986 - 1991) (Source: Social Welfare Department of Malaysia, Kuala Lumpur)

Year	Number of households	Amount ($) (1993 prices)
1986	10,432	462,835
1987	2,865	481,339
1988	4,519	153,021
1989	5,015	425,367
1990	13,453	193,159
1991	3,073	308,624

* The total amount given out to any household during any flood event is $5,000.

the aquatic environment but also other environmental resources such as landscape, soil, vegetation, and the hydrological cycle (not forgetting the impact of an architectural 'eye sore' on the natural landscape). As such, an important consideration of the adequacy of a flood hazard institution is the degree to which its policies safeguard and protect the environment.

Flood hazard projects need not be environmentally damaging if properly planned. Imaginative projects can enhance environmental assets and resources. Penning-Rowsell et al (1986 pp120-45) has demonstrated that this is possible in Britain. In Peninsular Malaysia, rapid economic development is the government's key to making the country an industrialised one in the near future but its policy on environmental protection is a positive one. Environment protection is always an important consideration and is proven by many recent Malaysia Plans. For instance, in the Sixth Malaysia Plan 1991-1995, one whole section is devoted to the environment (Government of Malaysia 1991a p389-412). 'Balanced development' is the prime consideration of the Sixth Malaysia Plan. To achieve balanced development the Malaysian government aims to develop better techniques for integrating environmental considerations in the formulation of programmes and projects. In terms of sustaining forestry and other depletable resources, it aims to progressively control environmental degradation through conservation of natural resources and preservation of the environment (Government of Malaysia 1991a p389). The Malaysian government has also played an important role internationally in the environmental movement. It initiated the Langkawi Declaration on the environment when it hosted the Commonwealth Heads of Government Meeting (CHOGM) in 1989 (Mahathir Bin Mohamad 1990 pp1-4).

Based on governmental policies on environmental protection, flood hazard institutions and organisations can no longer brush aside the environmental component on any of their schemes as 'unimportant'. In analysing the DID, the MMS, city councils and other organisations, it was found that environmental considerations are always maintained in the majority of projects. In fact, the concept of 'sustainable development' is usually embraced. According to one officer, environmental conservation and beautification programmes are usually incorporated into the majority of flood schemes. The DID constantly seeks to modify if not reject strategies and policies which have adverse environmental effects. The DID also advises other government bodies in their evaluation of development plans, especially if they have an influence on flooding or are related to rivers and their corridors. The DID's advice invariably includes environmental considerations over and above that related to flood prevention.

The concept of 'sustainable development' is preached by the Malaysian government in its 6th Malaysia Plan in the conservation of the country's natural resources (Government of Malaysia 1991a). In the light of rapid industrialisation, high population growth, increasing urbanisation, growing scarcity of land, forest, water and other resources, this plan focuses on maintaining a balance between the competing demands of growth and sustainable development. Flood hazard institutions and organisations therefore adopt this approach in their management of flood hazard projects. Officers in the DID, the MMS, the Forestry and other departments confirmed that the concept of sustainable development is one of the considerations in their approval of projects. However, as the concept is relatively new, its application and enforcement have been problematic and slow. Some critics have argued that sustainable development in Peninsular Malaysia is a myth as there is more lip-service than actual implementation of the fundamental concept (Singh 1991 p32-98). The problem of drawing the line between what is sustainable and what is not is another issue that needs to be solved before the concept can be fully applied. At the moment, the identification of this line depends largely on the discretion of flood hazard organisations.

As a result, most if not all flood mitigation schemes require independent Environmental Impact Assessment (EIA) reports. Only schemes which have favourable EIA reports will be passed. In some instances, even favourable EIA reports which are subsequently proven environmentally unfavourable (by others) will not be approved. A good example is the recent proposed development of the Penang Hill Region (the only remaining forested area) in Pulau Pinang. Initial EIA reports from consultants have indicated that the proposed developments would not be environmentally damaging but a subsequent report by a voluntary group indicated otherwise (Friends of Penang Hill 1991). This has resulted in the non-approval of the original development plans by the Pulau Pinang state government. Since environmental factors are currently high on the Malaysian government's list of considerations for embarking on development projects, including flood alleviation schemes, it can be said that the provision of environmental protection measures by flood hazard organisations is adequate.

The **extent of public consultation in decision-making** has a strong influence on the effectiveness of flood hazard schemes. Public consultation and choice of the majority[71] is

[71] In specific cases, the choice of minorities should also be accommodated where possible. For example, in the relocation of squatters from the Air Itam River area in Pulau Pinang in 1991, the squatters were consulted and given a choice of various relocation sites by the Pulau Pinang government.

a basic feature in a democratic system. In many western industrialised countries where the majority of the public is educated and affluent, major decisions which affect the people are made after public consultation (either through an appointed panel or through public forums). There are many reasons for public consultation and participation. While technical decisions are best left to competent technical personnel within an organisation, those decisions that are understood by the lay person should be given public consultation. Public consultation may have the effect of weeding out mal-practices, favouritism and corruption. In all major decisions, the public should have the right to know and the power to influence them. Such public consultation is not unlike a form of public auditing. With public consultation, there is less likelihood of misappropriation of funds or any other irregularities. Public consultation is needed when a certain flood alleviation scheme involves access to land, payment of compensation, environment protection agreements, scheme design, cost and contributions from beneficiaries (Penning-Rowsell et al 1986 p148). Public accountability and consultation are closely linked. According to Parker and Sewell (1988 p758), 'public accountability' is the cornerstone of democratic government. It refers to the extent to which a flood hazard organisation is responsible to the public for its actions or non-actions. In Arnstein's (1969) ladder of citizen participation there are a total of 8 levels, ranging from non-participation to citizen control (Table 5.3).

Malaysia is a democratic country where the government is voted in by the people every five years or so. As such, one would expect public consultation to feature highly in the state's development plans, especially with reference to flood management. Unfortunately, this is not the case. All decisions with regard to development projects are made by the relevant government authorities. Flood hazard management projects are no exceptions either. Development projects directly relating to flood hazard mitigation has no input from the public. This may be due to a number of reasons. Firstly, the public is not knowledgeable enough to sit in decision-making committees which may be highly technical, as in the case of engineering designs. This is especially so in flood-prone areas where the majority of the people has a low level of education. Secondly, people are neither interested nor have the spare time to sit in such 'voluntary' committees. Thirdly, the public feels that it is the responsibility of the relevant authorities to do the 'job' and not rely on the public to make contributions. Fourthly, the authorities are also reluctant to relinquish some of their decision-making powers to the public as this may be seen as a sign of weakness or incompetence. Fifthly, public consultancy is often seen as a nuisance as it slows down the process. Finally, it may be viewed as an avenue for the opposition parties to criticise government projects. The

Table 5.3: Arnstein's (1969) ladder of citizen participation

Level	Nature of involvement	Degree of power sharing
1 manipulation	rubber-stamp committees	non-participation
2 therapy	power holders educate or cure citizens	
3 informing	citizens' rights and options are identified	degrees of tokenism
4 consultation	citizens are heard but not necessarily heeded	
5 placation	advice is received from citizens but not acted upon	
6 partnership	trade-offs are negotiated	degrees of citizen power
7 delegated power	citizens are given management power for selected or all parts of programmes	
8 citizen control		

government view this seriously as opposition parties often politicise on sensitive issues in order to gain popularity. This can lead to public unrest and even stir-up unnecessary tension amongst the different ethnic communities.

However, decisions regarding development plans that may have an adverse effect on the environment usually requires an independent Environmental Impact assessment (EIA). This can be developed as a form of public consultation but often the consultants commissioned to undertake the EIA report may be biased as future contracts may be at stake. However, if the public is not satisfied with an EIA report, voluntary environmental groups may conduct their own EIA and publicise it. This is another form of more active public 'voluntary' consultation. In some instances, public demonstrations, signing petitions and writing articles in the newspapers may be other avenues for public participation. In the case of the former, it is becoming very rare as demonstrators can be charged for disturbing the peace or worse still be charged for endangering the security of the country. People (except the most 'hardcore' of them) are therefore reluctant and afraid to demonstrate. Many laws, the most severe of which is the Internal Security Act 1960, also deter the public from openly criticising the government. The FDRPC's preparedness, warning, evacuation, relief and rehabilitation programme is completely run by government officials. There is little, if any, input or consultation from flood victims. The programme can undoubtedly be more effective if flood victims are allowed to indicate their preferences and impart their rich flood experience[72]. The incorporation of informal traditional warning and evacuation systems into formal official systems is one good example (see Chapter 8).

Based on the above discussion, it is evident that the level of public consultation in government projects (including flood hazard mitigation projects) leaves much to be desired. At the present moment, this level of participation is at best only degrees of tokenism on the Arnstein's (1969) ladder. At most, citizens are heard but not necessarily heeded. In some exceptional cases such as the Penang Hill Development Project where public outcry and petition was very intense, the authority concerned may be forced to change their plans in order to placate the public. In this case, citizens are heard and heeded, even though the development of the project will still go ahead but with modified plans that have a lesser effect on the environment.

[72] Studies elsewhere have shown that pre-disaster planning is of limited effectiveness until the community that is affected participates actively in the programme (Ressler 1981).

However, according to in-depth interviews with government officials, and the higher incidence of public outcry (such as the Penang Hill controversy and the deforestation issue), there seems to be a change in attitude both on the part of the government and the public. In the future, the government will allow the public to play a more active role in major development projects that are likely to captivate the awareness of the public. This is important from the political point of view as it has a favourable effect on the image of the government. Furthermore, decisions made after public consultation will at least exonerate the government from total blame in the event of failure of the project or if adverse effects are felt after completion of the project. As such, it is envisaged that public consultation will begin to play an increasingly important role in decisions on flood hazard mitigation projects. While it is unlikely that Arnstein's (1969) level of citizen participation will ever reach 'citizen control', it is probable that the public will achieve at least the 'partnership' level with the authorities.

5.3.3 Summary and conclusions

In Peninsular Malaysia, flood hazard institutions and organisations have been set up by politicians and run by civil servants working within the influential and constantly evolving contextual forces of socio-cultural and political economy. As a result, institutional and organisational decisions are a reflection of such forces, the significance of which is better understood from a historical/colonial perspective and recent development trends relating to these forces.

The above evaluation has demonstrated that flood hazard institutions and organisations in Peninsular Malaysia are far from adequate. All four criteria are found to be inadequate in some ways. Only the environmental protection aspect appeared adequate. Even so, its application and enforcement of the concept of sustainability are problematic. Furthermore, economic and political considerations often override environmental ones in decisions regarding floodplain use. Two examples are the Penang Hill Development Project in Pulau Pinang (Friends of Penang Hill 1991) and the Kuala Lumpur Flood Mitigation Scheme (Pang 1987).

The missions, objectives and statutory duties of most flood hazard institutions and organisations are inadequate. Only the DID appears to be adequate in this respect but its flood obligations are still only secondary to its other functions of drainage and irrigation. Flood hazard organisations need to re-define and improve their objectives. Currently, the DID's objectives are too diverse, flood mitigation being just a minor objective. The Hydrological Section of the DID, currently in charge of flood mitigation, can be up-graded into a separate sub-agency specialising in flood mitigation. The objectives of other flood hazard organisations are not well defined and this need to be rectified. The PCFC is just a disjointed committee comprised of members from various government agencies whose meetings are irregular. Its effectiveness is therefore limited. The FDPRC is doing a good job, but that is as far as preparedness, relief and rehabilitation are concerned. The committee does not have a wider application of other flood management functions. The flood disaster machinery is also too rigid in its organisational set up. Organisational and administrative flexibility, as well as discretion are not some of its attributes. The areas that need improvement include the demarcation of responsibilities amongst agencies, more coordination and mutual support during the flooding off-season, and the improvement of warning procedures amongst the agencies involved. Although the NSC is the central controlling body for flood disasters, its main task is one of 'short-term' preparedness and relief rather than 'long term' flood prevention. The NSC is also not an expert body specialising in floods, although it deals mainly with flood disasters in the absence of other disasters in the peninsula.

Disaster reduction programmes that are over-dependent on a technocentric approach are unbalanced and are likely to prove ineffective (Horlick-Jones and Jones 1993 p34). Malaysian flood hazard organisations are largely dependent on structural measures although the official government policy (since the 1971 Water Resources Committee report) clearly favours the more affordable non-structural measures. As a result, high cost structural measures still feature strongly in the majority of flood mitigation schemes. While recognising the importance of non-structural measures in flood hazard management, there has not been enough effort to translate that recognition into action. Non-structural measures are seen, at best, as secondary or supplementary to structural schemes. For instance, flood forecasting, warning and evacuation procedures can still be substantially improved as the authorities have not applied current state of the art methods. The authorities have also not exploited the sociological aspects of adaptation to the flood hazard. Other non-structural measures that can be further developed are flood insurance, legislation, development planning, flood risk analysis, land use change, resettlement, flood proofing, and public education.

Current laws and regulations with regard to flood management is under legislated. Flood hazard institutions need new legislation for more stringent flood management, particularly with respect to floodplain use. Flood hazard organisations are not given enough legal power to carry out their duties and objectives. For instance, the DID has no legal power at all when it comes to the crunch of deciding the outcome of a development scheme that involves flood management inputs. Its position is at best one of an advisory nature. It is the state government and local authorities such as city councils, municipal town councils and district offices that ultimately make such decisions. Legislation should also be passed in order to reduce if not eliminate conflict of interests between the federal and state governments with regards to land and river use. The current situation with the latter holding the power appears to work negatively as far as flood management is concerned. This is largely due to the endemic problem in Malaysian politics of translating and enforcing federal policies in the various states (often under opposition hands) in the peninsula. Until such a time when the federal and state governments put aside political and ideological differences in favour of flood hazard management, effective flood hazard reduction will always be constrained.

Both financial and human resources of flood hazard organisations are generally found to be wanting. Although budgetary allocations have increased substantially since 1971, the actual increase may not be large if inflation is taken into account. Furthermore, such increases are mainly used in structural schemes and budgetary allocations for non-structural schemes are relatively small. This needs to be addressed. Finally, staffing is found to be inadequate in flood hazard organisations not only in terms of numbers but also in terms of the disciplinary composition. The majority of staff in the DID and the MMS, the two main flood management agencies, are engineers and physicists.

Finally, both the equity and public accountability issues are not adequately addressed by flood hazard institutions and organisations. Despite the government's focus on the former over all its 5 year Malaysia plans, flood hazard institutions and organisations have not built the equity criterion into their set up. Flood hazard reduction can significantly reduce income inequalities as the poor are the ones mostly affected by floods. Flood disaster preparedness, relief and rehabilitation programmes run by the FDRPC have helped the poor cope better and rehabilitate faster after a major flood. However, their effect is not significant as losses are usually greater than the aid given. Flood projects also do not concentrate on poor rural areas where the benefits are substantially less compared to densely populated urban areas. In terms of the latter, there appears to be a gradual move towards more public consultation and accountability in government activities, including flood schemes. However, governmental culture of secrecy and the threat of opposition parties abusing and distorting information may prevent public consultation and accountability from reaching a high level.

5.4 Institutions, organisations and individuals

This section analyses the ways and extent to which flood hazard institutions and organisations affect individual response to the flood hazard in Peninsular Malaysia. However, detail analyses of individual perception and response from the questionnaire survey is given in Chapter 7.

Malaysian floodplain society is made up of individuals from all walks of life who have different roles and aims, and suffer varying impacts in relation to the flood hazard. The floodplain house owner, the DID engineer, the peasant farmer, conservationists, and politicians are all actors who perceive and respond to the flood hazard through making decisions that ultimately affect overall flood hazard reduction. According to Kasperson (1969), the need to make decisions arises from 'stress' or 'pressure' caused by the flood hazard. These stress and pressure forces are 'catalysts' as they provide the motivation for taking action (Figure 5.3). In the case of the floodplain dwellers, these forces could be in the form of anxiety and worry over future flooding, or it could be property damage and other losses resulting from a recent flood. In the case of DID engineers, there could be the anxiety of holding on to their jobs, seeking advancement and pressure from the public. Peasant farmers are stressed by the extent to which future flooding would threaten their lives and those of their families and destroy their crops, livestock and houses. Conservationists are motivated to protect the river environment (from large engineering works) and swamp land (mangrove) ecosystem (from agricultural drainage). Finally, politicians are motivated to retain their voters support or to gain publicity to enhance their positions. Besides the catalysts, institutional forces such as legal constraints, flood aid, etc. also affect the individual's perception and response. In turn, institutional forces are themselves influenced by broader 'structural forces' belonging to socio-cultural and political economy contexts. The influences, however, are not strictly uni-directional as individuals (either as floodplain users, pressure group leaders, politicians, engineers of flood hazard organisations or government officers) can influence institutions and organisations through their actions.

Regardless of the stress and pressure factors inducing individuals to take action to reduce the flood hazard, the scope for individual action has been shown to be severely constrained by institutional factors, i.e. external factors beyond the individual's control. In Britain, for example, institutional factors are central to understanding flood hazard response as they constrain and severely limit the scope for individual action (Penning-Rowsell et al 1986).

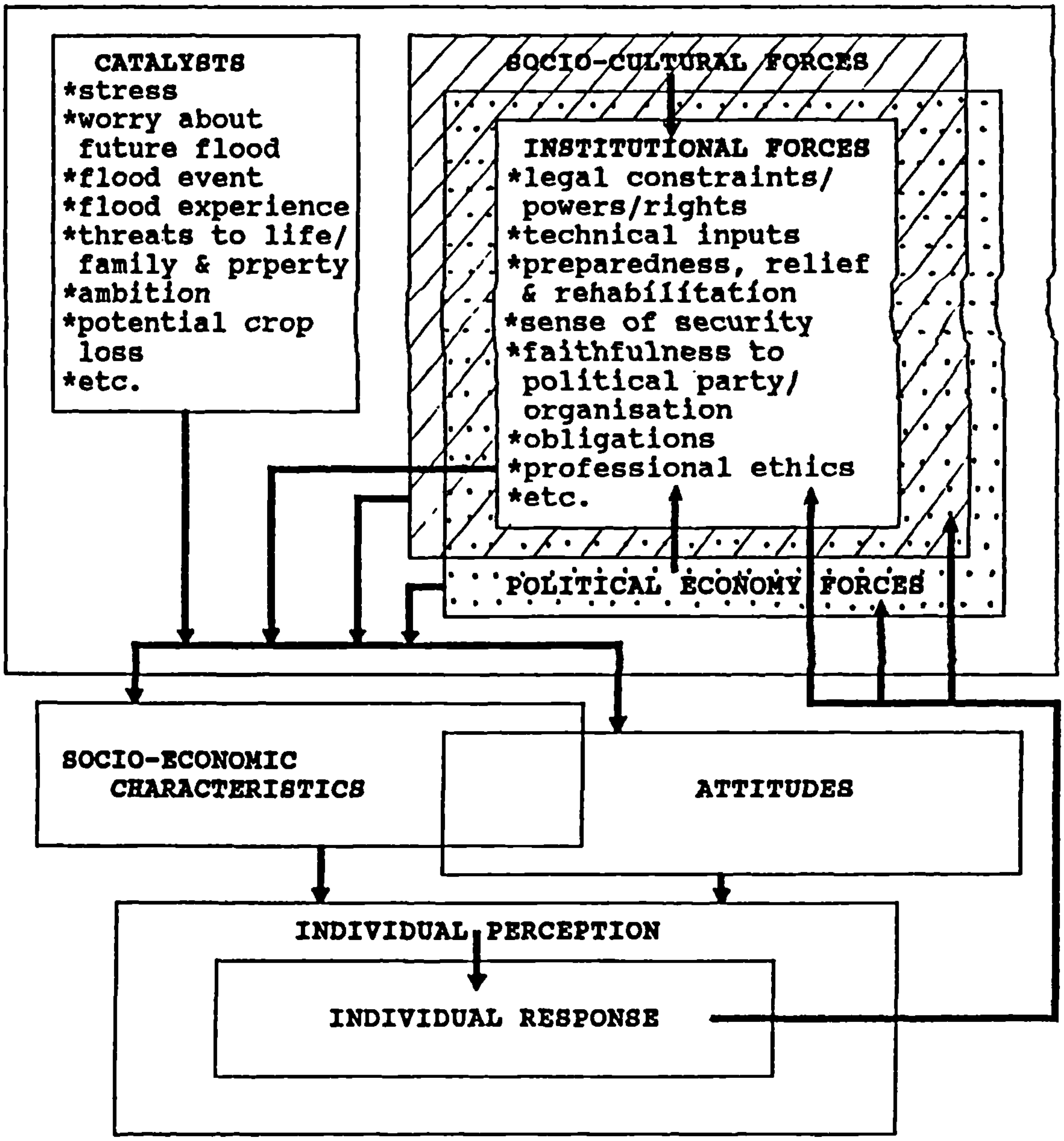


Figure 5.3: The influence of institutional and other forces on individual response to the flood hazard

5.4.1 Flood hazard institutions and their influence on individual response

In Peninsular Malaysia, flood hazard institutions such as laws and regulations have a pervading influence on individual action relating to the flood hazard. First, they control and restrict individual activities such as construction, farming, recreation and others which can exacerbate the flood hazard. Second, they affect and constrain individual options when responding to the flood hazard. For example, the National Land Code (1965) designates a large proportion of flood-prone land as 'reserved land' and individuals cannot buy, farm, develop or carry out any human use on such land. This puts a constraint on developers, farmers and floodplain occupation by individuals (although squatters do not care about such legislation). The above law also provides a framework within which government officers (as individuals) can carry out their duties. Without the guidelines of such a law, it would be difficult to monitor and control flood exacerbating activities. Consequently, this law can effectively contribute to flood hazard prevention and subsequent flood loss reduction.

Similarly, the Mining Enactment 1929 restricts the siting as well as the areal extent to which individuals can purchase or be granted concessions for mining. Regulations under this enactment also control the retention of slimes and the maximum permitted solid content of effluent discharged from mines. Mine owners are therefore constrained by these regulations and have to work within the law. Another law, the Waters Enactment 1920 not only controls the kind of activities individuals are allowed to carry out on rivers but also severely restricts the usage of land adjacent to rivers. Individuals cannot build houses or erect any structure which the state considers will have an adverse effect on the river regime and other related issues such as flooding, water pollution, destroying the aquatic ecosystem, etc.. In the case of the Land Conservation Act 1960, individuals are stopped from farming on steep terrain (notably hill slopes) or from carrying out any other activity which can progressively lead to soil erosion, siltation of river beds and increased frequencies and magnitudes of flooding. There are other laws and regulations indirectly relating to flood hazard reduction which restricts individual action. However, all the above laws and regulations are only effective if enforcement is carried out. Otherwise, personal interests of individuals can circumvent legislation and lead to the exacerbation of the flood hazard.

Legislation can also affect individual perception and response to the flood hazard. All the above laws and regulations are geared towards flood prevention or control. This can lead many individuals (especially the uneducated) to believe that floods have effectively been controlled. As such, many take a complacent attitude thinking that floods would not occur again. Consequently, they are caught unprepared when the next flood occurs and do not response in the normal way that they would. This 'weak' response then results in heavy losses, sometimes even the loss of life.

On the other hand, ill-planned flood warning regulations can often lead the public to disillusionment and scepticism. For instance, the ineffectiveness of the automatic solar-powered siren on the Pinang River (centred on the Jalan Perak area) has resulted in the majority of residents developing a negative attitude towards warning regulations. According to one Pulau Pinang state DID officer, the siren was initially set to go off at 'too low' a river level. This resulted in the siren going off many times without being followed by flooding. Such 'false warnings' have had a negative effect on individuals as many do not pay any attention to it any more. Later, the DID decided to raise the 'trigger' level in which the siren would go off but the residents were not told about it. Subsequently, the siren went off followed by flooding (as in the June 1991 flood) but people did not react to it and were caught unprepared. Similarly, people in Kuala Krai (Kelantan) often do not heed warnings as warning levels are too low resulting in the issuance of warnings not followed by flooding. For example, in Kuala Krai, the warning level on the Kelantan River is fixed at 22.86 m. From 1964 to 1993, a total of 24 warnings were issued (river level touched 22.86 m) but only 12 resulted in floods (river level exceeded the danger level of 25.91 m) (Figure 5.4). Likewise, residents in Kota Bharu and in the vicinity of Guillemard Bridge also receive more warnings than actual flooding. This has also given rise to an indifferent attitude towards warnings.

Policies and instruments are other attributes of institutions that can affect individual response to the flood hazard. In Chapter 4 (Section 4.2.3) it has been demonstrated that governmental flood hazard policies in Peninsular Malaysia over-emphasise structural measures as an instrument of flood hazard reduction. There are two ways in which structural measures can affect individual response to flood hazards. First, the large and well politicised structural schemes (such as the Kenyir Dam in Terengganu) have the effect of making individuals think that their flood problems have been solved. Thus, structural mitigation schemes such as dams, floodwalls, levees, channel deepening and embankment of channels can result in a false sense of security among the public. Informal discussions held by the author with floodplain occupants, government officers and private consultants reveal that the majority of all three groups of individuals believe that structural schemes are the answer to flood problems. Also,

Area	Alert level (meters)	Warning level (meters)	Danger level (meters)
Kuala Krai	19.81	22.86	25.91
Guillemard Bridge	12.19	15.24	17.68
Kota Bharu	3.66	4.57	5.49

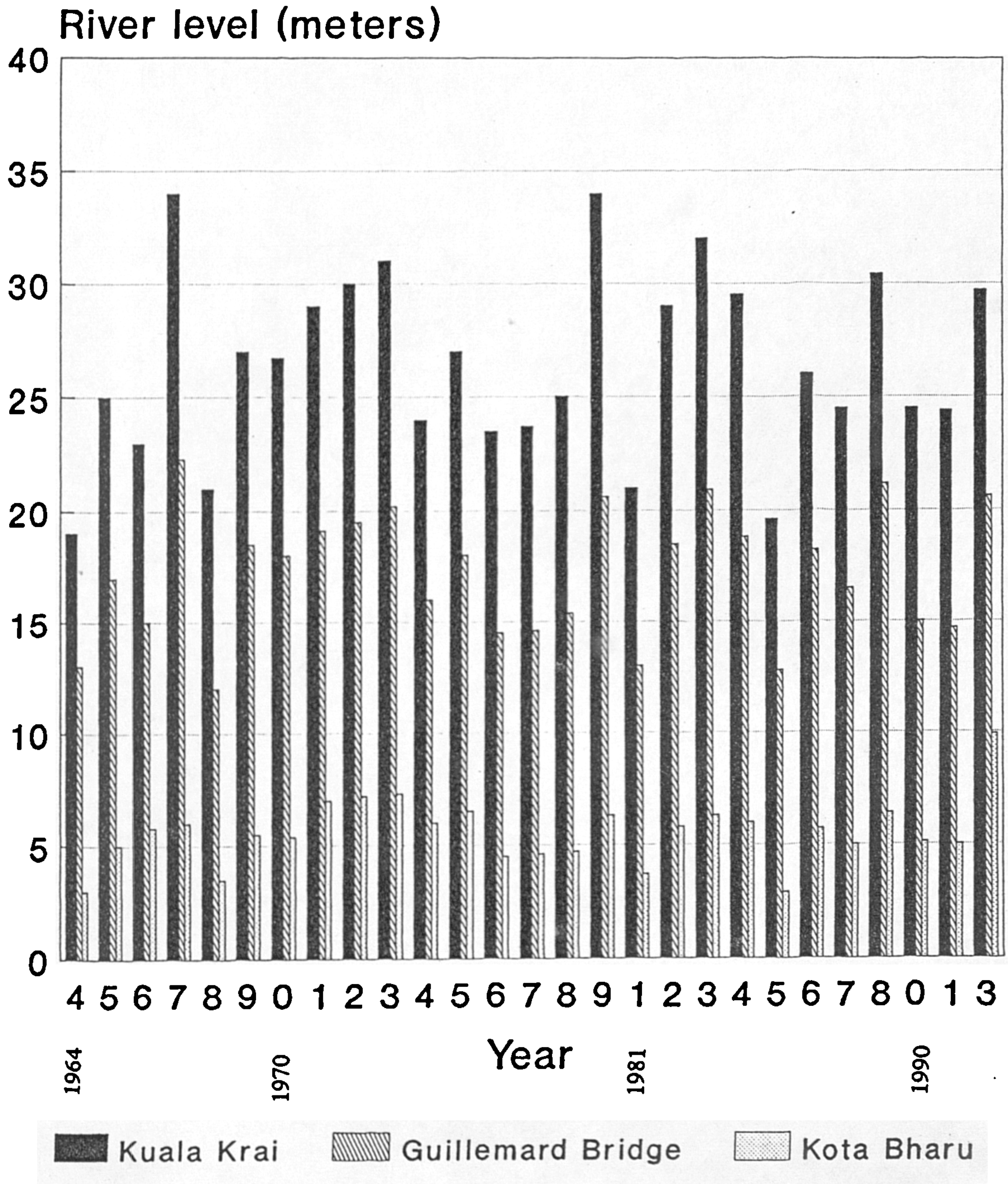


Figure 5.4: Recorded levels of the Kelantan River against pre-determined alert, warning and danger levels at various points on the Kelantan River

in the questionnaire survey on floodplain occupants, 29.8 per cent of those interviewed mentioned structural measures as measures of flood prevention. Channel deepening was mentioned as an effective method by the highest percentage of respondents (68.2 per cent). The above percentages include only respondents who voluntarily mentioned each measure. The percentage could be much higher if respondents were asked about the effectiveness of each structural measure. As a result, individuals become passive and non-active in their response to the flood hazard as they believe that it has been overcome by the structural measures. This can lead to greater loss when the next flood occurs. For instance, the construction of the Batu Dam and the raising of the existing Kelang Gates Dam by three metres in 1987 have reduced flooding in the Kelang River Valley around the federal capital (Sooryanarayana 1988 p8). The publicity that went with the completion of the two dams probably gave floodplain residents a lot of confidence. Yet subsequent flooding occurred in the many flood-prone areas such as the Old Kelang Road, Kampung Baru and Kampung Pantai Dalam. In fact, the losses suffered were even higher as people were not as prepared as before in taking action to reduce the effects of flooding. This was the general consensus with residents from the Kampung Pantai Dalam and Kampung Baru areas (predominantly Malays). The predominantly Chinese Old Kelang Road area, however, did not show any real increase in flood loss. This area is mostly controlled by the opposition DAP party and residents are very critical and sceptical of government projects.

Another example is the Pulau Pinang Flood Mitigation Scheme involving a section of the Pinang River. This scheme did not prevent the June 1991 flood which inundated much of Georgetown. Residents in the city, with the exception of those living in the highly flood-prone areas, were perhaps led into a sense of belief (through wide publicity via the media) about the effectiveness of the scheme. Another example is the multi-purpose Kenyir Dam in Terengganu. Although widespread flooding appear to have decreased since the dam's completion, local scale flooding still occurs and one DID officer remarked that there is always the probability of a big flood hitting Terengganu in the future and that the dam's flood control function was not infallible. Because of this sense of security, complacency may affect individual perception and response to the flood hazard. Also, the constant employment of structural schemes to combat the flood hazard by the government relegates the individual to play a secondary, even non-active role in flood reduction. Because of this predominantly structural policy, individuals become over-dependent on governmental response and they gradually lose the important traditional coping mechanisms practised by their ancestors.

Second, poorly planned structural schemes may also give rise to a negative attitude towards the government. For instance, the many structural schemes carried out on the Kelantan River have not reduced the flood hazard in Kota Bharu and its vicinity. This has led Kelantanese to believe that such schemes are useless and that the federal government is not doing enough for them. This gives rise to a sense of mistrust amongst the Kelantanese towards the federal government (this is probably reinforced by opposition political parties which control much of Kelantan state at the moment). Consequently, this negative attitude can spread into other areas such as flood warning procedures, preparedness, relief and rehabilitation. In flood warning, those who do not trust governmental flood mitigation schemes will also not trust the warning system. As a result, warnings issued are often not heeded by the people and individual response is often too late and rather limited. Furthermore, when people do not pay attention to warning procedures, they often respond poorly when the warning is followed by a flood. Similarly, not following preparedness procedures can severely increase individual flood losses as the public are not aware of pick-up points (for evacuation), time to move, where to go etc. Relief and rehabilitation programmes are also not as effective if the public do not follow governmental procedures and instructions.

Policies which retard the development of non-structural measures result in individuals not having a chance to learn and familiarise themselves with these measures. Some non-structural measures which are not well developed are flood warning procedures, relocation, public education and others. Because such measures are not well developed, their effectiveness is low and since individuals are not well tuned to react to these measures and procedures, their response is curtailed.

Not withstanding its over-emphasis on structural measures, the Malaysian government's main non-structural flood reduction instrument is its preparedness, relief and rehabilitation programme under the FDRPC. Every year the FDRPC carries out the programme in anticipation of the seasonal monsoon floods. And each year, thousands of families are temporarily evacuated from their homes, put up in relief centres, provided with food and clothing, and even given loans to help them rehabilitate. Years of getting used to this annual routine has made the flood victims extremely reliant on government flood aid. This again has the effect of eroding many of their traditional coping mechanisms. Flood victims do not have to worry too much because the government looks after them. This has given rise to an apathetic attitude towards individual flood hazard response.

5.4.2 Flood hazard organisations and their influence on individual response

Flood hazard organisations are made up of individuals who work within the organisation's aims and functions. Individuals can, therefore, influence organisation decisions to a certain degree. For instance, the elite or the top echelon of the management staff of an organisation often make decisions on behalf of the organisation. However, the more profound influence on flood hazard response is the other way around, i.e. by the organisations on the individuals. Thus Penning-Rowsell et al (1986 p24) has demonstrated the naivety of interpreting the individual's decisions in isolation from a wider analysis of administrative, economic and political forces affecting them. As individuals are affected by institutions and organisations, overall flood hazard response should be viewed within an institutional context. Although Malaysia is a democratic country where freedom of choice is guaranteed by the constitution, the constraints exercised by flood hazard institutions usually result in individual house owners, farmers, floodplain squatters, flood victims, engineers and government officials seldom being able to exercise that freedom fully. Institutions not only dominate collective decisions but also affect the perception and response of individuals.

Organisational structures demarcate the responsibilities, functions and powers of an organisation. In terms of flood hazard organisations, these attributes can have a profound effect on individual response. For instance, flood hazard organisations can enhance individual participation in flood hazard response through public education, flood hazard awareness, and teach the public methods of flood proofing, evacuation procedures, survival techniques in times of flood, etc. Flood reduction measures would be of limited success if the public does not know how to respond appropriately to organisational advice. Although **flood hazard awareness and public education programmes** have often been documented as unsuccessful (Handmer and Milne 1981; Scanlon 1990 p233; Fordham 1992 p147), they remain important instruments which, when planned carefully can effectively reduced losses resulting from hazards and disasters (Davis 1982 pp8-9; Kreps 1992; Smith 1992 p88). In a compilation of papers on risk communication, Handmer and Penning-Rowsell (1990) conclude that risk communication is getting better (through improved public education programmes), but people are not taking action or changing their behaviour. Public educational programmes are important in ensuring not only public awareness and appropriate response but also public support for organisation/government actions. Without such support, even the best conceived programmes can go to waste. Fielderman (1990) acknowledges that public education programmes can only be effective if planned properly and executed effectively through the media. This is because hazard information competes with other information in the media, and to be effective hazard information must be relayed to consumers by information producers in a way that would make a difference.

In Peninsular Malaysia, although public educational programmes, awareness and response strategies are carried out by the DID, the Road Transport Department, Information Department, and the Police Department, they are too infrequent and usually carried out on an ad hoc basis. In many cases, the programmes are put forward during or just after a flood. As such, the timing and place are far from satisfactory and flood victims are usually either too devastated or pre-occupied, not to mention being in a highly stressed emotional state to really absorb what is being relayed to them. Flood hazard awareness and response programmes should ideally be on-going at regular intervals all year round, for instance just before the flood season in September or October. An example is the circulation of awareness pamphlets on how to response appropriately when flooding occurs (Plate 5.2). Another example is the erection of sign boards with flood information such as forecasted time and depth of flooding (in downstream areas) (Plate 5.3) and roads that are flooded and closed (Plate 5.4). Hitherto, only heavy rains forecast are relayed via the radio network. Educational programmes in relation to flood response aired on the national television network can be effective but has not been attempted. The importance of quick response and prompt action on the part of respondents should be stressed. Hitherto, the majority of floodplain occupants rely too heavily on government assistance and guidance. Whether this situation has arisen due to decades of government assistance and pampering is debatable. The reality is that flood victims should be made to realise that their role in any flood situation is just as important if not more so than the government's action in providing transport, food, clothing and temporary shelter. By and large, Malaysians must be made to feel more responsible for themselves instead of always relying on the government. It is only through education programmes that this can be achieved.

At the moment, none of the flood hazard organisations in Peninsular Malaysia has such a comprehensive programme of public education. The DID periodically sends out pamphlets on proper response techniques and procedures. Local village flood committees sometimes hold meetings to teach the people the best ways to respond to floods. And the media (television, radio and newspapers) warn people of impending floods when nearing the monsoon season and tell them how to react. But there is no single agency which is responsible for public education on flood response. This is one avenue in which more

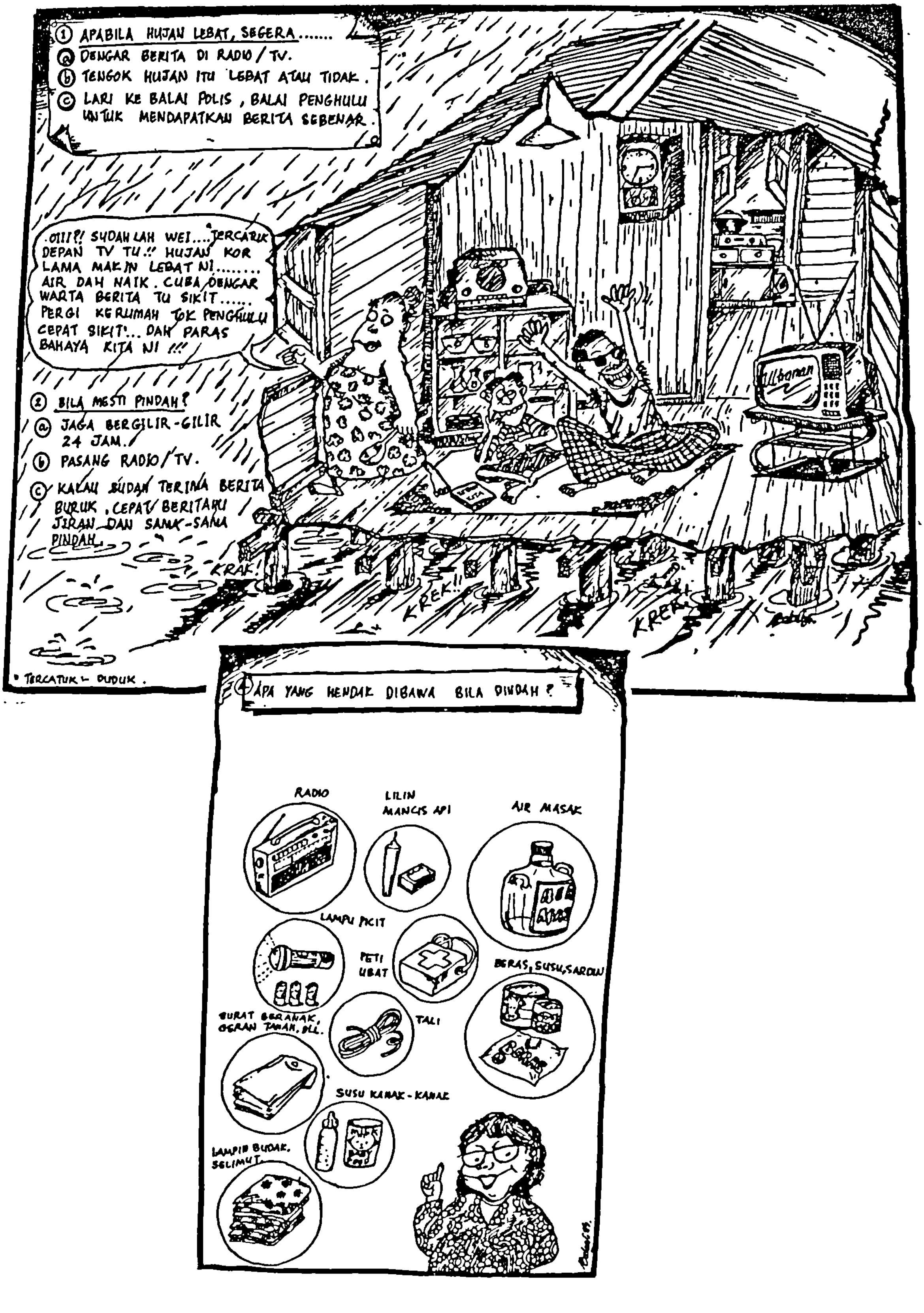


Plate 5.2: Information pamphlets sent out to the public with advice on how to respond appropriately when flooding occurs

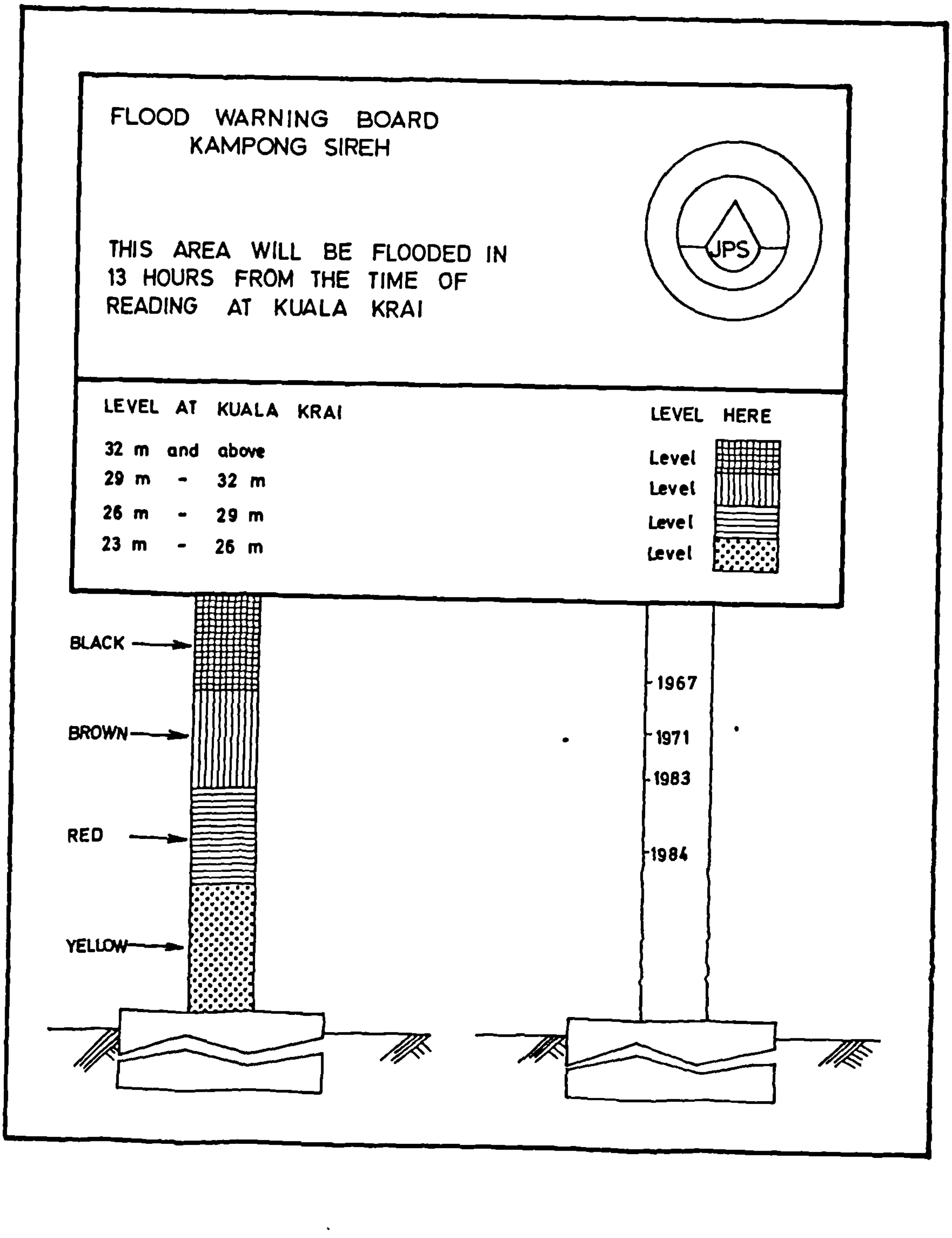


Plate 5.3: Flood warning sign boards with information such as forecasted flood time and depth of flooding (in downstream areas)

Plate 5.4: Sign boards erected on major road junctions indicating location, time and flood depth of flooded roads in the state of Pahang

effective individual participation towards better flood reduction can be achieved.

The administrative structure of an organisation can also affect individual response to flood hazards. A structure which is bogged down by bureaucracy and too many hierarchies is invariably difficult for individuals to access. Getting information on floods from flood hazard organisations should be made as easy as possible but government bureaucracy and the culture of secrecy are major obstacles faced by the individual (not just floodplain user but also researchers and individuals from other organisations). Although the DID is responsible for flood management, they do not have a 'hot line' where people can *phone in to get* information on various aspects of flooding. It is the same with the MMS (in charge of forecasting heavy rains) and the Police Department (in charge of warning dissemination). The typical government bureaucracy does not encourage the free flow of information to the public, probably for reasons of security, politics and others. Consequently, unavailability of flood information can severely inhibit individual response. Sometimes, ignorance on the part of individuals can often result in the wrong response being made. Because of the administrative bureaucracy, not many individuals know that the DID is in charge of flood management, or that the Police Department is in charge of warning dissemination.

Organisations dealing with flood warnings have a vital role in ensuring their effectiveness. The most important factor in an effective warning system is that it must instill confidence and believe amongst the public. If the public has no confidence in it, then the system will not work regardless of how sophisticated it is. Warnings must not be given out unnecessarily as 'false' warnings can have an adverse effect on future warnings. This is the case of the sirens operating in the Jalan Perak area on the Pinang River in Pulau Pinang and the Kampung Dato Keramat area in Kuala Lumpur. Residents in both areas are of the opinion that the sirens go off unnecessarily, often not followed by flooding. As a result, the residents do not trust the warnings and are often caught unaware when a flood warning is actually followed by a flood.

In Peninsular Malaysia, flood disaster preparedness, relief, rescue and rehabilitation programmes have been carried out since the colonial period. Based on past experiences, these programmes have been improved upon through the years. Flood hazard organisations such as the FDPRC ensures that the programmes are carried out each year, regardless of whether a flood will occur. Other organisations that play an important part in this programme are the Social Welfare Department (food, shelter and clothing), the Police Department (warning dissemination, evacuation and maintaining law and order), the Army (transportation during evacuation), the Health Department (looking after the health of victims and the prevention of epidemics), voluntary organisations such as Belia (a youth organisation), the Red Crescent, the St. John's Ambulance Brigade, and others. All these organisations contribute towards the reduction of flood losses and other intangible impacts of flooding. The programmes help put the flood victims back on their own feet and this in turn enables the latter to response better.

Organisational sub-cultures of flood hazard organisations also affect individual response to flood hazards in many ways. Organisational sub-cultures affect their employees in their work related to flood hazard management. For example, employees of the DID invariably approach flood problems structurally via engineering methods as the DID's policies are based on such an approach. DID employees have an important role to play as individuals because they are largely responsible for the effectiveness of the flood management programmes. With the constraints of sub-cultures within the organisation's structure, employees are restricted in their response to the flood hazard. Similarly, it would be hard to convince the FDRPC that structural measures are better than the non-structural ones practised by them. Employees of the FDRPC would not attempt to introduce structural methods of flood response. Organisational sub-cultures also influence floodplain users' response when each organisation employs its own specific approach when interacting with the public.

On the whole, institutions and organisations in Peninsular Malaysia, as is in many other countries, mainly address the physical cause of floods. With the exception of FDRPC and its state and district versions, the majority deal with flood forecasting, flood control, land use control, river embankment, dam construction and other physical/hydrological aspects of floods. Human and sociological dimensions of floods such as risk, exposure and vulnerability, all of which affect income and poverty levels, are largely neglected. Even though the NEP and the various 5-year Malaysia plans advocate poverty eradication and equity, the majority of flood hazard organisations do not have such objectives clearly spelled out in their mission statements and objectives.

This chapter has demonstrated how the institutional context affects the outcome of flood hazards in the peninsula via an evaluation of the adequacy of flood hazard institutions and organisations. The next chapter examines the extent to which choice of settlement is constrained by exogenous 'structural/societal' forces beyond the individual's control.

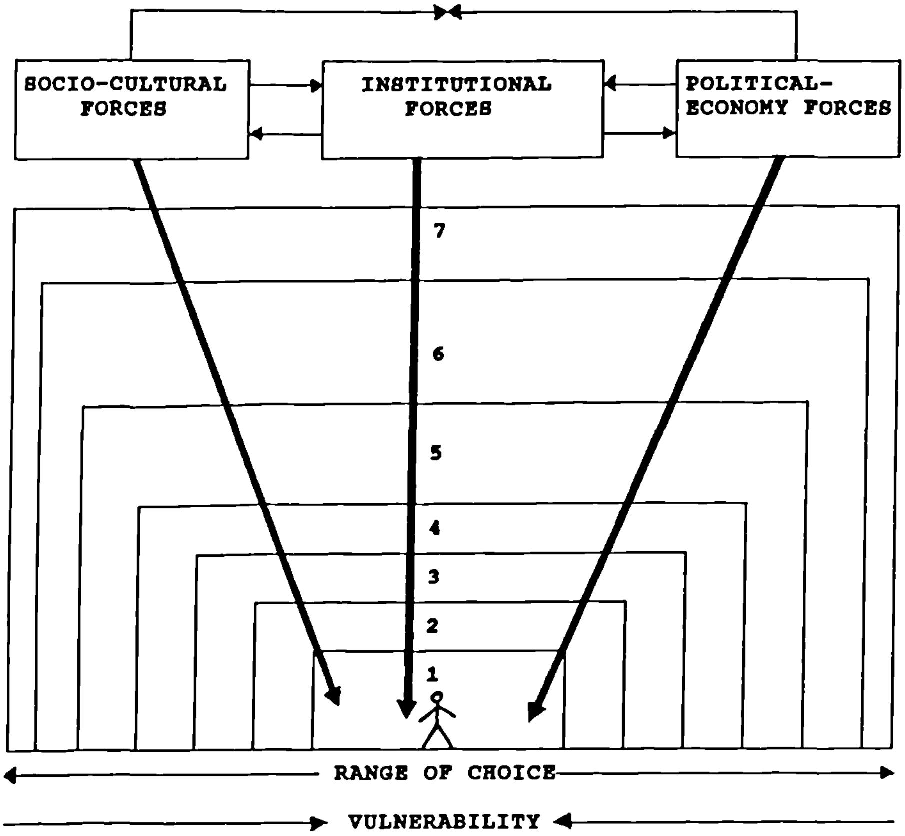
6 CONSTRAINTS AND CHOICE IN PERSISTENT OCCUPATION OF FLOODPLAINS

6.1 Introduction

This chapter examines the extent to which choice of settlement is constrained by exogenous 'structural/societal' contextual forces which are beyond the individual's control. In theory, Malaysia is a capitalistic country practising free enterprise, and individuals can expect to have choices in residential location. However, in practice, exogenous forces such as socio-cultural, political economy and institutional ones severely limit the choices of individuals. The more individuals are 'controlled' by these forces, the more disadvantaged and vulnerable they are to hazards. For example, impoverished East Coast farmers are more severely constrained in their response to flood hazards than their better off West Coast counterparts. The range of choices open to individuals, therefore depends on the extent to which they can free themselves from the 'control' of such forces (Figure 6.1). Some examples of the constraints and choice in persistent floodplain occupance by individuals in the peninsula are examined in detail in Appendix H.

Sections 6.2 and 6.3 examine the reasons why a significant proportion of Malaysians persist in inhabiting flood-prone areas (i.e. the stay option), focusing on structural forces which 'trap' them in their present locations. Sections 6.4 subsequently analyses the forces leading floodplain occupants to adopt the move/migrate option. Thus, the scope for individual action is expected to be severely constrained by these forces. The chi-square test in the SPSSPC Statistical Package is employed as a test of association between variables. When this is not appropriate, other tests of significance such as the t-test, correlation and regression are employed to determine the important variables affecting the 'stay' or 'move/migrate' options. The significance level is taken at .05. Test results are presented in Appendix L.

The key point in this chapter, therefore, is that despite a high level of flood hazard awareness, a high level of pessimism and a high level of expectation of future floods, the poorer individuals seldom attempt to leave for more advantageous locations. They are instead trapped in their present locations by structural/societal forces such as poverty and low occupational and residential mobility, development policies favouring rapid urbanisation and industrialisation and the emphasis on technical and engineering measures of flood control by flood hazard institutions (institutional), amongst others. They are also, together with wealthier



Key:
1. East Coast poor farmer, poor fisherman and others living below the poverty line.
2. East Coast average farmer, average fisherman, and others of average incomes. West Coast poor farmer, poor fisherman, other poor rural floodplain inhabitants and poor urban squatters.
3. East Coast rich farmer, rich fisherman, and others with high incomes. West Coast average farmer, average fisherman, and others with average incomes.
4. East Coast rural businessman, wage earner and others whose incomes are not related to farming or fishing. West Coast rich farmer, rich fisherman, and others with high incomes.
5. East Coast urban wage earner with moderate income not involved with farming or fishing. West Coast rural businessman, wage earner and others whose incomes are not related to farming or fishing.
6. East Coast professional with high income in urban areas. West Coast urban wage earner with moderate income not involved with farming or fishing.
7. East Coast wealthy urban businessman, large business corporations and other rich individuals. West Coast urban professional with high income, wealthy urban businessman, large business corporations and other rich individuals.

Figure 6.1: The hypothesised influence of exogenous structural/societal forces on the scope of individual action in flood hazard response in Peninsular Malaysia

individuals, strongly influenced to remain or stay by customs, traditions, ethnic values, the kampung way of life, traditional land inheritance, and government relief and other forms of agricultural and rural development aid. These forces exert a strong influence upon individuals and largely control their range of choices and action in flood hazard response. Figure 6.2 is a hypothesised model depicting individual choice to stay or move/migrate within the confines of structural forces. The wealthier group of individuals and a minority of their poorer counterparts (e.g. those who are fortunate to be resettled or chosen as settlers in government land schemes, those who have wealthy relatives and the more adventurous) have access to the move or migrate option. The majority of the poor are deprived of the move/migrate option. Despite their relative freedom from structural constraints offering better accessibility to the move option, the wealthier group[73] may not move as they are influenced and constrained by cultural forces. Therefore, like their poorer counterparts, they stay and seek to protect themselves from flood hazards.

6.2 Reasons for persistent occupation of floodplains

In Peninsular Malaysia, persistent occupance of floodplains is mainly caused by 'structural/societal' factors rather than individual choice. Research on flood hazards indicates that although many floodplain occupants are willing to be relocated, the lack of opportunities, choices and government incentives has prevented them from moving elsewhere (Chua 1972; Jamaluddin and Ismail 1983). According to Kates (1962), there are five reasons why people persist in occupying flood-prone areas:

1 They do not know about the hazard and are therefore not unduly concerned.
2 They know about the flood hazard, but personally do not expect a future flood, and therefore are not duly concerned.
3 They expect a future flood, but do not expect to bear a loss, and are therefore not duly concerned.
4 They expect to bear a loss, but not a serious one, and are therefore not duly concerned.
5 They expect to bear a serious loss and they are concerned. Therefore, they have undertaken or are planning to undertake some action to reduce the losses (Kates 1962 p135).

To these five reasons, Fordham (1992 p71) has added another two:

6 They expect to bear a loss but accept this outcome as an acceptable cost of enjoying

[73] For the purpose of comparison in statistical testing, households with monthly incomes of $2,000 and above are considered 'wealthy'. By comparison, 'poor' households have monthly incomes of $350 and below (see pxx).

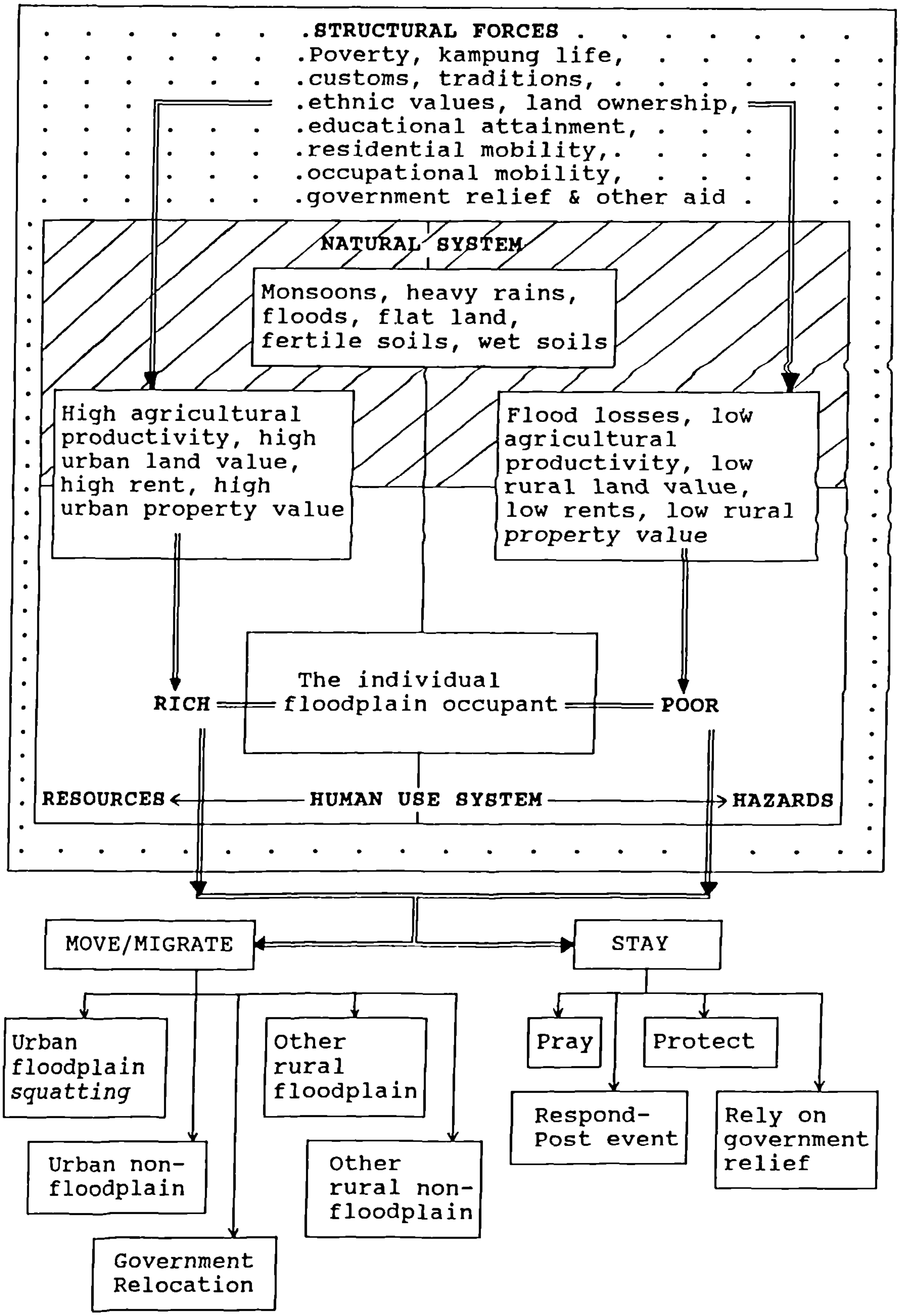


Figure 6.2: A hypothesised model depicting the influence of exogenous structural/societal forces on the 'stay' and 'move/migrate' options of individual floodplain occupants in Peninsular Malaysia

the locational (environmental) benefits.

7 They had little or no choice in location and/or have little or no choice but to stay.

While each of the above reasons is valid by itself in hazards research (most researches have identified one or more of them), not all reasons will be applicable to floodplain occupants at all times. In Peninsular Malaysia, reason 7 is the main reason why people persist in floodplains. Historical, colonial and post-colonial 'structural/societal' forces were reasons put forward in Chapter 4. To substantiate these reasons, the way in which such forces strongly influence individual decision to continue to occupy floodplains is further examined. It is likely that a combination of reasons 4 to 7 is responsible for people's persistence occupance of hazardous floodplains in the peninsula. Survey results[74] are used to substantiate the applicability of each reason for continued floodplain occupance in Peninsular Malaysia. The following discussion examines each reason separately.

Although a high level of 'unawareness' of flood hazards has been found amongst floodplain occupants (e.g. Parker and Harding 1979), the level of hazard awareness amongst those who have lived in an area for some time is generally high (Chua 1972; Moline 1974; Ramachandran and Thakur 1974; Jamaluddin and Ismail 1983; Fordham 1992). In Peninsular Malaysia, **Reason 1** is unlikely as there are probably very few people who actually do not know about the hazard (with the exception of some new residents who have moved into the area from elsewhere). Survey results reveal that 436 respondents (70.6 per cent of total respondents) voluntarily mentioned flood as the most important disadvantage in their locality (before they were told that the interview was about flood hazards). This group of respondents, therefore, has a high awareness of the flood hazard. However, when respondents were asked whether or not their locality was affected by floods, 95.3 per cent of them gave a positive reply indicating flood awareness.

Survey results indicate that the majority of floodplain occupants (66.0 per cent) expects floods to occur in the future. Furthermore, 80.4 per cent of respondents are found to be pessimistic, i.e. they expect a higher frequency of flooding compared to the actual. Thus, **reason 2** is an unlikely reason for continued floodplain occupance in the peninsula.

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[74] Hereafter, the term 'Survey results' refer to results from the current household survey in this research, unless otherwise specified.

Reasons 3 and **4** are probably only valid in the areas where the flood hazard is not so severe, for example in areas with flood frequencies less than 1 in 10. Flood frequencies and magnitudes are low in these areas (depth of flooding is usually lower than stilt height of houses) and respondents may expect future flooding, but do not expect to bear a loss, or may only expect to bear a minor loss. They are therefore not duly concerned. Results from the current household survey indicates that 64.8 per cent of those living in areas with a flood frequency of 1 in 10 or less believed that floods are not serious. Based on this, it can be assumed that they did not expect to bear any great loss in future floods. Furthermore, only 48 (37.8 per cent) out of 127 respondents living in areas with a flood frequency of 1 in 10 or less experienced a flood loss in the most recent flood.

Reasons 5 and **6** are two common reasons why people persist on the floodplains in Peninsular Malaysia. Flooding occurs almost annually in the East Coast and other flood-prone areas on the West Coast. People who persist in such areas expect to bear a serious loss and have or are planning to take positive action to reduce the losses. They expect a loss and accept it as an unavoidable cost of enjoying the locational benefits of cheap land, fertile soil, proximity to work place and other reasons. In the current household survey, 84.5 per cent of all respondents have taken steps to reduce flood losses. When respondents were asked to indicate the most important advantage of living in their present area, 494 of them (79.9 per cent) indicated various locational benefits as the reasons. These include the owning of land in their kampung, proximity to nearby town, proximity to work place, proximity to relatives and proximity to public amenities such as hospitals, schools, etc. Also, of those who intend to remain on their present locations, 54.0 per cent gave reasons associated with locational benefits.

Reason 7 is the main reason why a significant proportion of Malaysians live on floodplains and also why the majority continue to remain on them. It applies most appropriately to the landless and impoverished who neither have the choice nor the resources to move elsewhere. A fifth of those interviewed do not own their houses and are landless. If squatters (they own the houses but not the land) are included in this category, then 38.2 per cent of respondents are landless. In Malaysian society, rural peasants and urban squatters are the two main groups associated with this reason. In the current research, 21.8 per cent of those who reported that they had no choice in location are squatters. Amongst floodplain squatters, more than half revealed that they live there because they have no choice. Rural peasants (farmers and fishermen) represent 25.2 per cent of those reporting the absence of choice in their location.

More significantly, 32.3 per cent of farmers and 28.9 per cent of fishermen indicated that they occupy floodplains because of the lack of alternatives. On the whole, a total of 533 respondents (86.3 per cent of total sample) indicated that they will continue to live in their present location despite the flood problem. Given the magnitude and frequency of flooding in the sample areas, this is a strong indication that floodplain inhabitants have little or no choice but to stay. For example, 37.9 per cent of respondents who intend to remain in their present locations quoted reasons such as 'I have no money to move', 'I have no where to go' and 'It's the same everywhere'. All these reasons indicate that the respondents have little or no choice but to continue to occupy floodplains. Farmers who attempt to move are either the more well off or the more fortunate ones with external help (from relatives, friends or the government). Even those who migrate to urban areas may be confronted with high rents and shortages of low cost housing, forcing them to occupy urban floodplains as squatters (see Figure 6.2).

In the current research, 75.2 per cent of respondents who indicated that they have no choice but to remain in their present location, are aware of the flood hazard. Obliviousness is, therefore, not a valid reason why the majority of Malaysians continue to live on hazardous floodplains. Being optimistic[75] about economic opportunities, as has been documented by Saarinen (1966) on Great Plain farmers, is also not a valid reason for Malaysian floodplain occupants who exhibit a high degree of pessimism. For example, 78.9 per cent of all respondents are classified 'pessimistic' as they over-estimated the number of flood years when compared to the actual flood frequency. Amongst those who had no choice in location, 65.2 per cent are pessimistic. Furthermore, expectation of future floods is generally high amongst respondents. For those who have no choice of location, more than half expect at least a 50.0 per cent chance that flooding would occur in the next few months. With the same level of expectancy for future flooding in the next year, the number of respondents was 83.2 per cent. More than three-quarters of those with no choice of location are certain flooding would occur in the medium term (next 5 years) and long term (next 10 years).

Thus, despite high levels of awareness, pessimism and high expectations of future floods, people continue to inhabit floodplains. This persistence, therefore, cannot be attributed to

[75] Respondents are grouped as optimistic or pessimistic by comparing their estimation of the number of bad years to the actual (based on number of flood years in an area). Optimistic respondents are those who under-estimate the number of bad years while pessimistic ones are those who over-estimate them.

ignorance. Neither can it be attributed to 'optimism' or 'low flood expectancy'. People are forced to inhabit floodplains by structural forces beyond their control.

6.3 Structural forces leading to persistent occupation of floodplains

In Peninsular Malaysia, structural 'contextual' forces are hypothesised to be largely responsible for the persistent occupation of floodplains. Political economy forces such as landlessness, poverty, low levels of residential and occupational mobility, and ineffective public policies relating to floodplain development and flood management can contribute to the aggravation of flood problems. Similarly, socio-cultural forces such as ethnic culture can have a significant influence on individual response to flood hazards. Malays, Chinese and Indians are distinct from one another not only because of their physiognomy, language, religion, main occupation and usual habitat, but more importantly because of their culture. Each group's culture is deeply encoded with unique value systems and a code of ethics which clearly differentiates each group. The 'kampung way of life' is a unique cultural force which binds the Malay community to its natural environment, and which can explain the Malay's reluctance to move or migrate to urban areas. Other socio-cultural forces such as traditional land inheritance, ethnic values, customs and traditions are also expected to influence decisions to persist with floodplain location. Finally, other structural forces such as government aid in rural development schemes (e.g. in agriculture, fishing and rural industries) and government flood relief are also expected to play significant roles in reinforcing floodplain occupance.

This section seeks to test the above hypothesis that structural contextual forces have led to the persistent occupation of floodplains. It draws on data gathered from the structured questionnaire survey and unstructured qualitative interviews with selected farmers.

6.3.1 Poverty

Poverty due to the lack of access to resources is a fundamental cause of hazard vulnerability amongst specific groups in society, and is a central theme in vulnerability studies (Davis 1978, 1984a, 1984b; Blaikie et al 1994; Cannon 1994). In Peninsular Malaysia, poverty is one of the main reasons why many people persist on hazardous floodplains. Chapter 4 has demonstrated how contextual forces have created poverty and perpetuated flood hazards in the peninsula. This section analyses why impoverished floodplain inhabitants have little locational choice and seeks to demonstrate how they have been forced by poverty (a structural/societal force) to live and persist on floodplains.

The Government of Malaysia (1991a p12) reports that the poverty level in the country in 1990 was still significantly high at 17.1 per cent. Most of the poor households are located in the remote traditional kampungs (mostly Malays), deteriorating rubber plantations (mostly Indians), new villages (mostly Chinese) and squatter settlements in urban areas (mixed ethnicity). Poverty is a structural problem initially generated by colonial neglect but presently reinforced by ineffective public policies and over-emphasis on economic development of urban areas vis-a-vis rural areas. In the context of the flood hazard, because poor areas roughly coincide with flood-prone areas, the majority of floodplain inhabitants in the peninsula are either poor or living close to the poverty level (see Appendix H Case 10).

Figure 6.3 reveals that approximately 9.0 per cent of all respondents are 'hard-core' poor households earning incomes below $175 while more than a quarter of respondents are poor, earning monthly incomes below $350. A third of floodplain households are also low income families living close to the poverty level with monthly incomes between $350 and $749. On the whole, nearly two-thirds of all respondents are either poor or living close to the poverty level. A majority of those who had no locational choice are from the lower income group, with 61.4 per cent earning monthly incomes less than $750 and 43.9 per cent earning monthly incomes less than $500. Considering that the 1993 poverty level is estimated at $394 (see pxx), a significant proportion of those who had no choice in location are either poor or are living on the margin of poverty. In Figure 6.4, the income distribution of the four sample areas indicates that households from the two East Coast areas are comparatively poorer than their counterparts from the two West Coast areas. Therefore, households from the East Coast who are also more exposed to flood hazards, are expected to be more vulnerable to flood hazards compared to those from the West Coast.

The capacity to anticipate, cope with, resist and recover from the impact of flood hazards depends largely on an individual or household's economic situation. Generally, the wealthier ones are less vulnerable because they have a greater capacity (at least economically) to withstand floods. Accumulated wealth enables them to survive and recover with ease. In the worst scenario, they have the option to move or migrate. In contrast, the poor are the most vulnerable simply because of their limited ability and resources in the face of flood disasters. Thus, on the basis of the high levels of poverty amongst floodplain inhabitants, vulnerability to flood hazards is consequently high.

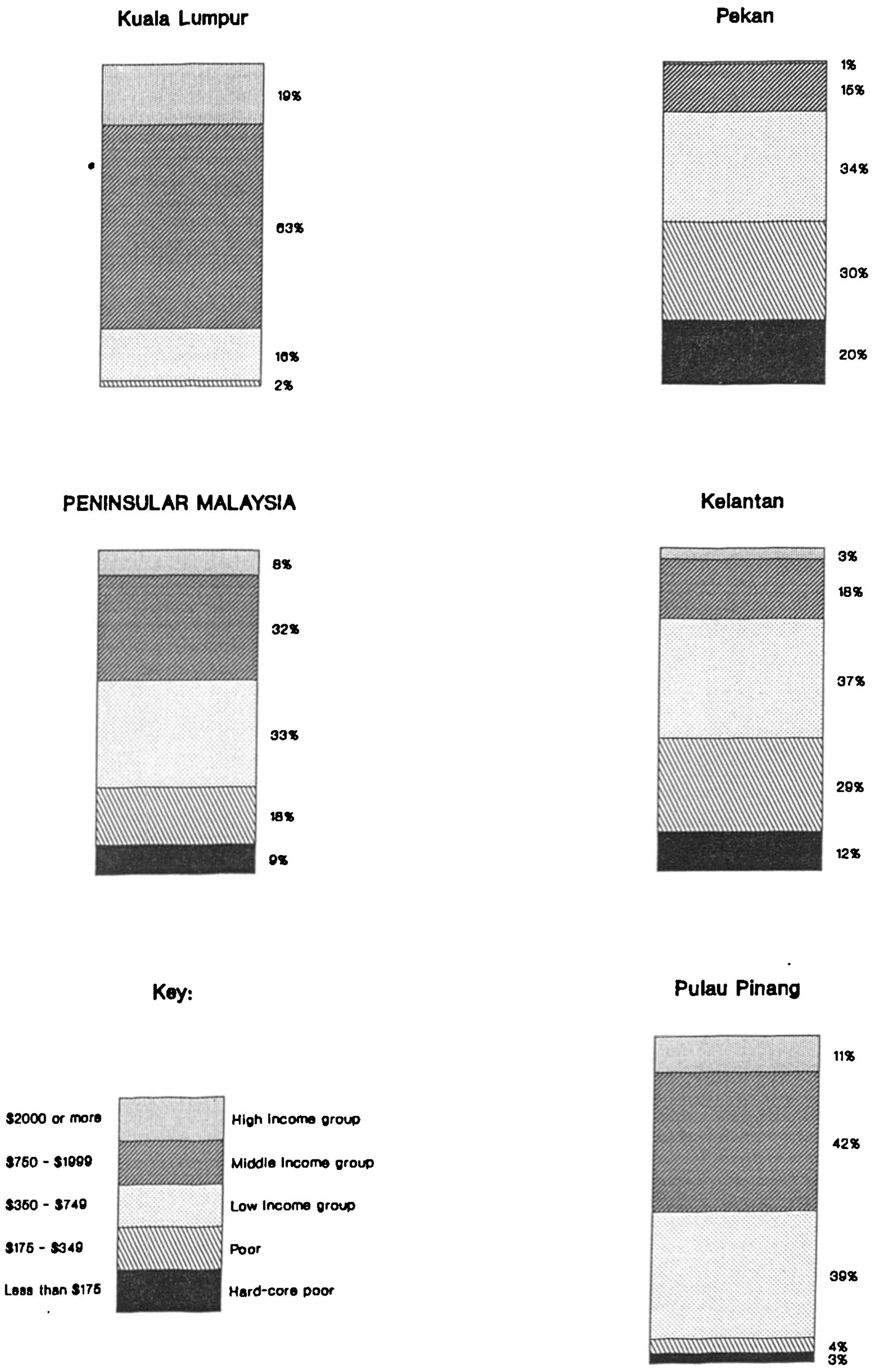


Figure 6.3: Poverty levels and income groups amongst floodplain households in Peninsular Malaysia and the four selected case study areas

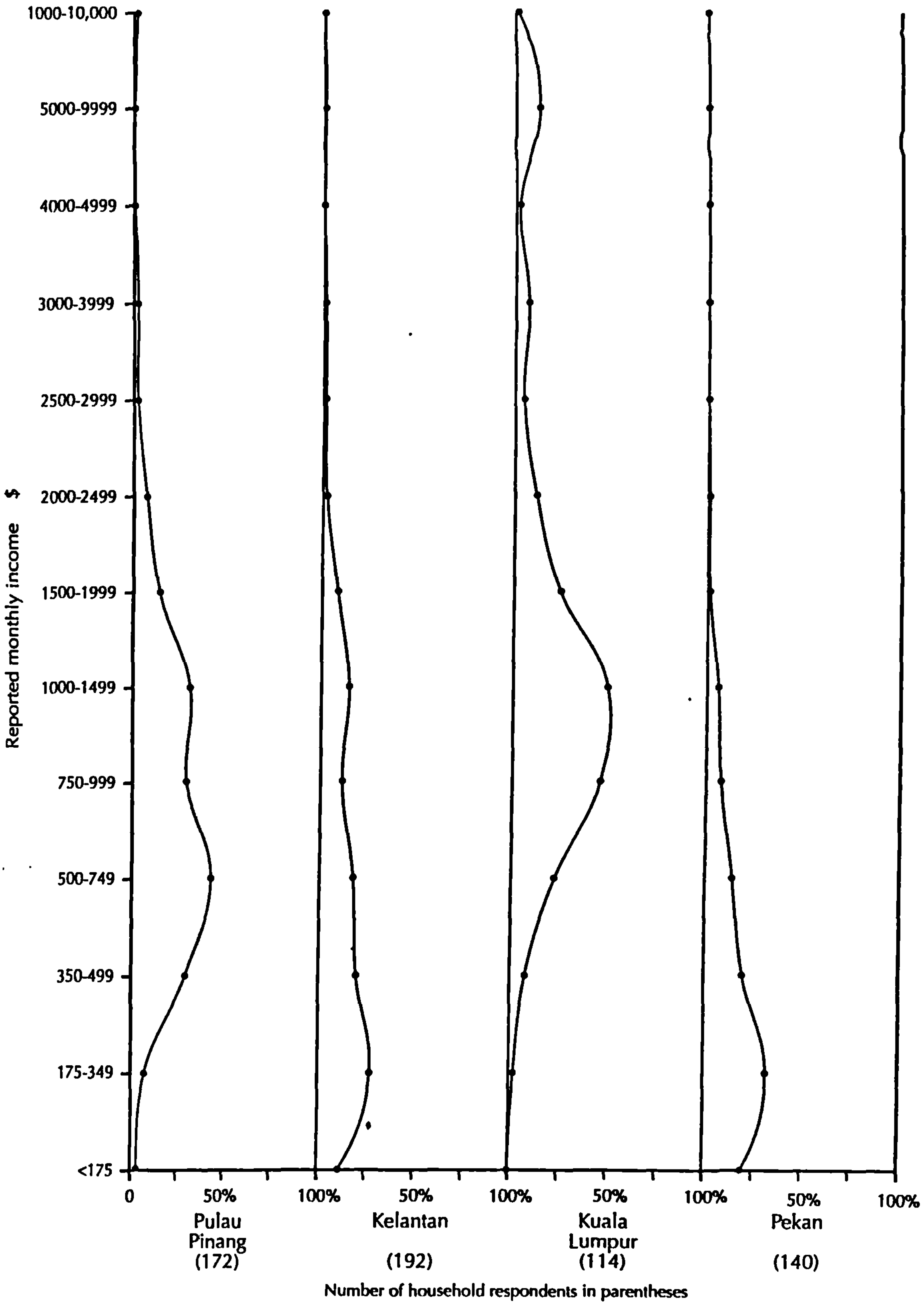


Figure 6.4: Distribution of reported monthly household incomes amongst floodplain respondents from four selected case study areas in Peninsular Malaysia (From: Chan and Parker Forthcoming)

6.3.2 Low residential and occupational mobility

Another structural reason why floodplain inhabitants continue to occupy floodplains is their low residential as well as occupational mobility. As a measure of their residential mobility, 74.6 per cent of all households interviewed have lived in the present location for 10 years or more. This low residential mobility is further confirmed as 45.1 per cent of households have not moved for 20 years or more. Residential mobility is generally low amongst floodplain inhabitants for a number of reasons. In rural areas, poverty, a general attachment to the kampung way of life, low occupational mobility, low educational attainment, land ownership and government policies (including disaster preparedness, relief and aid) have resulted in low residential mobility (a detail analysis of these reasons is given below). In urban areas, especially squatter areas on urban floodplains, the reasons for low residential mobility is mainly the lack of alternative housing. Because of higher educational attainment, incomes and economic opportunities, it is expected that West Coast respondents would exhibit greater residential mobility than those from the East Coast. However, survey results reveal that there was no significant difference. This is because respondents interviewed are all floodplain inhabitants experiencing similar circumstances. Even though West Coast respondents are relatively more well off than their East Coast counterparts, the high cost of living in the West Coast have off-set it, forcing them to 'stay' or persist on hazardous floodplains. Low residential mobility is an important structural reason partly responsible for the perpetuation of a significant proportion of Malaysians on floodplains.

Occupational mobility is measured by the respondent's ability to earn as good a living or better elsewhere. The ability to move from one job to another with ease usually gives one the option of choosing one's home. For example, skilled workers find it relatively easy to move from one place to another wherever there is work. A skilled worker can therefore get out of hazardous floodplains by looking for a job elsewhere. Unfortunately, the majority of floodplain respondents (73.1 per cent) in the current research, especially those in rural areas, are either farmers, fishermen, unskilled labourers, unemployed, retired or housewives. These people find it hard to move elsewhere because of their disadvantage of low occupational mobility. Only a quarter of rural inhabitants are professionals, skilled workers or businessmen who have the occupation mobility to move elsewhere when it matters. Therefore, the choice to choose where one wants to live is an advantage seldom enjoyed by the majority of rural floodplain inhabitants.

In the current research, 53.2 per cent of respondents are certain that they will be able to get a similar job or better elsewhere. However, the remaining 46.8 per cent believe they would not be able to. It is this latter category that has low occupational mobility. Thus, nearly half the respondents interviewed showed a low level of occupational mobility. Low occupational mobility inevitably leads to low residential mobility as the two are closely linked. The inability to take a job elsewhere (where there are less floods) traps the individual and his household on floodplains. This is a structural reason severely limiting the individual's ability to choose residential location. Farmers and fishermen are the ones most affected by low levels of occupational mobility, and resultant low levels of residential mobility. For example, 46.4 per cent and 59.5 per cent of farmers and fishermen respectively are either not sure of earning as good a living or better elsewhere or are sure they will not be able to do so. As a comparison, the corresponding figures for professionals and artisans are 36.7 per cent and 26.4 per cent respectively. On the other hand, 80.0 per cent of farmers and 71.4 per cent of fishermen are sure they will continue to remain in their present locations. All these indicates that rural farmers and fishermen have low levels of occupational mobility as well as low levels of residential mobility. Both are structural reasons which have increased their vulnerability to flood hazards as well as severely restricted their ability to relocate themselves elsewhere.

6.3.3 Low educational attainment

Generally, floodplain inhabitants in Peninsular Malaysia have low levels of education (Figure 6.5). In the current research, 56.5 per cent of respondents dropped out from school after primary school education (see Appendix N Table N.19). A significant proportion of respondents, 12.9 per cent, are illiterate and only 5.0 per cent have tertiary education. The less educated respondents are from the two East Coast areas of Pekan and Kelantan. In the former, 67.9 per cent of respondents have only primary education and 17.9 per cent are illiterate. The corresponding figures for the latter are 56.7 per cent and 20.8 per cent respectively. Low educational attainments generally give rise to low incomes, low occupational mobility and low residential mobility. This reinforces vulnerability to flood hazards and restricts one's ability to choose settlement location and respond effectively to hazards.

For those who indicated that they have no choice in settlement location, 61.9 per cent of them are educated only up to the primary school level. In the East Coast, the majority of them are

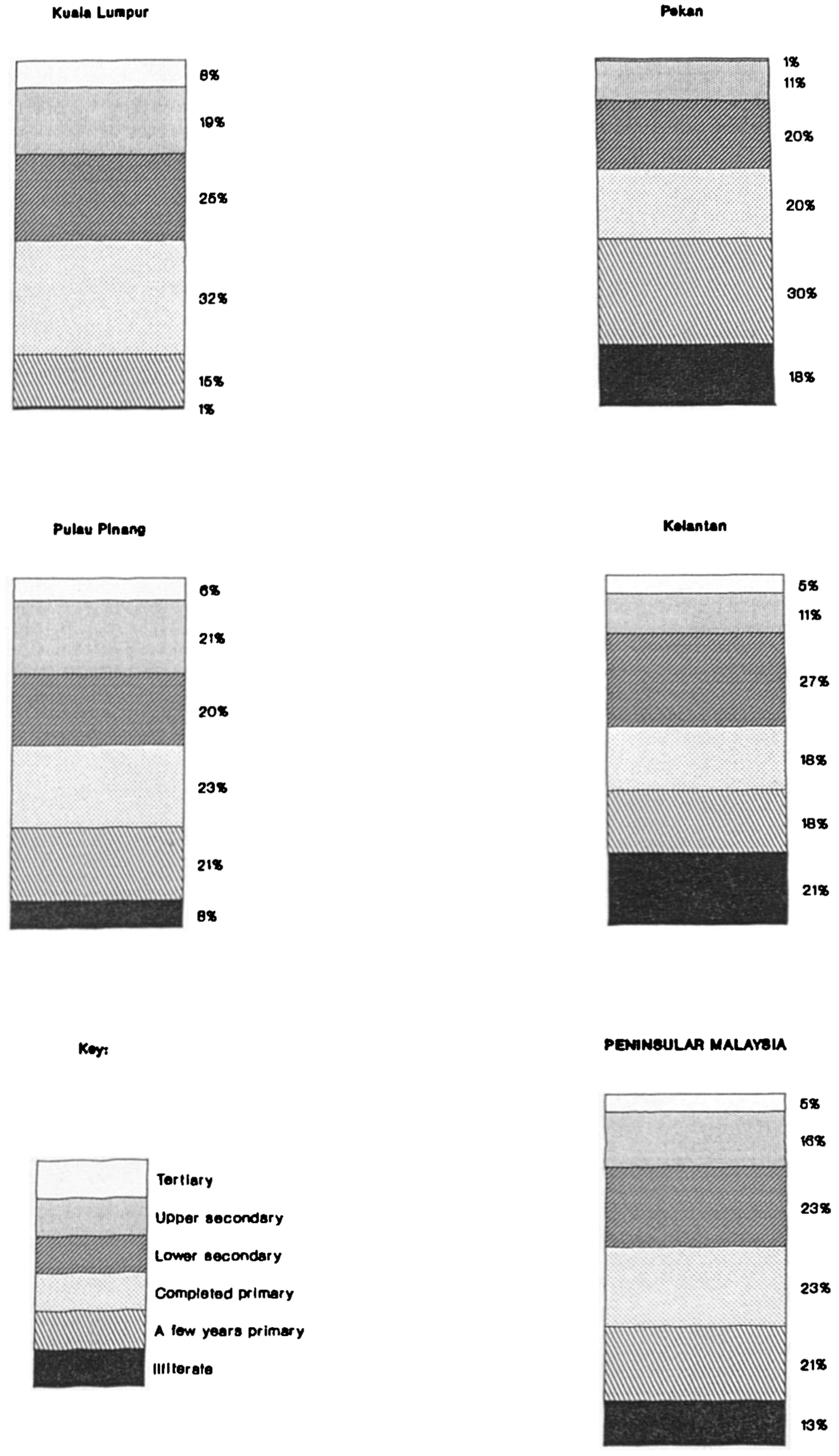


Figure 6.5: Educational attainment of floodplain respondents in Peninsular Malaysia

educated in religious school rather than the normal academic or technical schools. This has in some ways, influenced not only the respondents's ability to choose settlement location but also his/her perception and response to flood hazards (see Chapter 7).

6.3.4 The 'kampung way of life'

The 'kampung way of life' (Figure 6.6) appeals to the majority of rural Malays as they are basically a contented people. Floodplains generate both resources and hazards and rural farmers and fishermen lead a way of life which is well adapted to both. Farming by the river banks and fishing in rivers and estuaries is an accepted traditional way of life that comes with flooding and other risks. Rural Malays, especially the older generation, venerate this traditional way of life are reluctant to leave their ancestral homes, their village, friends and relatives and relocate elsewhere. They preferred to live with the flood risk. Family ties are strong and the majority of peasant farming and fishing communities have occupied fertile floodplains for many generations. For the majority of farmers and fishermen, farming and fishing are often the only means of livelihood known to them. Although the younger generation is now better educated and many have moved on to better jobs in the cities and towns, the older generation still remains and is quite contented with the traditional kampung way of life. In Peninsular Malaysia, rural society is bonded closely by kinship and friendship ties that span generations and many are not keen to leave their kampung. Furthermore, many respondents, particularly those who own family land in rural farming areas, hold great pride over their plot of land and will not part with it. Remarks such as 'This is where I am born and will be where I die', 'This is my kampung, my family is here, my friends and my life', 'I am happy here. Life in the kampung is very relaxed and the pace suits me'. Other remarks include 'Here I farm my land, and I save a lot of entertainment cost' and 'My parents still live here. I have to look after them, especially during floods'. According to Wan Hassan, a farmer in Pekan district,

> '...Life is pleasant here in the kampung. Its pace is slow and that gives me a lot of time to spend with my family. The land is fertile and flat, ideally suited for padi farming. I was born here, so was my father, grandfather and great-grandfather. Our family has lived here for a long time and we have always been farmers. We fish at other times when we are not working in the padi fields but that is only a supplementary source of food. We do not sell the fish we catch. If there is any surplus, we process them into salted fish which can be kept as stored food for a long time. Salted fish and rice is our main source of food during floods and other times when the harvest is not so good. We can usually cope with the normal seasonal floods but sometimes the 'big floods' are very dangerous. I was a teenager during the 1971 flood which inundated the whole of Pekan town. Even the 'istana' (palace) situated on

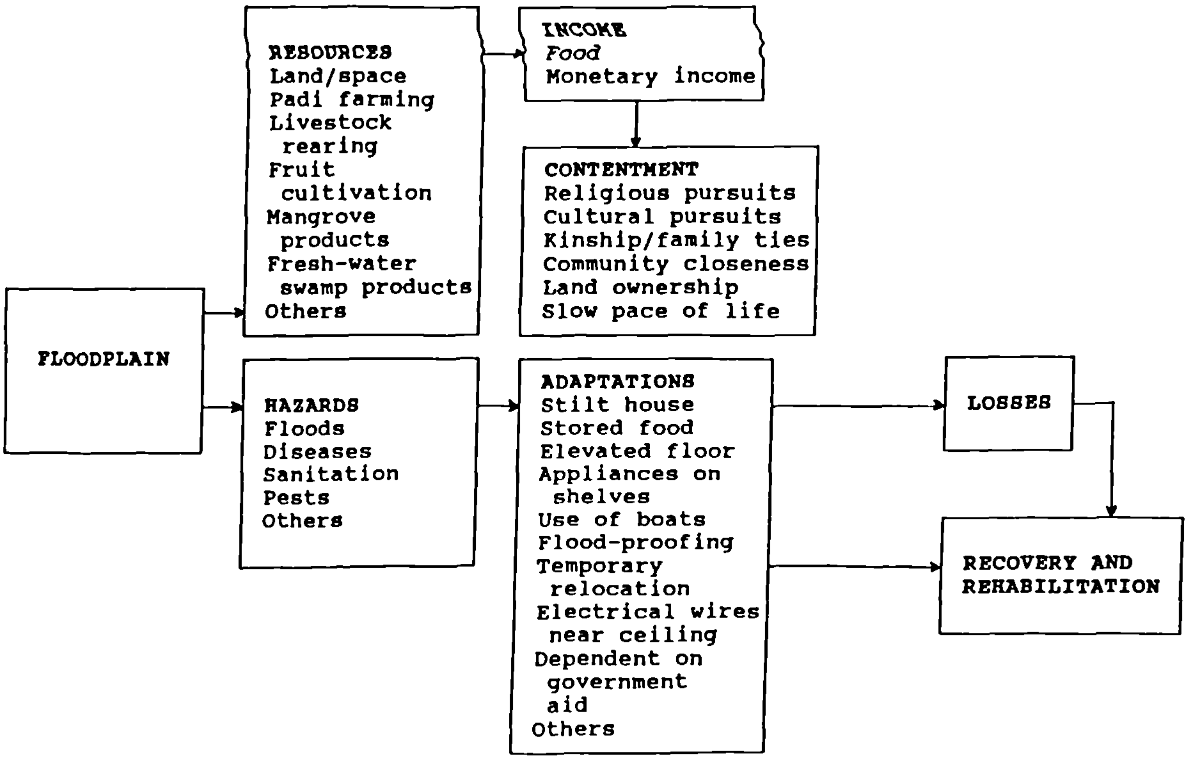


Figure 6.6: The traditional 'kampung way of life' in relation to resources and hazards on floodplains

high land was partly flooded. Quite a number of people drowned during this flood but the biggest news was that a crocodile was trapped in the town 'padang' (field) which was fenced. It was a huge one, more than 7 metres long. The army tried to catch it but somehow it escaped. It was really exciting. In fact, this drama, watched by a lot of people was the high point of this flood in Pekan. It attracted the people's attention and made them forget about their flood woes. But according to my father, the 1971 flood was nothing compared to the 'red flood' of 1926. This flood was termed 'red' because the flood waters were red in colour and the flood level reached up to roof level in his old house. Still, such big floods only come once in a very long time. I think we now better prepared than our ancestors. Despite the floods we will continue to live here for a long time, although some of our children with government scholarships have gone on to live in the big cities on the West Coast.'

Many villagers who are used to a lot of space and fellowship amongst each other also find it difficult to live in towns and cities where they are confined to a small house with a small compound, and where one hardly knows the neighbours. Remarked Hasbullah Jahi, a farmer in Kampung Tendong in Kelantan,

'...In our kampung, we know all the neighbours very well. In fact, I think everybody knows everybody in the kampung. All strangers are recognised instantly. You must have realised how the kampung folks were staring at you and your interviewers when you first came into this kampung. Well, because of this, there is very little crime in the kampung. Thieves get caught easily. That is why living in the kampung is safe and pleasant. Anyway, everybody is poor and there is not much to steal. Because we know each other so well, we help one another in all sorts of ways. For example, when someone gets married, everybody in the kampung is invited and everybody helps out in the 'kenduri' (feast). Well, you ask me about floods. When the floods come, we get prepared and help one another. We warn one another about floods. For example, Ali lives nearest to the river and his house is the first to get flooded. So he is the one who warns others near to him, and in turn the others warn those further away. So we can then prepare to move our children and the women out to higher ground or to the relief centres. We also help the elderly and the disabled to move during floods. For example, Makcik Hasnah is a widow who lives alone and Pakcik Abdullah is a polio victim also living by himself. I am responsible for the former while my neighbour Mohammad is responsible for the latter. It is this kind of mutual help and understanding that makes kampung life so enduring and satisfying. People are treated like human beings here in the kampung. We are one big family. Of course it is very inconvenient to move to the relief centres every time we are flooded but we are used to it. It's the same everywhere in Kelantan. Everywhere gets flooded. You cannot escape, unless you move to the mountains in the interior and live amongst the aborigines! Do you want to do that? Well, I don't. So I will continue to live in my kampung. So will many of my children and grand-children. The smarter ones will get scholarships and move on to professional jobs in cities but I can see that the majority will stay behind. We love our kampung. If you live in the big city, you cannot say you belong to

> the city. But in this kampung, I can proudly say that I belong to it and vice versa. I cannot see anything that would make me leave my kampung, unless my wife wants to. But she loves this kampung as much as I do, and we will live and die here.'

6.3.5 Customs and traditions

Rural Malay folks are also steeped in customs and traditions, both of which are commonly practised in the village but are often eroded and non-existent in the towns and cities. The 'adat' (traditional custom) is very strong amongst rural Malays. It is a structural force which ties them to their roots in the traditional kampungs. The adat is so strong that there is a Malay proverb that says 'It is far better that our children die rather than our adat' (Mahathir Bin Mohamad 1970 p105). For example, in relation to the flood hazard, customs associated with padi farming (since it is located on floodplains) best illustrates this point. In padi farming, the padi plant is seen not just as a food crop. To the Malays, it has evolved to acquire a socio-cultural value which is evident in many of the elaborate customs and rites associated with the entire padi planting cycle (Wilkinson 1957). The beginning of planting is usually marked by feasts and ceremonies in the kampung. After the crop was planted, the farmer either indulge in part-time fishing, traditional crafts such as batik printing or wood carving, or pursue hobbies such as top and kite making. All are associated with some form of ceremonies or other. For example, competitions for top spinning and kite flying are held with colourful ceremonies in Kelantan and other East Coast states. While waiting for the padi to ripen, there would be the occasional ceremony of a birth, a marriage or death, and ceremonial rites would suddenly spring to life. Finally, the kampung would bustle with activities during the harvest season, the highlight of a season of toil (Lim 1977 p228). The kampung folks are captivated, sometimes even submerged in and obsessed with their indulgence in customs and ceremonies which are often regarded as more important than the main event. All these activities reinforce communal life and firmly bind kampung folks together and it is perhaps not difficult to envisage why they loathe life in cities which are devoid of such activities. Perhaps it is even less surprising to find that the majority of kampung folks are reluctant to relocate elsewhere, despite the risk of floods.

According to Wan Ali, a farmer from Pasir Mas, Kelantan,

> '...City life is despicable. I have been to my son's house in Kuala Lumpur for a week and all we did was go to the super-market, walk around department stores, eat in restaurants and see posh hotels. Almost everything is foreign.

> There is nothing Malaysian about the tall buildings, highways, hotels, restaurants, etc. They try to put on traditional Malay dances in the hotels to hoodwink the foreigners and city folks but all of them are frauds. Ceremonies and customs are almost dead in the big cities. Even if they exist, much of them are very artificial indeed. I attended a wedding in the city and the city folks got it wrong in almost all the important ceremonies. They try to adapt to convenience and made a mockery out of our traditional ceremonies and customs. At least we in the kampungs carry on the customs and ceremonies correctly. It is very important that we do. If we don't, we would have lost all our identity. Life is not just a matter of day-to-day existence like what is happening to my son. He lives in comfort but is slowly losing his roots. We in the kampungs look forward to festivals, ceremonies and customs. In our kampung, such events are the highlights to which every family looks forward to outside of family life. It is what makes our life in the kampung so rich, meaningful and interesting.'

Many older folks from rural areas are also 'shocked' at the clothes worn by city girls and the general 'loose' morality in cities. Moral decadence is often the reason why many rural folks dislike city life. Those who have children living in cities often see behaviour that is unacceptable in the traditional kampung scene. Consequently, it is not surprising why the majority of rural folks, especially the older generation, decide to remain in their kampungs. This is especially so in the state of Kelantan which recently passed a law for the introduction of the islamic 'sharia' penal system to reinforce moral values. Under this law, passed by the islamic based PAS state government, thieves could have their right hands amputated, drinkers of alcohol receive 60 lashes apiece and adulterers be stoned to death-with, the bill specifies, stones of medium size' (The Economist 27th November 1993).

6.3.6 Ethnic value system

Another major reason why rural Malays remained trapped in their kampungs can be found in their value system. Unlike the Chinese and Indian who were previously poor immigrants seeking their fortunes in a foreign land, Malays have always been less inclined to material things in life. In fact, the early British administrators had described the indigenous Malays as passive, indolent and in little haste to become wealthy (Lim 1977 p235). An understanding of the value systems and ethical codes of the Malays is a prerequisite to understanding why they prefer to remain in the traditional kampungs to lead a simple subsistence way of life rather than move to the more lucrative locations of cities to try to seek riches. According to Mahathir Bin Mohamad (1970 p157), the Malay views life as transient, as a time when one prepares for the hereafter. Worldly life is therefore not to be dedicated to the preoccupation with worldly things such as the accumulation of wealth but to more serious religious pursuits. Malays living in kampungs are contented but resigned to accept whatever fate befalls them, and floods are seen with this philosophical attitude. Hence, their reluctance to relocate themselves.

Religious values amongst rural Malays are partly responsible for increasing their vulnerability to flood hazards. For example, one is the Islamic stigmatization of usury or 'riba'. Because of this religious belief, Malay peasants and fishermen regard interest as sinful and are conditioned not to accept it. Thus, those with whatever little savings are unable to invest them in ways which could earn them an interest. This problem is made worse by the fact that Malays could borrow money even though they could not lend it to earn an interest. Consequently, usurious non-Malays (non-muslims) who are not bound by such a belief serve as money-lenders to Malays. This has often led to many Malay farmers owing considerable debts to non-Malays. Ungku Abdul Aziz (1962) claims that one of the main causes of rural Malay poverty is the high rates of interest charged by non-Malay moneylenders and shopkeepers for their loans and credit extended to farmers. A notorious example is that of the 'padi kuncha' system whereby shopkeepers would purchase padi 'futures' at a depressed price from padi farmers and, in return, provide them with small loans and credit through the long months before padi harvest. The padi kuncha system is believed to have been one of the reasons responsible for driving padi farmers into destitution, landlessness and immiseration (Nonini 1992 p155).

As a result, economic advancement and the acquiring of material riches are never high on the rural Malay's priorities in life. Rural Malays, therefore, perpetuated their traditional way of life and seldom did many of them became rich. Although modern teachings of Islam has now allowed muslims to save in banks and earn interest (these banks are run by religious authorities, for example the Bank of Islam), many hard-core muslims in rural areas are staunch in their thinking and beliefs and refuse to change. Besides, even if they did change their attitudes, they do not have much to save. The analysis on poverty and incomes above testifies to this claim. The vast majority, therefore, remain living close to or below the poverty level. Although Malay peasants and fishermen are generally attuned to normal floods due to their years of experience, they remain extremely vulnerable to major floods which render many of them unable to recover without government assistance.

6.3.7 Traditional land inheritance

According to Davis (1981 p14),

> '...there have been many rather facile and politically expedient attempts to treat the symptoms of vulnerability with planning bodies, bye-laws, etc. when the real issue is clearly that of land tenure'.

In Peninsular Malaysia, land tenure is a major reason that binds the rural Malays in floodplain locations. More specifically, traditional land inheritance is a structural force largely responsible for the continued occupance of generations of Malays on floodplains. While Malays do not subscribe to money-making and the accumulation of riches as Chinese and Indians would, land is one possession that they value greatly and would hold on to. This is understandable as without land, the peasant would be deprived of his livelihood. He would then be forced into wage labour and be subject to exploitation by rich land-owners (Rajmah A Samad 1978). Because of its importance to farming, land completely dominates the Malay mind. Land constitutes most of the property Malays own, since the Malays are largely peasants. For most Malays property and land are almost synonymous because apart from land, the Malays have very little else that they regard as property (Mahathir Bin Mohamad 1970 p166-7). As a result, land is seldom sold to others. It is kept within the family at all cost. Traditionally, the Malays hold on to their land by inheritance. A father's would be equally divided amongst his children, and so on. Herein lies one of the most serious problems faced by the rural farming community, viz. land fragmentation. The following example clearly demonstrates this point:

> '...Lahuma sat motionless. He was counting his seven children, as if he had forgotten how many there were. One, two, three, four, five, six, seven. His father had owned twenty relongs (1 relong approximates 0.53 hectares) of rice-land. Six relongs had fallen into the hands of a Chinese through a mortgage. That left fourteen relongs. And fortunately Lahuma was an only child. All fourteen relongs of rice-land became his by inheritance. But the fourteen relongs remained fourteen relongs. No less, no more. Not one inch more. He had seven children. Two relongs each. What could be done with two relongs? What indeed? Lahuma stared at the dusty earth. To try to increase the number of relongs was out of the question. There was simply no ways open in that direction. Nor was there any point looking for another source of income. So far the fourteen relongs had served to feed him and his family. He and Jeha had never yet starved. And his children had never had to eat boiled tapioca or maize porridge for lack of rice. For this he thanked God, Allah the Almighty. But what would happen after his death? The fourteen relongs of rice-land would be divided up. Two relongs each. And when his children had children of their own, their shares would again be divided up. His grand-children would get very little each. And perhaps by the time it got down to his great-grand-children, there would not be even a hand-span left for each.' (Shahnon Ahmad 1972 p3)

In the current research, the most common reason given by respondents for their willingness to stay on is that they did not want to leave their farm and land. Elsewhere, people have been found to locate themselves on hazardous sites because of the proximity to family land (Davis 1984a). In the current research, 40.5 per cent of all respondents cited land as the reason for not moving. To Malaysians, especially the Malays, the importance of land ownership can not be underestimated. Family land is almost sacred to the Malays and traditionally, it is the responsibility of those inheriting it to pass it on to their children. This system of land inheritance ensures that land is kept within the family. And because it is government policy to improve the economic status of the Malays, it would defeat the objective if the Malays lose their land to the other ethnic groups or to foreigners. As a result, many Malays have chosen to stay even when their land is subject to the flood hazard. In this research, one in every five Malay respondents mentioned that they have inherited land which they did not want to part with. It would be infilial to leave inherited family land. Besides that, another popular reason to stay is that business and farming in the area is good. 15.4 per cent of respondents said so. According to one farmer, 'My ancestors have been farming here for generations and this piece of land has been passed down to me. It belongs to my family and I cannot leave my land. When I die my children will continue to farm on this land'. Another said, 'My land is all I have. Farming is all I know. If I leave my land I would not know where to go or how to find a living elsewhere'. In another earlier survey, Chua (1972 p66), noted that one respondent said 'Here is my land, I own this house and a few acres of rubber nearby, it is not worthwhile to move to another area'.

In the case of the landless and houseless, the most hazardous zones on the floodplain offers free land where squatters and other illegal settlers have a free-hand. A prominent example is Pulau Pekan Baru, an island settlement located in the shallow banks of the Pahang River off Pekan Town where Cambodian refugees have settled since the 1970s (Plate 6.1). In the cities and towns such areas are usually located on the banks of rivers where frequent flooding has discouraged any form of development. These are places usually taken up by squatters who can erect wooden huts faster than the authorities can tear them down (Squatting is examined in detail in Section 6.4.2). Rural-urban migration (Section 6.4.1) adds a further dimension to the housing problem. Because of the availability of such 'free land', the poor, landless and houseless are attracted to the floodplains, even though such areas may be subject to frequent flooding. On the whole, the pull of land over-rides the danger posed by the flood hazard. People are generally willing to take the risk of flooding for something that is difficult if not beyond their reach. The proliferation of squatter houses on the floodplain has

Plate 6.1: Location of squatter houses in Pulau Pekan Baru in the shallow bank of the Pahang River off Pekan town. Top - The author and interviewers board a sampan (Malaysian canoe) in order reach the squatter settlement. Bottom - Squatter houses are connected by wooden planks which serve as pathways as well as reinforcement binding the houses together against the flood waters

exacerbated flood problems in many areas. As such areas are not provided with basic amenities, squatters dump rubbish and sewage into rivers, often blocking drains and river channels which exacerbates flooding. Clearing of vegetation both for housing and agriculture by squatters may also have compounded the problem.

6.3.8 Government aid

Government aid is another structural force which influences decisions to persist on floodplains. For political, economic, strategic and other reasons, the Malaysian government provides many kinds of aid and subsidies to farmers, rubber smallholders, fishermen and other rural inhabitants. In the case of padi farming, maintaining self-sufficiency in rice (the staple food of all Malaysians) is the ultimate objective for providing subsidies. The government is trying to encourage the farmers to keep their farms going, despite the fact that many farms are now uneconomical to operate due to land fragmentation, poor management and disinterest on the part of aged farmers. As such, many government incentives such as subsidies in the form of seeds, fertiliser, insecticide, marketing and price control are given to farmers (Chan 1991a p78-98).

In the 6th Malaysia Plan, a total of $1,020 million is allocated to the in-situ development of Integrated Agricultural Development Programme (IADP), of which three-quarters of this amount is for the provision of drainage and irrigation infrastructure (Government of Malaysia 1991a p98). The provision of flood mitigation schemes in many floodplain regions has given floodplain occupants a false sense of security (see Chapter 5 Section 5.4.1). Although such plans and schemes are still not fully implemented yet, extensive publicity in the media (Azman Awalludin 1991) and promises by politicians in charge of flood-prone constituencies may well have influenced people's decision to stay on in the floodplain, if not even encouraging floodplain encroachment. Examples of such schemes are the Kuala Lumpur flood mitigation scheme (Ferng 1988), the Pulau Pinang flood mitigation scheme JICA (1990) and the Kota Bharu flood mitigation scheme (Malaysia International Consultants Sdn. Bhd. (Undated)).

To overcome the problem of 'idle land'[76] (i.e. agriculture land, usually padi land, which has become too small as a result of land fragmentation over generations, to be economically

[76] For a more elaborate discussion on the problems of idle land, see Burrows (1980).

farmed and therefore left idle), the government has commissioned the Federal Land Consolidation and Rehabilitation Authority (FELCRA) to consolidate and rehabilitate such land. An estimated 150,000 hectares of idle land (constituting 40.0 per cent of total identified agriculture idle land) will be rehabilitated during the 6th Malaysia Plan. This will cost the government an estimated $905 million (Government of Malaysia 1991a p121). As a significant proportion of such idle land is located in floodplains, padi farmers will therefore benefit and justifiably remain in their present locations. The rehabilitation of padi land is envisaged to replace padi with other crops such as oil palm and rubber.

6.3.9 Government flood emergency preparedness, relief and rehabilitation

Government flood emergency preparedness, relief and rehabilitation is another manifestation of a structural force which often convinces floodplain inhabitants to continue to live in floodplain locations. In Peninsular Malaysia, flood hazard preparedness, relief and rehabilitation of flood victims is a major task of the federal and state governments every year. Each year around October, just before the Northeast Monsoon breaks, the National Security Council convenes the FDRPC and a meeting of the various members comprising federal agencies responsible for flood forecasting, emergency planning, evacuation, relief and rehabilitation (see Chapter 5). Procedures and responsibilities are discussed and allocated, and manpower and other resources within each agency checked. A 'restricted'[77] guideline of flood emergency procedures is given in the 'Buku Peraturan Tetap Jentera Bantuan Banjir' (Permanent Procedures for Flood Aid Machinery) published by the National Security Council Emergency (Majlis Keselamatan Negara 1992). The procedures in the book are to be followed by all government departments and voluntary bodies involved with preparedness, relief and rehabilitation. From the moment the committee meets, the defence mechanism against flood is activated.

Years of flood experience have attuned the floodplain inhabitant towards responding to this mechanism. The men are supposed to know when to look out for floods, how to report flooding to the ketua kampung or penghulu, when to listen to weather forecast and flood warnings on the radio, and when to move the children and women, where to move them to

[77] The term 'restricted' carries with it the connotation of confidentiality. Items, including books, endorsed with this term are strictly for government use and not for the public. The writer has been granted a complimentary copy of this book on application to the National Security Council with the promise that it will only be used as a reference in this research.

and finally when to evacuate themselves. According to one government officer, this defence mechanism is likened to an 'immunity system' facing a virus attack. People respond accordingly when flooding occurs without having to be told. Those living in the floodplains in the East Coast are expected to know exactly what to do and where to go during times of flood. Because the Malaysian government places a lot of emphasis and publicity on emergency planning, relief and rehabilitation, a sizeable proportion of floodplain occupants are bound to build up a false sense of security and actually believe they are 'safe' and 'protected' from floods by the authorities. In the current survey, when respondents were shown the statement 'A flood won't happen again because the DID and other government agencies can now control flooding through river and coastal management', 34.4 per cent of all respondents agreed to it. Surprisingly though, 67.0 per cent of this group were urban dwellers. This could be due to the fact that government schemes are usually built in urban areas because of the high damage potential. Furthermore, such schemes are politicised and publicised in urban areas and urban dwellers also have better accessibility to the media. A significant proportion of residential (43.3 per cent) and farming (31.6 per cent) households also agreed to the statement but only a small percentage of commercial households (17.2 per cent) believed so. This could be attributed to the fact that commercial households do not receive any form of compensation from government relief other than evacuation and shelter. And since they suffer the most losses (see Appendix K), they always feel that the government has not done enough to protect them, hence the negative attitude.

Another reason why many floodplain occupants have chosen not to move elsewhere may be attributed to their reliance on government flood warning schemes. In the current research, 39.0 per cent of all respondents relied on some form of government flood warning, be it an automatic siren, police warning, or through the media. Of this total, 74.3 per cent were from the East Coast, underlining the importance of warning there. Flood warnings are usually more effective in the East Coast than the West Coast because rivers in the former are longer, giving rise to a fairly adequate lead time. For instance, on the Kelantan River, upstream telemetric rainfall and river level gauges enable the DID to forecast the river level at Kuala Krai between 6 to 10 hours in advance. Further downstream in Kota Bharu the lead time is about 24 hours. Towns and villages in between Kuala Krai and Kota Bharu receive flood warnings between 6 to 22 hours (DID Kelantan 1991 p4). Through years of experience and using a combination of computer forecasting based on the Tank model and conventional stage correlations between upstream and downstream gauging stations, the forecasts made for downstream stations are fairly accurate. Understandably, floodplain occupants on the East

Coast feel secure as they rely heavily on the formal/official flood warning service (flood warnings are examined in more detail in Chapter 8).

6.4 Structural forces leading to migration/movement

While structural forces are largely responsible for persistent floodplain occupance, on occasions they may also be mainly responsible for driving people (especially the youth) out of their kampungs, new villages and estates into the cities and towns. Thus, the same 'poverty' force which traps impoverished farmers in their kampungs may also be driving a significant number of farmers (especially the younger ones) from rural areas into urban areas to seek a better life. Fragmentation of family land (leading to the problem of 'idle land') through successive generations may be another structural force reinforcing rural poverty and threatening the traditional farming community (Burrows 1980). The government's policy on free education and easy access to scholarships for Malays under the NEP restructuring objective have improved educational attainment of rural Malays (Government of Malaysia 1991a pp157-69). Together with increased awareness of the world beyond their kampungs through wider accessibility of the television, radio and other forms of the mass media, young Malays are encouraged by the government to migrate to urban areas to upgrade themselves (Mahathir Bin Mohamad 1970 p109; Faaland et al 1990 pp251-2). Malay youths representing a dispossessed rural peasantry migrate to the cities for further education, jobs, the 'bright lights' and generally to seek a better life (Hua 1983 p127). Rural-urban migration is not just confined to Malays. Chinese youths from new villages and Indian youths from rubber estates are also involved in the process. Rural-urban migration has become an important structural force which is exerting pressures on urban housing and other public amenities. It has led to another structural force, that of squatting. The problem is intensified by international migration of illegal immigrants, mainly Indonesians and Thais into the cities resulting in the 'mushrooming' of squatter settlements on major urban floodplains. This section, therefore, aims to examine the extent to which these structural forces have contributed to the move/migrate option, especially on the extent to which rural-urban migration has led to encroachment of urban floodplains.

6.4.1 Rural-urban migration and encroachment of urban floodplains

Successful modernisation and growth in a developing country like Malaysia brought growth to the urban sector with accompanying problems of urban unemployment, squatters and slums

(Faaland et al 1990 p299). Since independence, there has been a rapid development of the country's urban areas accompanied by a general rise in education level, especially among the children of rural inhabitants. Education is provided free to all Malaysians by the government. The NEP[78] also emphasised improving the status and standard of living among the Malays and most Malay school children get some form of scholarship. This has resulted in an influx of young rural migrants into the major urban centres for education and employment (Muhammad Razha 1978). While this influx has initially solved some of the problems of labour shortages, it has now become a significant problem not only because it has exacerbated urban unemployment (Khor 1987 pp63-70) and put great demands on housing and other public services, but more significantly because it enhances floodplain encroachment and exacerbates flood hazards. According to Faaland et al (1990 p301), a net exodus of at least 375,000 Malays and 300,000 non-Malays migrated from rural to urban areas over the period 1967 to 1985. Some of these migrants may have moved directly into modern urban employment, but the majority of them are forced into the low-productivity, high unemployment, increasingly over-populated traditional urban sector. For housing, the majority of migrants end up in low priority areas such as ex-mining land, hill slopes, and on flood-prone riverine areas (see analysis on squatter settlements below). Rural-urban migration has, therefore, increased floodplain encroachment and increased the flood vulnerable population. Rapid urbanisation (induced by rural-urban migration) is a key factor in the growth of vulnerability, particularly amongst low-income squatters (Davis 1981, 1987; Blaikie et al 1994). People continue living in riverine squatter settlements in the cities despite recurrent flooding simply because it is the only place they can afford to live in. Rural-urban migration can, therefore, be considered a structural force partly responsible for the creation and perpetuation of people on floodplains. With the rapid development of the economy in recent years, rural-urban migration is expected to have increased significantly bringing with it an even greater threat to urban floodplain encroachment.

6.4.2 Squatting and floodplain occupance

In Peninsular Malaysia, squatting is a major structural force which creates and exacerbates urban flood hazards. It results from a combination of poverty, landlessness, rural-urban migration (to search for better paying jobs), influx of illegal immigrants (mostly Indonesians

[78] NEP - New Economic Policy is an equity attainment government policy examined in Chapter 4. See also Chapter 8.

and Thais) and other structural causes. Since urban floodplains are probably the only vacant space left undeveloped in the cities, squatters inevitably occupy these hazardous flood-prone areas, and consequently become exposed to flood hazards. In urban areas, squatters are the most vulnerable group of people as they are amongst the poorest in Malaysian society (see Chapter 8 Section 8.3.1), and least able to recover from a flood disaster. Because squatting is a significant social problem in Peninsular Malaysia, this section examines the extent to which squatters are forced by structural/societal forces into perpetuating on floodplains.

Squatting is both a historical as well as a modern phenomenon. During the colonial period, squatters were mainly immigrant Chinese and Indians but after independence, squatting by Malays due to rural-urban migration, also became a problem (Azizah Kassim 1982). In 1957, one out of three persons in Kuala Lumpur was a squatter and there were as many as 20,000 squatter families (Fish 1957). By 1980, there were 48,709 squatter families in Kuala Lumpur and it has been estimated to increase at a rate of 9.7 per cent per annum (Dewan Bandaraya Kuala Lumpur 1982). Wan Abdul Halim (1982) has identified 202 squatter settlements in Kuala Lumpur, the majority of which lie on flood-prone areas near the main rivers running through Kuala Lumpur (Figure 6.7).

Squatting in Kuala Lumpur is only one example. All the major urban centres in Peninsular Malaysia have squatter settlements. For example, Ipoh (Perak state), Johor Bahru (Johor state) and Prai (Pulau Pinang state) have approximately 60,000, 50,000 and 20,000 squatter families respectively (Khor 1989). In the current research, a total of 110 squatter households (17.8 per cent of all households) were surveyed. The breakdown among the sample areas are as follows: 36 squatter households in Pulau Pinang; 26 in Kuala Lumpur; 26 in Kelantan; and 22 in Pekan. Some examples of squatter houses in Kuala Krai (Kelantan) and Pulau Pekan Baru (Pekan) are illustrated in Plate 6.2.

Squatting on flood-prone areas in the major in Peninsular Malaysia urban centres is a social problem facing the authorities. Squatters live in the most hazardous of floodplains simply because they are too poor to live any where else. In the current survey, it was found that 62.9 per cent of squatter households were flooded 10 times or more in the last 10 years compared to 43.3 per cent of non-squatter households. The story of Makcik Mabee, a squatter who lives with her family on the bank of the Air Itam River (Pulau Pinang) clearly demonstrates the dangers and inconvenience due to flooding (Appendix H, Case 1). Over the last decade, her house has been flooded on the average of at least 5 times a year. In 1992,

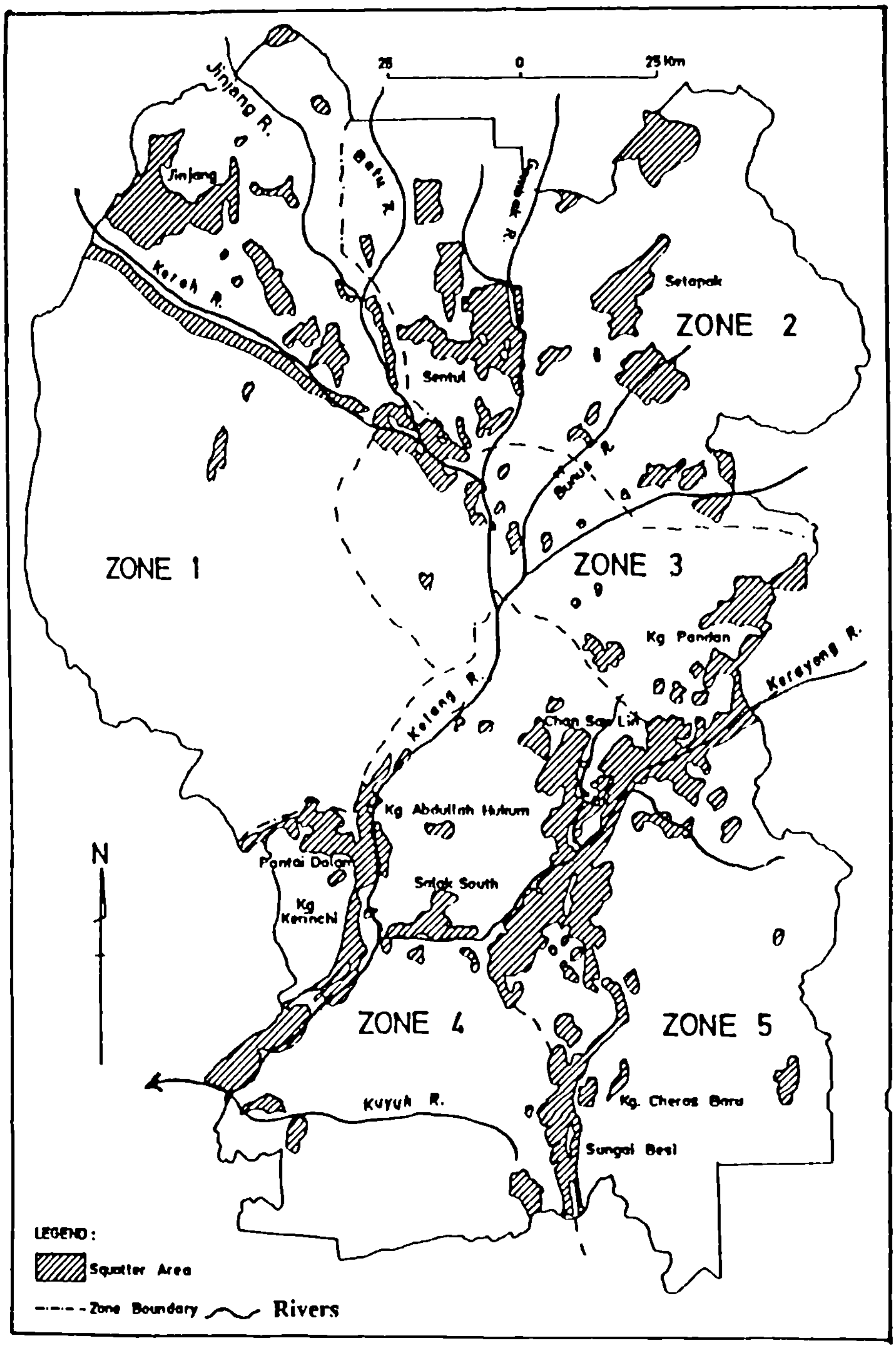


Figure 6.7: Squatter areas in Kuala Lumpur (After Wan Abdul Halim 1982)

Plate 6.2: Top: Squatter houses known as 'rumah rakit' (raft houses) in Kuala Krai on the Kelantan River. Bottom: Squatter houses in Pulau Pekan Baru (Pekan) located in the shallow waters of the Pahang River

it was flooded 7 times. Abdullah is a typical example of a poor kampung boy who has migrated to the city with the hope of making his fortune, but ends up as a squatter (Appendix H Case 9).

Thus, the squatters have little or no choice in location and/or have little or no choice but to stay. According to Wan Abdul Halim (1982), squatting is a phenomenon arising from a basic human need for shelter. There are many categories of people who become squatters: (1) those who have just migrated to towns and cities; (2) those who have moved out of their parents' house; illegal immigrants who have migrated into the country (mostly Indonesians and Thais); (3) the landless and homeless who capitalise on empty unoccupied land; (4) others who simply cannot afford housing of any sort.

Squatting is a process reinforced by broader socio-economic and political forces. These are the contextual forces examined in Chapters 3 and 4. Social forces of rural-urban migration is in response to a need to improve one's standard of living and the attraction of 'pull' factors of the cities. In the rural areas, the younger generation is now armed with a better education and finds farming and other rural occupations unrewarding. There is a tendency for them to move to towns and cities to seek their fortune (Muhammad Razha 1978). Social forces of housing shortages also reinforce the squatter problem as there is not enough low cost housing for the growing population. Poverty, another social issue confronting the government is another force that reinforces squatting. Political forces also reinforce squatting. First, it has been documented that many political parties have their support at the 'grass root' level in squatter settlements. For instance, Wan Abdul Halim (1982 p92-6) found that politics and squatting are closely linked. Squatters have no legal rights in Malaysia. Thus, politicians are quick to capitalise on this point. To gain support, local politicians set up local branches of their parties supposedly to protect the squatters from being evicted from their houses. In the case of the United Malays National Organisation (UMNO), the basic requirement is only 50 members and this requirement is easily met. Thus, it is not surprising to find branches of political parties in squatter areas. In the case of squatter areas which are too small to start a branch, squatters are encouraged to become members of a nearby branch. Thus, through the political system, squatting is reinforced to the extent of being 'institutionalised' albeit not officially. However, not all squatter settlements support the ruling government. Some support the opposition parties such as the DAP and the PAS. In such cases, the opposition parties champion their cause by making the eviction of squatters into a political issue and often make it extremely difficult for the government to enforce the law.

Based on the above analysis, it is clear that squatting on flood-prone areas is not done by choice. People who squat are those who are poor, have no land or house of their own, or are illegal immigrants. This is reinforced by socio-economic and political forces which strongly influence squatting and thereby the persistent occupation of floodplains and their increasing encroachment. Consequently, given the high squatter population in the peninsula, it can be said that a significant proportion of Malaysians have little choice but to remain on floodplains. In the household survey, respondents who said 'they had no money', 'no where to go' and 'same everywhere' are classified as having no choice. A total of 202 respondents (32.7 per cent) in the current research are in this category.

Of the 202 respondents who implied that they had no choice, 52.8 per cent were either farmers or fishermen. In terms of location, 81.4 per cent were from the East Coast and only 18.4 per cent from the West Coast. And 57.1 per cent were from Kelantan. This was followed by 24.3 per cent from Pekan and 17.1 per cent and 5.7 per cent from Pulau Pinang and Kuala Lumpur respectively. However, 41.8 per cent of urban folks were under the no choice category as compared to 33.6 per cent of rural folks. Therefore, the hypothesis that rural folks are more susceptible to the flood hazard does not hold. Rural folks may in fact be more adaptable to floods as their livelihood has evolved around the occurrence of floods for many generations (see Chapter 7).

6.4.3 Government relocation/resettlement schemes

Blaikie et al (1994 p211) classify relocation as the worst option, as it gives one the impression that nothing else can be done about the flood hazard, and therefore floodplain inhabitants have to be moved. Plans to relocate entire communities are rarely feasible. They are costly as alternative locations and housing have to be provided (Davis 1984a). More significantly, at least on the part of those being relocated, it provokes social disruption and upheaval when people are bundled into an alien environment. Notwithstanding the influence of structural forces examined earlier, people are also reluctant to be relocated far from relatives, friends and their place of work (or schools in the case of children). In the literature of hazards and disasters research, there is evidence of serious health and social consequences resulting from relocation (Hansen and Oliver-Smith 1982; Harrell-Bond 1986). Blaikie et al (1994 p211-2) believe that relocation stems from political sources or landowning interests using hazards as an excuse. Their research has demonstrated that relocation is an undesirable response to hazards and that its success rate is low. While researching disasters and settlements, Davis (1981) discovered that relocation is of limited success. Other researches have suggested that relocation has actually resulted in more deaths due to disease in the receptive zones (Kebbede 1992). Elsewhere in the hazards literature, Alexander (1993 pp520-2) has shown how relocated refugees can be subject to more hazards in foreign receptive areas. Smith (1992 p69) has also demonstrated that urban relocation within a limited distance has a limited degree of success as the relocated settlement was again hit by the same hazard. The biggest problem with relocation is that the majority of resettled people tend to return to their original settlements. A good example provided by Smith (1992 p68) is the relocation of the entire population (264 people) of Tristan da Cunha, a remote South Atlantic island to Britain following an eruption in 1961. Within two years, most of the inhabitants had returned to the island.

Despite the unfavourable literature on relocation, it is a structural force which, when employed appropriately, can effectively reduce flood losses. This section examines the extent to which permanent resettlement has been successful in moving floodplain inhabitants and thereby reducing flood hazards in Peninsular Malaysia.

In the state of Kelantan, the bulk of its population is concentrated in the Kelantan Delta (around Kota Bharu) and its fertile river valleys. Consequently, the majority of its settlements or kampungs suffer from river flooding during the Northeast Monsoon Season. It has been estimated that a major flood such as the 1967 flood would inundate almost 70.0 per cent of kampungs in Kelantan or affect nearly half of the state's population (Government of Malaysia 1978). Because of the magnitude and extent of the seasonal monsoon floods, a feasibility study was commissioned to look into resettlement and other measures of flood reduction. According to Malaysia International Consultants Sdn. Bhd. (Undated), relocation is a passive and expensive method of overcoming the flood problem as it usually involves the relocation of high valued property away from flood-prone areas. In the Pahang River Basin Study, a relocation of 1 family is estimated to cost $18,000 (1974 prices). The number of families affected in Greater Kota Bharu is about 14,300 and this would put the total relocation cost at about $474 million[79] (current prices) for a flood of the 1967 magnitude. This figure would be much higher if the commercial and public sectors, growth of prosperity, population growth and the urban nature of most of the population are taken into consideration. It is therefore,

[79] This figure is calculated based on the Consumer Price Index with 1974 (100.0 percent) as the base year.

unfeasible to relocate people from townships such as Kota Bharu. However, resettlement can be feasible in rural areas where land and property values are comparatively much lower than in urban areas.

According to Government of Malaysia (1978 p20), kampung folks are flexible, and if given the opportunity to achieve a better way of life, they will accept change of home site and lifestyle. People are prepared to move to achieve a better life, not necessarily for themselves but mainly for their children, and also especially if it is for the good of the state. Chua (1972 p73) also found that a greater percentage of Pekan floodplain residents are willing to resettle elsewhere provided that the government assured them of a prospective job and a residential area with prospective lands nearby.

However, rural peasants, especially the Malays, are extremely polite and tend to be very agreeable. They will not usually speak out against the government or criticize flood schemes unless their livelihood is threatened. Thus, according to Mahathir Bin Mohamad (1970 p116) the Malay is courteous and self-effacing and he is always prone to giving way to others as a sign of good etiquette. Often, when interviewed by government officials or private consultants commissioned by the government, the rural Malay responses in a conformed positive way, usually in agreement to what is asked of him. Willingness to relocate elsewhere must be seen in the context of 'guarantees' from the authorities. Without the guaranteed assurance of a job, home and land, it is very unlikely that rural peasants will be willing to relocate and given the high cost of relocation, it is equally unlikely that the government will embark on a costly scheme of mass relocation considering that the estimated floodplain population is currently well above 2.7 million and the total flood-prone area is estimated at approximately 29,000 km^2 or 9.0 per cent of the total area of the peninsula (Lim 1988 p10).

Social attitudes and values must also be taken into account when attempting to resettle a population that is almost endemic at a location. Many attitudes and values have been acquired over a long time and the rural folks of Kelantan are quite satisfied and contented with their unhurried traditional kampung way of life. People value their kampungs and grow very attached to them. Kampung means home, familiar surroundings, relatives and neighbours. It is their focus of life and activities, ranging from their padi plots to fellowship amongst friends and relatives, communal rites, social functions, padi farming routine and most importantly religious fulfilment. This feeling can sometimes be obsessive even though one is not openly aware of it. Even those who have migrated to the towns and cities return on an annual pilgrimage to their kampungs during the Malay festive new year or 'Hari Raya'. The success of any resettlement scheme will therefore depend on the extent to which the social attitudes of kampung folks can be reoriented and attuned towards modern living and detachment from their roots.

Relocation programmes for flood victims in Kelantan are carried out by the Lembaga Kemajuan Kelantan Selatan (KESEDAR), a state agency, under its 'Traditional Kampungs Development Programme'. However, its main objective is not to resettle flood victims but to restructure the poor rural inhabitants by increasing incomes through resettling them in more productive agricultural areas. And because the majority of those resettled under this programme is located in the interior hilly areas, its effect on flood victims is minimal. Because of this, resettlement of the flood-prone population in Kelantan is largely ineffective (Hanisah bte Mat Jusoh 1990 pp167-9). In the current study, it was found that only 8.4 per cent of the respondents were willing to move elsewhere. Within this group of respondents, 21.2 per cent are willing to relocate within the same mukim and another 11.5 per cent within the same district. In Kelantan and most East Coast states, a major flood of once every five years or so inundates a significant extent of these states. For example, the 1967 flood inundated over 300,000 hectares which is equivalent to 20.0 per cent of the total area of Kelantan (Takenada 1988 pp9-11). Thus, relocating in the same mukim or district is unlikely to solve the flood problem.

In the federal capital, under the Kuala Lumpur Flood Mitigation Study, it is estimated that the total cost of relocation of settlers to make way for the building of the Batu and Gombak Dams and Reservoirs (both for flood mitigation and water supply) is about 2.3 million and 0.6 million respectively at 1979 prices (United States Department of the Interior 1981 p3). The corresponding adjusted current prices are approximately \$3.7 million and \$1.0 million respectively. The Batu Dam was completed in December 1987 but as of June 1988, the proposed Gombak Dam was cancelled. The official reason given is the difficulty relating to problems associated with land acquisition. However, in reality, land acquisition problems arose because land and house owners have opposed the scheme and were unwilling to relocate (The Star 29.11.84).

In the Pahang River basin, it has been estimated that more than 60,000 people live in rural kampungs within the basin inundated by a flood of 20 year return period and half this number is inundated by a five year flood (Australian Engineering Consultants 1974a). In 1974, the

Australian Engineering Consultants (1974a p10) reported that the ideal target for rural resettlement in Pahang was to relocate all inhabitants within the 20 year flood area to areas above the 50 year level. However, the Pahang state government only adopted a programme which targeted at relocating about 30,000 people, which is about half the number flooded in a 20 year event. However, a study carried out by the Australian Engineering Consultants (1974a p10-11) revealed that existing resettlement schemes are generally incomplete and lacking in proper amenities and facilities, and in order to ensure their success, it is necessary to provide more extensive services to make them fully acceptable to settlers. By the end of the 1980s, it was reported that the Pahang state government had resettled only 2,600 families (approximately 15,600 people, based on the average household size of 6 in the current household survey). This is only half its original target.

There is no official resettlement scheme for flood-prone inhabitants in Pulau Pinang, although some individual squatters along the banks of the Air Itam River have been relocated to nearby flats. The number of families relocated is relatively small (personal communication by flood duty officer of the state DID in Pulau Pinang).

In Peninsular Malaysia, the issue of relocation is expensive and further complicated by political and ethnic sensitivities. It is therefore only used as a last resort. Chua (1972) studied the possibilities of resettling inhabitants of the Pekan floodplain. Her study concludes that it is difficult to persuade Malaysians to break off from their cultural and social ties. Unless the Malaysian government can guarantee the inhabitants jobs and residential land, they are unlikely to move. Thus, the resettlement of floodplain occupants is a delicate matter as it has widespread economic, social as well as political implications. In-depth sociological and economic studies must be carried out to determine the best possible approach prior to any resettlement effort. But policies on resettlement have always been closely tied to political reasons. Floodplain squatters are not relocated because the ruling party does not want to lose their support or give the opposition avenues for making it an issue. The worse scenario is one in which the squatters are of one ethnic origin. Any resettlement action on the part of the government may be seen as 'ethnically motivated' and is potentially 'explosive' in a multi-ethnic society which has bad memories of the 1969 racial riots (Chamhuri Siwar and Nik Hashim Nik Mustapha 1988 p24). Opposition political parties and other pressure groups which champion squatter rights can also contribute to the escalation of ethnic tensions. Consequently, this results in non-action on the part of the government as maintaining ethnic harmony may override flood management strategies.

Even without ethnic complications, many resettlement schemes face problems because floodplain occupants are often against relocation. At the moment, resettlement schemes do not go hand-in-hand with that of educating the public. Floodplain occupants (especially urban squatters) should be taught and told about the danger of residing on flood-prone areas. The government should offer alternative places which are at least of the same quality in terms of land prices, agricultural potential, accessibility, public amenities and others. Otherwise, it is highly unlikely that the people will be willing to relocate themselves. Squatters who occupy riverine areas illegally also have human rights even though the law is not on their side. These people have been squatting in such land for decades, some even a generation or more. As such it is extremely difficult to force them to move. To prevent further squatting, the government should make sure that such land is not occupied illegally through more stringent enforcement. Any attempt at illegal construction of houses should be dealt with promptly. For so long, securing the vote has been the ultimate objective. Yet, the government has a moral duty to its people, whether they be poor illegal riverine squatters or rich tax-payers who have expensive river-side properties. If and when the government decides that a certain location is not feasible for flood protection, then all occupants in the area should be prepared for resettlement. If undertaken properly, resettlement can be one of the most successful means of reducing the effects of the flood hazard (Australian Engineering Consultants 1974a p11).

On the whole, permanent resettlement is a positive structural force which leads to flood hazard reduction but it can dislocate communities. However, such programmes have not been employed to their full potential either as a measure of restructuring rural society or reducing flood losses. In many flood mitigation schemes employed in the peninsula, resettlement schemes are only employed as minor measures. Some prominent examples of such schemes are the Pahang River Basin Study (Australian Engineering Consultants 1974b), the Kelantan River Basin Study (Government of Malaysia 1978), the Kuala Lumpur Flood Mitigation Project (Ferng 1988), the Kelantan Flood Mitigation Studies (Takenada 1988), and the proposed Flood Mitigation Scheme of the Kelang River Basin (JICA 1989). Consequently, the potential of resettlement schemes as measures of flood reduction have seldom been realised as they are often overlooked and other measures preferred because of a wide array of difficulties and constraints. It is this reason, more than any other, that has made resettlement appear ineffective.

Finally, the existence of many constraints towards resettlement often make it unpopular and ineffective. The attachment of rural folks to their kampungs and land has already been examined. Others are reluctant to move because of the uncertainties of being pushed into new environments with which they are not familiar. On the part of the authorities, resettlement schemes are expensive, alternative land and houses have to be allocated to those resettled, amenities and facilities have to be installed, and other social welfare such as health and education provided. Furthermore, political forces can also affect the outcome of resettlement schemes as opposition parties and other pressure groups capitalise on sensitive issues related to resettlement which make the government look bad. An example is the proposed resettlement of about 8,000 people to make way for the construction of the Gombak Dam in Kuala Lumpur. Residents of the area affected formed an action committee to oppose the proposed dam project and even sent a petition to the Prime Minister urging him to consider other sites (The Star 29.11.84). Because of its political implications, the authorities treat resettlement with great caution and scepticism. Hence, many resettlement schemes never take off. Because of public pressure, negative publicity and its unpopularity, the Gombak Dam, first envisaged in the late 1970s was shelved for two decades and finally officially cancelled in 1988.

6.5 Other forces influencing persistent occupation of floodplains

Location is a prominent non-structural force influencing persistent occupation of floodplains. For example, the more developed and commercialised West Coast offers floodplain occupants better opportunities to choose the move option than the under-developed East Coast. Survey results reveal that more than three-quarters of interviewed respondents are aware of places with less or no floods where they can find a similar (if not better) living, but the majority (91.1 per cent) have little choice but are instead forced to take the stay option and continue to live in the same place. However, the tendency for West Coast respondents to move elsewhere is slightly higher than their East Coast counterparts. This difference is explained by the fact that the West Coast offers greater employment and other economic opportunities than the East Coast. Thus, Pekan (94.9 per cent) and Kelantan (92.5 per cent) have higher percentages of respondents who are forced to stay than Pulau Pinang (87.7 per cent) and Kuala Lumpur (89.0 per cent). Thus, despite being more flood-prone, more people are being forced to persist on floodplains in the East Coast. This is especially so in the case of Pekan where floods occur annually and flood depths reaching roof level of houses are not uncommon (Plate 6.3).

Plate 6.3: The 1971 flood in Pekan town. Top - The old market was flooded up to its roof. Bottom - The old court house is half submerged

Although **flood characteristics** such as frequency, recency and severity are initially expected to affect decisions to move or stay, survey results reveal that they do not have any significant influence. Despite high flood frequencies and severities, and the occurrence of recent events, floodplain occupants continue to live on floodplains. This implies that they are constrained in their capacity to move by other forces. Other than height of stilts, house type and other **building characteristics** do not appear to have any significant influence on respondents' decisions to move or stay. It was hypothesised that respondents living in buildings with high stilts may feel safer and are less bothered by normal floods. They therefore show more willingness to remain. This hypothesis was proven correct as a significantly higher percentage of respondents living in houses with stilts 1.5 m or higher were willing to stay as compared to those living in houses with stilts less than 1.0 m.

Length of residence was initially envisaged to have an influence on respondents' willingness to move or stay. However, the chi-square test revealed that there were no significant associations. Other than economic well being examined under the issue of poverty (Section 6.3.1), the **socio-economic characteristics** of respondents do not appear to have any significant influence on their decision to move or stay. **Attitudes and beliefs** also do not have any significant effect on their decision to move or stay. For example, there were no significant differences to move or stay between respondents who believed that flood is an 'act of God' and those who believed it is an 'act of humans'. Also, there does not appear to be any correspondence between respondents who accept and those who deny the existence of floods and their decision to move or stay.

Perceptual characteristics also do not appear to influence the move or stay options although it was envisaged that the respondent's awareness of other places without floods where a better living can be found would influence willingness to move. The chi-square test revealed that there were no significant differences in willingness to move between those who are aware and those who are not. The chi-square test also revealed that there is no apparent association between awareness of past floods and decisions to move or stay. For instance, for those who chose the stay option, the percentages between those aware of floods and those who are not is about the same, i.e. 90.9 per cent and 91.7 per cent respectively. It was initially envisaged that optimistic respondents would be more willing to remain where they are while the pessimistic ones will be more willing to move. However, the chi-square test indicates that there is no clear association between optimism or pessimism and the willingness to move or stay.

In terms of future flood expectation, respondents are asked to give their estimate of the number of flood years if they were to live 100 years. Their perception is then cross-tabulated with their willingness to move or stay. The chi-square test revealed that there is no significant association between those who over-estimated future floods and those who under-estimated them.

This chapter has demonstrated how the choice of settlement is constrained by exogenous 'structural/societal' contextual forces largely beyond the individual's control. The next chapter examines the influence of 'structural' and 'non-structural' contextual forces on individual flood hazard perception and adoption of flood reduction strategies.

7 INDIVIDUAL PERCEPTION AND RESPONSE TO FLOOD HAZARDS

This chapter examines the influence of structural and non-structural contextual forces on flood hazard perception and response of individuals. Variations in individual perception and their choices in the adoption of hazard loss reduction strategies are strongly influenced by both sets of contextual forces.

7.1 Contextual forces influencing individual flood hazard perception and response

Research on how people perceive hazards is a means to understand how and why they respond to hazards in the way that they do. People living with flood hazards for a long time develop specific perceptions and respond with specific hazard reduction strategies, often coping reasonably well. Despite their limited scope, individual strategies based on local/traditional coping mechanisms have evolved over a long time and are often well adapted to flood hazards. Usually, such strategies are practical, inexpensive and based on household level responses. They often prove to be much more effective than modern imported technical/engineering solutions which do not have a clear understanding of local conditions (Waddell 1983 p35; Watts 1983 pp246-9).

In Peninsular Malaysia, survey results reveal that the majority of floodplain occupants have attempted (employed strategies) at one time or another to reduce flood losses (Figure 7.1). The results also reveal that Malaysians choose from a wide range of flood reduction strategies (Figure 7.2). Government should therefore capitalise on traditional mechanisms and help individuals more effectively respond in the way that they do. Instead, government often ignores how individuals respond and selects some form of response strategies that prove ineffective. Housing Third World disaster victims in western-styled prefabricated houses is one of many examples of ineffective official strategies (Davis 1978). According to Green (1992 p181), government can use its scarce resources more effectively to help the public adopt the most effective response, or to improve the effectiveness of the response adopted by the public. Understanding individual perception (including beliefs, attitudes and expectations) can help government plan and choose flood reduction strategies that complement individual responses. This is true in Peninsular Malaysia where common extensive flooding, especially in the East Coast, puts a severe limit on the use of engineering solutions. There are just too many rivers and too wide an area to protect through expensive engineering works. Capitalising on local/traditional individual response mechanisms by improving on their

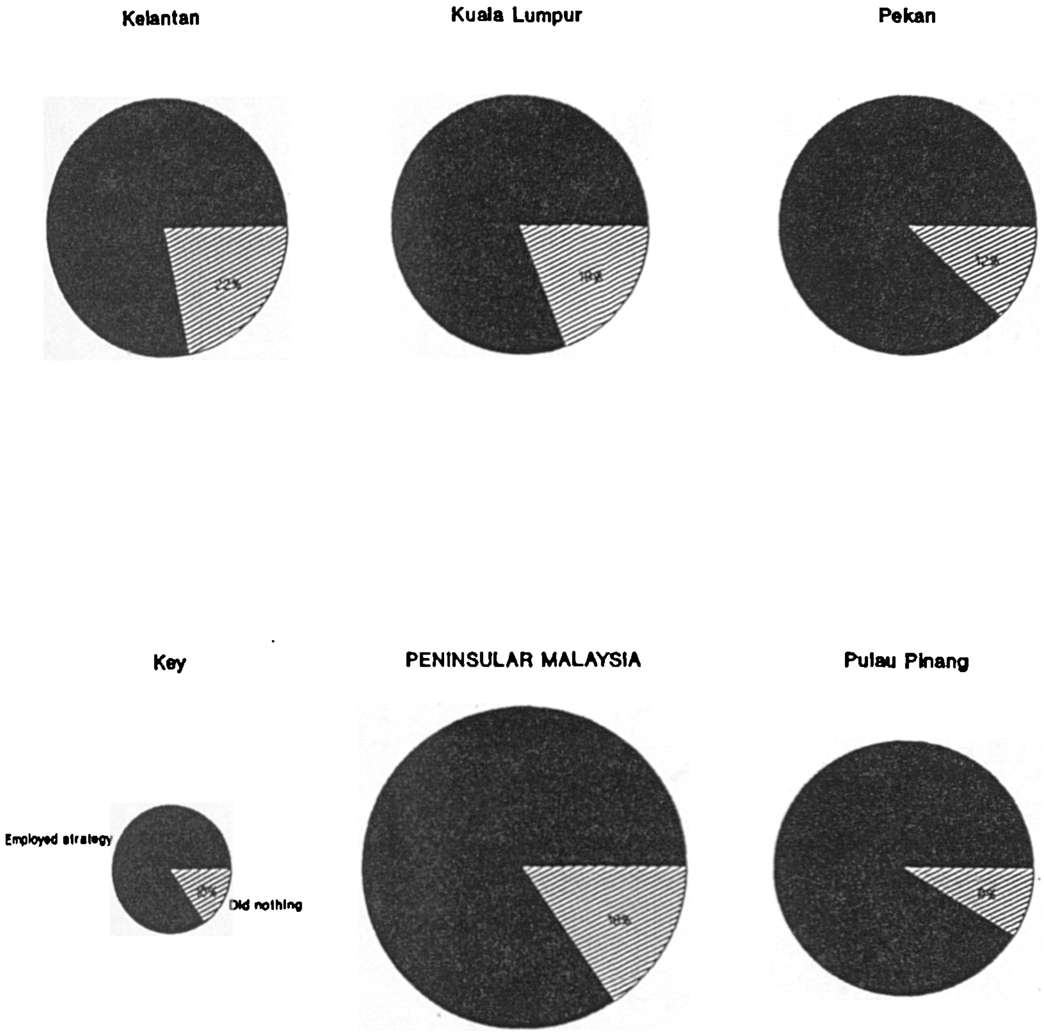


Figure 7.1: Percentage of respondents who have employed flood reduction strategies during past floods against those who did nothing

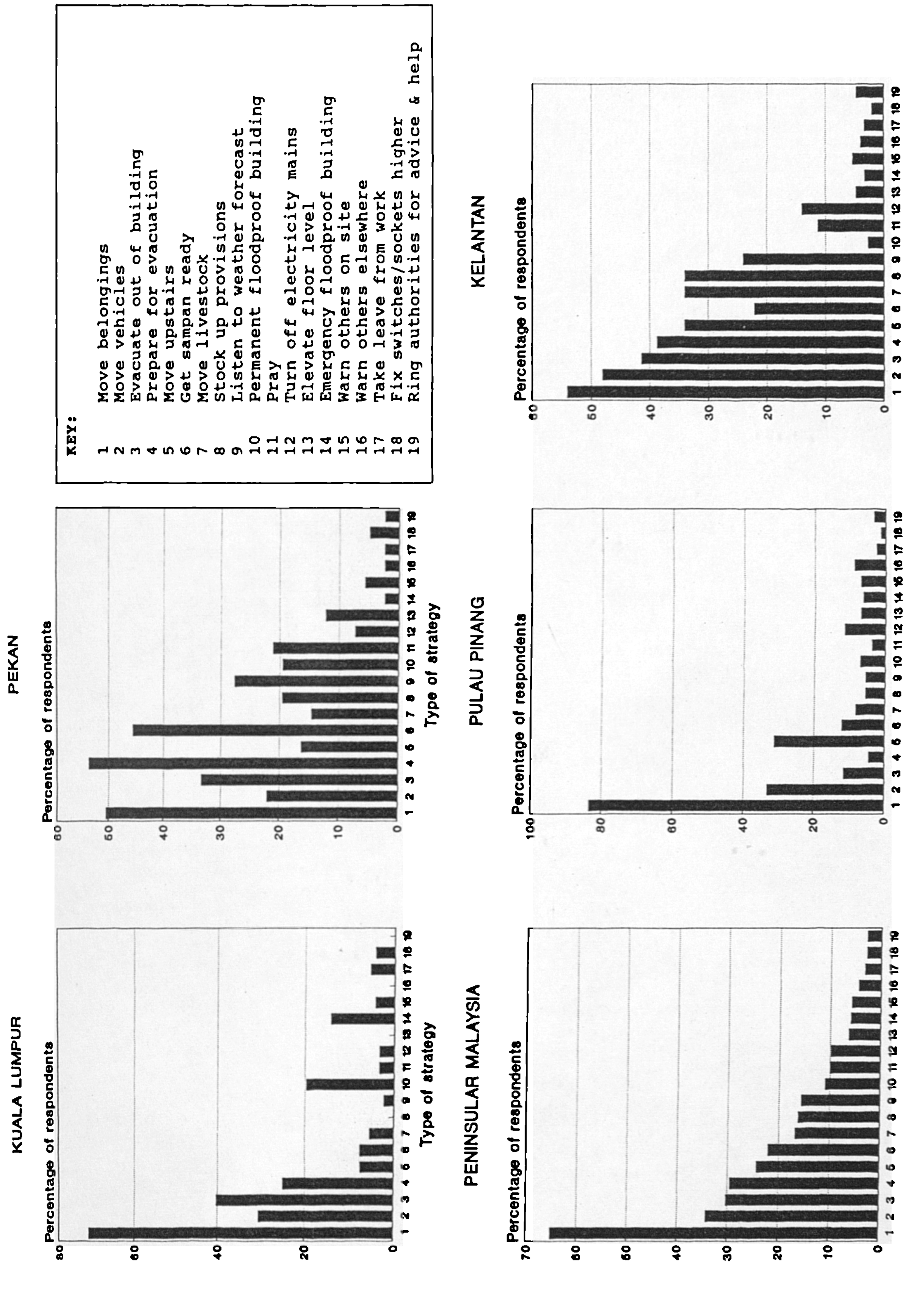


Figure 7.2: The employment of different types of flood reduction strategies in Peninsular Malaysia

effectiveness is one area where there is much potential for flood hazard reduction without incurring too much cost on the part of the government.

Many contextual forces are hypothesised to strongly influence individual perception of and response to, flood hazards. Some of them may be structural/societal forces while others are not. Structural/societal forces such as poverty, low educational attainment, cultural background, squatting, and government policies are expected to strongly influence people's perception and response. Non-structural/non-societal forces such as residential location, flood characteristics, building characteristics, and the respondent's socio-economic characteristics, attitudes and perceptual characteristics are also expected to be important. Both quantitative and qualitative interviews are employed to examine the extent to which both sets of forces influence individual perception.

The analysis aims to reveal that the ways in which individuals perceive flood hazards and the range of reductive options open to them are strongly influenced by these forces. Statistical tests of associations such as the chi-square test, t-test, correlation and regression in the SPSSPC Statistical Package were employed to determine the important variables affecting perception and the adoption of strategies. The significance level is taken at .05. With so many inter-related variables, it is likely that many significant associations will be statistical artifacts and not substantive. The analysis is, therefore, limited to those relationships which are considered to be of interest, important and subject to logical interpretation. However, all test results are presented in Appendix L.

7.2 Structural/societal forces influencing individual flood hazard perception and response

Hazard-prone communities often perceive and respond to hazards in a wide variety of ways reflecting their unique circumstances and situations. Despite extensively studying the process of adaptation, Burton et al (1978) have found that people often appear ignorant of the hazard or seem prepared to take unnecessary risks, thereby making the process of modelling their decisions difficult. To compound the problem, people are not completely free when it comes to making choices. Their behaviour is often constrained by socio-economic and cultural forces, and everyday problems, and people therefore act according to the logic of their circumstances (Horlick-Jones and Jones 1993 p27).

7.2.1 Poverty

(a) Flood hazard Perception

Poverty is an important structural force which shapes people's perception of flood hazards. As the majority of the poor generally occupy the most hazardous areas on floodplains, and are mostly farmers and fishermen who are poorly educated with low residential and occupational mobility, their perception of flood hazards is different from that of the wealthier group. This section examines differences in flood hazard perception between the poor and the wealthier group.

Survey results reveal that the poor have a greater awareness of flood hazards than those from the wealthier group. The poor are also generally more optimistic than their wealthier counterparts. They also have a lower expectation of future floods, the wealthier group being more inclined to expect flooding to be almost certain in the near future. This may be due to the fact that the wealthier ones have more to lose and are more anxious about their flood loss when compared to the poor (who have few material possessions). The majority of the poor (89.7 per cent) live in stilt houses and treat seasonal flooding as normal and may even consider normal floods as 'high waters'. In contrast, only 3.7 per cent of the wealthier group live in stilt houses.

The wealthier respondents also have a greater tendency to believe that flooding will worsen in the future. They are also more inclined to believe that flooding could happen any time as compared to a greater inclination of the poor to believe that flooding is regular or seasonal. While the majority of respondents generally do not believe that the government is able to control the flood hazard, the poor generally have more confidence in the government in this respect than the wealthier ones.

In their perception of specific flood prevention solutions, the poor have a higher inclination to mention praying as a form of flood prevention and reduction. In contrast, the wealthier ones are more inclined to mention the use of artificial drainage and cover crops to prevent and reduce floods. They also perceive the flood proofing of properties, flood forecasting and warning, the use of cover crops, and removing debris from rivers as forms of flood reduction. Many of the above strategies are expensive and beyond the reach of the poor. For example, the cost of flood proofing is high and the poor cannot afford it. The majority of the poor also live in old wooden houses which are not worth flood proofing. In the case of squatter houses, the flood proofing cost may be more than what the run-down huts are worth. On the other hand, the poor believe in using a boat as a form of flood reduction while the wealthier respondents do not. This is because the majority of the poor live in rural areas, many by the banks of rivers, and own boats which are used for fishing, transportation and as a vehicle of flood loss reduction (moving people, livestock, food and household contents) during flood emergencies.

On the whole, the richer an individual, the more preventive and reductive strategies he/she can afford to employ. Thus, poverty determines the extent to which an individual perceives flood prevention and reduction. Even though the poor perceive a specific strategy to be effective, and if the cost of employing it is beyond them, then it would be considered inappropriate. The research results reveal that the wealthier respondents show a greater tendency to mention more flood reduction strategies than the poorer ones.

(b) Adoption of flood hazard reduction strategies

This section examines the extent to which poverty influences the scope for individual adoption of flood hazard reduction strategies. As a force which strongly influences perception, poverty is also expected to largely determine the range of reduction strategies adopted by individuals. Often, the strategy adopted or not adopted is dependent on whether or not individuals can afford it. Poverty, therefore, operates at the broadest level and determines the 'room' for manoeuvre in which individuals have on flood hazard reduction.

Although some flood reduction strategies such as moving family members and house contents upstairs, warning family members and others, and turning off the electricity mains do not incur any expense, the majority of flood reduction strategies usually involve some degree of expense on the part of the individual. For example, evacuating family members elsewhere can be costly not just in terms of the transportation cost but also in the expenditure incurred for temporary accommodation, food and other expenses. According to Wong Ah Sun (sundry shop owner in Pekan),

> '...Every time it floods I have to spend money on temporary evacuation of my family. If the flood lasts a week, it is about $350. More if it lasts longer'.

Parking one's car far away (to avoid being flooded) can also increase transportation cost as well as parking cost. According to Richard Anthony (a taxi driver from Jalan P Ramlee in Pulau Pinang),

> '...My taxi is my life. Without it my family will starve. I have to take good care of it. Because my house floods so frequently I need to park it in my boss's compound and he charges me $100 a month for it. On top of that, I have to commute by bus to and from my boss's house. This extra cost is at least $2 a day ($30 a month) and I lose an hour each way. I could have earned an average of $30 during those two hours, more if I am lucky'.

Some strategies such as elevating the floor level of the house, flood insurance, moving livestock (permanently), and permanent flood proofing of property are potentially expensive and often beyond the reach of most floodplain occupants. For example, one respondent revealed that raising the floor level 1.5 metres by adding planks on top of the existing floor cost him $5,000. Another confided that he spent $9,000 by building a one metre high brick wall all around his house (permanent flood proofing). Another complained that no insurance[80] company would insure his property against flood losses as it was too flood-prone. The insurance salesman told him that even if the company were to accept his coverage, the insurance premium would be excessively high. Even listening to the weather forecast requires the purchase of a radio or television (including the annual fees charged on such services). Taking leave from work can also result in lost incomes which the poor can rarely afford. Therefore, the type and number of flood reduction strategies adopted depends to a large extent on whether or not an individual can afford them. Without the necessary resources, the range of such action would be limited.

Consequently, the poor are therefore most vulnerable to flood hazards not because they are apathetic and do nothing out of choice. Rather, they do nothing because they cannot afford to employ flood reduction strategies which often cost more than the flood loss. Poverty, therefore, limits the range of choices available to the individual. It sets a constraint to the effectiveness of overall individual flood hazard response in poor communities. And because the majority of floodplain inhabitants are poor or living close to the poverty line, it is a very

[80] Flood insurance is not well developed in Peninsular Malaysia (see Chapter 5 Section 5.3.2 b). In the household survey, only 9 respondents (1.7 per cent) out of 522 respondents who attempted flood reduction strategies used insurance to protect their properties. This could be due to both the poorly developed nature of the industry as well as the public's general scepticism about using insurance. Only 28.7 per cent of respondents feel that insurance would be an effective flood loss reduction strategy. Even in developed countries such as the United Kingdom, flood insurance has been found to be problematical (Harding and Parker 1976).

significant structural problem which needs to be addressed (by the authorities/government) before any improvement in individual flood hazard reduction can be achieved. The constraints of poverty on the adoption of flood reduction strategies is demonstrated by the following cases:

(1) '...What can I do? The flood waters are so unpredictable. One year the flood depth is just a metre or so, the next it can be as high as four or five metres. According to my father, many kampung houses were swept away during major floods such as the 1926 and 1954 floods. The recent 1988 flood submerged half my house, about a depth of two and a half metres. The only thing I can do is either to sell my house and to buy another one on higher ground (permanent relocation), or to build another house with much higher stilts (permanent flood proofing). The former is impossible because my current house will only fetch a low price because of its proneness to floods. The latter is also beyond my reach as I will have to tear down my house and build it all over again. It costs too much. So the only thing to do is to be well prepared, move out temporarily, survive on government charity (aid) and pray that a big flood like the 1926 flood would not occur again. If it does, I am afraid my house would be washed away.' (Hashimah, a widow from Pasir Mas, Kelantan).

(2) '...I cannot even afford to live in a proper house. That is why I live in this hut near this God-forsaken river. You think I want to be a squatter? I wished I had the money to get myself and my family a nice house in Bangsar Park on top of that hill. What strategies can I use to reduce flood loss other than to move my family and my motorbike to my brother's place temporarily (even my brother is sick of me troubling him every time my hut gets flooded)? I store my house contents in the attic, but even the attic gets flooded sometimes. It is a dog's life here. There is nothing I can do. The poor gets poorer and the rich gets richer. Only we poor people are subject to such hazards. Mind you, it's not only floods that affect this area. There is the danger of fire as most of the huts have roofs built of 'atap' (palm) leaves. A few years ago, the adjacent village was almost burnt down by children playing fire crackers. This area is also terrorised by gangsters and the environment is filthy. People treat the river as an open sewage and rubbish dump. I hate this area but what can I do? (Muthusamy, a labourer from Kampung Haji Abdullah Hukum, Kuala Lumpur).

(3) '...When the floods come, all I can do is make sure my wife and the younger children go to the government flood relief centre in the school hall on top of the hill. My son and I stay behind to guard our belongings from thieves. During one big flood (I think it was in 1970 or 1971), our refrigerator, television and furniture were stolen when we were all forced to evacuate by the police. At least, we can still repair the refrigerator or television if they were flooded. My son and I also try to save our padi crop by removing floating garbage and tree branches from our padi field. If not, these floating things will crush what is remained of our padi crop. It is the only thing we can do. Perhaps, we should go back to the primitive days of our ancestors by living on top of trees! Otherwise, there is little we can do to reduce flood losses. We cannot afford to leave our land and go elsewhere. All we can do is live with the floods. Losing material things is alright. As long as I am healthy and alive, I can work and earn a living. I only pray for my safety and that of my family. What else can I do?' (Pak Kadir, a farmer from Pekan).

Survey results reveal that significant associations exist between poverty and the adoption of flood reduction strategies (Appendix L d1). For example, poor households are less likely to adopt flood reduction strategies than their wealthier neighbours. Although there is no significant difference in the total number of strategies adopted, the wealthier households have a greater tendency to adopt more expensive strategies than the poor households. This indicates that they can afford such strategies while the poor cannot. For example, wealthier households have a greater tendency to: move vehicles elsewhere; move belongings; employ permanent flood proofing of property; employ emergency flood proofing of property; and take leave from work. They also indicate a greater inclination to experiment or try different strategies during future floods.

On the other hand, the poor are more inclined to adopt strategies that do not incur much expenses. For example, they have a greater tendency to: pray; prepare for evacuation; move upstairs; move out of building; move livestock; buy provisions; and get the boat ready.

The above analysis confirms that poverty has a strong influence on individual perception and adoption of hazard reduction strategies. More significantly, it reveals that the poor's response to flood hazards are constrained by their inability to pay for strategies involving high expenditure. In other words, poverty determines the range of action available to them.

7.2.2 Educational attainment

(a) Flood hazard perception

Educational attainment influences one's attitudes, beliefs and understanding (especially if it involves technical issues) in relation to flood hazards. Survey results reveal that the more educated one is, the more one is aware of flood forecasting methods. A higher percentage of tertiary educated respondents also perceive weather forecasting as a way of predicting floods compared to lower educated respondents who are more inclined to perceive less scientific methods of predicting floods such as signs in nature, rats migrating, body aching, and others. The percentage of those not knowing any method of flood forecasting is also higher amongst the poorly educated.

The results also indicate that the more educated one is, the less likely one would perceive floods as an act of God. This is not to imply that the highly educated are less religious. It is due to their greater awareness of floods and their general knowledge associated with the problem. The highly educated are more inclined to believe that human activities and/or natural phenomena are the cause of floods. They are also much more likely to believe in flood prevention and reduction solutions than the less educated. They also show a greater tendency to suggest more strategies than the less educated.

Thus, because the majority of floodplain occupants in Peninsular Malaysia are poorly educated (about half are primary educated and 12.9 per cent illiterate), the influence of education (as a structural force) on their perception is significant. The results above testify to this claim. The less educated are less likely to believe that floods can be prevented or reduced but are conversely more likely to relate the flood hazard to the supranatural.

(b) Adoption of flood hazard *reduction strategies*

On the whole, although educational attainment does not appear to have a significant influence on the adoption of the majority of specific flood reduction strategies, it does have an effect on some aspects of flood hazard response (Appendix L d1). For example, respondents with secondary education and above have a greater inclination to adopt flood reduction strategies than those who have attained only primary education or lower. This is initially hypothesised to be a result of greater awareness of the benefits of reduction strategies as a result of being better educated. However, when respondents living in areas of similar flood frequencies were compared, there was no significant difference in the inclination to adopt reduction strategies between respondents of different educational attainment. Similarly, when the poor and the wealthy respondents were tested separately, there was also no significant difference in the inclination to adopt reduction strategies between respondents of different educational attainment. Thus, the effect of education on the adoption of strategies is a 'spurious' one, the likely reasons being that of flood frequency and/or poverty.

Despite the above analysis, some test results are significant. For example, respondents with higher educational attainment have a greater tendency to adopt the following strategies: move upstairs; move vehicle elsewhere; take leave; and are more likely to adopt different/new strategies when the next flood occurs. In contrast, those with lower educational attainment have a greater tendency to get the boat ready but are less likely to adopt different/new strategies when the next flood occurs.

7.2.3 Cultural background

One of the commonest failures in disaster management concerns the lack of understanding of the social and cultural mitigation measures of the local community (Davis 1981 pp15-9, 1985 p35). The sociological literature on hazards recognizes the importance of cultural forces in human response to hazards (Bailey 1971; Douglas 1986, 1992). Modes of human response to hazards synthesised by Burton et al (1978) also recognises cultural adaptation, and suggests that the roots of decision-making in the face of potential hazard may be deeply embedded in cultural formations (Horlick-Jones and Jones 1993 p28). One's cultural background is, therefore, a structural influence which shapes one's perception as well as behaviour in response to hazards.

(a) Flood hazard perception

In Peninsular Malaysia, culture is manifested in many attributes, but the two which have a more profound influence on flood hazard perception are ethnicity and religion. **Ethnicity** strongly influences individual perception. Individuals from different ethnic origins with different (sometimes contrasting) cultural backgrounds are expected to perceive flood hazards differently. For example, Malays who are culturally more experienced and attuned to floods are expected to perceive flood hazards with a more 'casual' attitude than Chinese or Indians who are less experienced and therefore more 'concerned'.

In general, although the majority of floodplain respondents are pessimistic in nature, Malays appear to be slightly more optimistic than Chinese and Indians. Survey results also reveal that Malays are most aware of floods and Chinese the least aware. Indians fall in between the two groups. This is due to the fact that the majority of Malays live in flood-prone rural areas in the East Coast and other floodplains on the West Coast. They are, therefore, more adapted to floods. In contrast, because of their occupational inclination for business, the majority of Chinese occupy urban centres in the West Coast which are relatively less flood-prone. Indians equally inhabit both urban and rural areas. Because of their cultural roots, urban Malays are also more aware of floods than urban Chinese and Indians, but there appear to be no significant differences in awareness amongst rural Malays and rural Chinese as both communities occupy rural floodplains. Rural Indians, however, are less aware of floods, mainly because a large proportion of them live and work in rubber estates which are located on the foothills where flood hazards are less frequent.

In order to establish whether or not ethnicity has a 'real' effect on awareness, households of different ethnic origins are grouped in terms of flood frequencies and then analysed. For example, households of different ethnic origins are grouped into those experiencing flood frequencies less than once in three years and more than once a year. In the first group, it was found that there are no significant differences in perception of flood awareness between the various ethnic groups. In the latter group, however, Malays (89.2 per cent) showed greater awareness than Chinese (70.7 per cent) and Indians (86.7 per cent). This indicates that, for areas of low flood frequencies, ethnicity is not a significant force affecting flood hazard awareness but it is statistically significant in areas of high flood frequencies. Overall, Malays generally show a greater level of flood hazard awareness than the other ethnic groups in Peninsular Malaysia.

Expectation of future floods amongst the various ethnic communities is tested by comparing those living in areas with similar flood frequencies. For example, for those living in areas of low flood frequencies, Chinese (generally sceptical), tend to have the highest expectancies of future floods in the immediate future (next few months) followed by Malays and Indians respectively. In areas of high flood frequencies (flooded more than once a year), Chinese again appear to have the highest future flood expectations, closely followed by Malays and Indians respectively. Thus, despite living in areas of higher flood risk, Malays are found to have the greatest propensity to underestimate the risk. This implies a high propensity of 'risk denial' by Malays.

The Malays' attitude to life is also characterised by an almost total acceptance of fate. To the Malays, life and death, wealth and poverty, and human society are all intricately related to fatalism. Fatalism affects almost every facet of Malay life. It makes acceptance of everything, whether good or bad, including natural disasters, possible with unprotesting tolerance and resignation (Mahathir Bin Mohamad 1970 p158). Even death is accepted calmly by the Malays. It is also accepted by close relatives and friends. As a measure of this acceptance, there is usually no wailing when someone dies although the closest relatives may sob quietly. And there is no very great distinction between the death of an old man and the death of a young man or a child. All deaths are treated the same, a pre-ordained thing which one can do very little about and which one accepts as fated (Mahathir Bin Mohamad 1970 p164). Hence, when death and other losses from disasters are attributed to fate, they are calmly accepted.

Significant differences in the perception of 'flooding as an act of God' exist amongst the ethnic groups. In general, Malays show a far greater tendency to agree to the statement than Chinese and Indians. However, this is due to differences in **religion** amongst the various ethnic groups. The survey results show that 93.7 per cent of muslims believed that floods are acts of God (in theory, all Malays are muslims in Malaysia). The corresponding percentages for christians, buddhists/taoists and hindus are 67.5 per cent, 40.0 per cent and 29.8 per cent respectively. The chi-square test value of .00 indicated significant differences in the belief that God created floods between respondents of different religion.

To the Malays, all of whom are muslims, almost everything on earth may be attributed to God. And although many of the modern educated Malays are aware of the human and natural dimensions of flooding, they tend to consider flooding as an act of God. The Malays believe that life is a gift of God and so is death. Good fortune and tragedies in one's life can all be attributed to God's will. Hence the common muslim saying, 'God willing I will do this or that.....', even when it involves merely day-to-day chores. This can be carried to the extreme. For example, in the more conservative rural communities, life is almost exclusively a period of preparation for the hereafter (Mahathir Bin Mohamad 1970 p162). God gives and takes and the Malays comply and accept. It is not for them to question God's will. Hence, flood and other forms of natural disasters are accepted calmly in the Malay community.

Because of this strong faith in God, especially amongst the uneducated, the majority of Malays are willing to leave their fate to God. Thus, they stay put and risk living in flood-prone areas. To them, 'Life and death, dearth and plenty, are in the hands of God. In the hands of Allah the Almighty' (Shahnon Ahmad 1972 p1). This is the prevailing attitude of the majority of the Malay peasants interviewed, and the belief that God determines one's fortune in life is best demonstrated by the following quotation:

> '...Each human born into the world has his 'rezeki' -his share of food and the world's goods. God allots this rezeki. Lahuma's grandchildren and great-grandchildren would each receive his rezeki. It was up to God to decide the kind of life each person was to have. It was up to Allah the Almighty. But Lahuma never made a value judgement on the rezeki given. For good and plentiful rezeki, one needed faith in hard work as a way of life. One must extend one's land. But if one led a beggar's life, it was still rezeki. If one had to eat carcases floating down the river, it was still rezeki. Even if one had to go naked night and day, still one lived and breathed. For Lahuma, the question of eating carcases and going naked was entirely up to God. Up to

> Allah the Almighty. What could he do if Allah wanted him to eat carcases? What could he say if God wanted his descendants to go naked? (Shahnon Ahmad 1972 p5).

As for the Chinese and Indians, the relatively low percentage of respondents who believe that 'flooding is an act of God' do not necessarily mean that they are less religious compared to the Malays. The difference lies in the fundamental teachings of the religions embraced by these two immigrant communities, mainly Buddhism, Taoism and Hinduism, and Christianity to a smaller extent. This research does not go into great depth about religious differences as it is not within its scope. However, a brief analysis is given here for the purpose of providing a better understanding of perceptual differences amongst the various ethnic groups. Buddhism is in fact, not as much a religion as it is a way of life. Thus, Buddhists believe in leading a good life but rarely attribute life and death to God. Taoists also believe in leading a good life so that one can enjoy a better 'after-life' but good fortune is probably the main concern of most taoists. Therefore, Taoists believe in luck, and good and bad events are attributed to luck rather than God. When a flood drowns a Taoist the relatives and friends will say it is just bad luck. Similarly, Hindus are also firm believers of luck/good or bad fortune. But Christians are a minority group. Their religious thinking is not unlike muslims. They too believe that life and death are in the hands of God. However, because the majority of Christians in Malaysia comprise the better educated section of society, they tend to attribute the cause of natural disasters to more practical reasons such as human activities or changes in the natural system. Religion as a structural influence is also tested in the perception of whether or not anything be done to prevent floods. The results revealed that muslims are more inclined to believe that 'nothing can be done' compared to the other religious groups. Also, the majority who indicated that praying to God may either prevent or reduce floods are muslims.

(b) Adoption of flood hazard reduction strategies

Like their perception, individual response in terms of strategy adoption is strongly moulded by cultural forces. Indigenous Malays, the majority of whom are still predominantly living in areas affected by seasonal floods, are more exposed to flood hazards than Chinese who dominate the cities and towns, and Indians who populate the rubber estates. Because of higher levels of exposure to flood risks, floods have become and still are an integral part of Malay culture and an accepted part of their lives.

Disasters often act as 'agents of change', resulting for example, in innovations in hazard-resistant architectural and construction designs (Davis 1983). In Peninsular Malaysia, probably the most unique adaptation that has evolved in response to flood disasters is the Malay stilt house (Figure 2.8). The stilt house originally evolved as an adaptation to the occupation of swamp-land and frequent flooding in riverine/coastal areas. This permanent form of flood proofing is still predominant in the traditional rural areas where frequent flooding is prevalent. Elsewhere, despite the absence of floods, Malays have perpetuated the architectural form as a unique cultural trait. However, modernisation and economic consideration are forces which increasingly put the stilt house beyond the reach of the average Malay. Although the building of modern day stilt houses is still influenced by the Malay culture and tradition (socio-cultural influences), other structural forces such as poverty (low household income vis-a-vis building cost), institutional influences (legislation on housing and housing loans, flood management and flood relief schemes, etc.) and politics (government policies which advocate low cost terrace houses and flats) are threatening the end of the stilt house in the more urbanised and densely populated areas[81]. According to one respondent living in an old stilt house,

> '...My son Fauzi is going to get married next year and as you can see he is building a new house beside mine. Notice that his new house does not have stilts. It is too expensive to build stilt houses. A stilt house will cost at least $5,000 more and we poor people cannot afford it. Furthermore, skilled carpenters are needed to build a stilt house and we have to pay someone to do it. My son cannot afford to pay a skilled carpenter to build his house. He is not a skilled carpenter, but since he has to build his house himself, he has no choice but to build a simple one without the complication of stilts. But then, what can poor people like us do? We know houses without stilts will be flooded easily but we have no choice. Only the richer farmers can afford to build stilt houses nowadays. My stilt house is nearly 50 years old and I make sure I reinforce the stilts by a layer of fresh cement every other year. If not, the constant flooding will erode them and the house will collapse. This was what happened to poor Mat Zin during this year's (1992) flood (Plate 7.1). He did not check or look after his stilts. He has since moved to live with his son in another kampung because he cannot afford to build another stilt house. If my house collapses, I think I will have the same problem. I dare say that most of the people in this kampung will have the same problem because we are mostly poor farmers. My son has no choice. He knows his new house will be easily flooded. I think he and his wife will have to spend at least a month a year living in my house during the monsoon season. My son intends to have cement flooring and at least two feet of bricks all around the base of the four

[81] Rural Malays love their stilt houses and are generally reluctant to move into government aided prefabricated low cost houses or small flats. Thus, unlike the poor Indians of Andra Pradesh whose 'view over the fence' of 'pukka' reinforced concrete houses is 'greener' (Davis 1979), rural Malays prefer their traditional flood proofed stilt houses.

Plate 7.1: A collapsed house in Kuala Krai, Kelantan after the 1992 flood

walls of his house. This way, the effects of floods will be less and the rubbish easily cleaned after the floods have subsided. But his new house will not last as long as my old house because of frequent flooding in this area.' (Azizi Haji Ahmad, a farmer from Kuala Krai, Kelantan).

The stilt house remains a very important form of adaptation to flood hazards in Peninsular Malaysia, particularly in rural areas. In the current study, 364 respondents (58.9 per cent) live in stilt houses (Figure 7.3). In general, a much higher percentage of houses in the East Coast have stilts compared to those in the West Coast, the highest percentage being in Pekan and the lowest in Kuala Lumpur. Of those living in stilt houses, 70.6 per cent are Malays while only 17.6 per cent and 5.5 per cent are Chinese and Indians respectively. While the above figures indicate that the stilt house is predominantly a Malay cultural feature, they also suggest that other ethnic groups living in flood-prone areas are gradually adopting it as a flood loss reduction strategy.

Although stilt houses are originally built as an adaptation to floods, Malaysians rarely consider them as a flood reduction strategy. Only a small minority of less than 6.1 per cent of all respondents did so. This is because a stilt house is a necessity if one were to live in a flood-prone area. Stilt houses are therefore considered as a normal form of habitat in flood-prone areas. According to one respondent,

'...In this kampung, one would have to be mad not to build one's house on stilts. Normal floods come often, on an average of a few times a year and a major flood every four or five years. Everyone in this kampung lives in stilt houses. We do not think stilts are a flood reduction strategy. It is a must! It is too dangerous to live here in a house without stilts, especially if one has young children. Only the shop-keepers have their houses built without stilts. They need the space and since their shops are adjacent to the main road, the highest land in the kampung, only the major floods will affect them.'

Even so, the stilt house serves an important function as it keeps out waters from normal floods. Although more than four-fifths of respondents reported that their houses were flooded during the most recent flood, flood waters did not enter the houses of all these reported households. People tend to consider that a flood had occurred when their compound or the road is flooded. By comparing stilt height and flood depth during the most recent flood, it was found that all houses without stilts were flooded, but less than a third of stilt-houses experienced the same fate (Figure 7.4). However, during a major severe flood, even stilts will not be able to keep the flood waters out (Figure 7.5).

Ethnicity is a cultural trait that influences one's way of life, values, attitudes, thinking,

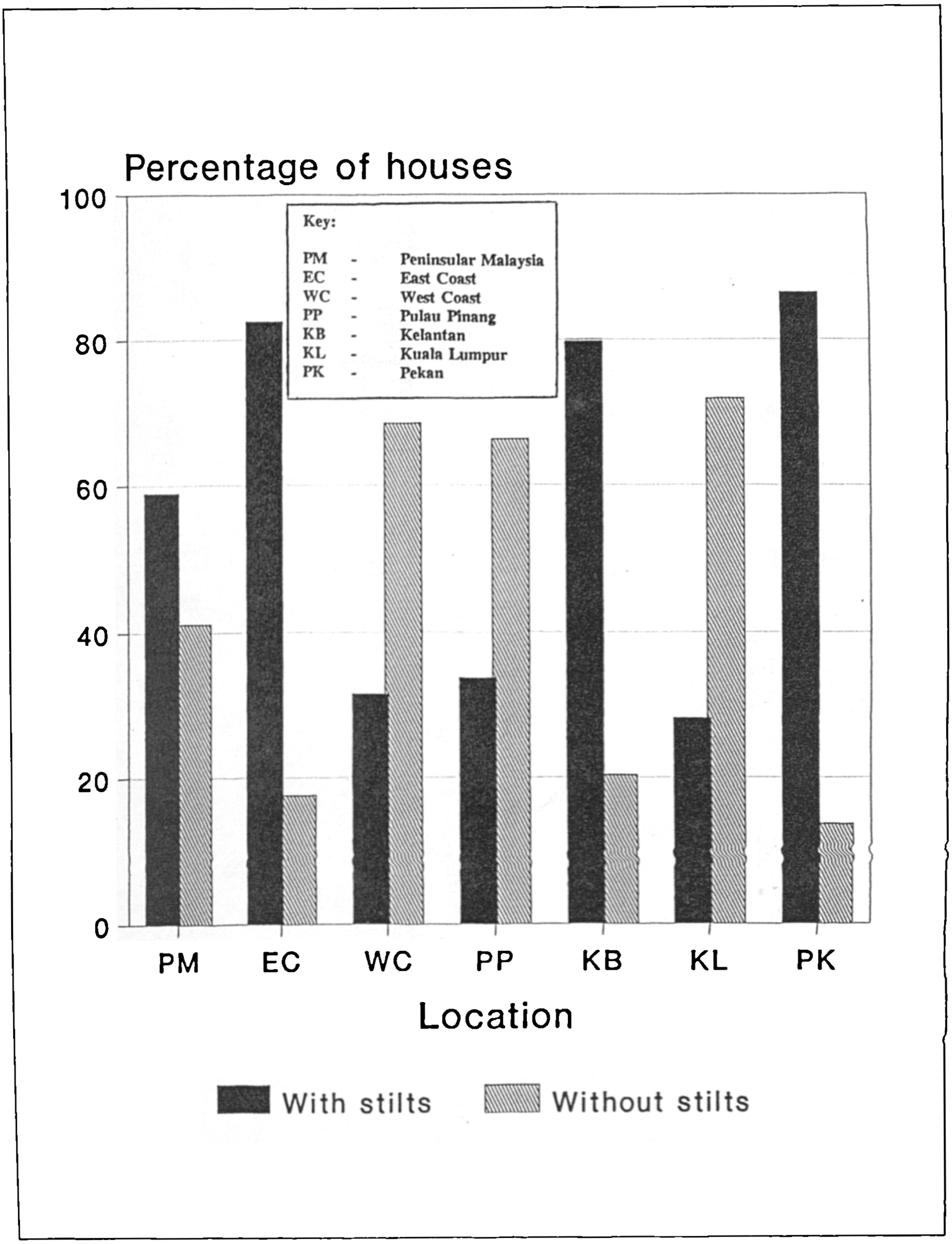


Figure 7.3: Percentage of houses with and without stilts in Peninsular Malaysia

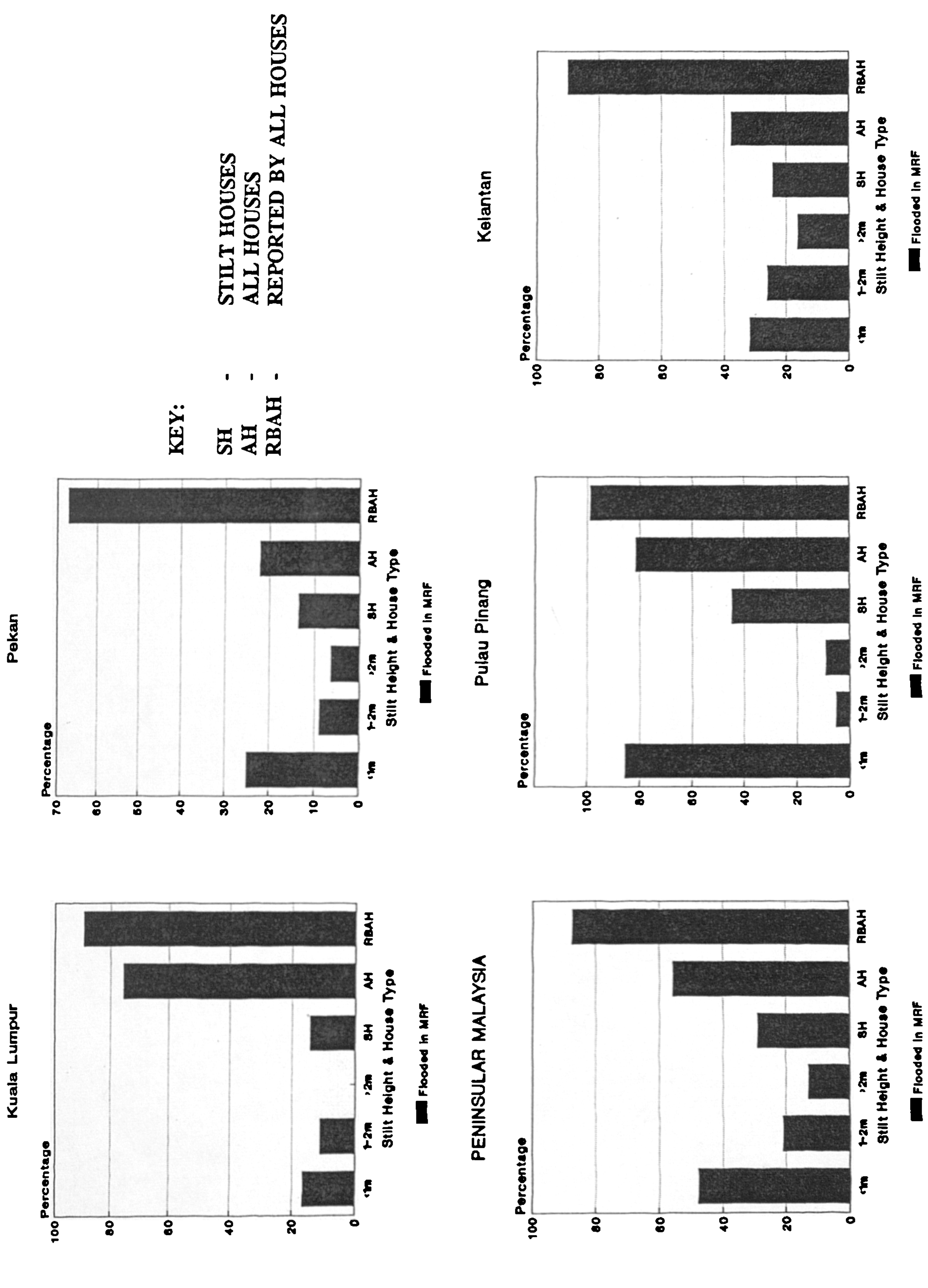


Figure 7.4: Percentage of houses flooded during the most recent flood in different parts of Peninsular Malaysia

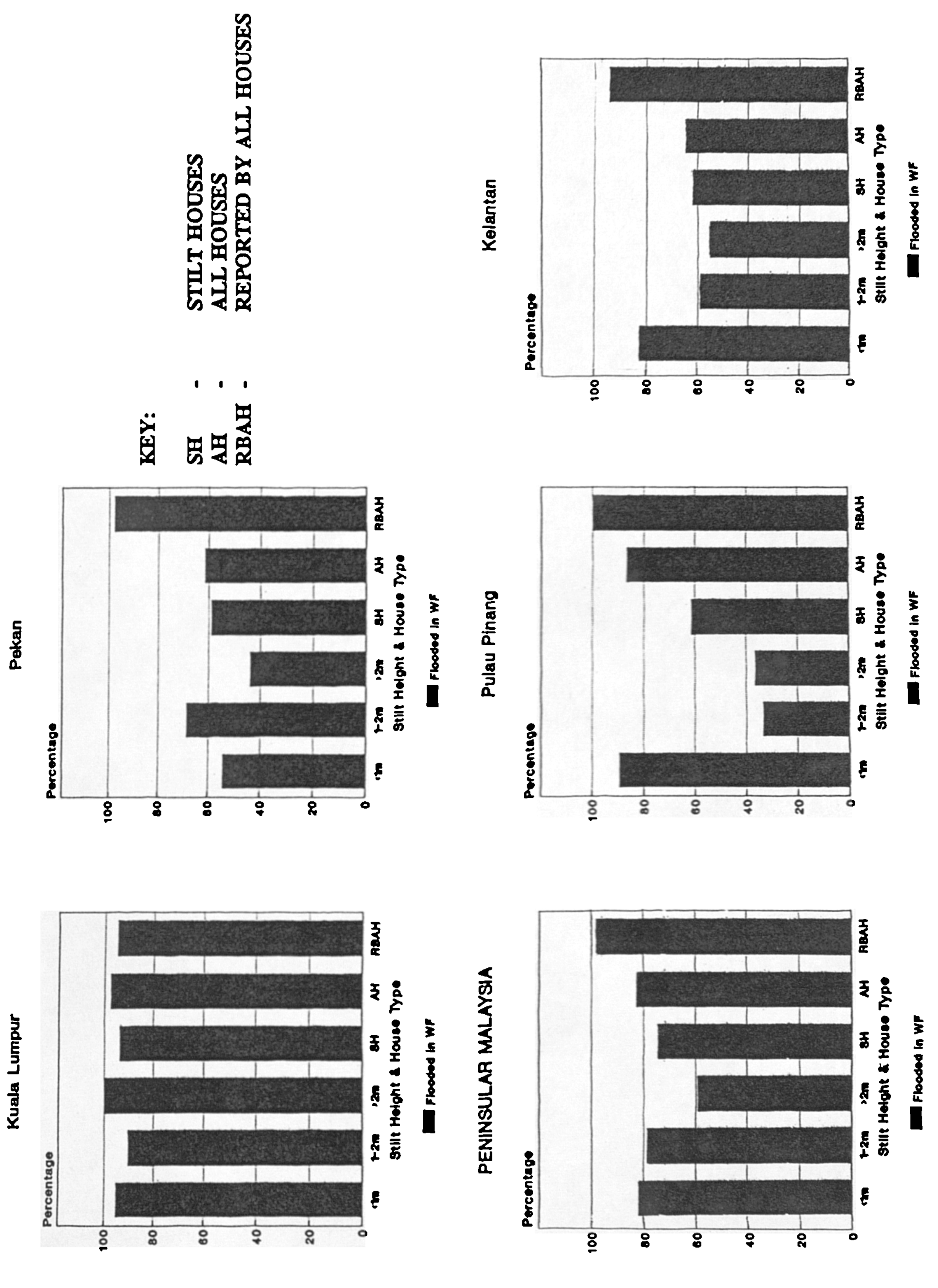


Figure 7.5: Percentage of houses flooded during the worst flood in different parts of Peninsular Malaysia

perception and hence one's selection of flood reduction strategies. Results from the current research reveal that significant differences exist between the various ethnic groups in terms of their adoption of flood reduction strategies. For example, Chinese appear to be most ready to take steps to reduce flood losses, closely followed by Indians and Malays. This seems surprising as Malays live in the most flood-prone areas and are expected to be most eager to take such steps. There are many reasons for this. Malays are so attuned to floods that they have developed a resigned attitude towards it. Malays are muslims who believe that flooding is an 'act of God' and therefore beyond human control (see below). Year in and year out they are required to evacuate temporarily and living in stilt houses give them a further sense of security. On the other hand, Chinese and Indians are generally not as attuned to floods as Malays. Few of them live in stilt houses and because of this, their houses are more vulnerable to floods. They therefore treat flooding with greater concern and are thus more eager to take steps to safe-guard their lives and properties.

In terms of the adoption of specific strategies, Malays have the greatest tendency to: pray (see discussion on religion below); prepare to evacuate; move livestock; and buy provisions. Malay farmers have also developed specific strategies to reduce crop losses from flooding. Farmers traditionally go into their rice plots to remove all kinds of floating litter which are brought by the current from upstream. If not, the weight of the litter will crush the rice plants. The following account of a farming family's struggle against floods by Shahnon Ahmad (1972 p139-40) most appropriately illustrates the point:

> '...Sanah and Milah and Jenab went down to the ridge which was already covered with rushing water. The water already reached up to Jenab's waist. They waded towards the rice-plots. They moved aside the areca nut flower-sheaths blocking their way. Brittle stems, branches of fallen trees, dead weeds, sodden pieces of paper, empty tins, bins, and all kinds of filth, they pushed aside to be swept away by the currents which were growing faster. ...When they reached the rice-plots, the water had risen to the tops of the rice plants; only the shoots could be seen quivering far apart above the water. But most of the shoots were bent under the weight of litter and branches from upstream. Sanah pushed away the litter from corner to corner with her stick. The litter floated away and clung to another section. She kept pushing the litter till it reached the edge. Milah started by removing a tree-stem as big as a forearm. The stem had destroyed nearly ten rice-plants along the ridge. She pulled the stem aside. She pushed it to the edge and the stem rolled about...wobbled and floated under a pile of litter and moss.'

One interesting adaptation amongst Malay fishermen in Kampung Sabak Tengah and Dasar Sabak (Kelantan) is the dismantling of their wooden houses just before the Northeast

Monsoon Season and move further inland to rebuild them temporarily on higher grounds (New Straits Times 1.12.92). The fishermen engage themselves in the cottage industry or become part-time padi farmers during the monsoon season when they cannot fish. When the monsoon is over, they return back to their kampungs and rebuild their houses, and resume their normal lives.

In contrast, Chinese and Indians do not have the rich variety of flood reduction strategies as Malays, mainly because the majority of them do not live in flood-prone zones. Still, for those who do, Chinese have the greatest tendency to: move upstairs; move vehicles, employ emergency flood proofing of property; ring authorities for advice; and take leave from work. Indians, however, have the greatest tendency to move their belongings and are keenest to adopt new/different strategies when the next flood occurs.

Religion is another cultural trait that significantly affects many aspects of strategy adoption. For example, Buddhists/taoists have the greatest inclination to take steps to reduce flood loss. They are closely followed by Christians, Hindus and Muslims respectively. It should be reiterated that muslims have the lowest tendency to take steps for flood reduction because of their staunch belief that flooding is an 'act of God'. This 'passive acceptance of risk' (Burton et al 1978) is a kind of religious resignation. It reduces the muslim's propensity to adopt flood reduction strategies. To thoroughly understand the muslim's beliefs and actions, one must delve into the 'Koran' but suffice to say here that attributing the cause of flooding to God gives rise to a resigned attitude that 'nothing much can be done about flooding'. According to one farmer,

> '...Allah gives and takes away. My life depends on Allah. If it floods, then it is Allah's will. It is Allah's punishment for people's sins. It is Allah's reminder for the people to lead a good and religious life. What can a mere human like me do? I can only pray to ask for forgiveness. Nothing else. People try raising the stilts and the flood waters become even higher. No one can escape the flood. No one can escape from Allah's hold.'

Besides being more resigned about flooding, muslims also have the greatest tendency to: pray; prepare for evacuation; move livestock; buy provisions; and get the boat ready. On the other hand, buddhists/taoists have the greatest tendency to: move upstairs; move vehicles elsewhere; move belongings; and employ emergency flood proofing of property. They also have the greatest inclination to employ the most number of flood reduction strategies. Finally, christians have the greatest tendency to take leave from work and hindus have the greatest tendency to employ new/different strategies when the next flood occurs.

7.3 Non-structural/societal forces influencing individual flood hazard perception and response

7.3.1 Location

(a) Flood hazard perception

Location has been shown to affect hazard perception significantly (Baker and Patton 1974; Hankins 1974; Waterstone 1978; Fordham 1992). In Peninsular Malaysia, differences in location between East and West Coast, study areas, and urban or rural sites, are expected to affect one's perception. In general, survey results reveal that East Coast respondents are more aware of the flood hazard than their West Coast counterparts, with residents in Kelantan and Pekan being more aware of the flood hazard than their counterparts in Pulau Pinang and Kuala Lumpur. Rural respondents are more aware of floods than their urban counterparts (Appendix L a).

West Coast respondents are generally more optimistic than those in the East Coast, with respondents from Pulau Pinang being the most optimistic and those from Pekan being the most pessimistic. East Coast respondents tend to have higher expectations of future floods compared to those in the West Coast. Kelantan has the highest percentage of respondents who perceive that future floods in the short term would be a certainty. This is followed by Pulau Pinang and Pekan. Kuala Lumpur respondents have the lowest expectations. In perceiving flood frequencies in the long term, Pekan respondents have the highest expectations, followed by Kelantan and Pulau Pinang respondents. Again, Kuala Lumpur respondents have the lowest expectations.

East Coast respondents generally have a better memory of past floods. A significantly higher percentage of East Coast respondents remembered floods before the 1980s. The majority of West Coast respondents, however, remembered only recent floods in the late 1980s and 1990s. This could be due to the fact that the majority of floods in the West Coast are flash floods and are therefore not as severe as the monsoon floods in the East Coast. People tend to remember infrequent major flood events rather than frequent smaller ones.

Despite wider flood hazard experience, East Coast respondents are less aware of flood forecasting methods than West Coast respondents. East Coast respondents also show a greater tendency to believe that 'floods are an act of God' and 'floods come at regular interval'. They are also convinced that they are more adapted to floods than West Coast respondents. In contrast, West Coast respondents are more likely to believe that 'floods are an act of human activities' and/or 'floods are a combined act of humans and nature'. They are also more convinced that 'floods are likely to worsen' and that 'floods can happen anytime'. However, they tend to have more faith in government flood control than their East Coast counterparts. Thus, Kuala Lumpur and Pulau Pinang residents show a greater tendency to agree that flood is an act of human and/or nature than their counterparts in Kelantan and Pekan. They are also more likely to believe that 'floods can happen any time'. Respondents in Pulau Pinang have the greatest tendency to believe that floods will become worse in the future while those from Kuala Lumpur are most likely to believe that the government can control floods.

In general, West Coast respondents show a greater tendency to perceive that floods can be prevented or reduced than their East Coast counterparts. In contrast, East Coast respondents show a greater tendency to perceive praying both as a method of flood prevention and reduction. They also believe that dams and reservoirs would prevent floods. Similarly, East Coast respondents also show a greater tendency to perceive floodwalls, embankments, levees and dykes, the use of river diversions, retention ponds, and the use of boats (for flood reduction only) as measures of flood prevention and reduction. On the other hand, West Coast respondents tend to perceive channel improvement as a method of flood prevention and reduction.

Because of their greater exposure to flood hazards, East Coast respondents tend to perceive a greater number of flood preventive solutions than their West Coast counterparts. Furthermore, East Coast respondents have a greater capacity to perceive most flood reduction strategies as effective than West Coast respondents (Table 7.1)

(b) Adoption of flood hazard reduction strategies

Significant differences exist between East and West Coast respondents in adoption of flood reduction strategies (Appendix L a1). A higher percentage of East Coast respondents live in

Table 7.1: Perception of specific flood reduction strategies as effective by East and West Coast respondents in Peninsular Malaysia and the chi-square significance level

Strategy	West Coast (% Respondents) N=286	East Coast (% Respondents) N=332	Chi-square Test Value
Pray	51.8	81.0	.00
Prepare to move	75.0	89.1	.00
Move upstairs	74.0	84.4	.01
Move out of building	76.9	95.9	.00
Move livestock	68.1	94.6	.00
Move vehicles	93.0	98.1	.01
Flood proof building (P)	43.9	55.8	.02
Flood proof building (C)	29.1	44.3	.00
Flood proof building (E)	32.8	47.7	.00
Flood insurance	40.8	53.9	.01
Warn others on site	69.5	87.3	.00
Warn others elsewhere	67.0	88.1	.00
Buy provisions	77.5	93.9	.00
Turn off electricity	91.2	86.7	.10 (NS)
Listen to weather forecast	62.7	94.4	.00
Phone authorities	45.2	67.0	.00
Elevate floor	44.4	72.1	.00
Change cropping pattern	21.5	56.2	.00
Prepare boat	64.5	95.3	.00
Take leave	66.0	93.4	.00
Fix switches higher	75.8	94.6	.00

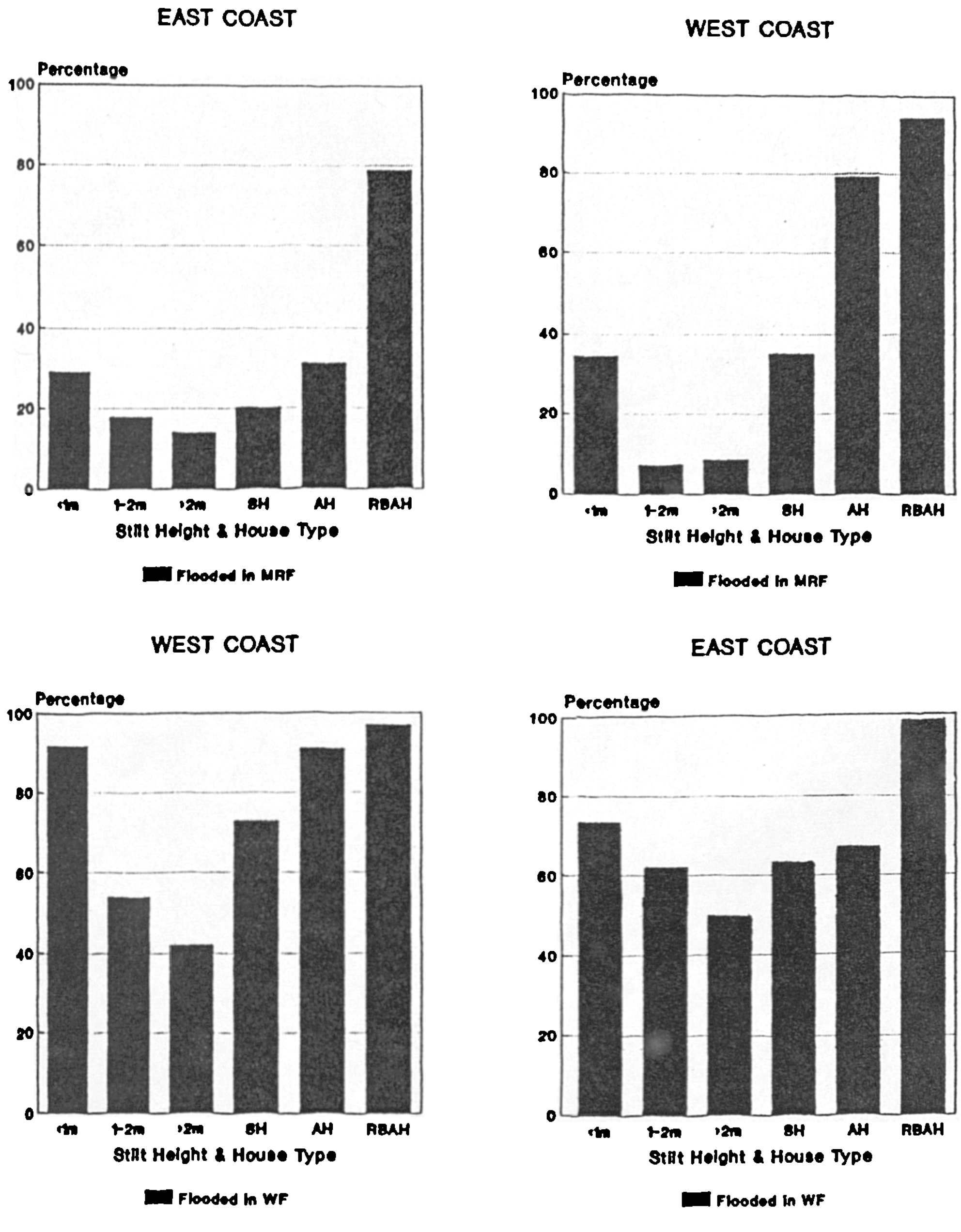
P - Permanent (e.g. building a raised bund around the building).
C - Contingent (e.g. building a removable flood proof door).
E - Emergency (e.g. using sand bags).
NS - Not significant

stilt houses with higher stilts (see Appendix N Table N.10). With higher stilts, East Coast houses are rarely flooded during normal floods but the results of major floods are similar on both coasts (Figure 7.6). East Coast residents are, therefore, more adoptive of the stilt house as a flood reduction strategy than their West Coast counterparts. East Coast respondents also appear to have a greater tendency to adopt more strategies than their West Coast counterparts. For example, during the most recent flood, East Coast respondents adopted an average of four strategies compared to three by West Coast respondents. Half of East Coast respondents used more than three strategies as compared to a fifth of West Coast respondents. East Coast respondents also show a greater tendency to adopt flood reduction strategies (Table 7.2).

In contrast, West Coast respondents are more likely to attempt different/new strategies in future floods than East Coast respondents. This indicates that the former are not yet well adapted to flooding and are still in the process of adapting to it. In the East Coast, flood reduction strategies have evolved for a long time and are quite 'fixed' or stable. East Coast respondents are, therefore, well adapted to floods and are not likely to attempt anything different. East Coast respondents are also more resigned to the fact that seasonal flooding in the East Coast is unavoidable.

During the most recent flood, Kelantan and Pekan respondents adopted more flood reduction strategies than their Pulau Pinang and Kuala Lumpur counterparts (Table 7.3). In Pulau Pinang, respondents have a greater tendency to adopt strategies such as moving upstairs, moving vehicles, moving belongings, turning off the electricity mains and warning others. In Kuala Lumpur, flood proofing of buildings appear to be a common strategy along with moving out of building, moving vehicles, and moving belongings. Because of the high concentration of Malays and muslims in the East Coast, respondents from Pekan and Kelantan are much more likely to resort to praying as a form of flood reduction strategy. People pray not for flood reduction to their property but mainly for the safety of their families. They are also more likely to move livestock, buy provisions, prepare boats and listen to the weather forecast other than the usual moving upstairs, moving out of building, moving vehicles and moving belongings. Because they are used to seasonal monsoon flooding, people from Pekan and Kelantan are also far more likely to prepare for evacuation than those from Pulau Pinang and Kuala lumpur.

However, the urban or rural characteristics of a location do not appear to have significant influences on the adoption of flood reduction strategies. In instances where significant chi-



KEY:

SH	-	STILT HOUSES
AH	-	ALL HOUSES
RBAH	-	REPORTED BY ALL HOUSES

Figure 7.6: 'Percentage flooded' of stilt houses of different stilt heights, all houses and reported flooding by respondents in the East and West Coast of Peninsular Malaysia

Table 7.2: Adoption of specific flood reduction strategies during the most recent flood by floodplain occupants in Peninsular Malaysia and the chi-square significance level

Strategy	West Coast (% Respondents) N=286	East Coast (% Respondents) N=332	Chi-square Test Value
Pray	3.6	15.8	.00
Prepare to move	12.0	45.4	.00
Move upstairs	22.1	37.7	.00
Move out of building	22.5	26.0	NS
Move livestock	7.2	25.3	.00
Move vehicles	32.1	36.3	NS
Move belongings/house contents	79.1	52.4	.00
Flood proof building (P)	11.6	10.3	NS
Flood proof building (E)	9.2	2.9	.00
Warn others on site	6.0	5.5	NS
Warn others elsewhere	5.6	3.3	NS
Buy provisions	3.6	27.5	.00
Turn off electricity	8.4	11.0	NS
Listen to weather forecast	4.4	25.6	.00
Phone authorities	2.0	3.7	NS
Elevate floor	4.4	8.1	NS
Prepare boat	10.4	32.6	.00
Take leave	3.6	2.9	NS
Fix switches higher	2.4	3.3	NS
Used > 3 strategies	22.1	50.2	.00
Used > 6 strategies	1.6	10.3	.00

P - Permanent (e.g. building a raised bund around the building)
E - Emergency (e.g. using sand bags)
NS - Not significant

Table 7.3: Adoption of flood reduction strategies by respondents from different sample areas in Peninsular Malaysia during the most recent flood

Strategy	P.P.	Kel.	K.L.	Pek.	Chi-square Test Value
Pray	3.8*	11.3	3.3	21.1	.00
Prepare to move	4.5	38.7	25.0	53.7	.00
Move upstairs	31.2	34.0	7.6	16.3	.00
Move out of building	11.5	41.3	40.2	33.3	.00
Move livestock	8.3	34.0	5.4	14.6	.00
Move vehicles	33.1	48.0	30.4	22.0	.00
Move belongings	83.4	54.0	71.7	50.4	.00
Flood proof building (P)	7.0	2.7	19.6	19.5	.00
Flood proof building (E)	6.4	3.3	14.1	2.4	.00
Warn others on site	7.0	5.3	4.3	5.7	.84 (NS)
Warn others elsewhere	8.9	4.0	0.0	2.4	.00
Buy provisions	5.7	34.0	0.0	19.5	.00
Turn off electricity	11.5	14.0	3.3	7.3	.03
Listen to weather forecast	5.7	24.0	2.2	27.6	.00
Phone authorities	3.2	4.7	0.0	2.4	.20 (NS)
Elevate floor	7.0	4.7	0.0	12.2	.00
Prepare boat	12.1	22.0	7.6	45.5	.00
Take leave	2.5	3.3	5.4	2.4	.59 (NS)
Fix switches higher	1.3	2.0	4.3	4.9	.23 (NS)
Used >3 strategies	22.3	55.4	21.8	43.9	.00
Used >6 strategies	1.3	8.7	2.1	12.2	.00

P.P. - Pulau Pinang (N=172)
Kel. - Kelantan (N=192)
K.L. - Kuala Lumpur (N=114)
Pek. - Pekan (N=140)
* Figures are percentages of respondents in each sample area
P - Permanent (e.g. building a raised bund around the building)
E - Emergency (e.g. using sand bags)
NS - Not significant

square results are obtained, they are likely to be due to some other variables. For example, rural respondents are more likely to be poorly educated, belong to the lower income group, mostly of Malay origin and have less occupational as well as residential mobility.

7.3.2 Flood characteristics

(a) Flood hazard perception

Flood characteristics such as frequency, recency, type, and magnitude/severity may affect a person's perception. The influence of hazard frequency and recency is well documented by Kates (1962), White (1974), Harding and Parker (1974). However, although magnitude/severity has been shown to be influential by some researchers (Kates 1962; Baker and Patton 1974), its influence has also been found to be insignificant by others (Harding and Parker 1974).

In the current research, flood type is either riverine, tidal or a combination of both, i.e. riverine-tidal. Flood severity is defined in terms of total actual damage. Of the four flood characteristics, frequency appears to significantly affect perception as seen by the significant chi-square results of the majority of the questions (Appendix L (b)). Flood recency and flood type appear to be influential for only a minor section of the questions while flood severity is generally not significantly associated with almost all questions pertaining to perception.

In terms of **flood frequency**, those flooded more frequently are more aware of the flood hazard, are more optimistic, and have higher expectancies of future flooding. They are also less likely to perceive flooding as a freak event (i.e. more likely to perceive flooding as a common event), and believe that floods could happen any time rather than occurring at regular intervals. They are more convinced that flooding is likely to worsen, and less likely to believe in the government's ability to control floods. They are more concerned about flood prevention and reduction strategies, and pay more attention to the media when such strategies are broadcasted. Those who are flooded only once a while generally do not pay much attention to such broadcasts but are instead more concerned about day-to-day problems such as unemployment, inflation or other more pressing issues confronting them. Finally, frequently flooded respondents are rather optimistic about the effectiveness of flood reduction strategies but those flooded on the rare occasion are not knowledgeable about such strategies and are sceptical of their effectiveness.

Flood recency does not appear to be significantly associated with most of the answers on perception but there are some exceptions (Appendix L b). Those flooded more recently are more aware of the flood problem, show a higher expectancy of future flooding, and are likely to believe that flooding is caused by nature and/or humans. They perceive flooding as a common event occurring irregularly (at any time), are convinced that floods would worsen in the future and believe that they are used to floods.

In terms of **flood type**, those living in areas flooded by a combination of river and tidal floods (for example in estuaries and delta areas) are more aware of flooding as this is the most severe and frequent flood type and people are therefore more concerned and aware about it. They also believe that raising the *ground/floor level of houses would help reduce* flood losses. This is because a significant percentage of the respondents occupying areas affected by river-tidal floods live in traditional wooden houses whereby floors can be easily raised by adding in another layer of planks. Those living in areas affected by river floods also believe this method would work. In contrast, those affected by tidal floods live in concrete houses in urban centres and raising the floor level may prove difficult and expensive.

Respondents living in areas affected by tidal floods have a greater tendency to perceive future flooding as almost certain. This is because tidal floods are regularly occurring, and in many of the lower-lying areas affected by such floods, the frequency of occurrence is twice a month. They also have the highest estimate of future flooding over a 100 year period, have a greater tendency to perceive flooding as a common occurrence and that it is not serious. They do not believe that the government have flooding under control.

In the perception of the effectiveness of methods of flood reduction, there is generally no significant difference in perception amongst respondents living in areas with different flood-type. However, respondents affected by tidal floods are less inclined to believe that moving out of the building will work because they are not too bothered about tidal flooding which is not as severe as river flooding. They are more inclined to believe that warning others on site or elsewhere would help reduce flood loss. In contrast, those affected by river-tidal floods show a greater tendency to believe that listening to the weather forecast would effectively reduce flood loss.

The results of tests of associations in Appendix L (b) revealed that there are generally no significant differences in perception (in the majority of the questions asked on perception) between respondents who experienced different degrees of **flood severity** (in terms of flood losses suffered during the worst flood).

(b) Adoption of flood hazard reduction strategies

In general, tests of associations reveal that flood characteristics (frequency, recency, type and severity) do not appear to have significant influences on the adoption of flood reduction strategies (Appendix L b1).

However, there are some exceptions. Those who are flooded more frequently have a greater tendency to employ reduction strategies, show a greater tendency to prepare for evacuation but have a lesser tendency to move belongings. This is due to the fact that they are well prepared and have previously moved their belongings (for example storing them in the attic). Those flooded more recently (within the last three years) are more likely to have adopted flood reduction strategies, resorted to praying but are less likely to have employed flood proofing (emergency and permanent).

Respondents flooded by a combination of tidal and river floods are most likely to have adopted flood reduction strategies than those affected solely by either river or tidal floods. They are also more likely to have prayed, used permanent flood proofing of their properties (except emergency flood proofing), bought provisions, listened to the weather forecast and had the boat ready for evacuation. They also tend to employ the most number of strategies. Finally, those flooded by tidal floods are most likely to move belongings.

7.3.3 Building characteristics

(a) Flood hazard perception

In many rural flood-prone areas, respondents living in stilt houses may perceive and respond to floods quite differently from those who live in houses without stilts. Other than the stilt variable, building characteristics such as house type, wall type, age of house and floor type are also tested against all questions on perception.

Results in Appendix L (c) indicate that building type, wall type, floor type and whether or not the building is built on stilts are the variables that have a significant influence on people's perception. However, further cross-checking between these variables indicates that the 'stilts' variable is the predominant one. The other variables show up significantly because they are highly associated with the stilt variable. For example, 75.0 per cent of detached buildings are built on stilts, hence the 'detached' characteristic of buildings does not have a 'real' effect on perception, the likely effect of which comes from the stilt variable. It only has what is termed a 'spurious effect'. The correlation test revealed a significant value (at .001 level) of .33 between building type and 'with/without stilts'. Similarly, wall type and floor type are also two variables highly correlated with the stilt variable, yielding a correlation coefficient of -.52 (significant at .001) and -.49 (significant at .001) respectively. These variables are, therefore, not further analysed with respondent's perception in this section, but the chi-square test values are indicated in Appendix L (c). In contrast, building age does not appear to have significant correlations with the stilt variable and is further tested against all the perception questions. However, the focus of this section is on the 'stilt' variable, as it is expected to be the main influence on perception.

Respondents living in houses with stilts are more aware of floods, more optimistic, and have higher expectancies of future floods. They also tend to believe that flooding is an act of God, a common occurrence, and occurs at regular intervals. More significantly, they tend to believe that they are 'used to' floods. They also show a significantly greater tendency to resort to praying as a form of flood prevention and reduction, and tend to perceive the majority of individual flood reduction strategies to be effective.

In contrast, respondents living in houses without stilts show a greater tendency to agree that flooding results from 'human activities' or from a combination of 'natural phenomena and human activities'. As a result, they are more inclined to perceive structural methods such as artificial drainage, the removal of debris from rivers, improving river channels, flood proofing of buildings and the use of cover crops as forms of flood reduction. They perceive that floods are freak events, likely to worsen, can happen any time, and do not believe that they are being controlled by the authorities. Finally, they tend to believe that floods can be prevented and reduced.

Building age does not appear to have any significant effect on the perception of respondents living in newer or older houses for the majority of the perception questions. However, the few exceptions are highlighted here. In general, respondents living in houses more than 60 years old are more aware of flooding than those occupying houses between 11 to 60 years old. However, respondents living in houses less than 11 years old are most aware of flooding. This is due to the fact that the majority of them are squatters living in flood-prone areas. If squatters are taken out of the analysis, then there are no significant differences in perception between those living in old and new houses.

(b) Adoption of flood hazard reduction strategies

On the whole, building characteristics do not appear to have significant effects on the adoption of adjustment (Appendix L c1). However, in many instances, respondents living in houses with stilts are found to respond differently to flood hazards than those living in houses without stilts. For example, those living in houses with stilts show a greater tendency to pray, prepare for evacuation, move out of their houses, move livestock, buy provisions, listen to the weather forecast and get the boat ready. They also tend to adopt a greater number of flood reduction strategies.

In contrast, as might be expected, those living in houses without stilts show a greater tendency to move upstairs, move vehicles elsewhere, move belongings, and adopt emergency flood proofing of property. They are also more likely to adopt new or different strategies in future floods.

7.3.4 Socio-economic characteristics and flood hazard perception and adoption of flood hazard reduction strategies

The influence of socio-economic variables on hazard perception and adjustment is well documented (see Appendix J). In the current research, the independent variables are length of residence, age, education, family size, ethnic group, religion, occupation, income, gender, tenure and group membership. These variables are tested against all questions on perception and the results in Appendix L (d) indicate that the majority of socio-economic variables do not have significant associations with perception and the adoption of flood hazard reduction strategies, with the exception of ethnic group and religion. The influence of these two variables (as structural forces) on perception has been examined earlier in Section 7.2.3 (a).

7.3.5 Attitudes

(a) Flood hazard perception

In relating attitudes to flood mitigation schemes against perception, Fordham (1992) has shown that those who had a higher expectation of flooding are more likely to show support for flood hazard reduction schemes while those who are more prepared to live with the flood risk tended to show less support. However, survey results indicate that attitudes (e.g. on religious beliefs and attitudes towards government) affect only a minority of the questions on perception (Appendix L e).

Those who believe that flooding is an act of God are more optimistic, more aware of floods, and have higher expectancies of future flooding. They tend to resort to praying as a form of flood prevention and reduction and perceive it as an effective method. In contrast, those who do not believe that flooding is an act of God have a greater awareness of flood forecasting methods, have a greater tendency to perceive flooding as due to natural and/or human activities, are more inclined to perceive that it is getting worse and that it could happen any time. They believe that floods can be prevented and/or reduced. Consequently, they tend to believe in human methods of flood reduction such as artificial drainage, the use of cover crops and the removal of river debris. They also tend to suggest shifting house contents as a form of flood reduction and have a greater tendency to suggest more methods of flood reduction.

Attitudes towards the government also influences a respondent's perception. For example, those who have a positive attitude towards the government (i.e. they believe that the government is capable of controlling floods) are more aware of floods and have a greater tendency to believe that flooding is an act of nature. They also tend to believe that floods can be prevented and/or reduced and believe in improving river channels as a form of flood reduction. They also believe in telephoning the authorities to get information to help them in flood reduction.

In contrast, those who have a negative attitude towards the government tend to believe that floods occur at regular intervals and that the floods would worsen. They also tend to believe that the authorities have not studied and understood the flood problem thoroughly. They tend to believe in self-help strategies[82] such as evacuation, raising floor levels, getting boats ready, shifting contents and planting cover crops as forms of flood reduction. Because they do not believe in government flood management, they tend to rely more on themselves and consequently have a greater capacity to perceive and suggest more strategies for flood prevention and reduction.

(b) Adoption of flood hazard reduction strategies

The chi-square test results in Appendix L (e1) generally show that attitudes do not have significant influences on the adoption of flood reduction strategies. However, there are some exceptions. For example, those who believe that flooding is an act of God have the greatest tendency to adopt the following strategies:(1) pray; (2) prepare for evacuation; (3) buy provisions; and (4) listen to the weather forecast. In contrast, those who believe that flooding is due to human activities (an objective attitude) have the greatest tendency to: (1) prepare for evacuation; (2) employ permanent flood proofing of property; (3) employ emergency flood proofing of property; (4) warn others elsewhere; (5) take leave from work; and (6) use new/different strategies when the next flood occurs.

Respondents who believe that floods are a common phenomenon (i.e. possessing a more 'concerned' attitude towards flooding) in their locality generally show a greater tendency to take steps to reduce flood losses. In contrast, those who believe that floods are uncommon or not serious in their locality (i.e. possessing a less concerned attitude towards flooding) show the least tendency to do so.

Those who have a positive attitude towards government flood management (i.e. believe that the government can control floods) have a greater tendency to move out of their properties when flooding occurs. Many of these are floodplain occupants who have benefited in some ways from government flood mitigation schemes. This may be in the form of flood warnings, temporary evacuation and shelter, food, rescue, relief and rehabilitation, and other forms of aid. Respondents living in cities may also have benefited from structural/engineering flood mitigation schemes. Political propaganda via the media can also influence attitudes towards

[82] Self-help or self-reliance of the local community is a well documented strategy in disaster management. When confronting disasters many vulnerable communities from Third World countries cope reasonably well in adversity through self-reliance (Davis 1981; Blaikie et al 1994 pp61-70).

such schemes. This group of respondents are less active when it comes to the adoption of flood reduction strategies as they rely heavily on official help. Years of over-reliance on government aid have developed a positive attitude towards the government but has rendered them more vulnerable to floods as 'self-help', 'survival instinct' and the ability to recover by various traditional flood reduction strategies are gradually lost through leaving the fight against floods to the authorities.

In contrast, those with a negative attitude towards government flood hazard management have a greater tendency to adopt strategies such as moving vehicles elsewhere, moving belongings, and buying provisions. This group of respondents consists of those who have either not received any form of aid from the government, or those who have received insufficient help. Some may also have received warnings which are not followed by actual flooding. In the state of Kelantan where the people support the opposition PAS government, it is not surprising that their attitude towards the federal government would not be favourable. This group of respondents are therefore more inclined to act positively in times of floods. They do not 'trust' government promises/schemes and would rather 'help themselves' in their adoption of flood reduction strategies.

7.3.6 Perceptual characteristics

(a) Flood hazard perception

It is envisaged that perceptual characteristics such as flood awareness, outlook in life (optimistic or pessimistic) and perception of future flood risk can have significant influences on how people perceive other aspects of floods. Survey results reveal that those who are aware of floods in their locality are generally more optimistic, have higher expectancies of future flooding, and are more aware of flood forecasting methods. They are more inclined to agree that flooding is an act of God and, therefore, are more likely to believe in praying. They perceive floods as serious problems but are also likely to believe that they are used to them. They tend to perceive floods as common rather than freak events and are more likely to believe in the government's ability to manage floods.

Survey results also reveal that optimistic respondents are more aware of floods, have higher expectancies of future flooding, and are more aware of flood forecasting methods. They tend to believe that flooding is an act of God, that it is a common occurrence, and are more likely to believe that they are used to it.

The perception of flood frequency is measured by Question 11. Respondents are asked to give their expectation of the number of floods occurring in their present property if they were to live 100 years. The results in Appendix L (f) reveal that respondents with different perception of flood frequency in their locality perceive flood hazards differently. For example, those who perceive flood frequencies 1 in 3 years or less are more likely to be pessimistic, less aware of floods in their locality and believe that the chances of future flooding is almost negligible. They are less aware of flood forecasting methods, believe that flood is a freak event and perceive flooding as not serious.

In contrast, those who perceive flood frequencies 1 in 1 year or more are more likely to be optimistic, more aware of floods in their locality, and believe that the chances of future flooding is almost certain. They are more aware of flood forecasting methods and believe that flood is a common event which can happen any time. They perceive flooding as a big problem but believe that they are used to them. They feel that flooding is likely to worsen in the future although they believe that floods can be reduced.

(b) **Adoption of flood hazard reduction strategies**

Respondents who are aware of floods generally have a greater tendency to take steps to reduce flood losses compared to those who are not (Appendix L f1). They are also more likely to adopt strategies such as moving livestock, buying provisions, and getting the boat ready. In contrast, those not aware of floods are more likely to adopt impromptu strategies such as moving vehicles, moving belongings and attempting emergency flood proofing. Plate 7.2 shows the likely result of not moving one's vehicle.

Whether a person is optimistic or pessimistic in perception also affects the adoption of strategies. For example, those who are optimistic have a greater tendency to move out of buildings when flood occurs. This is because the majority of the optimistic are East Coast farmers or fishermen who are evacuated frequently or are warned frequently to evacuate. Moving out of buildings is therefore a normal routine to them. The optimistic also have a greater tendency to get the boat ready as a form of precaution. On the other hand, the pessimistic have a greater likelihood to move their vehicles elsewhere. This is expected as they have a higher expectation of floods than the actual. The pessimistic also have a greater

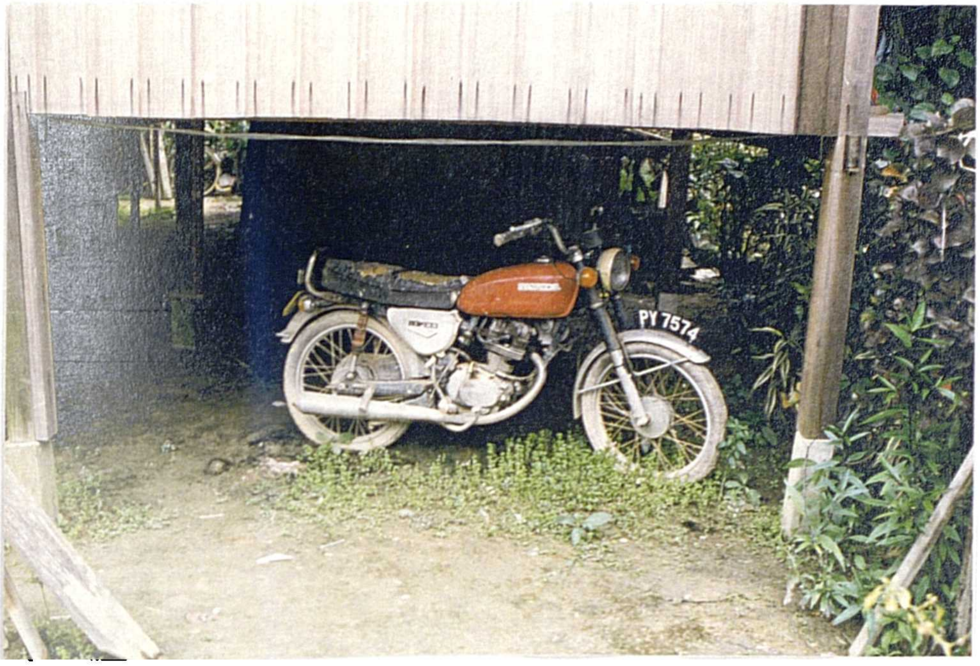


Plate 7.2: Top: A rusted motorbike (estimated value $1,500 when it was roadworthy) destroyed during one of the frequent floods in Kampung Seronok, Pulau Pinang . Bottom: A motorcar (estimated value $7,000 when it was roadworthy) destroyed by floods is cannibalised and left to rust in the Kota Bharu area. Note the flood mark of the recent flood on the wall of nearby building.

inclination to adopt emergency flood proofing methods.

The perception of flood frequency also has an effect on strategy adoption. In the current research, those perceiving a high flood frequency are more likely to take steps towards flood loss reduction than those perceiving a low flood frequency. For example, 90.3 per cent of respondents perceiving a flood frequency of at least once a year have taken steps to reduce flood loss. On the other hand, only 77.8 per cent of respondents perceiving a flood frequency of once in three years or less do so. Respondents perceiving a high flood frequency also have a greater tendency to prepare for evacuation and buy provisions as flood reduction strategies.

In contrast, respondents perceiving a low flood frequency have a greater tendency to move their vehicles elsewhere and move their belongings. This is expected, as those perceiving low flood frequencies generally live in less flood-prone areas. As such, an unexpected flood inevitably results in frantic moving of furniture, carpets, electrical appliances, clothes etc.. On the other hand, those perceiving high flood frequencies generally live in the most flood-prone areas and are well adapted to floods. As such, they have already put away their belongings in high places. For example, electrical appliances, furniture and other expensive belongings are usually put on the first floor or in the attic (Plate 7.3) while the ground floor is usually empty and used as a play area for children and for storing inexpensive things. When electrical appliances are located on the ground floor, they are usually propped up to prevent them from being flooded (Plate 7.4).

7.4 Summary

This chapter has demonstrated that both structural and non-structural contextual forces affect (to varying degrees) individual perception and response to flood hazards. It indicates that structural forces such as poverty, educational attainment and cultural background (mainly ethnicity and religion) strongly influences individual perception and adoption of flood reduction strategies. Likewise, non-structural forces such as location, flood frequency, building type (with or without stilts), attitudes and beliefs, degree of optimism and flood hazard awareness are also significantly associated with individual perception and response.

Although structural forces have been shown to put constraints on an individual's situation and hence limit the scope of action, they are not totally inhibitive. People do have some room for manoeuvre/action in the face of disasters. Blaikie et al (1994 p61) assert that 'people faced

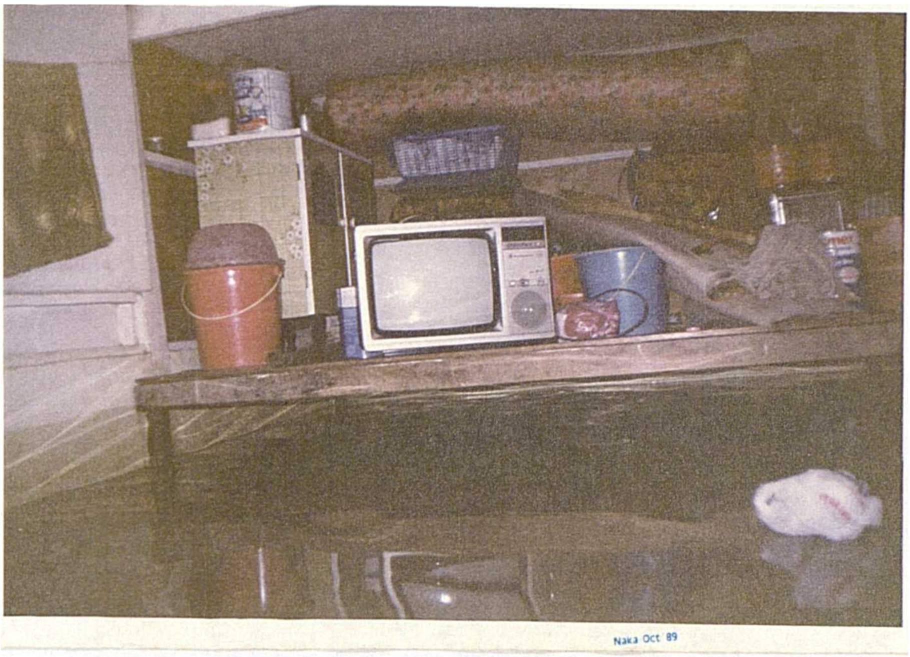


Plate 7.3: The storing of electrical appliances and other expensive belongings on shelves in the attic of two house's in Kampung Pantai Dalam, Kuala Lumpur

Plate 7.4: Top: The propping up of a refrigerator to prevent it from being flooded. Notice the high location of electrical sockets as a form of flood damage reduction (from a respondent's house Kampung Tendong, Pasir Mas, Kelantan). Bottom: The propping up of cooking utensils in the same house

with disasters develop strategies to try to secure their livelihoods and are not passive recipients of a profile of opportunities hedged about by constraints of the political-economy of which they are a part'. Thus, there is a consistent evidence of the high 'coping ability' amongst disaster victims (Davis 1981 p14). In Peninsular Malaysia, the majority of floodplain occupants have attempted (employed strategies) at one time or another to reduce flood losses. Malaysians were generally found to have developed a wide range of individual flood reduction strategies, the most unique of which is the stilt house. Incorporating the principle of the stilt house into modern low cost houses may be an effective government strategy. Government should therefore capitalise on traditional mechanisms and help individuals more effectively respond in the way that they do.

This chapter has examined the influence of *structural and non-structural contextual* forces on individual flood hazard perception and adoption of flood reduction strategies. The next chapter focuses on an in-depth 'segment analysis' of the 'flood warning and evacuation' and 'income equity' segments.

8 SEGMENT ANALYSIS ON 'FLOOD WARNING AND EVACUATION SYSTEMS' AND 'INCOME EQUITY' IN RELATION TO FLOOD HAZARDS

8.1 Introduction

Segment analysis is pioneered in this research as a method of investigating links between 'contexts' (contexts may also be termed 'contextual forces'). In segment analysis, contexts affecting flood hazard creation and human vulnerability are visualised as spheres of influence, with broader contexts having spheres which encompass narrower contexts within them. Individuals are conceptualised as situated at the core of all the contextual spheres which affect them. The broadest contexts, i.e. those having the greatest influence, are situated at the outermost spheres. They include the socio-cultural, the political economy and the institutional contexts. Segments are issues, problems, ideas or political ideology which cut across all these spheres. Because of this, the analysis of segments reveals links and relationships between contexts which may have profound influences on one another. The methodology on segment analysis has already been examined in detail in Chapter 2.

This chapter focuses upon two key 'segments' or components of the flood hazard in Peninsular Malaysia, viz. the flood warning and evacuation segment and the income equity segment, and traces them through from the socio-cultural and political economy contexts, to the institutional context and to individuals (Figure 8.1).

The flood warning and evacuation segment is selected because warning and evacuation are important responses to flood hazards in Peninsular Malaysia, both as formal/government response and as traditional/cultural response[83]. While informal warning and evacuation of the traditional kind have been practised by floodplain inhabitants in the peninsula for centuries and are still an important part of seasonal response to monsoonal floods, many formal[84]

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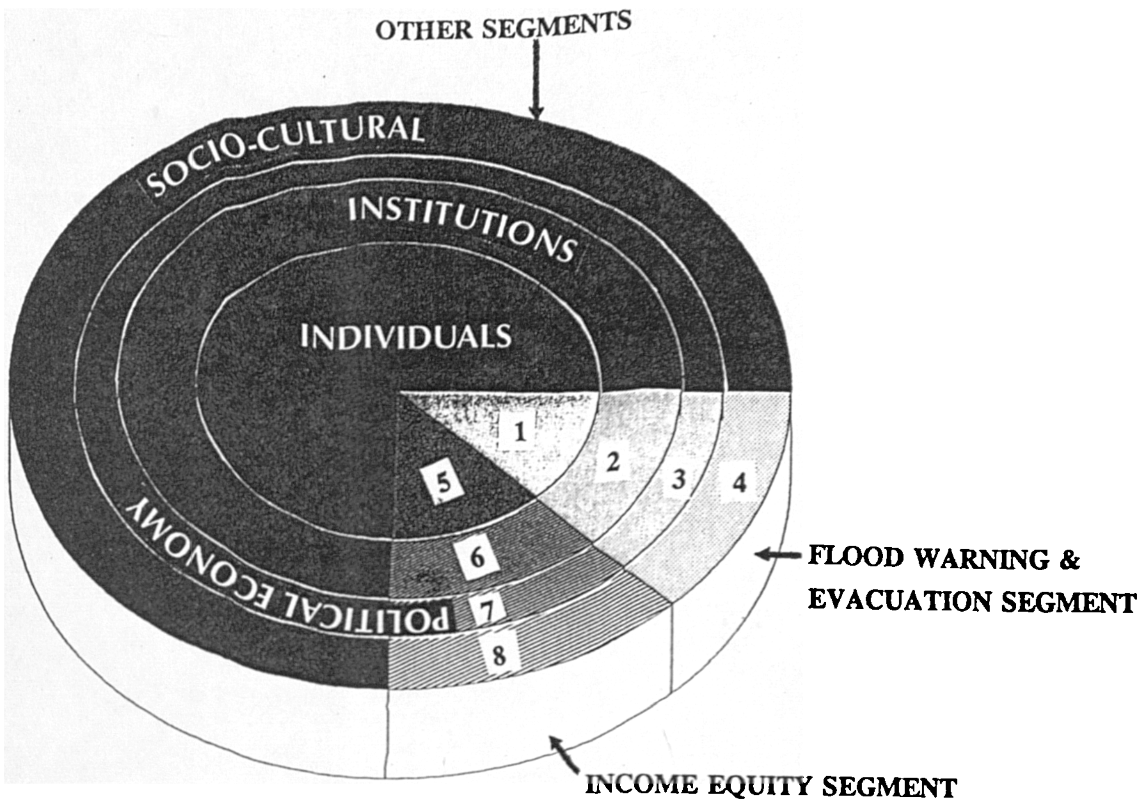
[83] In this research, official/government flood warning and evacuation systems set up and managed by the FDRPC and other government agencies are termed 'formal flood warning and evacuation systems'. In contrast, traditional/cultural flood warning and evacuation systems which are organised and operated by flood victims are termed 'informal flood warning and evacuation systems'.

[84] Formal flood warning and evacuation systems are official systems operated by flood hazard organisations (e.g. the FDRPC) set up by the government. In contrast, informal flood warning and evacuation systems are traditional systems largely operated by flood victims themselves, usually on a kampung scale.



KEY:	
1	Flood wardens, ketua kampungs, District officers, mayors, elected members of parliament, other government officers and flood victims
2	Official/formal flood warning and evacuation systems, DID, MMS, Police Department, Information Department, District Office, local authorities and other agencies
3	Technocentric approach, economic policies, transfer of technology, neo-colonialism, and federal-state politics
4	Traditional/informal flood warning and evacuation systems, ethnicity, culture, religion, and attitudes
5	Flood victims who are impoverished farmers and other rural inhabitants, wealthy urban businessmen and other well to do urban inhabitants, and other middle income earners
6	State Economic Development Corporations, Federal Land Development Authority, Welfare Department, Municipal Councils, City Halls, political parties voluntary organisations
7	Communalism, NEP, Sixth Malaysia Plan, National Development Policy, and Vision 2020
8	Colonialism, economic function with ethnic group, ethnic values, religious influence, and ethnic harmony

Figure 8.1: The 'Flood warning and evacuation' and 'Income equity' segments within spheres of influence of contextual forces

systems were established fairly recently. More interestingly, formal 'flood warning and evacuation systems' (FWESs) have incorporated many of the practical aspects of informal FWESs. As such, the scope for individual action and self-determination is expected to be greater when responding to warning and evacuation than would, say the choice to live in flood zones. In Peninsular Malaysia, flood hazard policies translated from political ideology emphasise evacuation procedures. By tracing through the contextual spheres of influence of the segment, the chapter aims to reveal the intricate links and influences each level has on one another. For example, it aims to discover the extent to which socio-cultural and political economy contexts from the top constrain and limit the effectiveness of formal FWESs of institutions in the middle, and how both these contextual forces in turn impact upon individual response to warnings and evacuation. Likewise, the extent to which institutional contextual forces influence decisions at the top and how individual action affects flood warning and evacuation effectiveness at both the institutional and socio-political levels are also analysed.

The income equity segment is selected because it is a central issue in the development of modern Malaysia. Peninsular Malaysia is a first class example of a divided society in terms of income and ethnicity, and also in other terms including the marked division between its East and West Coasts, rural and urban populace, and between the sexes (gender). Tracing through the equity segment enables the researcher to examine the extent to which socio-cultural (ethnicity, religion and others) and political economy (political ideology, economic policies and others) contextual forces reinforce or reduce inequality. It is hypothesised that individuals have far less room for manoeuvre in the quest for income equity, an issue largely created by structural contextual forces. Analysing the influences between the contextual forces at various levels not only establishes the links but also bring to the surface the question of whether or not the equity issue is being tackled. Because income equity is linked closely to poverty, the key questions explored by this segment, then, are: (1) To what extent are contextual forces ranging from the socio-cultural, political economy, through to the institutional reduce people's vulnerability towards floods?; (2) To what extent do flood hazards contribute towards undoing wealth accumulation and reinforcement of poverty?; and (3) To what extent do flood hazard policies recognise (1) and (2) and attempt to support (1) and reduce (2)?

Investigating the income equity segment will entail discovering whether or not income inequality amongst the ethnic groups (mainly between Malays and non-Malays) is being reduced by flood hazard response at all levels. Successive Malaysian governments since independence (including the current one) have been trying to bridge income and other inequalities between Malays and non-Malays. Thus, are flood hazard policies and those relating to it, institutional response and individual response bridging such inequalities? For example, flood mitigation schemes targeted at reducing flood losses in the poverty-stricken rural agrarian sector (mostly Malay) can contribute significantly to reducing income inequalities but when such schemes are targeted in densely populated urban areas (wealthy areas comprising mainly Chinese), then the inequality gap would widen further. These are the other questions in which this section aims to explore.

8.2 The flood warning and evacuation segment

This section analyses the extent to which socio-cultural and political economy contextual forces influence individual response to FWESs[85] via institutions. There are two sub-sections: (1) Section 8.2.1 examines the damage-savings accruing from FWESs. Specifically, it aims to establish the importance and potential of these damage-savings to individuals in terms of flood hazard reduction. Damage-savings reflect the scope for individual action. For example, the amount of damage-savings is dependent on how effectively individuals take advantage of FWESs through actively taking part in both formal and informal FWESs; (2) Section 8.2.2 is the main section on segment analysis which attempts to identify the links between the socio-cultural and political economy contexts (macro level), the institutional contexts (meso level) and individuals (micro level) via the flood warning and evacuation segment. While the influence of contextual forces at all levels on one another is analysed, the scope for individual action (especially in actively taking part in informal FWESs and responding effectively to formal FWESs) is emphasised.

The overall effectiveness of FWESs is complicated and is seen as a web of links between all three levels in which inadequacies at any level will weaken the entire warning and evacuation system. Such inadequacies are demonstrated by the negative impacts of warning and evacuation systems on individuals/households. In other words, the effectiveness of warning and evacuation systems from the end user's (individual floodplain inhabitant) viewpoint is examined.

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[85] When it is not specified whether the system is a formal or informal one, the term FWES is then used in a general sense and/or implies relating to both formal and informal systems.

8.2.1 Damage-savings of flood warning and evacuation systems

The risk, exposure, vulnerability and flood damage potentials of flooding in many parts of the peninsula has increased substantially in recent decades because of progressive if not accelerated developments in floodplains (JICA 1991; Chan and Parker Forthcoming). Chapter 2 (Section 2.1.3) and Appendix K demonstrate that the level of annual flood damage suffered both by individuals and public bodies in the peninsula is substantial. Effective FWESs can help reduce flood loss and damage or alternatively increase damage-savings. This is an area where individuals are expected to play a more active role as they are not expected to be constrained by structural or other contextual forces. Because of this freedom and greater scope for action and self-determination, individuals are expected to take advantage and develop/play active roles in informal FWESs and heed official advice by responding more positively to formal FWESs[86].

Warning systems are non-structural/non-engineering flood mitigation measures the principal benefits of which are to help save lives and reduce flood loss. There is a considerable volume of literature supporting the beneficial effects of such systems on reducing flood damages (Day and Bugliarello 1969; Gruntfest 1977; Chatterton and Farrell 1977; Penning-Rowsell and Chatterton 1977; Penning-Rowsell et al 1978; Penning-Rowsell et al 1983; Smith and Handmer 1986; Neal and Parker 1989; Turnstall et al 1991). Using a linear model, Parker (1991b) found that flood damage savings can be significantly increased with improved reliability of the flood warning system, although the proportion of households available to receive a warning, and the proportion able to respond to a warning effectively, are also important.

In Peninsular Malaysia, the benefits of warning systems have been noted by The Technical Sub-Committee for Flood Control (1968), Leigh and Low (1978), DID (1983, 1988b), Jamal Abdullah (1991, Undated). As early as 1968, after the 1967 major flood which affected much of the peninsula, The Technical Sub-Committee for Flood Control (1968 pix) reported that expenditure (usually involving large outlays which severely taxes the country's financial

[86] However, it is recognised that certain groups such as the elderly, children, the disabled and those with health problems are more vulnerable during disasters and would encounter difficulty when responding to flood warning and evacuation systems (Welsh Affairs Committee 1990; Blaikie et al 1994).

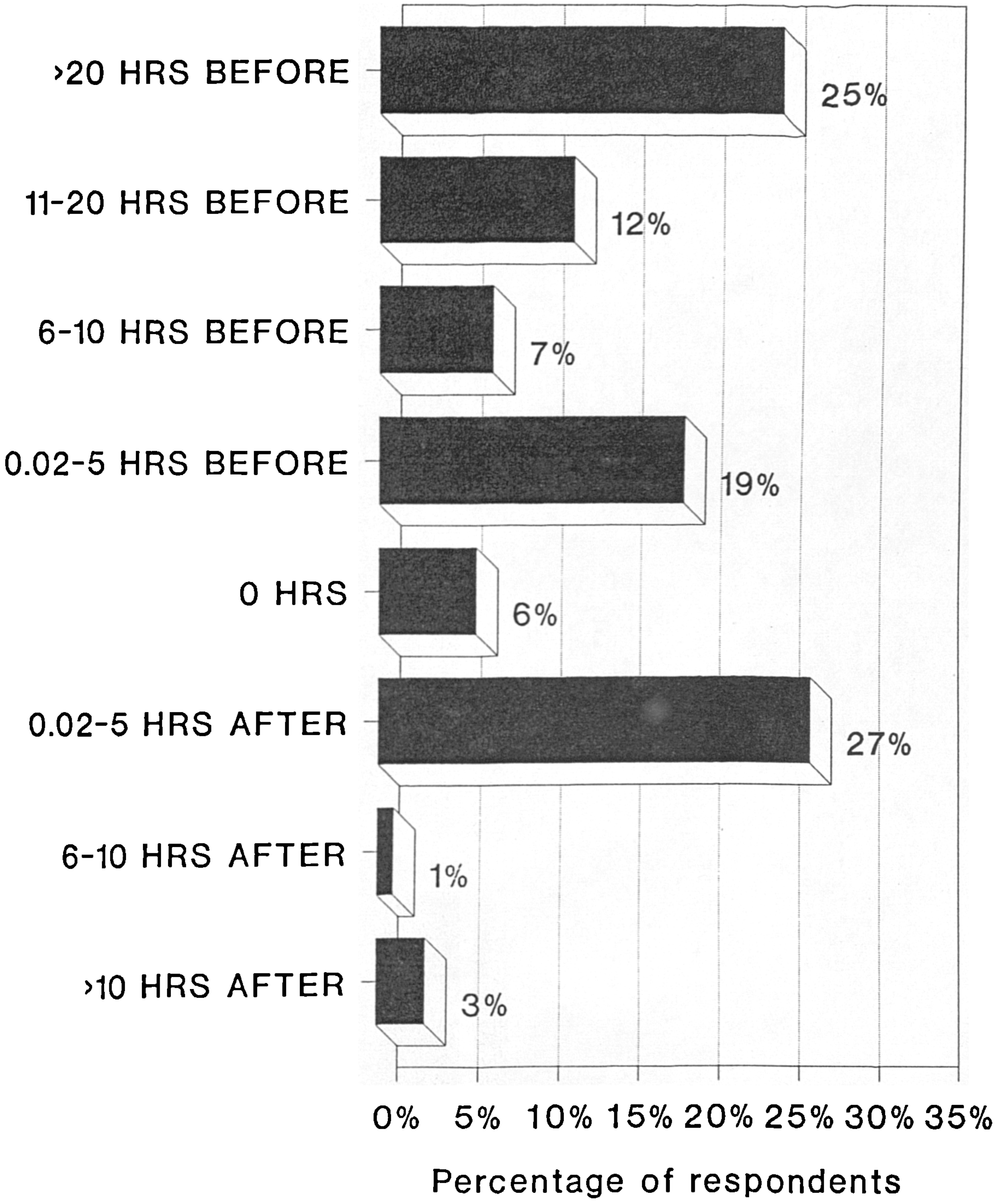
resources) on major structural/engineering flood mitigation projects (such as flood control reservoirs and major river-mouth dredging operations) are not warranted. Instead, it suggested a number of practical measures concerned with the modification of loss potential (which would not over-burden the financial resources of the country), one of which was the improvement of forecasting and warning systems. Despite improvements on warning systems over the years, this flood damage mitigating potential has not been fully realised as such systems are inadequately funded and have not been developed to their full potentials (see Chapter 5). Therefore, there is still a great potential for flood loss reduction to be gained by fully developing forecasting and warning potentials and bringing the systems up-to-date.

Flood damage savings are benefits from responses *taken as a result of receiving a flood* warning before the onset of flooding. In the current research, the average amount of estimated damage savings attributed to warnings varies according to sample area, with households in the two West Coast areas estimating much higher damage savings than the two East Coast areas (Table 8.1). Kuala Lumpur households, by virtue of having higher incomes, better houses, more house contents and other belongings (notably cars) have the highest damage savings estimates. In contrast, relatively poorer households in the Pekan area have the lowest damage savings estimates. Damage savings per household in the peninsula can be substantially increased if a greater percentage of flooded households are warned. In the most recent flood, only 36.4 per cent of households were warned. Furthermore, warning lead times have not been sufficiently long enough for households to respond effectively to reduce damage to belongings. Figure 8.2 reveals that 37.0 per cent of households flooded in the most recent flood received warnings just as they were about to be flooded or later. These households have, therefore, little time to respond effectively to save their belongings. This is a constraint imposed by institutional/organisational contexts of ineffectiveness (see Section 8.2.2).

Furthermore, Malaysians generally have a low level of awareness of formal flood warning systems. This is again due to institutional ineffectiveness in publicising them. In this research, only 45.1 per cent of respondents reported the existence of such systems in their locality. The remainder either live in areas without formal warning systems or are oblivious of their existence. Even fewer are aware of flood hazard organisations responsible for flood forecasting and/or flood warning dissemination. Only 5.2 per cent of respondents are aware that the DID is the organisation responsible for flood forecasting. However, 37.1 per cent of respondents were aware of various agencies responsible for flood warning dissemination,

Table 8.1: Number of respondents reporting flood damage savings as a result of receiving a flood warning during the most recent flood

	P. Pinang N=172	Kelantan N=192	K. Lumpur N=114	Pekan N=140	Total
Don't know	1	3	1	7	12
Did not save any	6	12	15	11	44
<$1,000	11	47	5	35	98
$1,000-$1,999	5	17	9	8	39
$2,000-$2,999	1	2	1	1	5
$3,000-$3,999	2	0	5	0	7
Total	26	81	36	62	205
Average savings per household	$865	$667	$1,625	$516	$705



N=618

Figure 8.2: Reported warning lead times during the most recent flood in various parts of Peninsular Malaysia

most notably the police and the media. Thus, if flood warning awareness can be increased and flood warning systems improved (in terms of accuracy and lead times), the amount of flood damage savings could be increased substantially.

Evacuation systems are also non-structural/non-engineering flood mitigation measures of which the principal aim is to save lives. The life saving benefits of timely evacuation before the onset of disasters are well documented (Cutter and Barnes 1982; Smith 1992 pp277-8; Alexander 1993 pp413-4). In Peninsular Malaysia, tens of thousands of people are routinely evacuated during the seasonal monsoon floods which hit many parts of the East Coast every year (see Table 2.2). On the West Coast, the occurrence of monsoon floods (due to the spill-over effects of the Northeast Monsoon) along the major floodplains, and flash floods in major cities and towns also result in the evacuation of thousands of people. As a significant proportion of those evacuated are the aged and children, it is fair to assume that many lives are saved as many would drown (even those who can swim get into trouble in the swift currents) if they were not evacuated.

An effective FWES, therefore, is a pre-requisite for effective flood loss reduction (in terms of lives saved) and increased flood damage savings (in terms of reduced property damage). Flood hazard policies are generated by political economy contextual forces via institutions, both of which indirectly determine the outcome of warning and evacuation systems. Consequently, the effectiveness of a FWES depends on flood hazard policies, other development policies, allocated funds and other considerations, all of which are translated from political economy contexts via institutions and impacted upon individuals. All three components from political economy through to institutions and individuals play important roles in the final outcome of FWESs.

8.2.2 Links between socio-cultural and political economy contexts, institutions and individuals in relation to flood warning and evacuation systems

The overall effectiveness of FWESs depends not only on a combination of contextual forces operating at the macro socio-cultural and political economy level through to institutions (meso level), but also inputs by individuals (disaster victims) at the micro level. This section examines the links between contextual forces and how these links affect the overall effectiveness of FWESs. Some of these links are identified in Figure 8.3. For example, the influence of socio-cultural contextual forces is seen in traditional warning and evacuation

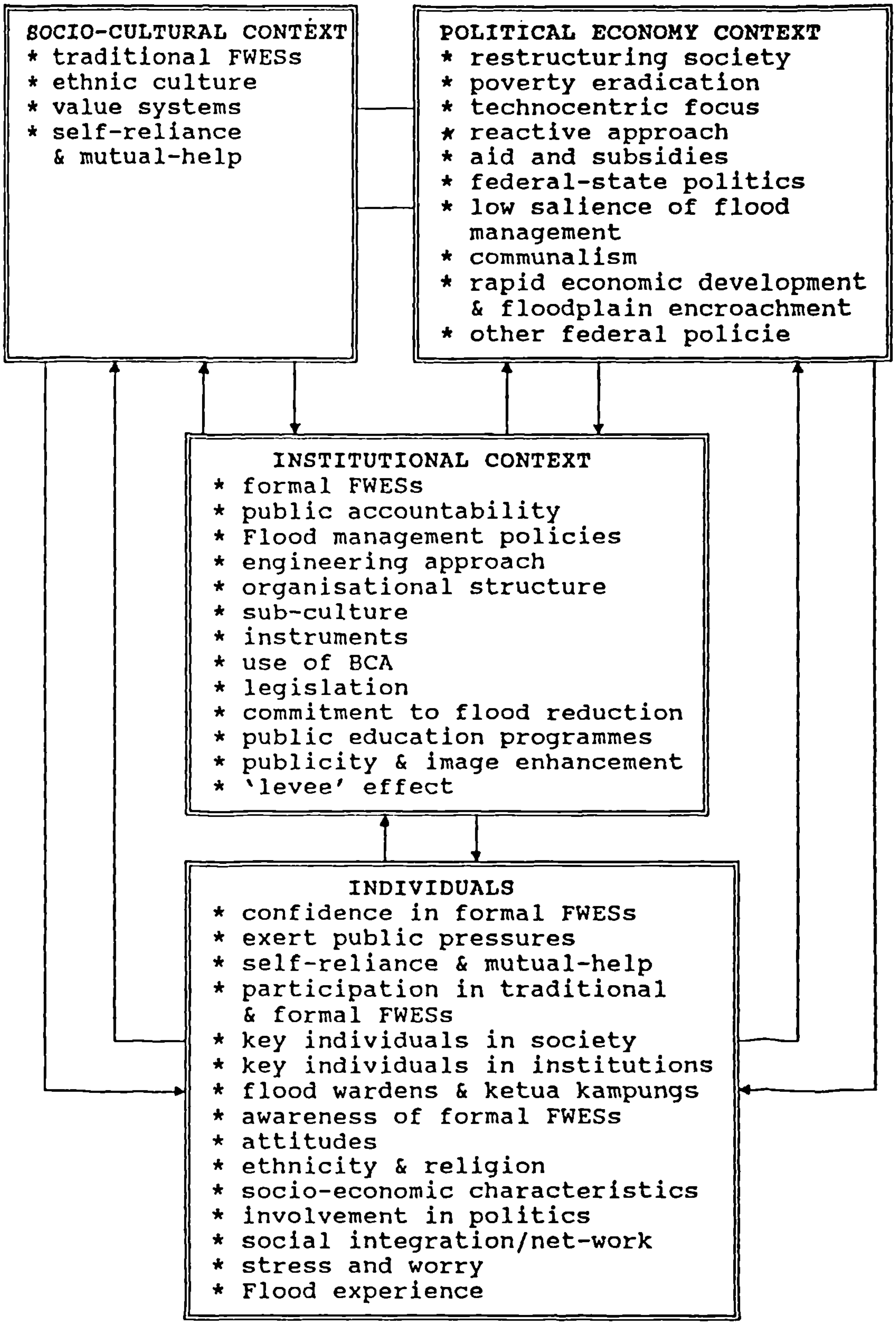


Figure 8.3: Links and influences between macro socio-cultural and political economy contexts, meso institutional contexts, and individuals (micro contexts) in relation to the flood warning and evacuation segment

mechanisms[87] which have evolved through generations of flooding experience. Malay peasants whose ancestors have lived with floods just as they do now, have developed crude warning and evacuation systems which are still practised in the remote villages and still play a vital role in saving lives. A simplified version of this kind of traditional warning and evacuation mechanism is illustrated by the following account:

> '...Kampung Tendong (Batu 3) is one of tens of villages located on the floodplain of the Kelantan River near the town of Pasir Mas. It has a total of slightly more than two hundred houses and a population of about slightly more than a thousand inhabitants. Its ketua kampung Haji Ali (village head) heads a village committee on flood warning and evacuation (Figure 8.4). Haji Ali has appointed several of his residents who live nearest to the river (those who get flooded first) as flood wardens. These wardens report to Haji Ali as soon as the flood waters rise above the banks of the river. Haji Ali alerts all villagers about the river breaching its banks. However, no evacuation order is given yet. Some families, usually those living nearest to the rivers may decide to evacuate to their relatives' place in other kampungs. The wardens usually move their wives and young children but they stay behind because of their duty. Once the river has overtopped its banks, the rise and fall of the river level are then monitored day and night by the wardens. When the water level has reached a certain level (usually above the normal stilt height of about 1.5 metres) and is still rising, the wardens abandon their posts and report to the ketua kampung who then orders all villagers to evacuate (usually to the mosque or school which are usually located on the highest ground in the kampung). The ketua kampung then informs the other ketua kampungs of nearby villages about the flooding in his kampung by telephone. This process is then repeated by the ketua kampungs of other villages when their villages are subsequently flooded. However, in remote kampungs without the telephone, the message is sent by a dispatch rider (usually on a motorbike).

The above informal traditional warning and evacuation mechanism has worked well, mainly because local expertise and self-reliance are employed as important inputs[88]. Supplemented by modern technology such as the telephone and the use of sirens (to warn villagers), informal FWESs are used effectively by many kampungs in the East Coast which have no

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[87] These are informal FWESs.

[88] Disaster management systems operating solely with inputs from outside the affected community are often of limited effectiveness. Plans need to be built around people's needs and perceptions rather than requiring people to fit into pre-determined plans without consultation (Davis 1986b). Thus, the importance of considering local needs and incorporating local expertise and social mechanisms (e.g. self-reliance through local coping mechanisms) into official disaster management programmes (Davis et al 1987).

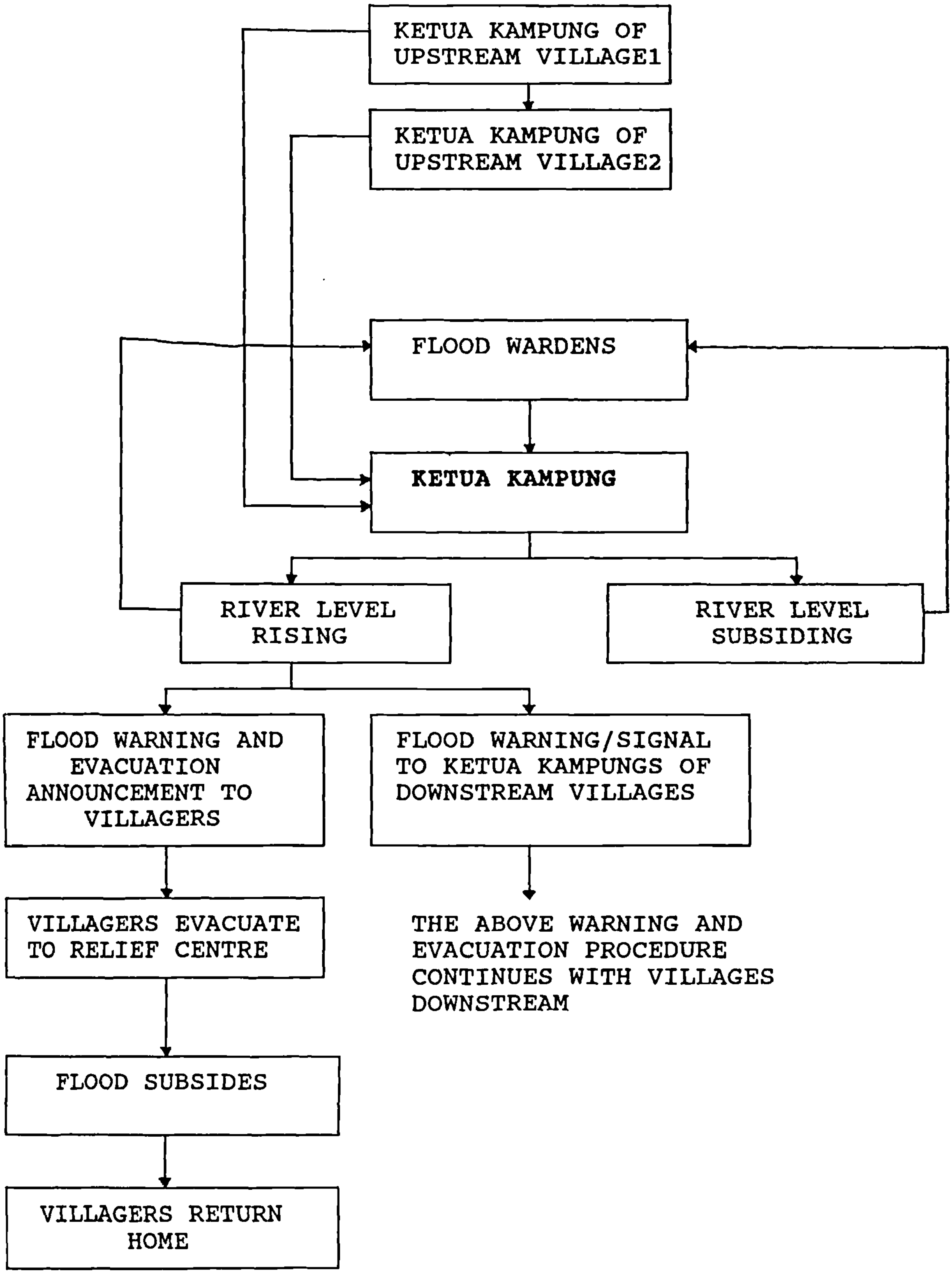

Figure 8.4: The traditional flood warning and evacuation mechanism practised by Malay peasants living in remote villages in Peninsular Malaysia (The ketua kampung is the one who first makes the announcement for evacuation)

formal warning and evacuation systems. This is because the mechanism is an 'active' system whereby people can actually see the flood and they need little convincing to take responsive action to save their lives and those of their families. This is in contrast to a formal FWES whereby the flood forecast is made by the DID based on rainfall (which falls in the catchment) and river levels (in the catchment). People living in villages downstream who are warned about impending floods actually do not see any heavy rainfall or the river rising above the danger level. Furthermore, a radio broadcast of impending floods without the actual signs of flooding does little to convince people to evacuate. This situation is certainly not helped by the many 'false warnings' (warnings not followed by flooding) which are often issued by the authorities. And because people living in flood-prone areas are flooded so often, they are 'hardened' by years of experience and begin to rely on themselves and the traditional mechanism which has served them for so long. The main shortcoming of the traditional mechanism is the short lead time before flooding occurs, which often is minutes.

The influence of the political economy contexts is manifested by current political ideologies of the Malaysian government relating to flood management. A 'two-pronged' flood management policy is employed: (1) predominantly employing structural/engineering measures in small but densely populated and developed urban floodplains (mostly involving towns and cities on the West Coast); and (2) predominantly employing a 'reactive' rather than preventive approach in the vast agrarian sector located in less densely populated rural floodplains (mostly involving the traditional padi farming and fishing areas on the East Coast). This reactive approach involves emphasising the use of disaster preparedness, FWESs, rescue and relief operations and rehabilitation. As a result, FWESs are strongly emphasised in the East Coast states.

Political economy contexts also manifest themselves in terms of government policies which favour rapid economic development rather than reinforcing and improving flood management. As a result of fast growth rates in recent years development policies are firmly focused at maintaining if not increasing this level of growth. The country also aims to be a newly industrialised country (NIC) in the near future. As a result, rapid economic growth such as industrialisation, forestry and commercial/plantation agriculture (all income earners) generally takes priority over 'expenditure based' projects such as flood management. Although protecting densely populated and intensively developed urban areas (e.g. cities) from floods is a prime concern (these are areas where damage potentials are highest), the protection of rural inhabitants and the environment (especially when both are located in poorly developed rural areas with little economic potential) is not a high priority on government agendas (see Chapter 5). The salience of flood hazards is therefore low on government spending, resulting in inadequate development of flood management. This in turn has a negative effect on the effectiveness of formal FWESs as funding allocations, human resources and infrastructure and other investments into such systems are severely short of what is needed. Appendix M presents a detailed examination of the low salience of flood hazards on government agendas and the inadequacy of government spending and development of formal FWESs.

Political economy contexts are also found in ideologies which the government are trying to communicate to the rural populace (which has a much lower standard of living compared to their urban counterparts). One is that of 'self-help to better oneself'. This is in line with the government's efforts in raising rural standards of living. The idea is that the government can only do so much and the rest is left to the people to take advantage of what is provided, and help themselves. This self-help ideology is best demonstrated by the traditional warning and evacuation mechanism. The government realise that people living in flood-prone areas are well adapted to floods and have looked after themselves for a long time. Thus, political economy contexts manifest themselves in government policies which incorporate such traditional coping mechanisms into official flood management. Realising that floodplain inhabitants are well attuned to their traditional warning and evacuation mechanism, the authorities have not been slow to adapt it to the formal FWES. Basically, the formal FWES can be broken down into three distinct parts: (1) flood forecasting; (2) flood warning dissemination; and (3) evacuation procedures. While government agencies are involved in all three parts, the traditional warning and evacuation mechanism is incorporated into the second and third parts.

In Peninsular Malaysia, warning systems can be roughly divided into two types: (1) Those targeted at seasonal/monsoonal floods on the larger and longer rivers, mostly on the East Coast. An example is the flood warning system for the Kelantan River in the state of Kelantan. Initial forecast of heavy rains by radar and satellite imagery is done by the MMS and relayed to the DID which uses them and its own network of telemetric rainfall and river level gauges in the state as inputs in its computerised flood forecasting Tank model. This model is further supplemented by conventional stage correlation flood forecasting between upstream and downstream gauging stations (DID 1990). Through years of flooding experience, the correlation models provide fairly accurate forecasts for downstream stations. When a flood forecast is made by the DID, the formal FWES is activated. Floodplain occupants living on the lower stretches of the Kelantan River are warned through the mass media, flood warning notice boards, the village head, the police, and other local authorities (see the Kelantan formal FWES below).

(2) Those targeted at flash floods on the relatively short and swift-flowing rivers in urban areas, particularly those flowing through the major cities such as Kuala Lumpur and Georgetown. For example, in Kuala Lumpur, the DID Kuala Lumpur employs a warning system based on a 'Flash-Flood Warning Model'[89] in which the forecast of flash flood is obtained using computed data of four parameters, viz. soil moisture deficit, the average rainfall in the last 24 hours, the average rainfall in the last hour and the duration of rainfall/storm (DID Kuala Lumpur 1984). Based on the above parameters the water level at Jambatan Sulaiman on the Kelang River is forecast. When this forecast level is above the danger level of 26.80 m, the DID will inform the police who then activate the warning and evacuation mechanism in the areas that would be flooded. Based on past experience, these areas are (with flood depths given in the parentheses): Kampung Pasir Lama (0-1.5 m), Kampung Pasir Baru and Old Kelang Road (0-1.5 m), Kampung Baru (0-1.5 m), Kampung Chendana (1-1.5 m), Kampung Dato' Keramat (0-0.5 m) and Brickfields (0-1.0 m). However, according to the DID officers in Kuala Lumpur, continuous dredging of the Kelang River, the completion of several dams, and the starting of new flood mitigation works along the river have changed the river regime and rendered the above model obsolete. Forecasts are now inaccurate and a new model has to be developed. So far, this has not been done and flood warnings are still based on the obsolete model. In some areas, however, solar-operated automatic sirens are located at strategic points along the Kelang River, for example at Kampung Dato Keramat. Sirens serve as a supplementary warning system, especially for those living in the vicinity, but their effectiveness is low (see Chapter 5).

In the state of Kelantan, political economy contexts (in terms of funding and policies) determine the FWES adopted. The policies and the system is then put into effect by flood hazard institutions who impose them on to individuals. Conversely, individuals partly influence institutions and policies by adhering to their traditional warning and evacuation mechanism, thereby forcing the authorities to incorporate it into the formal system. Likewise, institutions can influence federal policies by their feedback reports and suggestions on the

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[89] This model was first launched in 1981, but changes to the Kelang River system has made it obsolete in the current context.

performance and improvement of the existing warning and evacuation system. The following example of the formal warning and evacuation system in Kelantan state illustrates the above links:

> '...The MMS head office in Kuala Lumpur initially makes a forecast of heavy rains and accompanying wind speeds and directions over the state of Kelantan (Figure 8.5). Then it relays the forecast to the federal DID Hydrological Section (head office) in Ampang. The federal DID uses this information as an input in its computerised forecasting programme of the Kelantan River based on the Tank Model. In addition, the federal DID also uses inputs of rainfall and river level data from the state DID's network of telemetric as well as manual stations in Kelantan. Based on these inputs a forecast is made of the river level at a certain point. When the federal DID has ascertained that a danger level on a certain river will be reached, it relays the flood warning to the Malaysian Control Centre (for flood and other disasters) and to the Kelantan state DID. These two agencies then relay the warning to the State Control Centre which then passes the message on to the State Security Council. The latter meets to decide whether or not an formal warning should be announced. Once the decision to issue an formal warning is decided upon, the State Security Committee informs the Information Department which then announces the warning over the mass media, usually via the radio and television. The State Security Council then organises and coordinates warning dissemination by direct contact (the State Police Department is usually given this task), relief and rescue, and evacuation (transportation is usually provided by the Army using army trucks and by the Police Department using motorboats). It is at this point that the traditional warning and evacuation mechanism comes into the picture. In some kampungs (e.g. Kampung Tendong), flood wardens whose properties are flooded first inform the ketua kampung who informs the local police station (usually at the mukim level) about flooding. The Mukim Police Department then passes the information to the District Police Department which reports to the State Police Department which is in charge of the state's overall flood warning dissemination. Based on flood reports coming from victims who are flooded first, other villages are warned through their local police force and the ketua kampung (who receives phone calls from the officer in charge at the Mukim Police Department). Potential flood victims are then either evacuated by the Army or police, or those who are able and have their own transport evacuate themselves to evacuation centres nearest to their village.'

The above formal FWES is a prime example of how individuals can influence institutions (meso contexts) and policies (macro contexts). In this system, inputs by individuals (especially flood wardens) are crucial in determining its effectiveness. At the kampung level, it is the warnings issued by flood wardens which the people heed and not that issued by official sources. The formal FWES appears to work well when the traditional mechanism is incorporated into it, as people are not asked to do things that are very different from what they have been doing for years. They are not given complex instructions and evacuation procedures which they may not understand. Instead, institutions merely expedite the

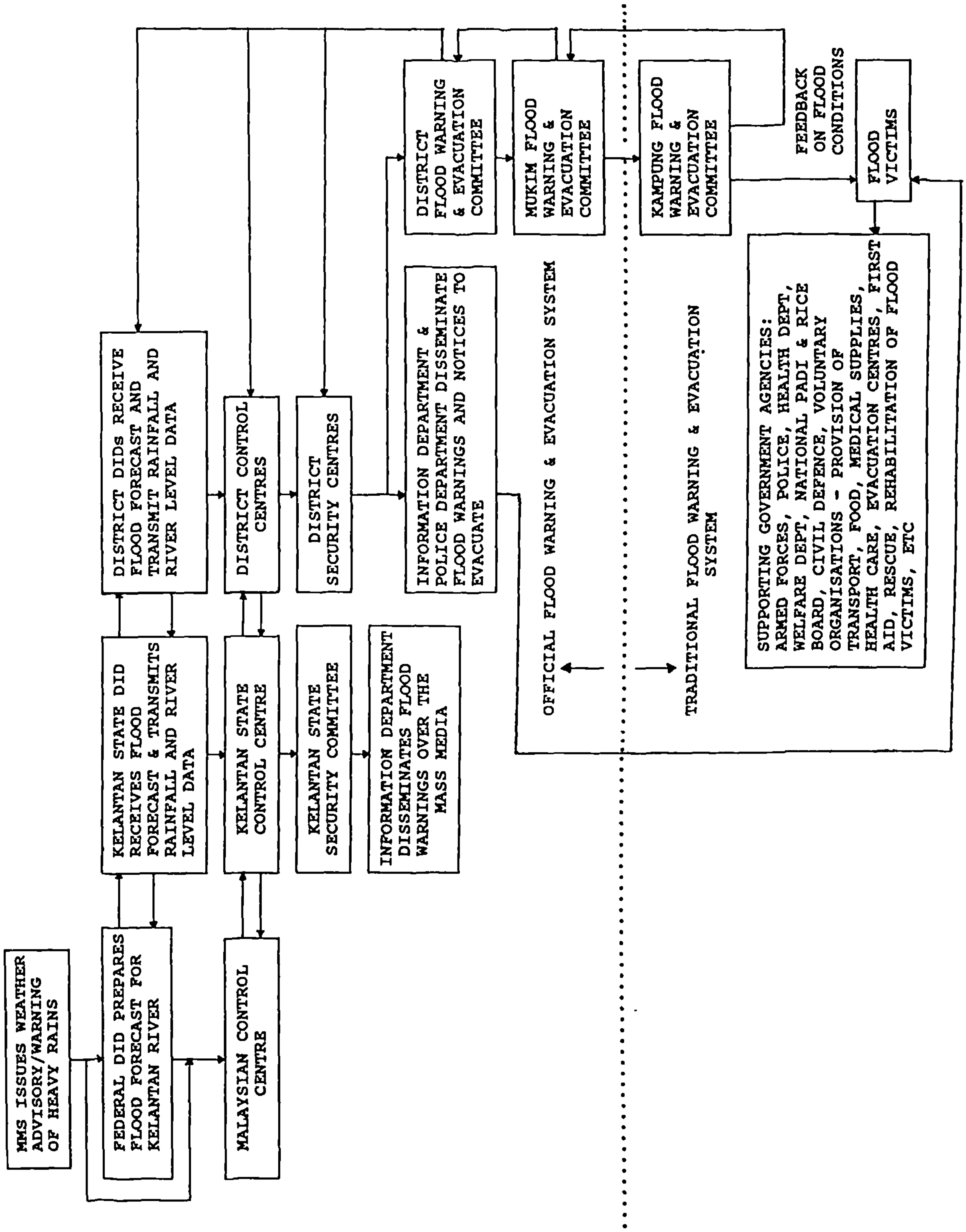


Figure 8.5: The formal flood warning and evacuation mechanism in the state of Kelantan, Peninsular Malaysia

mechanism and provide the means such as warnings, transportation, temporary relief centres, food, clothing, health care, law and order, and others (thus, the human resources in terms of government personnel involved are substantial). When the traditional mechanism is incorporated into the formal system, many flood victims are not even aware of it. Thus, they would respond to the formal system just as they would to the traditional mechanism. With the traditional mechanism incorporated, flood wardens actually get flooded and village heads initiate the warning and evacuation procedures, and the village folks respond accordingly. They respond positively as they actually see the flood waters rising, or a neighbour's house being flooded. In contrast, there are probably just as many kampungs without traditional FWESs as they are those with them. Residents living in kampungs without traditional FWESs either rely on themselves or on the formal FWES (if there is one). These are the kampungs in which the formal FWESs do not appear to work well as people are not attuned to them. Survey results indicate that formal FWESs which have not incorporated the traditional mechanism do not work as well with the people, mainly because the people do not see the signs of danger. In such a scenario, they would take some convincing to evacuate.

Current government policy is to make science and technology an integral component of socio-economic planning and development, especially on building a science and technology culture (Government of Malaysia 1991a p5). This technocentric policy (a political economy context) is translated into an institutional context when it is directed towards government agencies. Thus, flood hazard institutions such as the MMS and DID place emphasis in the first instance on developing the scientific and technological aspects of flood warning and evacuation, viz. improving the accuracy of flood forecasting (through the use of radar and satellite generated rainfall and weather forecast, telemetric rainfall and river level gauges, computerised forecasting programmes, etc.) and the timeliness of flood warning (automatic sirens, advanced communication equipment, etc.)[90]. However, the increase in warning benefits with improved accuracy of flood forecasting and timely issuance of warnings would be small if the warning dissemination system breaks down and/or the public do not respond positively to it (for example by ignoring the formal warning). For example, research has shown that seldom is the entire target population available to receive a warning and it is even more unlikely that

[90] The main advantage of employing remotely sensed data and telemetric computer forecasting is the increase in warning lead times (Collier et al 1993). Such techniques when applied simultaneously with well planned data management using Geographic Information System (GIS) can effectively reduce the vulnerabilities of communities to disasters (Davis and Bickmore 1993).

all those receiving the warning will respond effectively. Parker (1991b) found that for residential properties: the proportion of residents available to respond to a warning is about 55.0 per cent; the proportion of households able to respond to a warning is 75.0 per cent; and the proportion of households who respond effectively is about 70.0 per cent. All the above will have to be taken into account in order to ascertain the actual benefits of a warning. Thus, while scientific and technological inputs are important to improve the accuracy of forecasts and increasing the warning lead times (Neal 1989 p16), efforts must be aimed at improving the warning dissemination system and educating the target population to respond effectively. The 'accuracy' and 'efficiency' of warnings have to be balanced against the 'effectiveness' of warnings as measured by public behaviour and response (Horlick-Jones and Jones 1993 p25). And such behaviour and response can only be effective if the public is well attuned to warnings through comprehensive preparedness, awareness, education systems and systematic evacuation procedures. At the moment, warning dissemination and public response are not emphasised as much as forecasting. Research has revealed that such a lop-sided approach on the use of technology to improve forecasting and warning systems (an essentially 'technocentric' approach) is an ill-conceived and common misconception of hazard reduction (Jones 1991 p37).

In the Kelantan River, the formal FWES appears to work well in the few kampungs with the traditional mechanism incorporated but not elsewhere. Survey results revealed that only 42.0 per cent of flooded households received a formal warning (although a significant number of respondents do not receive a formal warning because they are not concerned enough to switch on the radio, check readings on the flood warning board regularly, check with their village head, or are at work). According to the DID, formal warnings are usually given in advance of flooding. For instance, there is a time lapse of between 6 to 10 hours for the flood waters in the catchment area to reach Kuala Krai. Further downstream in Kota Bharu the time lapse is about 24 hours. Towns and villages in between Kuala Krai and Kota Bharu receive flood warnings between 6 to 22 hours (DID Kelantan 1991 p4). Therefore, flood warnings are usually given out well in advance by the DID. Yet, people lose their lives and have their properties and belongings damaged because they do not heed the warning. There are many reasons for this. The main reason is because there are too many warnings issued during the monsoon season. The warning is often announced over the radio a day in advance (similar to a weather forecast). As such, people tend to take it easy and many even forget about it as they are concerned with other more pressing problems. Also, people think they can cope with floods as they are used to them and this is partly true in the case of 'normal' floods but they get caught out when a major flood occurs. A vivid picture of how people get caught is given by the following account given by a victim of the 1981 flood in Kelantan:

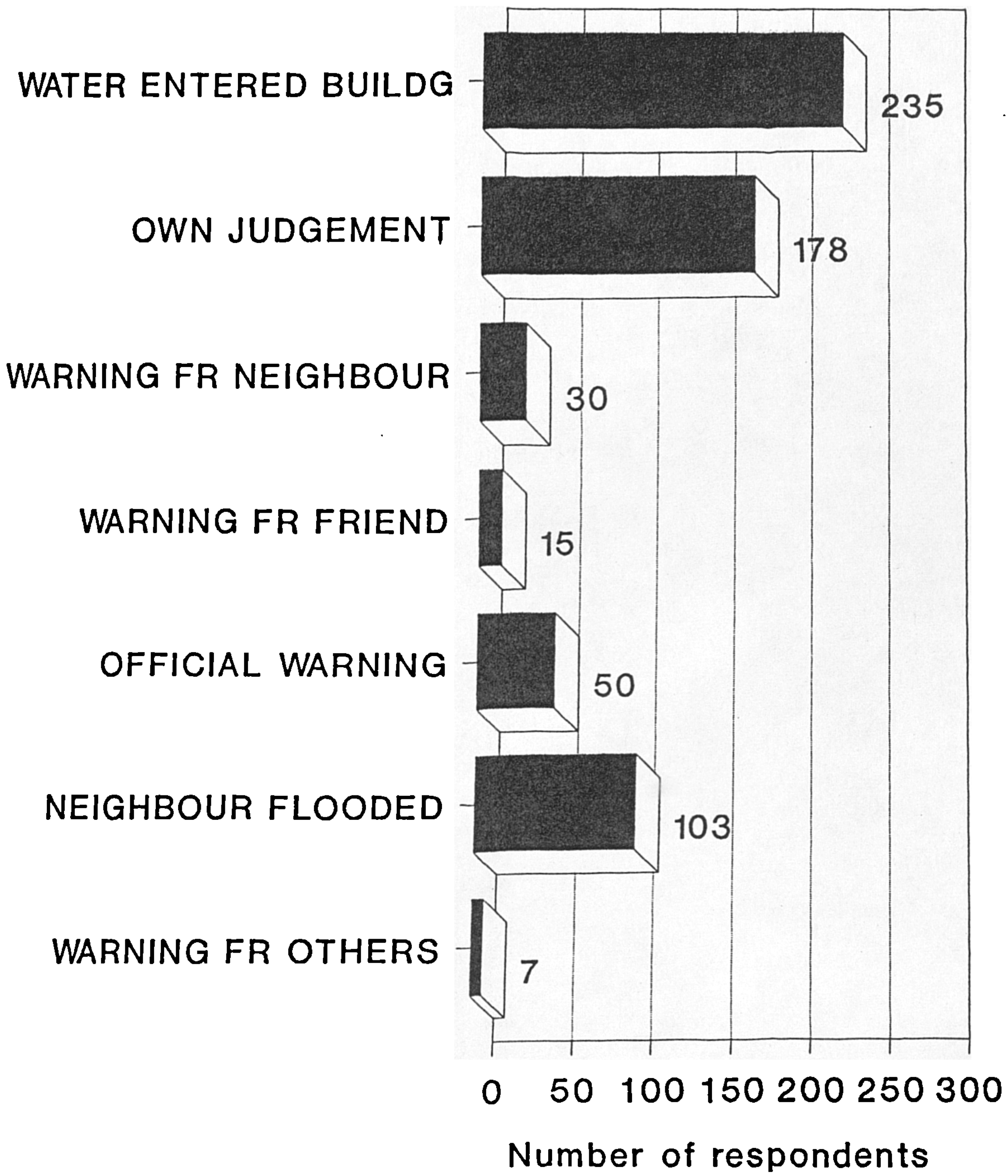
> '...**10.00 am**-Ahmad is warned by fellow villagers about possible flooding as many living nearest to the river are already flooded. He shrugged off the warning and prepares to go to work in his padi fields as such warnings are not uncommon during the monsoon season. **12.00 noon**-Ahmad comes home for lunch. His wife informs him that the river is still rising and that fellow villagers are preparing to evacuate. Some have already evacuated to the relief centre. Ahmad nods calmly and tells his wife to get their children from the school while he has his lunch. His 65 year old mother instinctively starts to pack her things as well as things for the family. After lunch, Ahmad moves all his furniture and valuable belongings to the attic. His wife packs clothes and food for the family. It is **2.00 pm** now and the flood waters have reached Ahmad's house. His three children aged between three to twelve are excited and start to play in the flood waters in the house compound. Ahmad shouts at them and instructs them to follow their mother to the relief centre but the eldest boy wants to stay behind with Ahmad. For a second, Ahmad thought it might be a good idea since the boy could swim now and it was around this age that Ahmad experienced his first flood watch with his deceased father. But the stare from his wife said 'no'. The kampung is now almost chaotic with people running and shouting. Women are trying to round up their children and scores of villagers running towards the main road which leads to the mosque, the designated relief centre located on a hill. Ahmad sees his family off to the relief centre but remains behind to guard his house and belongings. Often, thieves take the opportunity to burglarize deserted houses. So it is normal for an adult male to stay behind until the last minute when he will escape by his 'sampan' (small Malay canoe). Ahmad prepares his sampan and ties it securely to his house. He sits back and waits. From a distance he can hear the faint voice through a loud hailer, probably the police, telling all villagers to clear out. He looks towards the other houses and finds his neighbours Atan, Ramli and Zul all in their respective houses without their families. They are all in the same boat. It is **4.00 pm** now and the flood waters have just exceeded stilt height and are rushing into his house. Through experience, Ahmad thinks it is still okay as many times the waters had subsided. However, his neighbour Atan is getting ready to evacuate as the latter's house is built on lower stilts and on lower ground. The flood waters had submerged a third of his house. Ahmad motioned for Atan to come and join him. Atan rowed his sampan over. At least he would have company and could still look after his house from that distance. **4.30 pm**- the waters were still rising and Ramli and Zul are getting ready to abandon their houses. Ahmad and Atan motioned them over. They come with their sampans and joined the other two in Ahmad's house, which to them is still 'okay'. **5.00 pm**-the waters were still rising and show no signs of subsiding. They all decide it was time to go. Zul's sampan was trapped in some tree branches and he had to get into Ahmad's. The currents were too strong and they could not control the sampans to go to the relief centre. The currents just carried them along and soon Ahmad and Zul lost sight of the others. On their way they saw scores of other men escaping in their sampans. Some were swimming, presumably because their sampans capsized but there was nothing they could do. One sampan crashed into the crown of a coconut tree and capsized. The owner hung on to the tree crown and stayed there shouting for help. No one could help him. It was every man for himself. Ahmad and Zul were drifting in their sampan for nearly an hour before a police patrol and rescue boat picked them up and re-united them with their families. They were the lucky ones. The Star (3.12.81) reported that there were others who were not so lucky.

The above events took place in the day time when people are awake. When floods happen at night when people are sleeping the proportion of those caught unaware is higher. Thus, night floods are more hazardous than day floods. Some kampung folks have evolved a flood watching role during the monsoon season. For example, the aged folks reverse their sleeping pattern during the flood season by sleeping in the daytime and staying awake at night, to keep an eye on flooding, especially when it rains. Besides the elderly, some of the more anxious would not be able to sleep when it rains heavily during the flood season. Thus, people's attitudes to floods, their reluctance to leave their houses until the last minute, the unique role of the elderly in flood watching, and possibly other roles, and their cultural and sociological characteristics, must be studied and incorporated into the formal warning and evacuation system in order to maximize the benefits of improved forecasting and warning dissemination. If the people do not cooperate or respond effectively, even the best FWES would be unproductive.

Institutional contexts (through flood hazard organisations) play an important role in determining the effectiveness of formal FWESs which is reflected in their impacts on individuals. Section 8.2.1 has demonstrated that many aspects of the formal FWES are found to be wanting, frequently resulting in flood victims receiving warnings late, receiving 'false warnings', or not receiving any warning at all. As a result, individuals often have little time to take action for flood loss reduction. This is a constraint imposed by the institutional context of ineffectiveness. Because of late warnings, evacuation notices are often late resulting in transport (army trucks) not being able to reach the public as roads are already flooded. For example, during the June 1991 flood in the city of Georgetown (Pulau Pinang), boats belonging to the police (the boats were kept in various locations outside the city) could not be deployed because the roads leading to the worst-hit areas in the city were flooded and jammed by stalled vehicles. As a result, many families were trapped. One was Makcik Mabee's family (Appendix H Case 1) who had to endure the entire night in the attic of their house praying that the flood waters would not rise above the attic. The total number of rescue boats available in each district is also limited, and often fishing boats (belonging to the victims) have to be used.

Negative impacts of formal warning systems on individuals are manifestations of institutional ineffectiveness. In this research, the evidence show up in the results of the questionnaire survey. For example, only 36.4 per cent of those flooded in the most recent flood had received a formal warning. Of this group, 37.0 per cent received the warning just as they were being flooded or later, severely constraining the extent to which they can respond effectively. In fact, only 8.0 per cent of those flooded were first aware of flooding through a formal warning (Figure 8.6). In general, formal flood warning systems do not appear to work well in the peninsula as there are a high number of floods not formally warned (Figure 8.7). During the most recent flood, an average of about 54.0 per cent of those flooded in the peninsula were not formally warned (Figure 8.8). Generally, the percentage of flooded respondents not warned are highest in the two West Coast areas. Conversely, only 33.0 per cent of all respondents are warned and flooded. The total number of 'false warnings' (taken to mean 'warnings not followed by flooding') is highest in the Pulau Pinang area (84.0 per cent) followed by the Kuala Lumpur area (58.0 per cent). Finally, as Neal (1989) has shown, the effectiveness of warning systems is best evaluated through customer satisfaction. The customer in this case is the floodplain inhabitant who gets flooded. Results from the current research indicate that 40.5 per cent of all respondents are dissatisfied with the performance of the formal flood warning system during the most recent flood. Because of the general poor performance and 'unreliability' of formal warning systems, the public become sceptical about their effectiveness. Consequently, the public develop their own informal warning mechanisms and refuse to heed warnings from formal systems. In this research, the ineffectiveness of formal warning systems have resulted in much public scepticism towards them. For example, 61.0 per cent of respondents revealed that they do not rely on formal warning systems at all (Figure 8.9). In contrast, only a small minority from all areas indicate that they rely completely on formal warning systems. Figure 8.10 indicates that the low reliance on formal warning systems are mainly due to institutional ineffectiveness of late warnings, non-publicity of the system resulting in public unawareness, and general lack of faith in the system. The above analysis reflects the negative influence of institutional contexts on individual response to flood warnings.

Individual influence on institutions and macro structural contexts is largely through the exertion of public pressure on official organisations and government policies. For example, as a result of losses suffered, there is increasing public awareness and anxiety about floods. The educated public are no longer content with explanations of floods as a natural hazard beyond society's control. Even farmers and fishermen are influenced by modernisation and technology. More significantly, as people become more educated and informed they also become more inquisitive and demanding. Every flood event (especially flash floods) must be explained and is followed by an enquiry as to who is responsible and who is to be blamed.



N=618

Figure 8.6: Reported first awareness of flooding in the most recent flood experienced by respondents in Peninsular Malaysia

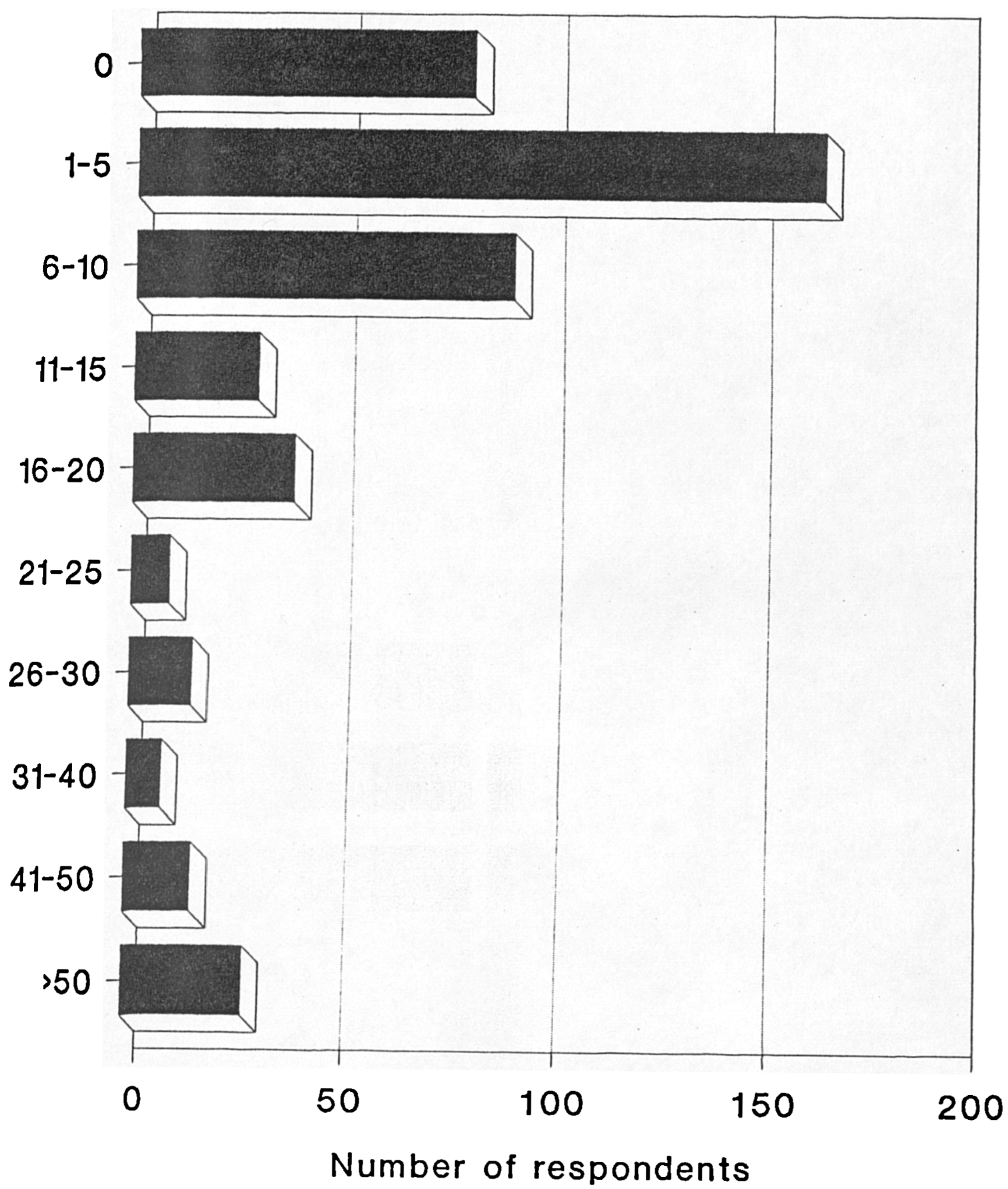


Figure 8.7: Reported total number of floods not formally warned in Peninsular Malaysia

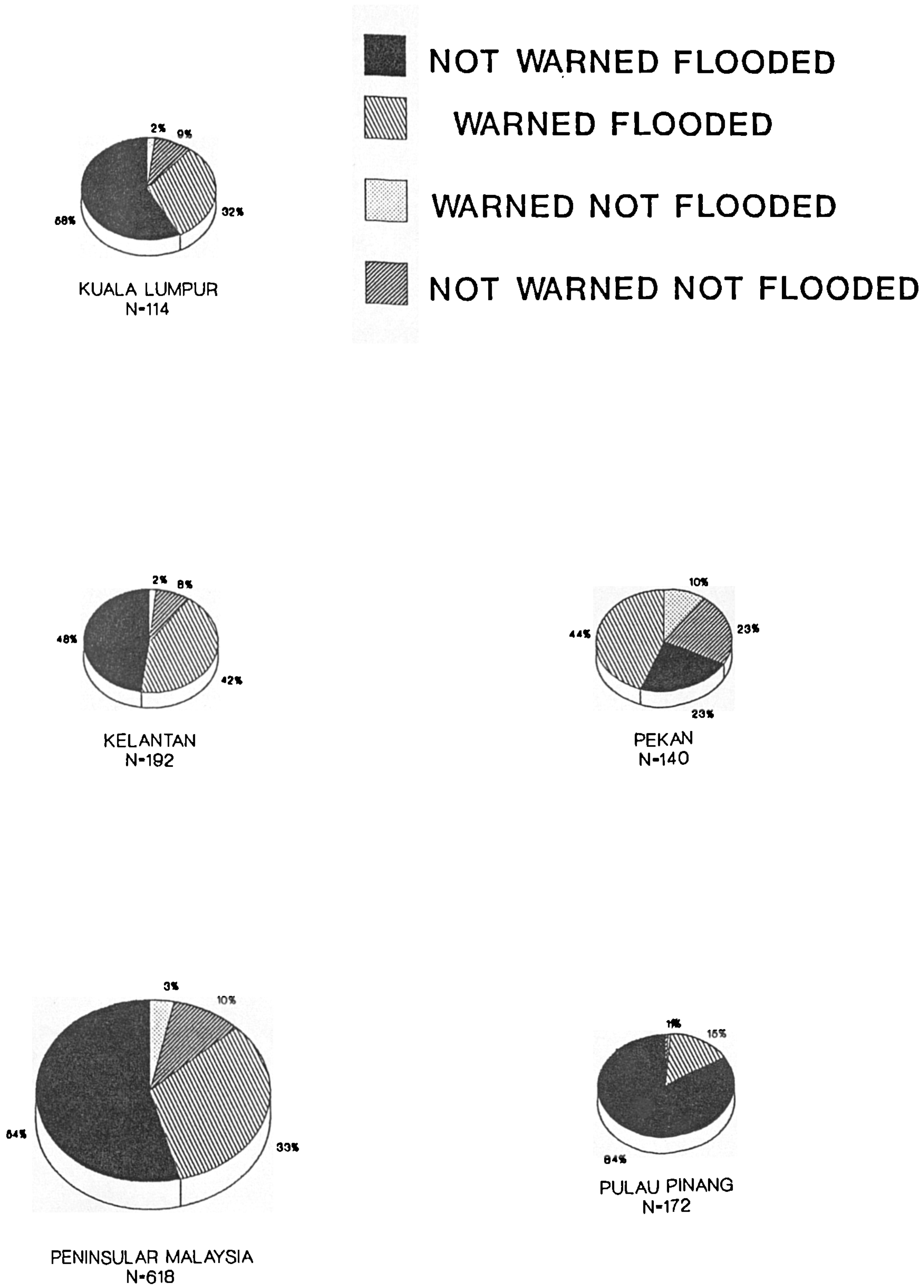


Figure 8.8: Break-down of households who are: (a) not warned but flooded; (b) warned and flooded; (c) warned but not flooded; and (d) not warned and not flooded, during their most recent flood experience

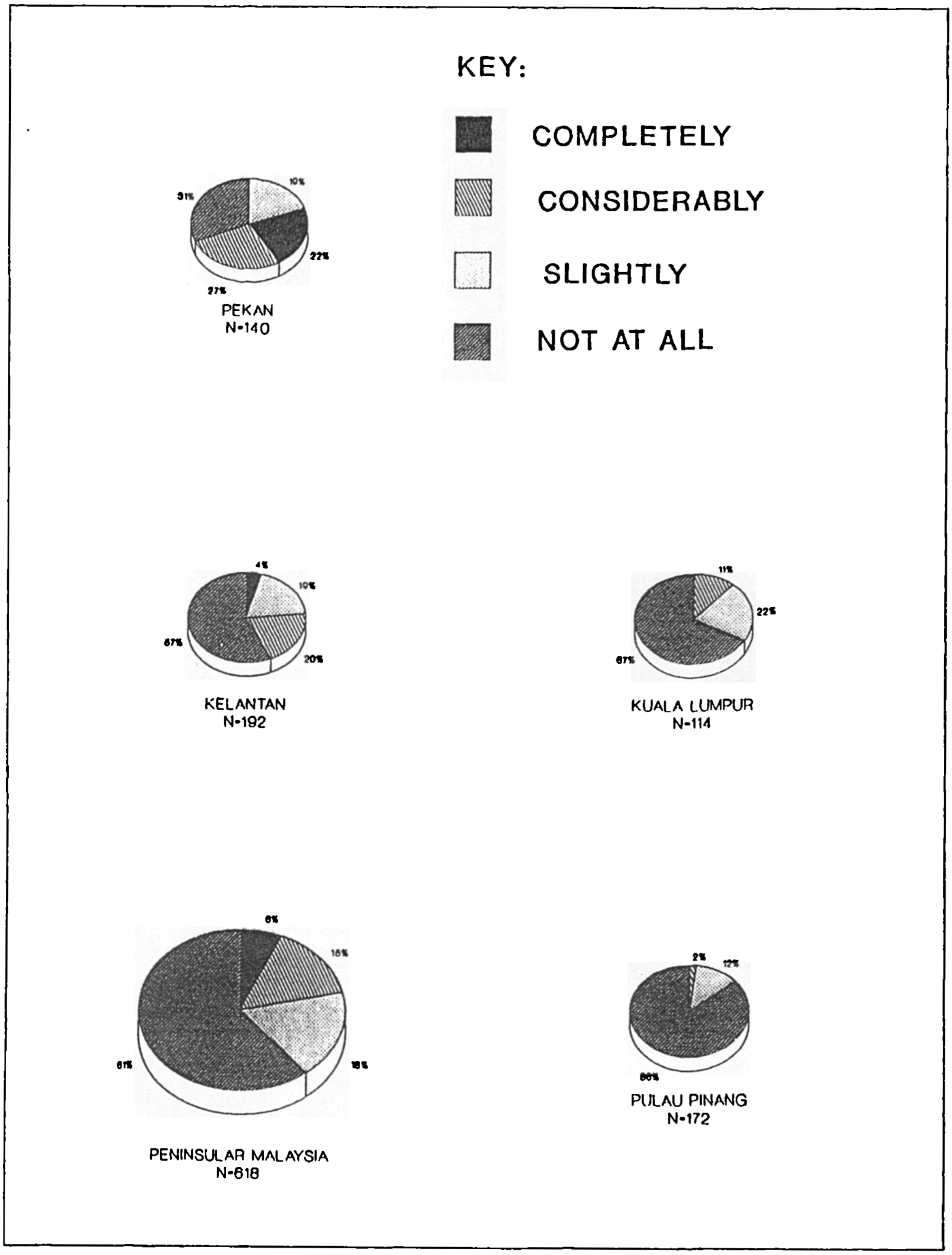


Figure 8.9: Respondents' degree of reliance on formal flood warning systems

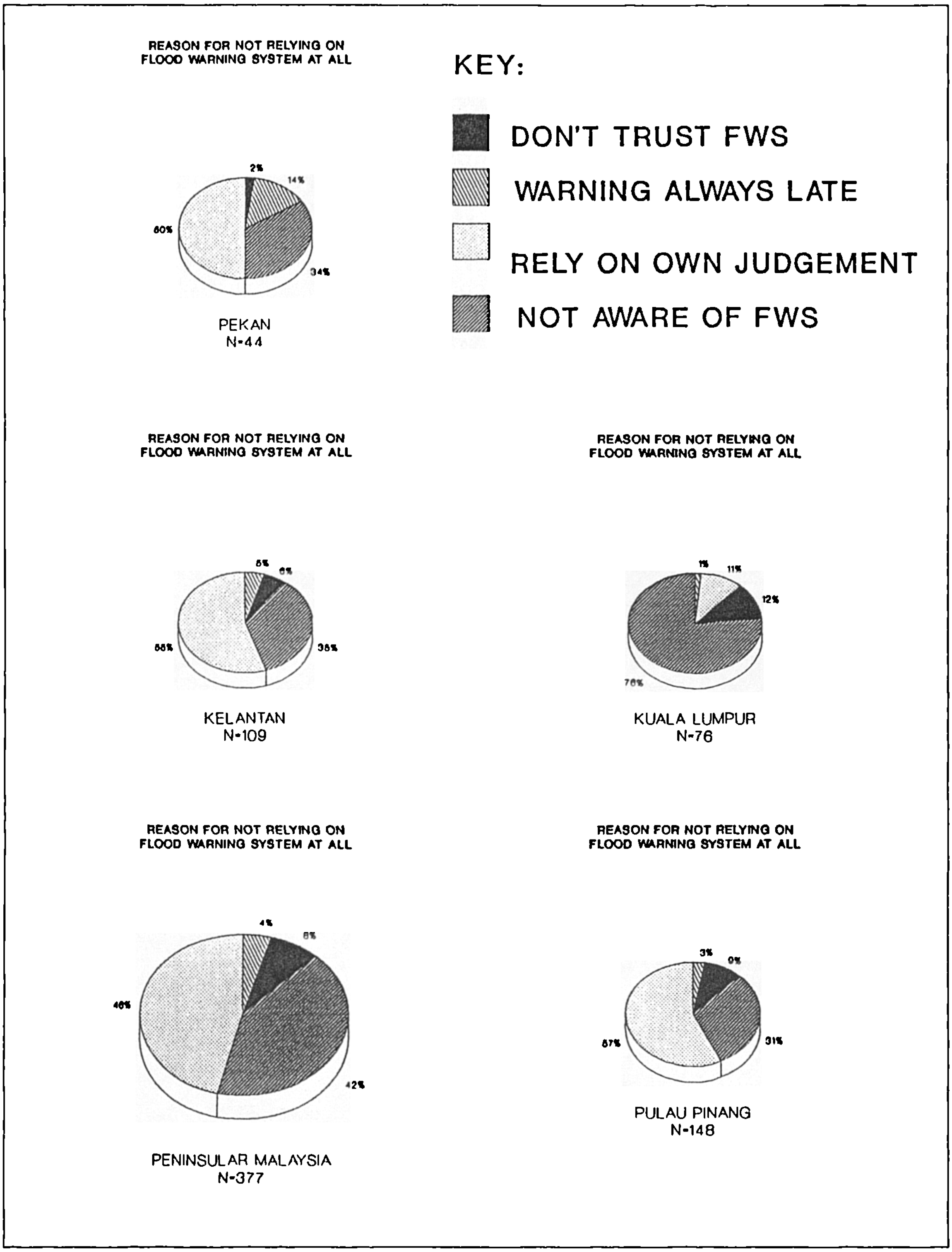


Figure 8.10: Reasons for respondent's non reliance on formal flood warning system

In Peninsular Malaysia, flood hazard management is still very much a function of the government (at least through its appointed agencies such as the DID, the MMS, the police, and the local authorities). Because of this, the educated public hold the government responsible for flood occurrences. In view of this, there is increasing pressure for the government and its agencies to perform and improve on the efficient management of floods. Public pressure is, therefore, one area where individuals can exert influence on institutions and structural contexts (e.g. policies). Often, public pressure can contribute to the development of many flood schemes (including the improvement of formal FWESs) and the influencing of public policies. From the government's point of view, effective public flood management strategies can improve people's confidence in the government (thereby relieving public pressure), and contribute to better political support as well as more effective flood loss reduction on the part of the people.

Individuals can also influence institutions and policies through political pressures at the grass-roots level. For example, an example was given in Chapter 4 (Section 4.2.5) when opposition parties took advantage of the issue of squatter relocation along the Pinang River and put pressure on the authorities to change flood mitigation plans. This has a negative effect as the implementation of the scheme was delayed considerably. Elsewhere, squatter and residential rights have also demonstrated the powerful influence of individuals over institutions and policies. The abandonment of the Gombak Dam scheme was brought about by individuals who refused to be relocated, albeit being prompted by opposition political parties (see Chapter 6 Section 6.4). Finally, the rivalry between the UMNO which forms the dominant party of the federal government and the PAS which rules the Kelantan state government, has projected the views of individuals to the forefront. Flood issues affecting individuals are often politicised to gain popularity and support contributing to the significance of public pressures. However, federal-state politics can also work against individuals as states which are opposition strongholds are often victimised through reduced funding allocations and other political means (see below).

The links between socio-cultural, political economy, and institutional contexts and the individual are probably best demonstrated by the **formal evacuation system**. Integration of informal evacuation systems into formal systems take into account the important role of social and cultural factors in effective reduction of vulnerability (Horlick-Jones and Jones 1993 p34). In many parts of Peninsular Malaysia, particularly in the East Coast states, it is probably no exaggeration to say that evacuation is a way of life. Annually, tens of thousands of floodplain inhabitants are routinely evacuated during the 'flood season'. For example, during the 1967 major flood, the number of flood victims evacuated total hundreds of thousands (see Table 2.2). The bulk of such evacuation is temporary as flood victims are housed in community centres, mosques, schools, multi-purpose town halls, police stations and even on the palace grounds of the Sultans (usually located on a hill). The victims gradually return to their homes once the flood has subsided. However, a significant proportion of flood victims are often left homeless when their wooden huts are swept away or destroyed by the strong currents during the flood. These victims then have to move in with relatives, moved to low cost housing areas, or stay on in the relief centres until they have found a place to live. This local response to disasters is a vital coping mechanism as Davis (1977 p30) discovered that 90.0 per cent of homeless disaster victims are absorbed by families and friends. Some fortunate ones are provided with aid by the government to help them rebuild their houses. They eventually rebuild their houses and move back into their village by which time the following season's flooding would have begun. Usually, major floods occur on the average of once in a few years, sufficient for most victims to rehabilitate and get back to their normal way of life. However, there are instances where two major floods have occurred simultaneously as in 1971 and 1972. During such floods, the most vulnerable victims (usually the aged and the poorest) cannot rehabilitate sufficiently and have to survive for long periods on government aid. Many of the aged are eventually forced into old folks homes.

Political economy contexts can also manifest themselves in federal policies that can have a 'retarding' effect on FWESs in states dependent on federal funding (see Chapter 4 Section 4.2.4). For example, in the state of Kelantan, which the federal government lost to the opposition PAS party in the recent general elections, political economy contexts translate directly into reduced development funds over the 6th Malaysia Plan, including that for flood management. This had a negative effect on the state of Kelantan, contributing to the reduced effectiveness of flood hazard institutions (e.g. the DID). The development of forecasting, warning, evacuation, relief and rehabilitation systems were also severely retarded.

Finally, political economy contexts such as the politicising of FWESs via institutions often generate a false sense of security on the part of the public (in the case of those who support the ruling party and believe in their policies). This will then influence the public's decision to remain on floodplains. In Chapter 6, it was found that one of the reasons why many people continue to inhabit hazardous floodplains and not move elsewhere is the existence of formal flood warning schemes in their localities. Approximately 39.0 per cent of all respondents in this research reported relying on some form of formal flood warning system. Of this total, the majority are from the East Coast where warning systems are generally more effective because longer rivers, better forecasting systems (using radar estimates of rainfall and telemetry) and a better coordinated warning dissemination system allow for a fairly adequate warning lead time.

8.3 The income equity segment

Income equity (encompassing poverty eradication) was introduced as a central issue in Malaysian development in Chapter 4. This section elaborates on this issue. More specifically, it analyses the extent to which socio-cultural, political economy and institutional contexts relating to flood hazard management work towards contributing to income equity between the ethnic groups and in the process reduces and eradicates poverty in Peninsular Malaysia. There are two sub-sections. Section 8.3.1 sets the scene by examining the magnitude of income inequalities and incidence of poverty in Peninsular Malaysia. It examines the extent to which flood hazards contribute towards undoing wealth accumulation, reinforcing poverty and widening income disparities. More specifically, it demonstrates how high incidence of poverty amongst indigenous Malays has given rise to wide disparities in incomes between Malays and the non-Malays, making the former one of the most vulnerable groups to flood disasters. The section further attempts to show how income inequalities between regions, states, urban and rural areas, specific groups in society (e.g. squatters), occupational types, and specific sub-groups within each ethnic groups have increased vulnerability of certain regions and groups to flood disasters. Section 8.3.2 focuses on identifying and explaining the links between the socio-cultural, political economy, and institutional contexts and individual response in relation to flood hazard reduction via the income equity segment. It is a critical analysis of government and institutional policies on equity achievement through reforms such as poverty eradication and society restructuring, and flood hazard management policies. It examines the extent to which policies (socio-cultural, political economy and institutional) reduce people's vulnerability towards floods. It also analyses the extent to which flood hazard policies emphasise vulnerability reduction, recognise that flood hazards contribute to poverty and income inequity and attempt to support the former while reducing the latter. If, for example, policies are focusing on the less well off in traditional rural areas, then they are reducing poverty and income inequity. If, however, they are focusing on urban, well developed and wealthy areas, then they would be aggravating poverty and income inequity (through pursuing economic efficiency at the expense of equity).

8.3.1 The magnitude of poverty and income inequity

Poverty makes people more vulnerable to floods simply because the poor are ill-equipped to cope with them. The analysis on flood damage in Appendix K and Section 8.2 have both demonstrated that the magnitude of flood damage is significant when viewed in the context of low average household incomes of floodplain dwellers, especially those in the traditional agrarian sector. For example, during the most recent flood, the average damage incurred by each flooded household was $1,393 (see Appendix K), or one and a half times the average monthly household income of floodplain residents which is $917. During the most severe flood experienced, the average damage incurred was $1,837 which is twice the average monthly household income. By comparing flood damage against average monthly household income, the gravity of the problem is brought to light. Table 8.2 illustrates clearly that the proportion of households incurring flood losses greater than their average monthly incomes are higher in the lower income groups. Thus, although the poor incur lower levels of flood loss compared to the wealthy, they are proportionately worse off. Malays also suffer the highest proportion of flood loss to income. Farmers and fishermen are also badly hit with a high ratio of flood loss to average income (although the latter appeared to have incurred a low level of flood loss in the most recent flood). On the whole, the above analysis verifies that flood hazards cause significant reduction of incomes to floodplain inhabitants, and that those who are worst affected are the poor and the Malays. Even though the most recent flood can be considered as a normal flood event the magnitude of flood damage is substantial. Flood damages reported for the worst flood is very severe. Consequently, the poor who have hardly any savings are made more vulnerable and are forced to rely on government aid and help from relatives.

Flood hazards, therefore, are at least responsible for undoing wealth accumulation amongst poor floodplain households. This has reinforced poverty, and even though the majority of rural floodplain households are well adjusted to normal seasonal floods, the occurrence of severe floods every once in a few years (e.g. in Kelantan the approximate statistical return period of severe floods is about 1 in 5) severely taxes these households. Although government flood aid is available, it is hardly adequate as only food, shelter and clothes are received during the flood period. A few of the more fortunate families may get financial help in terms of small loans to help them rebuild their houses but the majority remains unaffected. As a result, much of what little savings they possess are readily spent on coping and recovery from floods, and repairs to their houses. Rural floodplain occupants are mostly leading a life of

Table 8.2: Flood damage incurred by households during the most recent and worst flood experienced in relation to average monthly household income

Income level/ ethnic group/ occupation	Households incurring flood losses greater than monthly income		Mean flood loss during most recent flood	Mean flood loss during worst flood
	Most recent flood (%)	Worst flood (%)	$ at 1993 prices	$ at 1993 prices
All respondents	45.9	68.0	1,393 (917)*	1,837
Income level:				
< $175	50.0	87.8		
$175-$349	48.6	76.3		
$350-$499	36.6	66.7		
$500-$749	34.4	51.4		
$750-$999	30.3	29.4		
$1,000-$1,499	0.0	29.9		
$1,500-$1,999	20.7	33.3		
$2,000-$2,499	0.0	34.7		
$3,000 +	12.5	28.6		
Ethnic group:				
Malay	46.3	71.5	976 (625)	1,530
Chinese	35.4	55.1	2,062 (1,418)	2,433
Indian	30.0	47.3	1,630 (1,320)	2,036
Occupation:				
Professionals	37.5	57.1	3,044 (3,542)	4,667
Farmers	64.8	90.0	916 (346)	1,532
Artisans	34.8	59.3	1,054 (959)	2,025
Labourer	46.2	61.3	1,373 (606)	1,510
Fishermen	18.2	67.6	268 (325)	1,076

* Figures in parentheses are average monthly household incomes.

marginal subsistence. Farmers, fishermen and other agrarian workers are amongst the lowest income groups in the country (Table 8.3). They are, therefore, already vulnerable to flood hazards. Living in hazardous flood zones has aggravated their situation as the burden of flood damage firmly anchors them to the base of the income ladder. Consequently, large sections of the rural population are subject to high vulnerability to flood hazards.

And because the rural agrarian sector is largely dominated by Malays, this has reinforced income inequity which first became apparent during the colonial period. Chapter 4 has demonstrated that mass Malay poverty and backwardness vis-a-vis the other ethnic groups is embedded in the economic system of the country, reflecting nearly a century of neglect, discrimination and exploitation by the colonial masters and the inability of post-colonial governments to redress the issue[91]. Malay poverty is also largely caused by low productivity, exploitation and victimization, neglect and government policies with an urban bias (Ungku Aziz (1975). An important addition to this list of causes is the negative effects of floods which impose their 'taxes' on floodplain users for the contribution they make in the replenishment of fertile alluvial soils after each flood. Floods are, therefore, significantly responsible for perpetuating high incidence of poverty amongst rural Malay floodplain occupants.

Poverty and income inequity are important issues which successive post-colonial governments have attempted to address. Chapter 5 (Section 5.3.2) has also demonstrated that institutional policies (especially those relating to flood management) have been largely ineffective in addressing the two issues. Policies have mainly concentrated on increasing agricultural productivity in the Malay dominated rural traditional sector. Malay peasants have been given incentives and subsidies and other encouragement to increase productivity and thereby raise their standard of living (Ooi 1979 p302-3). Despite much effort in this area, including the opening of land schemes by the Federal Land Development Authority[92], employing the

[91] This is not surprising as the 20 year time constraint of the NEP (1970-1990) is hardly enough to rectify a structural feature that has been reinforced for nearly a century. To this end, Malays argue that their ancestors, having been colonised for centuries with devastating effect on them and their economy, would find it impossible to reverse the trend in 20 years (Quoted from Faaland et al 1990 p183-4).

[92] FELDA land schemes are expensive and their effects on the rural populace is small (Silcock and Fisk 1963). Although such schemes have benefited rural peasants somewhat and have indeed raised their income level, their overall effect is limited as the number of settler families selected are minimal compared to the number of applicants (Nonini 1992 pp150-154).

Table 8.3 Incidence of poverty by occupational groups and urban-rural areas and between selected states in Peninsular Malaysia

Occupational Groups:	Percentage of households in poverty
Padi farmers	57.7
Coconut smallholders	46.9
Rubber smallholders	46.9
Fishermen	27.7
Rural-Urban:	
Rural areas	24.7
Urban areas	8.2
Region:	
East Coast:	
Kelantan	31.6
Pahang	12.3
Terengganu	36.1
West Coast:	
Federal Territory*	5.2
Pulau Pinang	12.9
Selangor	8.9
National Average:	17.1

* Synonymous with federal capital

(Source: Government of Malaysia 1984 Household Income Survey; Faaland et al (1990 p123); and Government of Malaysia 1991a).

concept of the Green Revolution (Jegathesan 1977), loans and credit facilities, and other benefits, peasant farmers still remain one of the poorest sections of Malaysian society (Chan 1991a). Today, even as the country forges ahead as one of the most rapidly developing countries in the far east, peasants continue to lag well behind their urban counterparts (mostly Chinese and Indians). Even the disparity between rural Malays and urban Malays has widened and the former continue to be left behind by development policies which have not hitherto changed their traditional lifestyle and poor standard of living (Khor 1987 pp68-9; Chandra 1989 pp26-7; Government of Malaysia 1991a pp12-13). Stressing the continued existence of wide income disparities between urban and rural Malays, Faaland et al (1990 p189-90) remarked:

> '...Just in case some of them have forgotten their roots, or want to forget their roots because of their new found affluent styles of Guccis and Pierre Cardin and the social company they keep in the country clubs, during their short stay in the kampungs (during Hari Raya, an annual Muslim festival at the end of the fasting month) they are reminded again of their origins by the many unemployed rural youths queuing for jobs and by their parents petitioning about their inability to provide a decent livelihood for their families and the difficulties they encounter. These Malay better-off are reminded constantly about rural poverty and inequality vis-a-vis the modern sectors.'

Table 8.4 shows the wide income disparities and incidence of poverty between ethnic groups, regions, states and occupations. The figures, however, are not a true representation of all Malaysian households as this research is concerned only with floodplain inhabitants. Nevertheless, corresponding figures for all households (given in parentheses) are shown as comparisons. The income and poverty figures indicate that Malay floodplain households lag far behind their Chinese and Indian counterparts. Similarly, East Coast floodplain inhabitants do not compare well with those from the West Coast and farmers and fishermen are amongst the poorest of the occupational groups. Rural floodplain inhabitants also trail way behind their urban counterparts as their incomes are low and incidence of poverty high. However, impoverished areas are not solely confined to the East Coast. Other areas of low incomes and high incidence of poverty are also widely found in remote kampungs, new villages and rubber estates on the West Coast, notably in the states of Kedah and Perlis (Vokes 1990).

Finally, a significant proportion of urban dwellers are also poor. These are the urban poor who live in the slums/squatter settlements of the cities. Unlike their rural counterparts who are mostly Malays, the urban poor comprise all ethnic groups. The squatters settlements are mostly located on hazardous flood-prone land which are 'too risky' for any form of economic

Table 8.4 Mean Monthly Household Incomes of floodplain inhabitants in Peninsular Malaysia (1993 prices)

	Mean Monthly Household Income	Ratio to National Average	Incidence of poverty (below $350 per month)
National average:	1,378*	-	17.1
Floodplain households	917	0.67	27.0
Ethnic group:			
Malay	625 (1,012)**	0.45	35.2
Chinese	1,418 (1,785)	1.03	16.8
Indian	1,320 (1,300)	0.96	6.7
West Coast:	1,353	0.98	5.3
Federal Territory***	1,655	1.20	1.9
Pulau Pinang	1,151	0.84	7.6
East Coast:	550	0.40	45.2
Kelantan	629	0.46	41.3
Pekan	445	0.32	50.3
Occupation:			
Professionals	3,542	2.57	0.0
Farmers	346	0.25	64.2
Fishermen	325	0.24	56.1
Labourer	606	0.44	17.4
Artisan	959	0.70	8.4
Urban/rural:			
Urban	1,247 (1,831)	0.90	15.7
Malay	770	0.56	24.5
Chinese	1,860	1.35	8.5
Indian	1,410	1.02	5.7
Rural	529 (979)	0.38	40.2
Malay	503	0.37	44.1
Chinese	648	0.47	31.1
Indian	641	0.47	16.7

* This is the national mean monthly income for all households in Malaysia at 1993 prices. It is converted from the 1990 national average of $1,254 (Government of Malaysia 1991a p38).
**Figures in parentheses are mean monthly incomes for all households in Peninsular Malaysia converted to 1993 prices (International Law Book Services 1991 p235).
*** Synonymous with federal capital

development. In the current research, approximately a fifth of squatters households have monthly incomes below $350 and are therefore poor. Their mean monthly household income is $743, significantly higher than those of farmers and fishermen but it must be seen in the context of the location where that income is earned and spent. Most of the squatters live in cities where costs of living are much higher than in rural areas. If the 1993 poverty level of $394 and the higher cost of living in urban areas is taken into consideration, the percentage of squatters living below the poverty line would be higher.

The above analysis demonstrates that flood hazards contribute significantly towards undoing wealth accumulation, reinforcing poverty and widening income disparities between ethnic groups, regions, rural and urban locations, and occupational groups. The fact that the East Coast is subject to greater flood risks (because of seasonal exposure to the Northeast Monsoon) suggests that the poor peasant farmers and fishermen seldom have the chance to accumulate wealth. Surplus income earned during good years are quickly spent on coping with and recovering from floods. More significantly, the analysis shows that flood hazards have more adverse effects on Malays than they have on Chinese and Indians, resulting in high incidence of poverty amongst Malays. Flood hazards have, therefore, reinforced income disparities and are a hindrance to equity attainment.

8.3.2 Links between socio-political and institutional contexts and individuals within the income equity segment

In view of persistent problems of poverty and income inequalities, the key question in this segment is whether or not contextual forces ranging from the socio-cultural, political economy, through to the institutional recognise the magnitude of flood damage and attempt to reduce both human vulnerability towards floods as well as flood hazards themselves. Normal floods occurring every year cost the government millions of ringgits annually in disaster preparedness, evacuation, rescue, relief and rehabilitation. More significantly, the occurrence of severe 'major' floods every few years puts a heavy toll on the government's treasury (see Chapter 2). The estimated annual flood damage potential of $92.2 million in the peninsula is high and set to escalate with the current trend of rapid economic development on major floodplains (Chan and Parker Forthcoming). Within such a scenario, flood hazard reduction can be a potentially effective tool in achieving income equity. Reducing poverty and income inequalities can be achieved by increasing incomes of the poorer regions/states and groups, reducing the losses they suffer through hazards or both. Flood loss reduction can be in the form of lives saved, reduced damage to crops and livestock, properties and work, all of which contribute to better incomes. Better incomes reduces vulnerability and the poor are able to recover and get back to income generating activities faster.

There is a complex web of links between contextual forces and individuals who are affected by poverty and income inequity in relation to flood hazard vulnerability (Figure 8.11). Colonial policies have largely contributed to increased poverty and income inequity but post-colonial policies have both positive and negative effects. While focus on the modern commercial sector widens income disparities, the emphasis on redistributive policies in the rural sector reduces poverty and vulnerability to floods. This section examines the effects of the development of both sectors on poverty and income inequity.

Socio-cultural contexts play an important role in the quest for income equity. For example, all ethnic groups have lived together for a long time, and attitudes and values (cultural attributes) amongst all ethnic groups must change in order to attain income equity. As long as Malays (mostly muslim) believe that it is against their religion to accumulate wealth, and therefore do not put in extra effort to improve their economic condition, they will remain lagging behind the other ethnic groups. And as long Malays wish to remain on floodplains to continue their traditional mode of production and to pursue religious and traditional gratification ahead of economic advancement, they will always be subjected to the vagaries of flood hazards. Furthermore, as long as Malays view flood hazards as normal events and largely attributed to God, then they are less likely to take flood loss reduction response. Such attitudes have negative effects on flood hazard institutions and policies as scepticism and non-cooperation often limits their effectiveness. Many examples of such non-cooperation have been given in terms of reluctance to relocate (Chapter 6) and not heeding flood warnings (Section 8.2).

Similarly, other ethnic groups must also change their attitudes to enable income equity to be achieved. As long as Chinese and Indians do not open up their business world to Malays (according to Mahathir Bin Mohamad 1970, Chinese business is firmly confined within the Chinese community through a series of guilds), Malays will never catch up with them. This will foster resentment and may yet again erupt in racial violence which none of the ethnic groups want to see repeated. Socio-cultural contextual forces of prejudice and mistrust against one another have a communal origin which dates back to the colonial period, but they are still present in modern day Malaysia. Not only are communalism present amongst the masses but

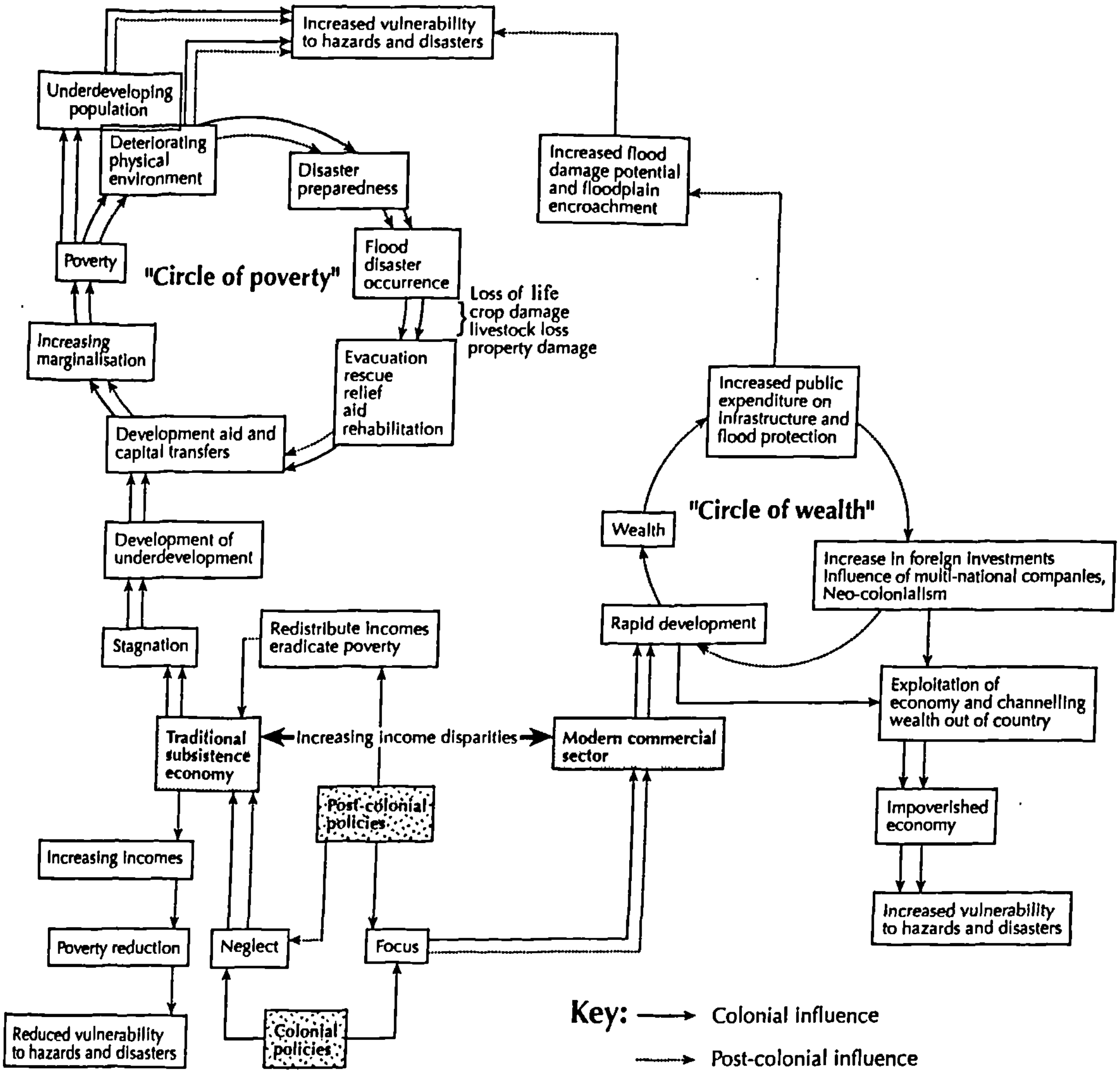


Figure 8.11: The links between structural/societal contextual forces (institutional forces are implicit in them) and poverty and income inequity in Peninsular Malaysia

it is being reinforced by political parties and institutions which work under the guise of promoting ethnic harmony (see Chapter 4). Malaysians must, therefore, change their attitudes and not identify themselves as Malays, Chinese or Indians but as 'Malaysians' and be proud of it.

Radical socio-cultural changes in attitudes and values take time but are now gradually taking place. More significantly, they have influenced institutions many of which have been set up to foster ethnic relations, harmony and the re-structuring of society (one of which is income equity). Institutions such as KEMAS (Community Development), MIDA (Malaysian Industrial Development Authority), RISDA (Rubber Industry Smallholder Development Authority), FELDA (Federal Land Development Authority) and many others have been restructured to deal with such cultural changes. They all have one common objective, i.e. to help Malays improve their economic position and reduce income inequity. Through their schemes and projects, these institutions in turn affect individuals who benefit through their participation in them. For example, FELDA settlers are acknowledged as significantly better off compared to traditional rural Malay peasants. There are currently better chances and more avenues open to urban Malays for economic advancement, but rural Malays are still hampered and constrained by poor access to these opportunities and avenues. Urban Malays are now more practical and open-minded about investments and making money from business and Islam is also viewed as more accommodating in this respect. Malays are currently doing well in business and are culturally evolving. In stressing the need for Malays to learn the business acumen from Chinese, the current Prime Minister has in the past been accused of trying to turn Malays into Chinese (Mahathir Bin Mohamad 1970). That Malays have benefited from these institutions is a fact, but there remains much to be done before income equity is completely achieved.

Institutional contexts are linked to structural ones through institutions and organisations. For example, political ideology is a structural context which, when translated into action, come into contact with the public via institutions. Although flood hazard institutions are not expected to directly reduce poverty and restructure society[93] (their policies are concerned

[93] 'Restructure society' in the Malaysian context refers to the transforming of an inequitable society (in terms of income and opportunity) to an equitable one. It also involves restructuring of the work force into one which is not identifiable by race. Currently, most Malays are in agriculture and government service, Chinese in business and the private sector. Indians are equally involved in agriculture (rubber tappers) and business.

with only flood management and related issues), they are important vehicles that can be harnessed towards contributing to such goals. Referring to Figure 8.11, institutional contextual forces come into effect in many areas. For example, post-colonial policies of redistribution of income and poverty eradication are mostly put into action by government agencies. Some examples mentioned earlier are FELDA, MIDA, RISDA and KEMAS. In terms of flood hazard reduction, the examples are DID, MMS, FDRPC, and the Welfare Department. These organisations carry out programmes designed to reduce flood hazards and their impacts on people and their properties.

The extent to which flood hazards and people's vulnerability are reduced depends largely on the effectiveness of these organisations. For example, if flood hazard organisations and non-flood organisations are aiming towards poverty eradication and equity attainment, then their effect on individuals would be positive. If however, they are more concerned in maintaining economic principals through the application of BCA methods, then it is likely that the poor will be over-looked and the rich protected instead. For example, the application of such methods is severely prejudiced against the less developed East Coast states or the poorer sections of society. East Coast states and poor floodplain occupants have low economic potentials, low population densities, and less built-up area per square kilometre. As such, they do not justify the federal institutions spending large sums of money on them for flood management purposes. Thus, the building of expensive dams, channel deepening, embankments, and other structural/engineering schemes are usually found in the more developed West Coast states or in more commercially developed urban areas. Therefore, poor East Coast floodplain inhabitants are 'less' protected than their West Coast or wealthier counterparts. Instead, a less expensive approach to flood management is planned for the East Coast and to this end, the government has decided on the current annual disaster preparedness, relief and rehabilitation (inclusive of warning and evacuation) programme. This, inevitably results in a reactive rather than proactive response, therefore exposing people and property to flood hazards rather than protecting them. This has often led to significant flood losses amongst East Coast states and the poorer floodplain occupants (see Appendix K), thereby reinforcing poverty and income inequity instead of reducing them.

Chapter 5 has demonstrated that institutional policies on flood management also do not have a clear-cut objective of poverty eradication and equity attainment, and also do not appear to work very well. Such policies were found to contribute little towards achieving the two objectives. Allocations of major flood mitigation funding were found to favour more developed West Coast states and densely developed and populated urban areas rather than more the hazardous rural floodplains where the majority of the poor are located. This again serves only to protect and benefit the wealthy rather than the poor. Consequently, institutional flood hazard policies suggest that poverty and income inequities are being perpetuated.

Political economy contexts manifested in federal policies such as 'poverty eradication' and 'restructuring society' can be vehicles for the reduction of flood hazards and vulnerability amongst the poor. The huge gap between the modern commercial and traditional agrarian sectors (due to colonial favouritism and ineffective post-colonial policies) have given rise to wide disparities in regional, sectoral and social development, all contributing to an increasingly unequal society. Since the May 13 tragedy (see Chapter 4 Section 4.2.6), rapid rural economic development strategies have been introduced by the government to reduce income inequity and poverty. To this end, poor regions and states were given more emphasis for economic development and regional integration was employed as a strategy to redress economic and structural inequity in society. The NEP (a structural policy), therefore, has a direct effect on institutions as government agencies (flood hazard and otherwise) are geared towards achieving equity objectives. In turn, the effectiveness of these institutions will affect individuals. Thus, by examining the extent to which the NEP and other structural policies work towards achieving income equity, the links between the structural, institutional and individual contexts are identified.

Income equity is closely tied to the issue of poverty. As the majority of the poor are Malays and the majority of the wealthy, non-Malays, eradicating poverty then becomes crucial to successful attainment of income equity. This section examines the links between structural policies, institutions and individuals, and the extent to which these links have contributed to poverty reduction. Despite many attempts at its eradication, poverty is still at large in Malaysian society. Its presence on the agendas of all recent Malaysia plans verifies that it is still present. Despite a 20 year period, the NEP has been unsuccessful in eradicating poverty. The NEP's links with individuals has been the improvement of rural standards of living and increased rural incomes (mostly Malays), making rural inhabitants less vulnerable to flood hazards. But, more significantly, the NEP's objectives on maintaining rapid economic growth in the commercial sector and in urban areas have resulted in greater increase in urban incomes (mostly amongst non-Malays). Thus, while Malay poverty has been partly reduced, Chinese and Indian wealth have also increased making income disparities even wider. Equity, therefore, remains an elusive long standing objective yet unattained.

There is much evidence from this research to suggest that structural policies have not been sufficiently successful to eradicate poverty. For example, the overall incidence of poverty for the country was 17.1 per cent in 1990, with rural poverty higher at 21.8 per cent. Some of the poorer Malay dominated states such as Kelantan and Terengganu have rural poverty levels in excess of a third of all households (Government of Malaysia 1991a p12). In absolute figures, there were more than half a million poor households in 1990 and of this number, a quarter were classified as the hard-core poor. Most of the poor households are located in the remote traditional kampungs, new villages, rubber plantations and squatter areas in some urban centres. Coincidentally, these are often floodplain areas highly prone to flood hazards. Some notable rural examples are on the banks of the Kedah and Muda Rivers, the Kelantan River floodplain (outside Kota Bharu), the Terengganu River floodplain and the Pahang River floodplain (outside Pekan). On the other hand, urban squatter settlements are found on the banks of the Kelang River in Kuala Lumpur, on the banks of Sungai Pinang in Pulau Pinang, and off the banks of the Pahang River in Pekan. These are areas of high flood risk, which when coinciding with human exposure, produces high vulnerability to flood hazards. In a comprehensive appraisal of the effectiveness of the NEP, Faaland et al (1990) came to the conclusion that the reduction in income equalities at all levels is somewhat short of its objective. Thus, the authors remarked:

> '..In Malaysia, in spite of considerable efforts, poverty continues to rule to an unacceptable extent in rural areas: there are considerable differences in the prosperity of the states comprising Malaysia.' (Faaland et al 1990 p149).

Chapter 6 demonstrated that two-thirds of the floodplain households interviewed are either poor or living close to the poverty level. Of this total, 74.4 per cent are Malays, with Chinese and Indians making up 17.9 per cent and 2.6 per cent respectively. In contrast, 63.6 per cent of the wealthy households (those with monthly incomes in excess of $2,000) are Chinese with Malays and Indians both making up 18.2 per cent each. Income inequity is therefore still prevalent in Malaysian society, at least amongst floodplain households. The magnitude of current income inequity has also been highlighted in Section 8.3.1. Table 8.5 reveals that the income disparity between Malay squatters and non-Malay squatters is small but the difference between Malay non-squatters and non-Malay non-squatters is large. This means there is little income difference amongst the poor, irrespective of ethnic group.

Restructuring society is a key government objective targeted at income equity attainment. This is largely because, compared to non-Malays, the majority of Malays are poor.

Table 8.5 **Mean Monthly Household Incomes of floodplain squatter households in Peninsular Malaysia (1993 prices)**

	Mean Monthly Household Income	Ratio to National Average	Incidence of poverty (below $350 per month)
Squatter	743	0.54	19.0
Malay	875	0.63	14.9
Chinese	981	0.71	8.3
Indian	650	0.47	11.8
Non-squatter	951	0.69	28.6
Malay	584	0.42	38.5
Chinese	1,451	1.05	17.4
Indian	1,585	1.15	4.7
Urban-squatter	894	0.65	8.8
Malay	964	0.70	6.5
Chinese	1,047	0.76	10.0
Indian	664	0.48	12.5
Urban non-squatter	1,326	0.96	17.3
Malay	720	0.52	29.2
Chinese	1,945	1.41	8.3
Indian	1,733	1.26	2.7
Rural squatter	515	0.37	34.2
Malay	703	0.51	31.3
Chinese	650	0.47	-
Indian	425	0.31	-
Rural non-squatter	531	0.39	41.2
Malay	484	0.35	45.4
Chinese	648	0.47	32.2
Indian	677	0.49	16.7

The 20-year NEP (introduced after the May 13 racial riots in 1969) accorded special privileges to Malays in the fields of education, commerce, banking and other fields. That the NEP has improved Malay economic status is undeniable, but has it effectively reduced income inequity? The fact remains that Malays have not caught up sufficiently with their Chinese and Indian counterparts. This is because, the NEP favoured those Malays with access to it, viz. the urban middle class and rich upper class Malays who lived in towns and other urban areas. They were the ones who benefited most, but they only constitute 35.0 per cent of the total Malay population. The majority of the Malays who live in the traditional rural areas continued with their impoverished way of life. Increased government expenditure and activities in the agricultural sector have not sufficiently raised rural standards of living. Instead, it was the rich farmers who form the main base of the Malay state bourgeoisie that benefited most (Hua 1983 p156). Faaland et al (1990) analysed income equalities between the ethnic groups and are of the opinion that the NEP objective of restructuring society has not been totally achieved. Perhaps the most obvious evidence that the NEP has not achieved its target after the 20 year period is that the current outlines of the NDP embodies much of the same objectives of the NEP it has replaced.

In many instances, many are also living in locations too remote to realise the economic benefits to be gained in the NEP. This is especially so in the case of the older generation of Malay farmers, who neither possess the resources nor the desire to pursue economic gains. Informal discussions and qualitative interviews conducted by the author revealed that they are quite unconcerned over issues of restructuring society. As far as they know, living in a remote kampung within a homogenous society, there is no need for restructuring as almost all are poor. In general they are contented with their life. Remarked one farmer,

> '..I have lived here all for 80 years. Society has always been the same. All my relatives and friends are poor but we are happy. We help one another when times are bad, for instance when there is a flood. I do not know how the Chinese or Indian live in the towns, or whether they are rich or poor. Of course I have visited relatives in towns where they live in small flats in tall buildings that I have difficulty climbing the stairs. You tell me they are better off but they live within a small enclosure and have no space for their children to play. After just one day I wanted to come home to my kampung. I am happy that three of my six children have government scholarships and have become successful in their lives. But they now live in towns and I do not get to see them and my grandchildren often, and I resent that. Since I cannot stand living in towns, I do not visit them often. My other three children are not so smart but thank Allah they are still living in the same district although in different kampungs. At least I get to see them and my other grandchildren. Even these children and grandchildren of mine do not like to visit their cousins in the towns.'

Because of this attitude, coupled with the ineffectiveness of the NEP to redress society sufficiently, the majority of the Malay peasantry remains poor and vulnerable to flood hazards. The current research reveals that farmers (78.9 per cent Malay) and fishermen (33.3 per cent Malay) still have the lowest incomes in Malaysian society. The ratio of farming and fishing households to the national average are 0.25 and 0.24 respectively. Within the farming community, Chinese farmers have higher average monthly household incomes ($391) compared to Malay farmers ($334). In contrast, the ratio of the incomes of professionals (52.6 per cent Chinese and 26.3 per cent Malay) is more than two and a half times that of the national average. Chinese professionals earn an average monthly income of $2,369 compared to $1,032 earned by Malay professionals. Indian professionals have a mean monthly income of $2,053. Elsewhere, the 6th Malaysia Plan reported that the ratio of Malay mean income to Chinese in 1990 was 58.8 per cent and that of Indian to Chinese stood at 75.9 per cent (Government of Malaysia 1991a p38). In terms of floodplain residents, the current research reveals that the ratio of Malay and Indian incomes to that of Chinese are 0.44 and 0.93 respectively (at 1993 prices). Thus, in spite of considerable efforts, income disparities between the ethnic groups continue to persist. Although the average Malay standard of living has improved over the NEP period, the other ethnic groups have forged even further ahead. This suggests that political economy contexts have largely been unsuccessful in reducing income inequity in relation to flood hazard reduction.

The NEP and its development policies have also been largely ineffective in redressing economic disparities between regions and states. Because the traditional sector of the economy is largely concentrated in the East Coast, the underdevelopment of this region is inevitable (Faaland et al 1990 p5). Policies of rapid growth under the NEP was necessary for raising incomes in the traditional sector, especially lifting rural poor households over the poverty line. However, rapid economic growth has increased urban incomes more vis-a-vis rural incomes as the modern sector has taken advantage of the opportunities generated by such growth. Rapid industrialisation and growth of commercial agriculture and mining has favoured the modern sector more than the traditional sector. Consequently, wide development disparities reflected in large differences in incomes and living standards have perpetuated between regions/coasts, states, districts and even within different sections in cities and towns. Arguably, nowhere is the difference as pronounced as that between the East and West Coasts. For instance, infrastructure such as roads, railways and other means of communication is well developed in the West Coast but is still poorly developed in the East Coast. There are also wide disparities in per capita GDP and mean household incomes (Table 8.6). Because of such

Table 8.6 Per Capita Gross Domestic Product and Mean Monthly Household Income By State in Peninsular Malaysia for 1990

State	Per Capita GDP (in 1978 prices)	Ratio to National Average	Mean Monthly Household Income	Ratio to National Average
West Coast:				
Federal Territory*	7,608	1.73	2,102	1.68
Selangor	6,558	1.49	1,790	1.43
Pulau Pinang	4,934	1.12	1,375	1.10
East Coast:				
Kelantan	1,739	0.40	726	0.58
Pahang	3,278	0.75	1,092	0.87
Terengganu*	7,124	1.62	905	0.72

* Synonymous with federal capital.

** Terengganu has a high Per Capita GDP due to the discovery of off-shore oil and gas fields. But this figure is misleading as the majority of its population remain poor, as indicated by the low mean household income.

(Source: Government of Malaysia 1991a Sixth Malaysia Plan 1991-1995, p38) differences, a very much poorer and less developed state such as Kelantan[94] is more vulnerable to the flood hazard, especially during the occurrence of major floods. In the same way, the poorer sections of cities and towns on floodplains are also highly vulnerable to floods.

The above analysis demonstrates the continued existence of spatial and communal income disparities in Peninsular Malaysia, but more significantly, it confirms that the NEP has fallen short of its targets. Regional income and other economic disparities have perpetuated and flood hazard reduction have not been effectively employed as a means to achieve that equity. Poor regions with poor inhabitants are generally the most vulnerable to floods. The occurrence of a severe flood of the 1926 or 1971 magnitude can severely cripple a poor state such as Kelantan or Perlis, which do not have the resources to cope with it. In such a case, relief and rehabilitation are functions heavily supported and in many instances provided by the federal government. In terms of poor individuals or households, there is clearly a direct relationship between vulnerability and poverty (Wisner et al 1976). This has been discussed above it is important to mention here that regional income disparity cannot be detached from the issue of poverty. There is also a close relationship between 'peripherality' and poverty in Peninsular Malaysia (King and Parnwell 1990). Table 8.6 also illustrates regional disparities in per capita GDP and mean household incomes. It reveals that .wide economic disparities still exist between regions and states further testifying to the inability of post-colonial governments to redress regional economic and development disparities.

In the same way as the colonial policies have created vulnerability to the flood hazard amongst East Coast states, post-colonial policies have reinforced such vulnerability. Because of favoured development in the urban areas of the West Coast, many of the traditional farming and fishing areas in the East Coast are peripheral areas where the inhabitants' are largely leading a marginal existence. In these impoverished areas, often the physical environment is less conducive to economic development (of which seasonal flooding is a major problem), soils may be poorer (badly drained and peaty) and terrain (swampy and thickly forested) and accessibility may present difficulties. Some examples are rural kampungs such as Kampung Tendong in Pasir Mas, Kelantan and Pulau Pekan Baru in Pekan, Pahang

[94] Kelantan is fast gaining the reputation as the poorest state in Peninsular Malaysia. It has the most number of hardcore poor households. Of the total 50,079 hardcore poor households in the peninsula, a total of 16,209 (32.4 per cent) are in Kelantan (The Star, 24.8.94).

9 CONCLUSIONS

This research set out to investigate a number of broad research questions set within specific boundaries in Chapter 1 (Section 1.2). It aimed to examine the importance of flood hazards and their effects, to analyse contexts responsible for their creation and perpetuation, and to explain human vulnerability to them in Peninsular Malaysia. The theoretical focus was based on a 'hazard response-in-contexts' model which aimed to explain individual perception and response to flood hazards within the influence of wider 'socio-political' and institutional contexts. It further aimed at investigating the response of institutions and organisations (which also function within the influence of socio-political contexts) to flood hazards. To this end, an investigation on the adequacy of current institutional and organisational strategies and policies (i.e. governmental) in flood hazard management based on the 'criteria *approach*' *was* attempted. Finally, the research used formal flood warning and evacuation systems and official policies on income equity as segments to *demonstrate the importance of contexts upon* individual flood hazard responses.

This concluding discussion focuses on these specified areas of study. It summarises the main findings and, where appropriate, suggests recommendations arising from these.

9.1 Research Question 1: The importance of the flood hazard and its effects in Peninsular Malaysia

This research has demonstrated that flooding is a major natural hazard in Peninsular Malaysia. It is frequent, widespread and of two types - 'normal' and 'major'. While normal floods occur almost every year, major floods are more irregular occurring once every few years. Major floods of the magnitudes of those in 1926, 1954, 1967, 1970, 1971, 1988 and 1993 have been demonstrated as disastrous as their effects resulted in significant loss of life and damage to properties, crops and livestock, businesses, industries and public amenities. Even the annual occurrence of normal seasonal monsoon floods (not considered severe) were shown to put strains on the country's resources. Annually, floods were shown to account for almost the entire reported national cost for disaster preparedness, mitigation, relief and rehabilitation. The household damage survey in this study revealed that both tangible and intangible, as well as direct and indirect flood damages and their effects were not high, but become significant when they are compared to mean household incomes. Damage to building contents and structures, crops and livestock, and vehicles were the main categories of flood loss suffered by individual households. Intangible effects such as stress, worry and health were also shown to be important. The survey also revealed that damages to commercial properties and their businesses, especially in large urban centres such as Kuala Lumpur and Georgetown were substantial. Finally, industrial damages were also shown to be substantial and under-reported.

The importance of flood hazards are, however, not just in terms of related losses. For five months a year, from November to March, life in the East Coast is structured and revolves around the monsoon season. Padi planting, fishing and other forms of the traditional economy are adapted to the monsoon or locally termed the 'flood season'. For example, public examinations, seasonal migration of labour (e.g. from fishing to padi farming), tourism and other activities are all affected by the floods. More significantly, Malay culture is intricately bound to the monsoon season and floods. The stilt house, informal traditional flood warning and evacuation systems and many other adaptive mechanisms have evolved in response to floods. In the East Coast, it was discovered that floodplain occupants are used to normal seasonal floods and can cope reasonably well. They only become vulnerable to major 'severe' floods which they cannot cope with and recover from, and have to receive aid from the authorities. In the West Coast, however, although life does not revolve around seasonal monsoon floods, unpredictable flash floods affect many urban floodplains. Urban flooding is closely linked to social issues of squatting and poverty, which further complicate the flood issue. Current rapid development of urban floodplains have also exacerbated flood problems resulting in high potential flood damage in such areas. The debate on deforestation is still unresolved as research relating flood occurrence to deforestation has been inconclusive. Yet, to treat deforestation as insignificant would be dangerously naive as deforestation has certainly changed hydrological parameters and contributed to flooding, especially that of urban flash flooding.

Finally, this research reveals evidence that flood risk, exposure and vulnerability are all increasing in Peninsular Malaysia. With the sustained rapid economic, industrial and agriculture development expected well into the next century, the country's urban and rural floodplains are expected to grow. More people are expected to live in flood zones as encroachment becomes an inevitable solution to population and land pressures. Greater exposure and vulnerability will lead to greater damage potentials and exacerbation of flood hazards.

9.2 Research Question 2: The important contexts responsible for the creation and perpetuation of flood hazards, and vulnerability to flood hazards in Peninsular Malaysia

A combination of natural and human factors have contributed to increasing flood hazards in Peninsular Malaysia. While natural characteristics such as exposure to cold surges and monsoon depressions leading to heavy seasonal rainfall, intense convection rain storms, low-lying topography, poor drainage and other local factors are responsible for high flood risk in many parts of the peninsula, inadvertent and deliberate human use of floodplains (both past and present) such as padi farming, plantation agriculture (mostly rubber and oil palm), tin mining, city and town expansion and others have resulted in increased human and material exposure and vulnerability.

More significantly, although floods have evolved to become a common feature in the lives of a significant number of Malaysians, increased exposure and vulnerability were demonstrated to be largely influenced by contextual forces. The socio-cultural, political economy and institutional contexts were identified and subsequently demonstrated as key contexts responsible for trapping individuals on floodplains, thereby increasing exposure and vulnerability. Within each key context are many facets which work independently or in tandem with other contexts to perpetuate human occupance on floodplains. This research has also demonstrated that the scope for individual action in response to flood hazards was severely constrained if not largely determined by contextual forces, many of which are 'structural'.

9.3 Research Question 3: The importance of 'socio-cultural' and 'political economy' contexts in flood hazard response

Socio-cultural and political economy contexts are macro structural forces which impinge upon, and strongly influence individuals and institutions in Peninsular Malaysia. They operate at the broadest level and can be abstract (e.g. beliefs) or real (e.g. poverty), but their common characteristic is that they pervade almost every aspect of flood hazards and were demonstrated to contribute significantly to the creation and perpetuation of flood hazards in the peninsula. In examining these contexts, both the elements of time and space (contexts by themselves) were also substantiated as important in the occurrence of flood hazards.

The socio-cultural contexts comprise many facets but three were identified as key facets affecting flood hazards: historical settlement; colonialism; and ethnic culture. Although some facets are historical, they were demonstrated as significant forces in shaping current flood hazards. For example, historical settlement and human use of rivers and their adjacent land precipitated the current pattern of riverine settlements. The majority of key cities and towns are located on floodplains, and as they grew, increasingly more hazardous zones were developed and occupied leading to increased exposure, vulnerability and flood damage potential.

The colonial facet was demonstrated as one exerting profound influence on current flood management approach, mainly through the DID (which originated as a colonial agency) and its lop-sided structural/engineering approach to flood problems. Colonial exploitation of the country's economy contributed to depleted national resources, leading to inadequate finances for development in general and flood management in particular. Colonial policies of uneven regional and sectoral development resulted in the neglect of the East Coast and the traditional rural agrarian sector, which to this day remain largely undeveloped. East Coast states, therefore, stagnated under colonial rule and became largely poor, as did its inhabitants, resulting in high vulnerability to flood hazards. In contrast, emphasis on resource exploitation (mainly tin and rubber) rapidly developed the West Coast. Large tracts of virgin forest were cleared for mines, rubber estates, settlements, roads and railways and other urban land use. Floodplain encroachment also became a feature of urban areas. These activities radically changed the hydrological cycle and were likely factors that contributed to increased flash floods in the West Coast.

This research also indicated that colonial policies on communalism had been prejudiced against indigenous Malays and favoured immigrant Chinese and Indians. The former, considered by the colonialists as only suitable for padi farming and other forms of traditional agriculture were left behind in the main stream of development. In contrast, the colonialists found Chinese and Indians useful in their exploitation of tin and rubber respectively and encouraged them into these activities. These two communities, therefore, lived in towns and rubber estates on the West Coast, areas which are relatively unaffected by seasonal floods. They also became wealthier vis-a-vis the Malays, of whom the majority became impoverished. Colonial oppression towards Malays gave rise to wide income disparities between Malays and the other ethnic groups. Malays continued to live in rural agriculture areas, mainly on fertile floodplains, river mouths, deltas and low-lying coastal areas, mostly in the East Coast (although a significant proportion have been forced to occupy marginal lands). Even when Malays started planting rubber in smallholdings, they were suppressed by the colonialists through a series of rubber production control schemes, the most notorious of which was the Stevenson Scheme. Consequently, Malays became the most impoverished ethnic group and since they largely live on floodplains, they were the most exposed and vulnerable to flood hazards.

When the colonialists introduced cash cropping in the peninsula, a significant number of padi farmers were attracted by the lucrative crop and switched to rubber smallholdings. While the majority still firmly remained in the production of traditional food crops, those who made the switch suffered the most when rubber prices plunged during world recessions. They were also suppressed by rubber production control schemes mentioned above. Thus, during times of floods, these individuals have lost their traditional coping mechanisms resulting in weakened resistance and increased vulnerability.

Colonialism also exerted its influence strongly in moulding current flood hazard policies, most notably in forming the DID in the 1930s and of reinforcing the structural/engineering approach. The exploitation of the Malayan economy for more than three-quarters of a century also drained the country of vital resources, contributing to a less than comprehensive flood management strategy.

The colonialists have come and gone. While Malaysians are generally grateful to them for developing and modernising the country, there remain many areas in which their influence has been negative and counter-productive. The perpetuation of flood hazards is one of many such areas. It is now nearly four decades since the colonialists left. One might be tempted to argue that Malaysians ought to have redressed the negative aspects of colonial rule during that period. Yet, this study has demonstrated (as have other studies) that many colonial legacies are too deep rooted and complicated to be fully redressed yet. Try as they may, successive post-colonial governments have been only partly successful in reducing but not wholly solving these issues. They, therefore, must take some of the blame for the perpetuation of flood hazards but some are tempted to argue that it is extremely difficult, if not impossible, to undo structural forces that have been implanted and reinforced for more than three-quarters of a century. Nevertheless, it is the contention of this research that colonial rule, through its policies, administration and exploitation of the peninsula's resources has, in more ways than one, contributed to increased human vulnerability as well as the creation and perpetuation of flood hazards in present day Peninsular Malaysia.

This research has also demonstrated that ethnicity is a vital ingredient in all aspects of Malaysian society, including flood hazard response. Research findings indicate that the ethnic culture facet strongly influences decisions to persist on floodplains. For example, ethnic values, beliefs, attitudes, religion, customs and tradition, particularly those of the Malays, were discovered to be crucial elements which bond them to a life of farming, fishing or other traditional activities on floodplains. Malays were found to resent modern living and preferred the 'kampung way of life'. They were also more interested in religious and cultural pursuits rather than the accumulation of wealth which the immigrant communities were more attracted to. The Malay family system of land inheritance also firmly traps them in their ancestral land, usually in kampungs on floodplains. More significantly, all these have been shown to give rise to low standards of living amongst Malays who often live below the poverty line and are therefore highly vulnerable to flood hazards.

Therefore, despite the fact that many are trapped on floodplains by exogenous 'structural' contexts, there are also many who live there as a matter of choice. Although attachment to place is a well documented reason in the hazards literature (White 1974), there is little contention of the view that 'People choose to live in hazard zones because they have lived there for a long time, are familiar with them, love their way of life and want to remain there'. A most interesting finding in this research, is the fact that a large section of Malaysians, particularly rural Malays, live near rivers (i.e. on floodplains) simply because it is a highly revered traditional way of life (a cultural context) that is treasured.

Further analysis of contexts revealed that many aspects of Malaysian society are influenced by political economy contexts. Flood hazard management (including emergency planning, relief, rescue and rehabilitation) in Peninsular Malaysia was discovered to be fundamentally affected by the pervasive forces of the political economy context. International contextual forces such as neo-colonialism exert considerable influence on the Malaysian economy which is heavily export-oriented and commodity based. Shifts in prices in the international market and exports, largely controlled by powerful imperialistic countries were shown to adversely affect the Malaysian economy. Protectionist strategies of developed countries or groups of them have also suppressed the country's trade. The power of foreign capital (which is still substantial in the country) is also demonstrated to have been responsible for Malaysia's subordination to neo-colonialism. Malaysia's industrialisation efforts have also been exploited by MNCs, mainly from Japan and the United States, and to a lesser degree from Britain, Korea and Taiwan. Imperialistic control and exploitation of the Malaysian economy was demonstrated as having a negative effect on the country's revenues resulting in fewer resources (financial or otherwise) for flood management.

Research findings revealed that political and economic ideologies translated into national policies have significant influence on flood hazards. For example, policies on rapid economic development and the 2020 vision of making the country an NIC by the year 2020 were found to have negative effects on flood hazards. Such policies favoured industrialisation, tourism, rapid urbanisation, rural-urban migration, and the opening of more forest land for agriculture and other human land use, all factors leading to increased encroachment of floodplains. Rapid economic growth in vulnerable Third World countries often create new problems (related to disasters) faster than the development of measures to deal with them (Davis 1985 p35). This research has demonstrated that rapid economic development policies have given rise to increasing flood risk, exposure and vulnerability (amongst certain sections of Malaysian society, viz. rural agrarian based peasant communities and urban squatter communities), and flood damage potential. Development policies have been shown to have lesser benefits on the rural traditional economy which remains the most vulnerable to flood hazards.

In Peninsular Malaysia, flood hazard policies are mainly based on a technocentric approach and have been shown to largely favour structural/engineering measures. The building of flood control dams, channel deepening, desilting, flood walls, embankments and levees, retention ponds and flood channels were discovered as some of the common measures. Non-structural measures are mainly practised in the East Coast but are focused only on emergency planning procedures. Flood warning systems are currently still under-developed as are other measures such as legislation and land use control.

It was found that many hazard-response decisions were fundamentally political in nature. Controversies and friction between federal and state governments retard the effective implementation of federal flood policies. This often leads to state governments straying from federal objectives, especially with regards to land, forest and river development. Similarly, the federal government has been shown to have financial control over some state governments, especially in the case of the poorer states. Friction between the two levels of government was demonstrated as having negative effects on flood hazard reduction.

Finally, post-colonial policies on communalism, equity attainment and poverty eradication were shown to have increased vulnerabilities amongst sections of Malaysian society. For example, communalism amongst the various communities continues to segregate Malays from Chinese and Indians. While Malays in rural areas remain poor and vulnerable to flood hazards, non-Malays have forged further ahead (i.e. economically) in cities and towns. Chinese and Indians have also not learned flood adaptation methods from the more experienced Malays, although those living amongst Malays in the rural areas are beginning to do so. Rural-urban migration has resulted in encroachment of urban floodplains and increased exposure and vulnerabilities. Equity attainment policies have brought about increased standards of living amongst Malays, but unfortunately only urban Malays (approximately one-third of the total Malay population) are the beneficiaries. Such policies have negative effects on poor Chinese and Indians who do not benefit from them but are trapped in their new villages and rubber estates. They too become vulnerable to flood hazards when affected. Poverty eradication is, however, theoretically practised across the board irrespective of ethnic group. So all the poor groups are expected to benefit. However, this research (and others) has shown that the NEP and its related policies have not done sufficiently enough to eradicate the problem. Poverty has certainly been reduced but currently more than half a million people (a large proportion estimated to be living on floodplains) are still classified by official statistics as poor. Results show that poverty is a fundamental cause of vulnerability. The poor are, therefore, the most vulnerable to flood hazards and the assertion that 'a disaster is a great leveller, striking all social groups irrespective of wealth' is indeed a myth (Davis 1978). Poverty reinforces low residential and occupational mobility, both of which trap people in flood-prone zones. Consequently, there remains a large section of Malaysian society which is exposed and vulnerable to flood hazards.

9.4 Research Question 4: The importance of institutional and organisational contexts in flood hazard response

In Peninsular Malaysia, the institutional context is found to be a main driving force in flood management. This is because flood hazard institutions (which include organisations) are set up by the government who is responsible for flood management. Effective flood hazard reduction, therefore, depends to a large extent on the effectiveness of institutions. In this research, the institutional context comprises four main facets of laws, organisational structures, attitudes, values and culture, and policies and instruments. An evaluation via the criteria approach revealed that the adequacy of flood hazard institutions and organisations in

Peninsular Malaysia is far from satisfactory. Institutions and organisations evaluated were found to be largely inadequate in all four criteria assessed. Only the environmental protection criterion appeared sufficiently adequate. Even so, its application and enforcement of the concept of sustainability remained problematic as economic and political considerations often override environmental ones in decisions regarding forests and land use change (especially relating to floodplain use).

In terms of the organisational structures facet, the missions, objectives and statutory duties of most flood hazard institutions and organisations were discovered to be inadequate. Only the DID appears to be adequate in this respect but its flood obligations are still only secondary to its other functions of drainage and irrigation. Flood hazard organisations were found to require re-definition and improvement in their objectives. They were also discovered to over-emphasise structural/engineering measures although the official government policy clearly favours the more affordable non-structural measures. In this respect, non-structural measures that have potential and can be further developed are flood insurance, legislation, development planning, flood risk analysis, land use change, resettlement, flood proofing, and public education.

The findings also revealed that the laws and regulations facet in relation to flood management is under legislated. Existing laws were found to be largely inadequate in regulating floodplain use, especially in relation to the conflict of interest between federal and state governments. It was further discovered that flood hazard institutions need new legislation and greater enforcement power for more stringent flood management. At the moment, flood hazard organisations (e.g. the DID) were found to lack legal power to enforce regulations pertaining to flood hazard management. It was also discovered that the insurance industry for flood losses is currently under-developed and is one area which has immense potential both for floodplain users as well as for insurers.

In terms of the policies and instruments facet, flood hazard organisations were found wanting in financial and human resources. Although total budgetary allocations have increased since 1971, the increase in 'real' terms is not large after inflation is taken into account. More significantly, such increases were mainly channelled into structural/engineering flood control schemes. Budgetary allocations for non-structural schemes remained relatively small and need to be substantially increased. This can only be done if major flood hazard organisations such as the DID and the MMS discard their current 'engineering' oriented approach and embark on a more multi-disciplinary approach with greater emphasis on non-structural measures of flood reduction. Staffing was found to be inadequate in flood hazard organisations not only in terms of numbers but also in terms of disciplinary composition. The majority of staff in the DID and the MMS, the two main flood management agencies, were engineers, physicists and mathematicians. It was also discovered that both the equity and public accountability issues were not adequately addressed by flood hazard institutions and organisations. Despite its focus on the former over all its 5 year Malaysia plans, flood hazard institutions and organisations have not built the equity criterion into their planning. The majority of flood projects did not concentrate on poor rural areas where the benefits were substantially small, but were largely targeted at densely populated urban areas where benefits vis-s-vis costs are justified. There appeared to be a gradual move towards more public consultation and accountability in government flood schemes but governmental culture of secrecy and the threat of opposition parties abusing and distorting information were found to prevent public consultation and accountability from reaching a high level.

Finally, organisations were found to develop their own values, attitudes and sub-cultures, a facet which influenced the outcomes of flood hazards. The concept of collective 'sticking together' was found to pervade the DID and other organisations. In the case of the DID, it was official policy to recruit only engineers in order to perpetuate its engineering culture and thereby its technocentric approach to flood management. In the case of the MMS, mainly meteorologists, mathematicians, and physicists are favoured. Flood hazard organisations such as the FDRPC have also developed distinctive behavioural characteristics reflecting their history, traditions, accumulated experience and collective perception of their roles beyond those laid down officially. Its bureaucratic structure were found to slow things down and it tended to view floods as unavoidable where only evasive actions and loss reduction are emphasised. Organisations have developed self-sustaining mechanisms designed to perpetuate both the organisation and its members. In the case of the DID, this mechanism is manifested in its recruitment programme, strong emphasis on engineering and its preoccupation and focus on agricultural land drainage and irrigation. The above analysis reveals that values, sub-cultures and attitudes can determine the outcome of flood hazards.

9.5 Research Question 5: Significant factors in individual perception and response to flood hazards

Findings from the four case studies of floodplain residents in Peninsular Malaysia supported to varying degrees the hypothesised relationships, confirming the importance of location, flood frequency, building type (with or without stilts), ethnicity and religion, attitudes and beliefs, degree of optimism and flood hazard awareness on both individual perception and response to flood hazards. For example, the ethnicity variable was found to be highly significant in flood hazard perception and response. Rural Malays are found to be well adapted to living on floodplains and are attuned to normal seasonal floods. They have a high level of flood hazard awareness and are likely to view floods as common events which are often seen as less threatening than they actually are. Because of higher levels of exposure to flood hazards (due largely to their occupance of hazardous flood zones), Malays view floods philosophically. Floods are so common that they have become an integral and accepted part of their lives. Another variable which was found to affect perception and response was religion. It has a particularly strong influence on Malays and their view of flood hazards. Malays show a far greater tendency to believe that flooding is an act of God than the other ethnic groups. As a result, they possess a more fatalistic attitude to life and are more likely to show resignation in the face of flood disasters.

Although the scope for individual response to flood hazards is limited and constrained by powerful socio-political contexts, such contexts are not totally inhibitive. Thus, despite their position in society being heavily determined by contexts, people do have some room for manoeuvre/action in the face of disasters. Malaysians were generally found to have developed a wide range of individual flood reduction strategies, the most unique of which is the stilt house. The stilt house is an adaptation to floods even though its modern version (in cities and towns) are built more for aesthetic and architectural reasons. In fact, the majority of rural Malays do not consider the stilt house as a form of flood proofing. It is a necessary house type for those who live on floodplains. Thus, the adoption of adjustments is found to be significantly associated to ethnic culture. Other than the stilt house, ethnic culture influences one's selection of flood reduction strategies. Chinese appear to be most ready to take steps to reduce flood losses, even though Malays live in more hazardous locations and are more exposed to floods. This is because the majority of Malays live in stilt houses and are not too bothered by normal floods than are the Chinese. However, because of their greater exposure, Malays were found to possess a richer and wider variety of flood reduction strategies than Chinese and Indians.

However, many of the hypothesised independent variables did not significantly affect the majority of answers on perception and response (i.e. the dependent variables). These include:

flood characteristics such as flood type, recency and severity; building characteristics such as building type, wall type, building age, stilt height, and stilt type; and respondent's socio-economic characteristics such as length of residence, age, education, family size, occupation, gender, tenure and group membership.

9.6 Research Question 6: The effectiveness of formal flood warning and evacuation systems and income equity policies in addressing flood hazards

The segment analysis in Chapter 8 revealed that although damage savings were significant and could be substantially increased, the effectiveness of formal flood warning and evacuation systems were wanting in many respects. For example, warning lead times reported were inadequate for more than a third of respondents. The proportion of respondents receiving a first warning from formal FWESs was less than a tenth. Conversely, the total number of floods where the respondents did not receive a formal warning was high. Only about one third of respondents who were warned were actually flooded (i.e. effective warning) as compared to more than half who were not warned but flooded (i.e. no warning). However, the proportion of respondents given 'false' warnings (i.e. warned but not flooded) was generally small, except for Pekan where a tenth of respondents reported so. Finally, a high proportion of respondents indicated that they do not rely on formal FWESs, with the majority either not aware of the existence of such systems or preferring to rely on their own judgement. Therefore, it is not surprising that formal FWESs are looked upon with scepticism by floodplain residents. On the whole, formal FWESs are found to be largely ineffective.

However, 'informal' traditional FWESs were found to be very effective when incorporated into formal FWESs. This is because people are well attuned to their traditional FWESs and are not asked to do anything different from what they have been used to. Also, traditional FWESs are based on 'real time' situations and people actually see signs of the river rising or their neighbours being flooded. In such cases they do not need any convincing to evacuate.

Analysis of the income equity segment revealed that the magnitude of income inequity was still pronounced, especially amongst ethnic groups, occupational groups, states/regions, and specific groups (e.g. squatters). This was closely linked to the problem of poverty. Annual flood losses were found to be significant vis-a-vis low household incomes, thus reinforcing poverty. Socio-cultural contexts reinforce Malay poverty and thereby reinforce income equity between them and the other ethnic groups. Similarly, political economy contexts also fail to adequately address poverty and income inequity, although some progress has been made. Likewise, institutions have also not incorporated income equity and poverty eradication more comprehensively into their flood management programmes. This has a retarding effect on income equity attainment.

On the whole, the analysis of segments identified close links between contexts at various levels. Macro structural contexts were demonstrated to have links with meso institutional contexts which in turn affect individuals at the micro level. Although these links were largely operating from the macro to the micro levels, they are not exclusively uni-directional. Thus, individuals can influence institutional as well as political economy decisions. Likewise, institutional contextual forces often bring about radical policy changes at the socio-political level. However, it was found that the presence of too many contexts tends to blur the links between the various levels and complicates the flood hazard scenario. Nevertheless, analysis into links via segments uncover intricate relationships which can be further explored to maximize flood hazard reduction.

9.7 The importance and appropriateness of the 'hazard response-in-contexts' model as an explanatory model for flood hazard response

This section examines the limitations and strengths of the hazard response-in-context model in Peninsular Malaysia based on the results and findings of this research. It also analyses the appropriateness and applicability of the model.

9.7.1 The strengths and limitations of the hazard response-in-context model

The hazard response-in-context model is a composite model largely based on a combination of the structural and behavioural paradigms. Thus, a major strength of the model is its ability to handle both the influence of structural contexts and individual response in relation to flood hazards, two contrasting perspectives which previous hazard models handled separately (Kates 1971; Hewitt 1983a). Unlike many previous research which either work within the 'dominant' behavioural paradigm and remain bound by its theoretical framework (White 1974; Parker and Harding 1979; Smith and Tobin 1979), move incrementally away from it (Penning-Rowsell et al 1986; Fordham 1992), or deviate radically from it (Waddell 1983; Hewitt 1983a; Blaikie et al 1994; Varley 1994), the model in this research begins with the admission that no single model or paradigm can justifiably claim to explain human response to the wide variety of hazards in a multi-cultural world which is at the same time dynamic and ever changing. By the same token, the hazard response-in-context model does not claim to be universally applicable in explaining human response in all situations.

Another strength is that the model possesses an extra dimension of 'contexts' which gives it added versatility. In its broadest form the model largely resembles the structural model as the influence of macro structural contexts on choice is emphasised. However, in its most detailed form, individual perception and response to flood hazards are modelled. Most significantly, the model attempts to advance hazards theory through explaining the creation and perpetuation of flood hazards in a rapidly developing country scenario. This is another strength as the model can be applied in developed, developing, or rapidly developing countries.

The model is a dynamic one and is able to take into account changes over time and space. For example, time and space changes in the natural system resulting in increased flood risk, similar changes in the human use system resulting in increased exposure and vulnerability, or the unexpected occurrence of critical events which affect hazards (e.g. world recession, international disputes and changes in policies) can be taken into account by the model. The effects of each of these changes can be explained in their contexts. All these changes were found in Peninsular Malaysia and are explained in the model. However, changes in contexts render previous explanations obsolete. These changes, therefore, needs to be updated all the time for the model to be valid and this can become a limitation. For example, during the course of this research, it was discovered that Malays are now encouraged by the government to venture into business and making money is gradually not being considered as taboo amongst muslims (except to the most fundamental of muslims). Such a change in attitude and values may be viewed as a change in context. This change will need to be investigated in further research to ascertain the extent to which it has influenced Malay response to flood hazards.

A limitation of the model is its generality. For any specific time and space, there may be many contexts affecting choice and decisions. It is difficult to include all of them. Thus, only key contexts can be explained and the rest left out. This reduces the comprehensiveness of the model in explaining choice in floodplain occupance and response to hazards. Thus, besides structural contexts, individuals in Peninsular Malaysia may be influenced by their own situational characteristics such as their health, degree of support from relatives and friends, and influence in the community. These are also contexts themselves and need to be addressed as no two individuals are exactly alike. The model cannot take into account individual contexts. In the current research, only vignettes or descriptive accounts of the situational contexts of individuals were examined and presented as individual flood experiences, both in the main text and in Appendix H.

While the influence of individual attributes are quantifiable and can be statistically tested, the influence of structural contexts are generally not (although structural contexts such as poverty and cultural beliefs [religion] were treated quantitatively). As a result, the influence of structural contexts are largely based on qualitative survey, historical analysis and secondary data. This may not necessarily be a limitation (as there are advantages when using these research methods, see Chapter 2), but the strength to which a broad structural context influence individual flood hazard response is not as directly measurable as would an attribute like gender or age.

Finally, the lack of literature in contexts relating to hazards research is a disadvantage. Because of this, contexts identified and modelled in the current research are largely based on hunches and hypotheses of the author's personal experience and sources outside the hazards literature. However, this is again not necessarily a limitation as it represents a major challenge in this research.

9.7.2 Performance of the hazard response-in-context model

A central focus of the hazard response-in-context model is on contexts. The influence of macro structural contexts in trapping a significant proportion of inhabitants on floodplains were found to be well represented by the model (see Section 9.3). For example, floodplain inhabitants in Peninsular Malaysia were discovered to live in flood zones mainly due to structural contexts. Early major settlements on floodplains (the historical facet of the socio-cultural context) largely pre-determined a large proportion of people (largely indigenous Malays) in flood-prone zones. Socio-cultural contexts, manifested in customs, beliefs, attitudes and a sedentary (kampung) way of life were demonstrated to contribute significantly to persistent occupation of floodplains by Malays, traditionally a riverine people whose society and culture revolve around rivers and their adjacent land.

Individual choices are also strongly influenced and sometimes severely constrained by colonial forces, a structural context which still pervades into many areas of current Malaysian society. The model was found to demonstrate the colonial influence effectively.

The influence of political economy contexts is also effectively represented by the model. Post-colonial governments endeavoured to raise Malay incomes, reduce their disparities with other ethnic groups and eradicate poverty but were hitherto only partly successful. Thus, ineffective post-colonial policies is another structural context that was effectively modelled. Together with the control of neo-colonialism, high incidence of poverty, low educational attainment, low residential and occupational mobility, many Malaysians (still largely rural Malays but increasingly more rural Chinese and Indians) continue to languish on floodplains and lead a vulnerable existence. Added to this group of rural Malays are rural-urban migrants of all ethnic groups who try to escape from the grip of rural poverty (rural-urban migration is another structural context examined via the model). These are the squatters who make it to the cities and towns but end up living in slums and squatter settlements, mostly on hazardous urban floodplains (squatting is yet another important structural context monitored by the model). More recently, Indonesians and Thais have crossed the international borders (largely illegally) into the peninsula to seek their fortunes. They too largely end up in squatter settlements, Indonesians in Kuala Lumpur and the southern part of the peninsula and Thais in Kelantan and the northern parts. Thus, flood hazard vulnerability amongst this combined group of rural Malays, urban squatters and illegal immigrants is explained by structural contexts in the model.

The influence of flood hazard institutions, manifested as the institutional context is also adequately represented in the model. The four facets of legislation, organisational structures, attitudes and sub-cultures, and policies and instruments were modelled via the criteria approach (see Section 9.4). These facets were analysed in-depth individually in the model. While the model allows for the broad interpretation of institutional contexts on the outcome of flood hazards, it also allows detailed examination of the influence of their facets. As was with the analysis of other structural contexts, the approach to institutional analysis was based more on qualitative than quantitative accounts. Thus, historical/colonial perspectives, past records, reports and more recent development trends of these forces were used. Research findings are therefore largely based on qualitative inferences and lacked quantitative details. This is unavoidable but qualitative analysis does not necessarily invalidate the results. On the contrary, it is empirical and the findings verify to its effectiveness in emphasising the influence of institutional contexts on flood hazards.

More significantly, the model was also able to link institutional contextual forces to macro contextual forces and individuals. Individuals and institutions were found to be closely related, each affecting the other. Institutions were found to affect individual response through legislation, organisational structures, attitudes and sub-culture, and policies and instruments. The strength of the model also lies in its ability to link institutional contexts to higher level contexts (e.g. political economy) and lower level contexts (e.g. individuals) (Chapter 8).

However, because of its generality, some contextual forces were not as fully explored as would have been the case if there were a limited number of them. For example, while the model identified rural-urban migration as contributing to increased vulnerability, it was not able to separate whether or not such migration was due more to a change in attitudes amongst the migrants, the result of official policies, or simply the need to escape from perpetual poverty on rural floodplains. Much greater detailed analysis into the subject would be needed to uncover the answers.

Finally, the hazard response-in-context model allows for the quantitative measurement of individual perception and response to flood hazards. Since a significant proportion of Malaysians are located on floodplains, and their work and livelihood centre in and around floodplains, they are invariably forced to make choices in response to flood hazards. In general, Malaysian floodplain occupants are highly aware of floods but are not as objectively knowledgeable about their characteristics as the flood expert. Thus, within the influence of structural contexts, they were found to make choices mainly through bounded rationality. In this respect, the extension of Kates' model into the 'model of individual flood hazard perception and mitigating adjustment' (Figure 3.6) was found to be appropriate. Research findings indicated that the ways in which individuals perceive and make decisions/choices in response to flood hazards closely resemble that hypothesised in the model. The majority of hypothesised relationships were measured by the model, the evidence of which is found in the research results (see Section 9.5 and Chapters 6 and 7).

9.7.3 Summary

A common pattern is identifiable amongst researchers working within the dominant paradigm who begin with a basic version of Kates's 1971 model (a ready made model), then testing it in the field and finally fitting in the results to prove its appropriateness (e.g. White 1974; Burton et al 1978, 1993; Fordham 1992). Unlike the above, this research draws on past and current developments in hazards theory and adds incremental advances to it. It begins with a model with a strong foundation of established theory but largely based on current thinking. More significantly, it comprises original contributions/increments to both in terms of a hazard response-in-contexts model. Only then it seeks to verify the appropriateness of the model via research findings. This research has revealed that it is possible to build a composite model of hazard response from widely opposing perspectives. Despite a combination of the behavioural paradigm, the structural paradigm and the current emphasis on hazard contexts, the hazard response-in-context model in this research has managed to explain the creation and perpetuation of flood hazards in Peninsular Malaysia (including human perception and response to them) quite effectively.

Results of the analysis on individual response in this research revealed that the behavioural model which emphasises the role of individuals is still valid and can be justifiably used to explain floodplain occupants' perception and response behaviour to flood hazards (albeit taking into account contexts). Thus, it verifies that, despite its limitations the Kates model is important because individual response to hazards is a significant part of overall societal response. The model should, therefore, be viewed as powerful within its own context, i.e. based on self-help, individualism and free enterprise in a rapidly developing country.

Similarly, although strongest in the context of developing or Third World countries, this research has revealed that the structural paradigm can be applied to rapidly developing countries in analysing hazard vulnerabilities of deprived or disadvantaged communities within them. Structural models largely contend that individualism is limited in impoverished countries, thus limiting their scope (Smith 1992 p43) but when a structural model is combined with a behavioural one, both sets of influence are represented. This research indicates that structural forces of the historical, socio-cultural, political economy and institutional contexts can be effectively modelled side by side individual response by the hazard response-in-context model.

9.8 Methodological issues

This research has employed both quantitative and qualitative methods in a triangulation strategy by engaging a combination of complementary research methods which includes the 'cultural insider' observer (i.e. the author himself), historical analysis, institutional analysis using the 'criteria approach', quantitative and qualitative surveys, and case studies.

The 'cultural insider' method was found to be useful in the analysis of government, institution and individual response to the flood hazard. However, the effectiveness of the method relies heavily on the expertise of the insider and the level of objectivity of the researcher involved. Much also depends on the extent to which the insider is received and treated in the institution being researched. A great deal of tact and circumventing of red tape and bureaucracy is also needed for its success.

Historical analysis was found to be a fairly straight forward but tedious method as in most cases it involves the scrutiny of historical records. Nevertheless, is was discovered to be very effective in studying how broader socio-political contexts with a historical background have created and perpetuated the flood hazard. However, the output of this method is more inferential than empirical.

Institutional analysis based mainly on the criteria approach but some observer participation was also found to be extremely useful in evaluating flood hazard institutions and organisations. However, confidentiality and secrecy in the institutions studied were major obstacles encountered. Nevertheless, the use of both quantitative questionnaires and qualitative interviews in the analysis allowed for greater depth of evaluation.

The use of case study areas solved the sampling problem as the floodplain population was unknown. The four study areas selected represent a cross section of different sets of conditions (physical and human) in relation to the flood hazard. However, the use of both quantitative and qualitative surveys within each of four selected case studies is a major strength.

Finally, this research has pioneered a method of analysis that allows researchers to identify and evaluate the links between different contexts affecting hazards. Segment analysis allows the researcher to analyse the extent to which macro structural contexts condition institutions which in turn largely determine the effectiveness of formal FWESs in the peninsula. In turn, the influence of structural and institutional contexts on individuals also determine their response and thereby the effectiveness of the system. The results reveal that individuals are extremely versatile and active in informal FWESs, which some local authorities have incorporated into the formal system. Therefore, structural and institutional contexts are less prohibitive in their influence on individual response but are instead benefiting from the experience of local traditional systems which have evolved over long periods of time.

Similarly, examining the influence of official policies on income equity reveals that individuals are firmly constrained in their response to the flood hazard. The income equity segment is different from the warning and evacuation segment simply because those who are most affected, i.e. the individual floodplain occupants, are helpless in the context of their poverty. The room for individual manoeuvre to attain income equity is limited. Segment analysis, informs us of the importance of contexts upon individual flood hazard response.

9.9 Future research directions

This research has demonstrated as well as reinforced the importance of contexts in current hazards research. Even while key contexts were examined in this research, some were found to change over time and space. The same contexts, therefore, need to be re-appraised as they change. Furthermore, new contexts continue to be discovered. Others appear to emerge as the factors affecting them change. Contexts are dynamic and rapidly changing. As contexts change, flood hazards will be affected as will human perception and response to them (Penning-Rowsell Forthcoming). Therefore, contexts remain a very challenging area in which hazard researchers can explore. Currently, contexts are largely under researched and there is a dearth of information on them (Mitchell et al 1989 p406). Because of this, contexts represent a vast frontier in hazards research. Currently, very little is known about contexts and the exogenous factors that drive them. Future research directions should, therefore, concentrate on contexts, their interaction on one another, and their influence on human vulnerability, perception and response to hazards.

As focus upon contexts is relatively new, it poses new challenges for the development of innovative research methods. In this research, segment analysis was developed as one such method. Other contexts may require different approaches and research designs as the analysis of contexts should be dynamic. While focusing on the study of contexts, researchers should also come up with new research designs and methods to be developed to study new contexts and associated phenomena.

Previous hazards research have largely concentrated on developed or Third World countries. This research revealed that the conditions that create hazards in a rapidly developing country with a colonial background is very different from both sets of countries above. Hazards research should, therefore, also focus on rapidly developing countries in the world. These are countries where changes are rapid giving rise to equally rapid changes in contexts. This is another area where future research should focus upon. Research findings from rapidly developing countries allow for a comparison with research results from developed countries such as the United States (e.g. Burton et al 1978, 1993), the United Kingdom (e.g. Penning Rowsell et al 1986) and Australia (Handmer 1988, 1991), and from Third World countries (Wisner and Mbithi 1974; Winchester 1992; Blaikie et al 1994) which have been widely researched.

Future research focus should also be on Malaysia, a country on the verge of industrialisation. Policies on economic development, ethnic equity, poverty eradication, environmental protection and sustainability are likely to change in the near future. Consequently, the contexts affecting them will also change as will new contexts emerge. Such changes need to be monitored if flood hazards are to be managed and not exacerbated to an uncontrollable degree.

For example, as more Malays become wealthier, more educated and their value system changes, the contexts to which flood hazards affected them in the past will change. Will rural-urban migration and squatting give rise to more pressing urban flood problems than will poverty in rural agriculture areas? Will policy changes integrate Chinese and Indians with Malays, and will the former two groups learn from the latter group about flood hazard reduction (e.g. adopt the Malay stilt house as a flood proofing strategy)? Or will legislation on floods reduce or exacerbate flood hazards? All these questions and more, need to be addressed. Their answers lie in the contexts which affect them, and these need to be researched.

In this research, only key contexts are explored. There are other contexts which have not been studied. They may or may not be important and the only way to find out is to research them. This should be another focus of future research.

This research has demonstrated the importance of cultural contexts in flood hazard perception and response of individuals. Although the current research has examined the influence of cultural values, attitudes, beliefs, religion, customs, and tradition on flood hazard perception and response, there remains other cultural aspects that have not been examined. Even the examination of many of these aspects have not been deep enough in a sociological sense. Thus, collaboration between geographers, anthropologists and sociologists in this area would greatly enhance and deepen the analysis on culture.

The 'hazard response-in-context' model developed in this research is versatile and can be adapted and applied to developed as well as developing countries. It would be interesting, both from an academic as well as applied stand point, to apply it in western developed countries such as the United States and Canada (from which the traditional paradigm originated) and the United Kingdom (from which the institutional perspective had strongly evolved). Equally, it would be interesting to see how the model fits in the impoverished Third World (from which the structural paradigm evolved).

Finally, it is worthwhile pointing out that in their frantic quest for modernisation and industrialisation, many rapidly developing countries (including Malaysia) are falling into the same trap as their western developed counterparts had done so in the past, i.e. the over-emphasis on the technocentric approach employing structural/engineering measures. This is where Malaysia should learn from its own flood experiences as well as from those of other countries. Unfortunately, societies have extreme difficulty in learning from their own past and there is even less chance of learning from other countries (Davis 1981 p210). While other factors including political ones have often intervened and watered down the lessons of experience (Parker and Handmer 1992), it is evident that many have not learned as much as they should from the advantage of experience (Parker 1994 p16). Flood hazards will always be present in a country where physical conditions and human use continuously foster them. We can, therefore, never eradicate floods from Peninsular Malaysia, but if we are to successfully manage them with a balanced strategy of structural and non-structural measures (incorporating both modern and traditional coping mechanisms), and also move towards sustainable development, then we would be moving on the right track towards their reduction.

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APPENDIX A

MIDDLESEX UNIVERSITY
Flood Hazard Research Centre

FLOOD DAMAGE, PERCEPTION AND MITIGATION STRATEGIES QUESTIONNAIRE SURVEY FOR PENINSULAR MALAYSIA

For Residential, Farming, Fishing, Commercial and Government Establishments

Notes for Interviewer

1 Any statement that is underlined should be read out to respondent

2 Any statement in parentheses is for interviewer's information only

3 All coded answers are for interviewer information only. They should not be read out to respondents unless SPECIFIED so in the question.

4 If any question is not applicable, write in 'NA'

5 Information on pages 2 & 3 is to be filled in by interviewer before the commencement of the interview (interviewers may refer to the respondent in the event of any ambiguity)

FOR OFFICE USE ONLY

Coast:	East Coast	1
	West Coast	2
Region:		
	Northwest	1
	Northeast	2
	Southwest	3
	Southeast	4
Site:		
	Pulau Pinang	1
	Kota Bharu	2
	Kuala Lumpur	3
	Pekan	4
Urban/Rural:	Urban	1
	Rural	2
Type of flooding:	River	1
	Tidal & River	2
	Tidal	3

Address ______________________________

____

Questionnaire No:______________________________

Type of Establishment:

Residential	1
Farming	2
Commercial	3
Public/Government	4
Fishing	5

Interviewer Number:__________ Signature: ______________

Interview date:______________________________

Time interview started:______________________________

Time interview ended:______________________________

Duration of interview:______________________________Minutes

I CHARACTERISTICS OF HOUSE/SHOP/BUILDING

(a) **Type:**

Bungalow	1
Detached	2
Semi-detached	3
Terraced	4
Flat	5

APPENDIX A:2

(b) **Outer Wall:**

Brick/concrete	1
Brick(Lower)/wood(Upper)	2
Wood	3
Others	4

(Specify____
____)

(c) **Age:**

> 100 years	1
81-100 years	2
61- 80 years	3
41- 60 years	4
21- 40 years	5
11- 20 years	6
< 11 years	7

(d) **Floor:**

Terrazo/marble	1
Carpet	2
Cement	3
Wood/parquet	4
Plastic/vinyl	5
Sand	6
Bamboo	7
Others,	8

(Specify____
____)

(e)(i) **Stilts:**

Yes 1 [GO TO Q(e)ii]
No 2 [GO TO Q(g)]

(ii) If Yes, how high are the stilts?

1 feet	1
2 feet	2
3 feet	3
4 feet	4
5 feet	5
> 5 feet	6

(f) **What are the stilts made of?:**

Concrete/brick/cement	1
Concrete(lower) & Wood(upper)	2
Wood	3
Bamboo	4
Others	5

(Specify____
____)

(g)(i) **Does the premise have a basement?:**

Yes 1 [GO TO Q(g)ii]
No 2 [GO TO Q1]

(ii) If Yes, what is it used for?

Storage	1	Dwelling	2
Parking	3	Business	4
Others, specify	5		

(TO BE READ OUT TO RESPONDENT)
We are carrying out a survey for the Universiti Sains Malaysia. The aim of the survey is to find out how people perceive natural hazards and the ways in which they react to them in Peninsular Malaysia. The survey is also partly supported by the Drainage and Irrigation Department and the Flood Hazard Research Centre at Middlesex University (UK). The survey is completely confidential. Unless permission is given by the participants, their names and views will not be revealed. The results will be published in statistical and unidentifiable form only.

II PERCEPTION

1 Are you the owner of this property/land/business?

Yes	1
No	2

2 (a) How many years have you lived/farmed/been in business in this village/town?
________Years

(FOR FARMING, FISHING & BUSINESS ESTABLISHMENTS ONLY. OTHERS GO TO Q3)
(b) During the years you have worked here how many years would you say your harvest/business has been: (by 'good', we mean in terms of your income)?

Good	_____ years
Bad	_____ years
Regular	_____ years

3 (a) What are the main advantages of living/farming/doing business in this village/town?
(RECORD VERBATIM. PROBE 3 TIMES)

____
____
____
____
____
____

(b) Most important advantage:______________________________

(c) Total number of advantages:______________________________

4 (a) What are the main disadvantages in living/farming/doing business in this village/town?
(RECORD VERBATIM. PROBE 3 TIMES)

____
____
____
____
____
____
____

(b) Most important disadvantage:______________________________

(c) Total number of disadvantages:______________________________

5 Are there more advantages or disadvantages to living/farming/doing business in this village/town?

More advantages	1
Equal	2
More disadvantages	3

6 List any hazards noted by respondent in 4(a):

____
____
____
____

7 Do the people living in this village/town have any trouble with floods?

Yes	1
No	2
Don't know	-9

8 (a) Do you belong to any group/organisation associated with flood problems?

Yes	1 **[GO TO Q8(b)]**
No	2 **[GO TO Q9]**

(b) If Yes, specify group/organisation:(PROBE FOR ADDRESS & TEL. NO.)

____

____

____

9 How many times has this property/building been flooded in the last 10 years?

None	0	7 times	7
Once	1	8 times	8
Twice	2	9 times	9
3 times	3	10 times	10
4 times	4	> 10 times	11
5 times	5	Don't know	-9
6 times	6		

10 *How likely do you think this property/building will be flooded at least once in the* following time periods on a scale of 0 (no chance) to 10 (almost certain)?
(SHOW CARD 1, READ OUT AND ENTER ONE CODE FOR EACH TIME PERIOD)

0	1	2	3	4	5	6	7	8	9	10	-9
no chance										almost certain	DK

In the next few months _____

In the next year _____

In the next 5 years _____

In the next 10 years _____

In the next 50 years _____

11 If you were to live 100 years, how many times do you expect this property/building to be flooded? _____times

12 How many times has this village/town been flooded in the last 10 years?

None	0	7 times	7
Once	1	8 times	8
Twice	2	9 times	9
3 times	3	10 times	10
4 times	4	> 10 times	11
5 times	5	Don't know	-9
6 times	6		

13 Please can you tell me all the years this village/town was flooded since you started living here?

Years (Start with the most recent and going back as far as you can remember)

____

____

____

____

____

14 When was the worst year for floods in this village/town? Year______

15 How likely do you think this village/town will be flooded at least once in the following time periods on a scale of 0 (no chance) to 10 (almost certain)?

(SHOW CARD 1, READ OUT AND ENTER ONE CODE FOR EACH TIME PERIOD)

0	1	2	3	4	5	6	7	8	9	10	-9
no chance										almost certain	DK

In the next few months _____

In the next year _____

In the next 5 years _____

In the next 10 years _____

In the next 50 years _____

16 If you were to live 100 years, how many times do you expect this village/town to be flooded? _____times

17 (a) Are there other places in MALAYSIA with fewer/no floods where you could earn as good a living as you do here? (READ OUT ANSWERS TO RESPONDENT)

Yes, certain	1	[GO TO Q17(b)]
Possibly yes	2	[GO TO Q18]
Probably not	3	[GO TO Q18]
No, certain	4	[GO TO Q18]
Don't know	-9	[GO TO Q18]

(b) If Yes, where? ______________________________

Within the same mukim	1	East Malaysia	6
Within the same district	2	Others, specify_______	7
Within the same state	3	Don't know	-9
Other West Coast states	4		
Other East Coast states	5		

18 (a) Knowing what you do now, do you think you will continue to live/work/do business in this village/town for many more years?

Certainly Yes	1	[GO TO Q18(b)]
Possibly yes	2	[GO TO Q18(b)]
Probably not	3	[GO TO Q18(c)]
Definitely No	4	[GO TO Q18(c)]
Don't know	-9	[GO TO Q19]

(b) If Certainly & Possibly Yes, what is the main reason stopping you from moving?

No money	1	My farm/business is here	6
No where else to go	2	Farming/business is good	7
All my relatives & friends are here	3	Floods not serious here	8
I can't leave my inherited land	4	Others, specify _______	9
It's the same everywhere	5	Don't know	-9

(c) If Probably Not & Definitely No:

(i) Where do you think you will move to?

Within the same mukim	1	East Malaysia	6
Within the same district	2	Thailand	7
Within the same state	3	Indonesia	8
Other West Coast states	4	Others, specify_______	9
Other East Coast states	5	Don't know	-9

(ii) When do you think you will move?

Within 1 year	1	Within 6 to 10 years	4
Within 1 to 2 years	2	> 10 years	5
Within 3 to 5 years	3	Not sure/don't know	-9

19 (a) To your knowledge, are there any ways of knowing that a flood is coming?

Yes	1	[GO TO Q19(b)]
No	2	[GO TO Q20]
Don't know	-9	[GO TO Q20]

(b) If Yes, specify (List all the ways known to respondent):

____

____

____

____

____

____

____

20 Here are some statements that have been made about the flood problem in this village/town. Can you tell me how strongly you agree or disagree with them, based on a scale of 1 (strongly agree) to 5 (strongly disagree)?
(SHOW CARD 2, READ OUT AND ENTER ONE CODE FOR EACH STATEMENT)

1	2	3	4	5
strongly agree	agree	neither agree nor disagree	disagree	strongly disagree

(a) A flood is an act of God

(b) A flood is an act of the devil

(c) A flood is an act of nature (weather , climate etc)

(d) A flood is an act of man's activities

(e) A flood is a combination of nature and man's activities

(f) Past flooding in this area was a freak event, unlikely to happen again

(g) Floods are very common here. Happens all the time

(h) The likelihood of flooding in this area is increasing and becoming worse

(i) A flood could happen again any year

(j) Floods come regularly every once in so many years

(k) Floods is a big problem to us

(l) We don't have real/serious floods here

(m) We have been living with floods for a long time. We are used to them

(n) A flood won't happen again because the DID and other government agencies can now control flooding through river and coastal management

(o) The authorities have not studied and understood the local flood problem thoroughly

III MITIGATION STRATEGIES

21 (a) Can anything be done to *prevent* floods?

Yes	1 **[GO TO Q22(a)i & THEN BACK TO Q21(b)]**
No	2 **[GO TO Q21(b)]**
Don't know	-9 **[GO TO Q21(b)]**

(b) Can anything be done to <u>*reduce*</u> the effects of floods?

Yes	1 **[GO TO Q22(a)ii]**
No	2 **[GO TO Q23]**
Don't know	-9 **[GO TO Q23]**

22 (a) If Yes to Q21(a) and/or Q21(b), what can be done? (CODE ALL THAT ARE MENTIONED. PROBE 'ANYTHING ELSE' 3 TIMES)

	(i) Prevent floods		(ii) Reduce floods	
	Yes	No	Yes	No
Pray	1	2	1	2
Use bomoh (witch doctor)	1	2	1	2
Dams and Reservoirs	1	2	1	2
Floodwalls, Embankments, Levees, Dykes	1	2	1	2
Channel deepening, straightening, etc	1	2	1	2
River Diversions, Relief channels	1	2	1	2
Storage reservoirs/retention ponds	1	2	1	2
Improve artificial drainage system	1	2	1	2
Flood abatement (plant trees to retain flood waters in upper catchment)	1	2	1	2
Evacuation/emergency Action	1	2	1	2
Raising Ground Level of building	1	2	1	2
Flood Proofing of building	1	2	1	2
Land use Regulation/zoning plans	1	2	1	2
Flood Insurance	1	2	1	2
Flood Forecasting & Flood Warnings	1	2	1	2
Artificial rain-making	1	2	1	2
Planting cover crops/trees on exposed land	1	2	1	2
Removal of floating logs/debris from rivers	1	2	1	2
Prepare boat	1	2	1	2
Shift belongings/house contents	1	2	1	2
Others, specify____________________	1	2	1	2

(b) Total number of strategies for flood prevention: ______________

(c) Total number of strategies for flood reduction: ______________

23 Have you, personally, taken any steps to reduce flooding or flood damage to your family, property & its contents, land or crop in the past?

Yes 1 [GO TO Q24(a)]
No 2 [GO TO Q24(b)]

24 (a) During the most recent flood, what did you do? (LET RESPONDENT VOLUNTARILY MENTION ALL THE STRATEGIES. PROBE 'ANYTHING ELSE' 3 TIMES)

(b) Besides the things you have done, the following are some of the things that others have done during a flood. (ASK THE RESPONDENT EACH REMAINING STRATEGY THAT HAS NOT BEEN USED BY HIM/HER IN SECTION (a))

(i) Do you think they are good or bad?
(ii) Why do you think they are good or bad?

	Section (a) Yes = 1 No = 2	Section (b)(i) Good = 1;Bad = 2; DK = -9	Section(b)(ii) See codes below
Nothing	____	____	____
Pray	____	____	____
Use bomoh (witch doctor)	____	____	____
Prepare to move	____	____	____
Move household members upstairs	____	____	____
Move household members out of premises	____	____	____
Move livestock/animals/pets elsewhere	____	____	____
Move vehicles elsewhere	____	____	____
Move contents/machinery/goods etc	____	____	____
Flood proofing (permanent)	____	____	____
Flood proofing (contingent)	____	____	____
Flood proofing (emergency) [eg. Prevent water entering premises]	____	____	____
Flood Insurance	____	____	____
Warn others on site/at home	____	____	____
Warn others elsewhere	____	____	____
Buy provisions	____	____	____
Turn off electricity	____	____	____
Listen to weather forecast	____	____	____
Ring fire brigade, police, MP, etc	____	____	____
Elevate the floor	____	____	____
Change cropping pattern/crops	____	____	____
Prepare boat	____	____	____
Take leave	____	____	____
Fix switches higher	____	____	____
Others, specify____________	____	____	____

(c) Total number of strategies used by respondent in the most recent flood: ________
[DO NOT ASK RESPONDENT. JUST SUM UP THE TOTALS OF SECTION(a)]

25 (a) When a flood comes the next time, would you do anything different?

Yes	1 [GO TO Q25(b)]
No	2 [GO TO Q26]
Don't know	-9 [GO TO Q26]

(b) If Yes, what would you do? (LET RESPONDENT VOLUNTARILY MENTION ALL THE STRATEGIES. PROBE 'ANYTHING ELSE' 3 TIMES).

	Yes	No
Nothing	1	2
Pray	1	2
Use bomoh(witch doctor)	1	2
Prepare to move	1	2
Move household members upstairs	1	2
Evacuate household members out of premises	1	2
Move livestock/animals/pets elsewhere	1	2
Move vehicles elsewhere	1	2
Move furniture	1	2
Flood proofing (permanent)	1	2
Flood proofing (contingent)	1	2
Flood proofing (emergency) [Prevent water entering premises]	1	2
Flood Insurance	1	2
Warn others on site/at home	1	2
Warn others elsewhere: neighbours/relatives	1	2
Buy provisions	1	2
Turn off electricity	1	2
Listen to weather forecast	1	2
Ring fire brigade, police, MP, etc	1	2
Elevate the floor	1	2
Change cropping pattern/crops	1	2
Prepare boat	1	2
Take leave	1	2
Others, specify_____________	1	2

(c) Total number of different strategies respondent is willing to adopt during the next flood: (DO NOT ASK. JUST ADD UP (b)):________

IV FLOOD WARNINGS

26 (a) If you were given a '2 hour' warning before the most recent flood occurred, would you have done anything different by way of preparation?

Yes	1	**[GO TO Q26(b)]**
No	2	**[GO TO Q27]**
Don't know	-9	**[GO TO Q27]**

(b) If Yes, what would you have done? (LET RESPONDENT MENTION ALL STRATEGIES. PROBE 'ANYTHING ELSE' 3 TIMES)

	Yes	No
Nothing	1	2
Pray	1	2
Use bomoh(witch doctor)	1	2
Prepare to move	1	2
Move household members upstairs	1	2
Evacuate household members out of premises	1	2
Move livestock/animals/pets elsewhere	1	2
Move vehicles elsewhere	1	2
Move contents/machinery/goods etc	1	2
Flood proofing (permanent)	1	2
Flood proofing (contingent)	1	2
Flood proofing (emergency) (Prevent water entering premises)	1	2
Flood Insurance	1	2
Warn others on site/at home	1	2
Warn others elsewhere: neighbours/relatives	1	2
Buy provisions	1	2
Turn off electricity	1	2
Listen to weather forecast	1	2
Ring fire brigade, police, MP, etc	1	2
Elevate the floor	1	2
Change cropping pattern/crops	1	2
Prepare boat	1	2
Take leave	1	2
Stop children from going to school	1	2
Others, specify_______________	1	2

(c) Total number of strategies respondent would have adopted if warned: ________

27 During the most recent flood, how much did you manage to save as a result of receiving a warning? (IF DID NOT RECEIVE A WARNING: How much do you think you would be able to save if a warning had been received prior to flooding? (PROBE FOR AN ESTIMATE)

($)

Did not save anything	0
< 1,000	1
1,000 - 1,999	2
2,000 - 2,999	3
3,000 - 3,999	4
4,000 - 4,999	5
5,000 - 5,999	6
6,000 - 10,000	7
> 10,000	8
Don't know	-9

28 Is there an official flood warning system/service in this village/town? ('Official' refers to warnings from the Drainage and Irrigation Department, Malaysian Meteorological Service, Police, other government departments, flood warden, farmers association, village headman, local authority and warning via the media)

Yes	1
No	2
Don't know	-9

29 (a) Do you know which organisation/authority is currently responsible for forecasting floods and issuing flood warnings in this village/town?

Yes 1 [GO TO Q29(b)]
No 2 [GO TO Q30]

(b) If Yes, can you tell me who that is? (Probe name of organisation/authority)

____
____
____

(c) Would you know where to contact this organisation if you wanted to? (PROBE FOR LOCATION, ADDRESS OR TELEPHONE NUMBER)

Yes 1
No 2

____
____
____

30 (a) Do you know which organisations/authorities are involved in delivering official flood warning messages to the public in this village/town?

Yes 1 [GO TO Q30(b)]
No 2 [GO TO Q31]

(b) If Yes, can you tell me who they are? (PROBE FOR NAME OF ORGANISATIONS/AUTHORITIES)

____
____
____
____
____

(c) Would you know where to contact these organisations by telephone if you wanted to? (PROBE FOR LOCATION, ADDRESS OR TELEPHONE NUMBER)

Yes 1
No 2

____
____

31 Have you ever been warned about possible flooding by any of the following while living at this address?
(SHOW CARD 3, READ OUT AND FILL IN ONE CODE FOR EACH ORGANISATION)

	Yes	No	Don't know
Police	1	2	-9
Drainage and Irrigation Dept.	1	2	-9
Malaysian Meteorological Service	1	2	-9
Other government departments Specify:______________	1	2	-9
Flood Warden	1	2	-9
Local Authority	1	2	-9
Media (TV/Radio/Rediffusion)	1	2	-9
Village Headman	1	2	-9
Farmer Association Representative	1	2	-9
Others, specify 1______________	1	2	-9
2______________	1	2	-9

32 (a) How many official flood warnings have you received since living at this address?
____

(b) How many of these warnings were actually followed by *flooding?* ____________

(c) How many of these warnings were not followed by flooding? ______________

(d) How many times were you not warned but flooded ever since living here?_______

33 (a) To what degree do you rely on the current *flood warning system?*

Completely	1	**[GO TO Q34]**
Considerably	2	**[GO TO Q34]**
Slightly	3	**[GO TO Q34]**
Not at all	4	**[GO TO Q33(b)]**

(b) If answer is 4, ask: Why not?

Don't trust warning system	1
Warning is always given too late	2
I rely only on my own judgement	3
Others, specify ____________	4

(READ OUT): DURING THE MOST RECENT FLOOD IN _______ (MONTH) _______ (YEAR), FLOODING OCCURRED ALONG THE RIVER __________ AND OTHER WATER COURSES IN THIS AREA AND ELSEWHERE.

34 During that time, was your property flooded?

Yes	1
No	2

35 During that time, was your village/town flooded?

Yes	1
No	2
Don't know	-9

36 During that time, can you tell me how you first became aware of the possibility of flooding?
(FILL IN ONE CODE ONLY, DO NOT PROMPT)

Water entered property	1
Own judgement	2
Message from neighbour	3
Message from relative/friend	4
Warning from Drainage and Irrigation Department	5
Warning from Malaysian Meteorological Office	6
Warning from the police	7
Warning from other government departments	8 Specify_____________
Warning from flood warden	9
Warning from village headman	10
Warning from farmers association	11
Warning from local authority	12
Warning from the Media (TV/Radio/Rediffusion)	13
When neighbour is flooded	14
Heavy rains for many hours	15
Warning from neighbourhood flood-watch committee	16
Others, specify__________________	20

37 (a) During that flood, were you officially warned?

Yes	1 [GO TO Q37(b)]
No	2 [GO TO Q44]

(b) If Yes, who was the first to officially warn you?

Police	1
Drainage & Irrigation Dept.	2
Malaysian Meteor. Service	3
Other government depts.	4 Specify_______________
Flood Warden	5
Local Authority	6
Media (TV/Radio/Rediffusion)	7
Village Headman	8
Farmer Association Rep.	9
Others, specify___________	10
Siren	11
Information Department	12

(c) Did you contact them or did they get in touch with you?

I contacted them	1
They got in touch	2

(d) When were you officially warned? OR When did you contact them?

> 20 hours before flooding	1
11-20 hours before flooding	2
6-10 hours before flooding	3
0.02 - 5 hours before flooding	4
0 hours before flooding	5
0.02 - 5 hours after flooding	6
6-10 hours after flooding	7
> 10 hours after flooding	8
Don't know	-9

38 Can you remember how you were first officially warned?
(SHOW CARD 4, READ OUT AND FILL IN ONE CODE ONLY)

Telephone	1
Loud hailer	2
Warning notice board	3
House call	4
Personal contact elsewhere	5
Police siren	6
Radio/TV	7
Others	10
No, can't remember	-9

39 Did you receive any further warning(s)?

Yes	1 **[GO TO Q40]**
No	2 **[GO TO Q42]**
Don't know	-9 **[GO TO Q42]**

40 If Yes for Q39, what further warnings did you receive? Please answer YES or NO for each type of warning and tell me, if you were warned by a neighbour, relative or organisation, whether you contacted them yourself or they got in touch with you.
(SHOW CARD 5 AND FILL IN ONE CODE FOR EACH TYPE OF WARNING)

	Warning Received		Contacted them myself	They got in touch
	Yes	No		
Message from neighbour	1	2	1	2
Message from relative	1	2	1	2
Warning from Drainage and Irrigation Department	1	2	1	2
Warning from Malaysian Meteorological Office	1	2	1	2
Warning from the police	1	2	1	2
Warning from other government departments	1	2	1	2
Warning from flood warden	1	2	1	2
Warning from village headman	1	2	1	2
Warning from farmers association	1	2	1	2
Warning from local authority	1	2	1	2
Warning from the Media (TV/Radio/Rediffusion)	1	2	1	2
Information Department	1	2	1	2
Siren	1	2	1	2
Member of State/Parliament	1	2	1	2
Others 1, specify__________________	1	2	1	2
Others 2, specify__________________	1	2	1	2

41 Can you remember how you were warned by each of the following? (SHOW CARD 6, READ OUT AND FILL IN ONE CODE FOR EACH ORGANISATION)

Drainage and Irrigation Department

Malaysian meteorological Service

Police

Other government department

Flood Warden

Farmer Association

Village Headman

Local Authority

Means of warning:

Telephone	1	Police siren	6
Loud hailer	2	Radio/TV	7
Flood warning board	3	Others,______	8
House call	4	Can't remember	-9
Personal contact	5		

42 In any 'official' warnings, that is from the Drainage and Irrigation Department, Malaysian Meteorological Service, Police, other government departments, flood warden, farmers association, vi lage headman, local authority or warning via the media, were you told any of the following?

(a) How long it would be before you were flooded?

Yes 1
No 2
Don't know -9

(b) How deep the flood might be at a particular place?

Yes 1
No 2
Don't know -9

(c) What to do if your property was affected?

Yes 1 [GO TO Q42(d)]
No 2 [GO TO Q43]
Don't know -9 [GO TO Q43]

(d) If yes, what were you told to do? (PROBE AND RECORD ANSWER VERBATIM)

____
____
____
____
____
____
____

43 (a) How satisfied were you personally with the way the flood warning system worked during the most recent flood in _____(month)_____(year)? (READ OUT AND ENTER ONE CODE ONLY)

Were you:

Were you:	Completely satisfied	1
	Quite satisfied	2
	Not very satisfied	3
	Not at all satisfied	4

(b) Why is that? (PROBE AND RECORD ANSWER VERBATIM)

____

____

____

____

____

____

(READ OUT): WE NEED TO KNOW WHAT YOU WOULD LIKE FROM AN 'IDEAL' FLOOD WARNING SYSTEM SO THAT FUTURE FLOOD WARNING SYSTEMS CAN BE IMPROVED.

44 (a) Can you tell me how you would prefer to be warned initially?
(SHOW CARD 7, READ OUT AND FILL IN ONE CODE ONLY)

Personal call by police, DID, MMS, other govt depts or flood warden	1
Telephone call by police, DID, MMS, other govt depts or flood warden	2
Police siren	3
Police loudspeaker or loud hailer in area	4
Alarm siren sounded	5
Radio announcements	6
TV announcements	7
Notices posted locally on a warning board	8
Emergency telephone number or answerphone to contact	9
Personal call by village headman	10
Others, please specify ______________________	11

(b) And how would you prefer to be kept informed subsequently?
(SHOW CARD 7 AGAIN, READ OUT AND FILL IN ONE CODE FOR EACH WARNING CATEGORY)

	Yes	No
Personal call by police, DID, MMS, other govt depts or flood warden	1	2
Telephone call by police, DID, MMS, other govt depts or flood warden	1	2
Police siren	1	2
Police loudspeaker or loud hailer in area	1	2
Alarm siren sounded	1	2
Radio announcements	1	2
TV announcements	1	2
Notices posted locally on a warning board	1	2
Emergency telephone number or answerphone to contact	1	2
Personal call by village headman	1	2
Others, please specify ______________________	1	2

45 In general, it has been shown that the longer the warning lead time, the less accurate would be a warning. Bearing that in mind, when would you prefer to receive a warning? (SHOW CARD 8, READ OUT AND FILL IN ONE CODE ONLY)

When there is only a possibility of a flood occurring eg. > 12 hours before it is expected	1
When a flood is more likely but not for some hours	2
When a flood is almost certainly going to occur within the next 2 hours	3
When upstream is flooded & it is going to hit me in the next 1/2 to 1 hour	4
Others, specify ______________________________	5
Don't know	-9

46 Do you think your household/business needs to receive an official flood warning or are you prepared to rely on your own judgement about the possibility of flooding?

Need to receive an official warning	1
Prepared to rely on own judgement	2
It depends on circumstances	3

V DAMAGE

<u>Now I would like you to try and remember back to the worst ever flood and the most recent flood experienced by you since living in this property</u>

47 (a) At what height above the ground would the flood water start coming into your property/building?

(b) At what height above the ground would the flood water become damaging to your property/building?

(c) At what height above the ground would the flood water become damaging to your family/business?

Code for Q47 (a), (b) & (c)	
1 feet	1
2 feet	2
3 feet	3
4 feet	4
5 feet	5
6 feet	6
7 feet	7
8 feet	8
9 feet	9
10 feet	10
> 10 feet	11
Don't Know	-9

WORST FLOOD IN ______

48 (a) Were you living/in business at this address at the time of the WORST flood in ____?

Yes 1 [GO TO Q48(b)]
No 2 [GO TO Q54]

(b) Were you f ooded at the time of the WORST flood in ____?
Yes 1 [GO TO Q48(b)i]
No 2 [GO TO Q54]

If answer is Yes, (i) What was the depth of the flood waters?
(USE SAME CODES AS Q47 FOR DEPTH OF FLOOD WATER)

(ii) How long did the flood last?

< 1 hour	1	3 - 4 days	7
1 - 2 hours	2	5 - 7 days	8
3 - 5 hours	3	8 - 10 days	9
6 - 12 hours	4	11 - 30 days	10
13 - 24 hours	5	> 1 month	11
1 - 2 days	6	Don't Know	-9

49 Did the WORST flood cause any damage, however minor, to this property, its contents or your business/crops/etc?

Yes 1 [GO TO Q50(a)]
No 2 [GO TO Q50(i)]

50 If Yes, was there any damage, however minor, to your:

		Yes	No	Cost($)
(a) <u>Building:</u>	Floor	1	2	______
	Wall	1	2	______
	Stilts	1	2	______
	Stairways	1	2	______
	Basement	1	2	______
	Garden	1	2	______
	Others, specify______________	1	2	______

Total cost of damages to building: ($)____________

(b) Contents:

	Yes	No	Cost($)
Carpet	1	2	_____
Furniture	1	2	_____
Electrical appliances	1	2	_____
Air conditioning	1	2	_____
Foodstuffs	1	2	_____
Pets	1	2	_____
Others, specify_______________	1	2	_____

Total cost of damages to contents: ($)____________________

(c) Vehicles:

	Yes	No	Cost($)
Tractor	1	2	_____
Lorry/truck	1	2	_____
Van	1	2	_____
Car	1	2	_____
Motorbike	1	2	_____
Bicycle	1	2	_____
Others, specify______________	1	2	_____

Total cost of damages to vehicles: ($)_____________________

(d) Livestock & crops:

	Yes	No	Cost($)
Crops	1	2	_____
Cattle	1	2	_____
Goats	1	2	_____
Poultry	1	2	_____
Pigs(Do not ask Muslims)	1	2	_____
Fish	1	2	_____
Others, specify________	1	2	_____

Total cost of damages to livestock & crops: ($)_____________

(e) Humans: (PLEASE BE TACTFUL WHEN YOU ASK THIS QUESTION)

	Yes	No	Cost($)
Killed	1	2	_____
Taken ill______________	1	2	_____
Anxiety, stress, worry	1	2	_____
Loss of work	1	2	_____
Loss of schooling	1	2	_____
Others, specify_________	1	2	_____

Total cost of damages to humans: ($)____________________

(f) Memorabilia:

	Yes	No	Cost($)
Photographs	1	2	_____
Antiques	1	2	_____
Jewellery	1	2	_____
Paintings	1	2	_____
Others, specify_________	1	2	_____

Total cost of damages to memorabilia: ($)________________

(g) Any other damages?:

	Yes	No	Cost($)
Clothes	1	2	________
Shoes	1	2	________
Machinery	1	2	________
Goods	1	2	________

Total cost of all other damages: ($)______________________

(h) Total cost of all damages in the WORST flood in____ = $__________________
(DO NOT ASK RESPONDENT. INTERVIEWER SHOULD SUM UP ALL DAMAGES TO ARRIVE AT THE FIGURE FOR TOTAL DAMAGES)

(i) How long did it take you to clean up the entire property after the flood?

< 1 hour	1
1 - 2 hours	2
3 - 5 hours	3
6 - 12 hours	4
13 - 24 hours	5
1 - 2 days	6
3 - 4 days	7
5 - 7 days	8
8 - 10 days	9
> 10 days	10
Takes weeks	11
Takes months	12
Takes years	13
Don't know	-9

MOST RECENT FLOOD IN ________

51 (a) Were you living/in business at this address at the time of the most recent flood?

Yes	1 [GO TO Q51(b)]
No	2 [GO TO Q54]

(b) Were you flooded at the time of the most recent flood in ____?

Yes	1 [GO TO Q51(b)i]
No	2 [GO TO Q54]

If answer is Yes, (i) What was the depth of the flood waters?

1 feet	1
2 feet	2
3 feet	3
4 feet	4
5 feet	5
6 feet	6
7 feet	7
8 feet	8
9 feet	9
10 feet	10
> 10 feet	11
Don't Know	-9

(ii) How long did the flood last?

< 1 hour	1
1 - 2 hours	2
3 - 5 hours	3
6 - 12 hours	4
13 - 24 hours	5
1 - 2 days	6
3 - 4 days	7
5 - 7 days	8
8 - 10 days	9
> 10 days	10
Don't Know	-9

52 Did the most recent flood in ______ cause any damage, however minor, to this property or its contents?

Yes	1 [GO TO Q53(a)]
No	2 [GO TO Q53(i)]

53 If Yes, was there any **damage**, however minor, to your:

(a) Building:

	Yes	No	Cost($)
Floor	1	2	_____
Wall	1	2	_____
Stilts	1	2	_____
Stairways	1	2	_____
Basement	1	2	_____
Garden	1	2	_____
Others, specify_______________	1	2	_____

Total cost of damages to building: ($)____________________

(b) Contents:

	Yes	No	Cost($)
Carpet	1	2	_____
Furniture	1	2	_____
Electrical appliances	1	2	_____
Air conditioning	1	2	_____
Foodstuffs	1	2	_____
Pets	1	2	_____
Others, specify_______________	1	2	_____

Total cost of damages to contents: ($)____________________

(c) Vehicles:

	Yes	No	Cost($)
Tractor	1	2	_____
Lorry/truck	1	2	_____
Van	1	2	_____
Car	1	2	_____
Motorbike	1	2	_____
Bicycle	1	2	_____
Others, specify_______________	1	2	_____

Total cost of damages to vehicles: ($)____________________

(d) Livestock & crops:

	Yes	No	Cost($)
Crops	1	2	_____
Cattle	1	2	_____
Goats	1	2	_____
Poultry	1	2	_____
Pigs(Do not ask Muslims)	1	2	_____
Fish	1	2	_____
Others, specify________	1	2	_____

Total cost of damages to livestock & crops: ($)_____________

(e) Humans: (PLEASE BE TACTFUL WHEN YOU ASK THIS QUESTION)

	Yes	No	Cost($)
Killed	1	2	_____
Taken ill_______________	1	2	_____
Anxiety, stress, worry	1	2	_____
Loss of work	1	2	_____
Loss of schooling	1	2	_____
Others, specify_________	1	2	_____

Total cost of damages to humans: ($)____________________

(f) Memorabilia:

	Yes	No	Cost($)
Photographs	1	2	_____
Antiques	1	2	_____
Jewellery	1	2	_____
Paintings	1	2	_____
Others, specify_________	1	2	_____

Total cost of damages to memorabilia: ($)________________

		Yes	No	Cost($)
(g) Any other damages?:	Clothes	1	2	________
	Shoes	1	2	________
	Machinery	1	2	________
	Goods	1	2	________

Total cost of all other damages: ($)______________________

(h) Total cost of all damages in most recent flood in ____(year) = $____________
(DO NOT ASK. INTERVIEWER SHOULD SUM UP ALL DAMAGES TO ARRIVE AT THE FIGURE FOR TOTAL DAMAGES)

(i) How long did it take you to clean up the entire property after the most recent flood in ____?

< 1 hour	1
1 - 2 hours	2
3 - 5 hours	3
6 - 12 hours	4
13 - 24 hours	5
1 - 2 days	6
3 - 4 days	7
5 - 7 days	8
8 - 10 days	9
> 10 days	10
Takes weeks	11
Takes months	12
Takes years	13
Don't know	-9

54 Please indicate the accuracy of each of the above estimates according to the scale below:

(a) The WORST flood:

Very accurate	1
Accurate	2
Moderately accurate	3
Inaccurate	4
Very inaccurate	5

(b) The most recent flood:

Very accurate	1
Accurate	2
Moderately accurate	3
Inaccurate	4
Very inaccurate	5

55 Now I would like you to rate the consequences of the following floods on your household's life, based on a scale of 0 (no effect) to 10 (most serious effect).

(SHOW CARD 9, READ OUT AND ENTER RATING FOR EACH FLOOD)

0	1	2	3	4	5	6	7	8	9	10
no effect									most serious effect	

(a) The worst flood in _____ ( )

(b) The most recent flood in _____ ( )

56 Now I would like you to try to summarise your experience of the most serious flood and its effect on your household's/business's life ever since you moved into this area and rate it on the same scale of 0 (no effect) to 10 (most serious effect).

(USE SCALE ON SHOW CARD 9 AGAIN, ENTER RATING)

0	1	2	3	4	5	6	7	8	9	10
no effect									most serious effect	

Effect upon your health and your family's/workers' health

Having to leave home/the building

Damage to replaceable items eg furniture, contents, etc

Worry and stress about flooding in future

Loss or damage to irreplaceable objects/memorabilia

All the problems and discomfort whilst trying to get the house/building back to normal

Damage to the house/building itself

Effect on gardens, land and outbuildings

Foul smell of f ood waters

Inconvenience caused by road and bridge flooding/transport problems

Effect on business/crops

57 **(FOR AGRICULTURE, FISHING AND COMMERCIAL ESTABLISHMENTS ONLY. OTHERS GO TO Q58)**
Did you suffer any loss/es in crop harvest/business during each of the floods below that was not made up during the period after the flood?

(a)(i) During the WORST flood in ______

Yes	1	**[GO TO Q57(a)ii]**
No	2	**[GO TO Q57(b)i]**
Don't know	-9	**[GO TO Q57(b)i]**

(ii) If Yes, how much was the % loss from normal?

1 - 10 %	1	71 - 80 %	8
11 - 20 %	2	81 - 90 %	9
21 - 30 %	3	91 - 100 %	10
31 - 40 %	4	> 100 %	11
41 - 50 %	5	Don't know	-9
51 - 60 %	6		
61 - 70 %	7		

(b)(i) During the most recent flood in ____:

Yes	1	**[GO TO Q57(b)ii]**
No	2	**[GO TO Q58]**
Don't know	-9	**[GO TO Q58]**

(ii) If Yes, how much was the % loss from normal?

1 - 10 %	1	71 - 80 %	8
11 - 20 %	2	81 - 90 %	9
21 - 30 %	3	91 - 100 %	10
31 - 40 %	4	> 100 %	11
41 - 50 %	5	Don't know	-9
51 - 60 %	6		
61 - 70 %	7		

58 (a) Have there been any long term effects of flooding in general on your property/land/business or contents ever since you have been living/farming/doing business in this location ?

Yes	1	[GO TO Q58(b)]
No	2	[GO TO Q59]
Don't know	-9	[GO TO Q59]

(b) If Yes, specify:

____
____
____
____
____
____
____
____
____
____

VI PERSONAL INFORMATION

The remaining questions are standard in most questionnaire surveys and are only used for our own classification purposes. Your answers are completely confidential.

59 Position of Respondent:

Head of house	1
Wife	2
Son	3
Daughter	4
Manager	5
Worker	6
Others, specify____________	7

60 Gender:

Male	1
Female	2

61 Age:

< 21	1
21-30	2
31-40	3
41-50	4
51-60	5
> 60	6

62 Ethnic Group:

Malay	1
Chinese	2
Indian	3
Others	4

63 Religion:

Muslim	1
Christian	2
Buddhist	3
Hindu	4
Taoist	5
Others, specify ______________	6

64 Occupation:

Professionals	1
Farmer	2
Artisan	3
Tradesman, businessman, services	4
Labourer	5
Education	6
Manufacturer	7
Unemployed	8
Retired	9
Housewife	10
Student	11
Fisherman	12
Others	20

65 Education:

None at all	1
A few years in primary school	2
Completed primary school	3
Lower secondary school	4
Upper secondary school	5
Tertiary/Diploma	6
Tertiary/Degree	7

66 Income:
Can you tell me which of the letters on this card represents *the gross annual income from* all sources in your household/farm/business? (SHOW CARD 10)

Letter	Annual ($)	Monthly ($)	
(L)	< 2,100	<175	01
(Q)	2,100-4,199	175-349	02
(F)	4,200-5,999	350-499	03
(G)	6,000-8,999	500-749	04
(A)	9,000-11,999	750-999	05
(H)	12,000-17,999	1,000-1,499	06
(T)	18,000-23,999	1,500-1,999	07
(C)	24,000-29,999	2,000-2,499	08
(D)	30,000-35,999	2,500-2,999	09
(M)	36,000-47,999	3,000-3,999	10
(X)	48,000-59,999	4,000-4,999	11
(R)	60,000-119,999	5,000-9,999	12
(B)	> 120,000	> 10,000	13
	Refused	Refused	-9

67 Family size/Total number of workers:____________

MIDDLESEX UNIVERSITY
Flood Hazard Research Centre

SOAL-SELIDIK KEMUSNAHAN, PERSEPSI DAN STRATEGI PENGURANGAN KESAN BANJIR DI SEMENANJUNG MALAYSIA

Untuk Perumahan, Pertanian, Perikanan dan Penubuhan-penubuhan Komersil dan Awam/Kerajaan

Nota-nota untuk Penemuduga

1 Sebarang ayat yang digariskan mesti dibaca kepada responden

2 Sebarang ayat di dalam kurungan hanya untuk maklumat penemuduga sahaja

3 Semua jawapan berkod adalah untuk maklumat penemuduga sahaja. Jangan baca jawapan tersebut kepada responden kecuali jika diminta dalam soalan

4 Sekiranya sebarang soalan adalah tidak berkenaan, tulis 'TB'di dalam jawapan

5 Maklumat dalam muka surat 2 & 3 perlu diisikan oleh penemuduga sebelum memulakan temuduga dengan responden (penemuduga boleh merujuk kepada responden jika terdapat sebarang keraguan)

UNTUK KEGUNAAN PEJABAT SAHAJA

Pantai:	Pantai Timur	1
	Panatai Barat	2
Wilayah:		
	Barat-laut	1
	Timur-laut	2
	Barat-daya	3
	Tenggara	4
Tapak:		
	Pulau Pinang	1
	Kota Bharu	2
	Kuala Lumpur	3
	Pekan	4
Bandar/Desa:	Bandar	1
	Desa	2
Jenis Banjir:	Sungai	1
	Sungai & Pasang surut	2
	Pasang surut	3

Alamat ____

____

No Soal-selidik:__________________________________

Jenis Penubuhan:

Perumahan	1
Pertanian	2
Komersil	3
Awam/Kerajaan	4
Perikanan	5

No. Penemuduga:_________ Tandatangan Penemuduga:______________________

Tarikh Temuduga:____

Masa mula temuduga:____

Masa tamat temuduga:____

Tempoh temuduga:____Minit

I CIRI-CIRI RUMAH/KEDAI/BANGUNAN

(a) **Jenis:**

Bungalow	1
Bangunan Terpisah	2
Separuh-Terpisah	3
Teres	4
Pangsa	5

(b) **Dinding luar:**

Batu bata/konkrit	1	Batu bata(bawah)/papan(atas)	2
Papan	3		
Lain	4		

(Nyatakan____
____)

(c) **Umur Bangunan:**

> 100 tahun	1
81-100 tahun	2
61- 80 tahun	3
41- 60 tahun	4
21- 40 tahun	5
11- 20 tahun	6
< 11 tahun	7

(d) **Lantai:**

Terrazo/marble	1
Permaidani	2
Simen	3
Papn/parquet	4
Plastik/vinyl	5
Pasir	6
Buluh	7
Lain,	8

(Nyatakan____
____)

(e)(i) **Tiang kaki bangunan:**

Ada 1 [KE S(e)ii]
Tiada 2 [KE S(g)]

(ii) Jika Ada, berapa tinggi?

1 kaki	1
2 kakı	2
3 kaki	3
4 kaki	4
5 kaki	5
> 5 kaki	6

(f) **Tiang kaki bangunan dibuat dari apa?:**

Konkrit/batu bata/simen	1
Konkrit(bawah) & Papan(atas)	2
Papan	3
Buluh	4
Lain,	5

(Nyatakan____
____)

(g)(i) **Adakah bangunan ini mempunyai tingkat bawah tanah (basement)?:**

Ya 1 [KE S(g)ii]
Tidak 2 [KE S1]

(ii) **Jika Ya, apakah kegunaan tingkat bawah tanah tersebut?**

Tempat simpanan	1	Tempat tinggal	2
Tempat letak kenderaan	3	Tempat berniaga	4
Lain________________	5		

(UNTUK DIBACA KEPADA RESPONDEN)
Tuan/puan, kami sedang menjalankan suatu kaji selidik untuk Universiti Sains Malaysia. Tujuan kaji selidik ini adalah untuk mengkaji tanggapan penduduk Malaysia terhadap bahaya/bencana semula jadi dan cara-cara penyesuaian mereka terhadap bahaya/becana tersebut. Kaji selidik ini adalah dibiayai oleh Universiti Sains Malaysia, Jabatan Parit dan Taliair dan Middlesex University (UK). Kaji selidik ini adalah SULIT. Kecuali kebenaran diberikan oleh responden, nama dan pendapat responden tidak akan diberitahu kepada sesiapa pun. Dapatan-dapatan kajian hanya diterbit dalam bentuk laporan yang tidak dapat dikenalpastikan.

II PERSEPSI

1 Adakah anda memiliki milikan(bangunan)/tanah/perniagaan(kedai) ini?

Ya	1
Tidak	2

2 (a) Berapa tahun sudah anda tinggal/mengerja sawah/berniaga di kampung/pekan ini?

__________Tahun

(UNTUK PERTANIAN, PERIKANAN DAN PERNIAGAAN SAHAJA. LAIN PERGI KE S3)
(b) Sejak anda mula bekerja di sini, berapa tahun agaknya boleh dikatakan mendapat hasil baik, buruk dan biasa (sederhana)?

Baik	__________Tahun
Buruk	__________Tahun
Biasa (sederhana)	__________Tahun

3 (a) Apakah kelebihan-kelebihan tinggal/mengerja sawah/berniaga di kampung/pekan ini? (CATAT SEPERTI YANG DIHURAIKAN. TANYA 'ADA APA LAGI' 3 KALI)

____

____

____

____

____

____

(b) Apakah kelebihan yang paling penting? ____________________

(c) Apakah jumlah bilangan kelebihan?____________________

4 (a) Apakah kekurangan-kekurangan tinggal/mengerja sawah/berniaga di kampung/pekan ini? (CATAT SEPERTI YANG DIHURAIKAN. TANYA 'ADA APA LAGI' 3 KALI)

____

____

____

____

____

____

(b) Apakah kekurangan yang paling teruk?____________________

(c) Apakah jumlah bilangan kekurangan?____________________

5 Yang mana lebih banyak? Kelebihan atau kekurangan?

Kelebihan	1
Sama	2
Kekurangan	3

6 Senaraikan semua bahaya/bencana semula jadi yang dinyatakan dalam S4(a):

____

____

____

____

____

7 Adakah penduduk yang tinggal di kampung/pekan ini mempunyai masalah banjir (mengalami banjir)?

Ya	1
Tidak	2
Tak tahu	-9

8 (a) Adakah anda menjadi ahli kepada mana-mana persatuan/organisasi yang terlibat dengan penyelesaian masalah banjir?

Ya	1 [KE S8(b)]
Tidak	2 [KE S9]

(b) Jika Ya, apakah persatuan/organisasi tersebut? (MINTA ALAMAT & NO. TELEFON)

____

____

9 Pada tempoh 10 tahun yang lepas, berapa kali telah *milikan/bangunan ini dibanjiri?* **atau** Jika < 10 tahun tinggal di situ, 'Sejak anda tinggal di situ'?

Tidak dibanjiri	0	7 kali	7
Sekali	1	8 kali	8
2 kali	2	9 kali	9
3 kali	3	10 kali	10
4 kali	4	> 10 kali	11
5 kali	5	Tak tahu	-9
6 kali	6		

10 Berdasarkan satu skala 0 (langsung tidak mungkin) sehingga 10 (tentu akan jadi), apakah kemungkinan milikan/bangunan ini dibanjiri sekurang-kurangnya satu kali pada tempoh masa berikut? (TUNJUK KAD 1, BACA KEPADA RESPONDEN DAN KEMUDIAN *MASUKKAN SATU KOD UNTUK SETIAP TEMPOH MASA)*

0	1	2	3	4	5	6	7	8	9	10	-9
LTM										TAJ	TT

Pada beberapa bulan depan ____________

Pada tahun depan ____________

Pada tempoh masa 5 tahun ____________

Pada tempoh masa 10 tahun ____________

Pada tempoh masa 50 tahun ____________

11 Jika anda hidup 100 tahun, berapa kali anda fikir milikan/bangunan ini akan dibanjiri? ____kali

12 Pada tempoh 10 tahun yang lepas, berapa kali telah kampung/pekan ini dibanjiri? **atau** Jika < 10 tahun tinggal di situ, 'Sejak anda tinggal di situ'?

Tidak dibanjiri	0	7 kali	7
Sekali	1	8 kali	8
2 kali	2	9 kali	9
3 kali	3	10 kali	10
4 kali	4	> 10 kali	11
5 kali	5	Tak tahu	-9
6 kali	6	TB	-8

13 Bolehkah anda ingat tahun-tahun di mana kampung/pekan ini dibanjiri? Sila beritahu seberapa tahun yang anda boleh ingat:

Tahun (Mulakan dengan tahun terbaru)

____

____

____

____

____

14 Tahun apakah yang mempunyai banjir paling teruk di kampung/pekan ini? ____

15 Berdasarkan satu skala 0 (langsung tidak mungkin) sehingga 10 (tentu akan jadi), apakah kemungkinan kampung/pekan ini dibanjiri sekurang-kurangnya satu kali pada tempoh masa berikut?
(TUNJUK KAD 1, BACA KEPADA RESPONDEN DAN KEMUDIAN MASUKKAN SATU KOD UNTUK SETIAP TEMPOH MASA)

0	1	2	3	4	5	6	7	8	9	10	-9
LTM										TAJ	TT

Pada beberapa bulan depan ____________

Pada tahun depan ____________

Pada tempoh masa 5 tahun ____________

Pada tempoh masa 10 tahun ____________

Pada tempoh masa 50 tahun ____________

16 Jika anda hidup 100 tahun, berapa kali anda fikir kampung pekan ini akan dibanjiri?
____kali

17 (a) Adakah tempat-tempat lain di MALAYSIA yang mengalami sedikit banjir di mana anda boleh mendapat rezeki yang sama seperti di sini?
(BACA JAWAPAN KEPADA RESONDEN)

Tentu ada	1	[KE S17(b)]
Mungkin ada	2	[KE S17(b)]
Mungkin tak ada	3	[KE S18]
Tentu tak ada	4	[KE S18]
Tak tahu	-9	[KE S18]

(b) Jika Tentu ada, di mana?________________

Dalam mukim sama	1	Malaysia Timur	6
Dalam daerah sama	2	Lain________	7
Dalam negeri sama	3	Tak Tahu	-9
Lain negeri di P. Barat	4		
Lain negeri di P. Timur	5		

18 (a) Dengan pengetahuan anda sekarang tentang masalah banjir di sini, adakah anda masih terus tinggal bekerja berniaga di kampung pekan ini untuk masa yang lama?

Tentu ya	1	[KE S18(b)]
Mungkin ya	2	[KE S18(b)]
Mungkin tidak	3	[KE S18(c)]
Tentu tidak	4	[KE S18(c)]
Tak tahu	-9	[KE S19]

(b) Jika Tentu ya atau Mungkin ya, kenapa anda tidak pindah?

Tiada wang	1	Tanah pern agaan di s ni	6
Tiada tempat nak pergi	2	Bekerja berniaga ba k di s ni	7
Saudara & kawan di sini	3	Lain, nyatakan__________	8
Tak mahu tinggal tanah	4	Tak tahu	-9
Mana pun sama sahaja	5		

(c) Jika Mungkin tidak atau Tidak:
(i) Ke mana anda akan pindah?

Dalam mukim sama	1	Malaysia Timur	6
Dalam Daerah sama	2	Negeri Thai	7
Dalam Negeri sama	3	Indonesia	8
Lain negeri di P. Barat	4	Lain_______	9
Lain negeri di P. Timur	5	Tak tahu	-9

(ii) Bila anda akan pindah?

Dalam masa 1 tahun	1	Dalam masa 6-10 tahun	4
Dalam masa 1-2 tahun	2	Dalam masa > 10 tahun	5
Dalam masa 3-5 tahun	3	Tak tahu/tak tentu	-9

19 (a) Setahu anda, bolehkah seorang tahu bahawa banjir akan datang?

Ya	1 [KE S19(b)]
Tidak	2 [KE S20]
Tak tahu	-9[KE S20]

(b) Jika Ya, nyatakan bagaimana:

____

____

____

____

____

____

____

____

____

____

____

20 Berikut adakah beberapa pernyataan yang telah dikatakan tentang banjir di kampung/pekan ini. Berdasarkan skala 1 (sangat setuju) hingga 5 (sangat tidak setuju), sila tunjukkan adakah anda setuju atau tidak dengan setiap pernyataan.
(TUNJUKKAN KAD 2, MASUKKAN SATU KOD UNTUK SETIAP PERNYATAAN)

1	2	3	4	5
sangat setuju	setuju	neutral (tiada komen)	tidak setuju	sangat tidak setuju

(a) Banjir adalah hasil kegiatan Tuhan

(b) Banjir adalah hasil alam semula jadi

(c) Banjir adalah hasil alam semula jadi (cuaca, iklim, dln.)

(d) Banjir adalah hasil kegiatan manusia

(e) Banjir adalah hasil interaksi alam semula jadi dan kegiatan manusia

(f) Banjir-banjir lepas di sini adalah kejadian luarbiasa yang tidak akan terjadi lagi

(g) Banjir adalah perkara biasa di sini. Ianya selalu berlaku di sini

(h) Kejadian banjir di sini semakin meningkat/tambah

(i) Banjir boleh berlaku pada mana-mana satu tahun

(j) Banjir berlaku dalam pola tertentu, iaitu setiap beberapa tahun sekali

(k) Banjir adalah masalah besar untuk kami

(l) Kami tidak mempunyai banjir benar/serius/besar di sini

(m) Kami sudah lama hidup dalam keadaan banjir. Kami sudah biasa dengan banjir

(n) Banjir tidak akan terjadi lagi kerana Jabatan Parit dan Taliair dan jabatan-jabatan kerajaan yang lain boleh mengawal banjir melalui pengurusan sungai dan pantai

(o) Pihak-pihak berkuasa belum lagi benar-benar memahami masalah banjir tempatan di sini lagi

III STRATEGI PENGURANGAN BANJIR

21 (a) Bolehkah sesuatu dilakukan untuk **mencegah** banjir dari berlaku?

Ya	1 **[KE S22(a)i & KEMBALI KE S21(b)]**
Tidak	2 **[KE S21(b)]**
Tak tahu	-9**[KE S21(b)]**

(b) Bolehkah sesuatu dilakukan untuk **mengurangkan** kesan banjir?

Ya	1 **[KE S22(a)ii]**
Tidak	2 **[KE S23]**
Tak tahu	-9**[KE S23]**

22 (a) Jika Ya untuk S21(a) dan/atau S21(b), apakah cara-cara itu? (BIARKAN RESPONDEN MENGEMUKAKAN SEMUA STRATEGI SENDIRI. SOAL 'ADA APA LAGI?' 3 KALI)

	(i) Cegah Banjir		(ii) Kurang kesan	
	Ya	Tidak	Ya	Tidak
Sembahyang	1	2	1	2
Guna bomoh	1	2	1	2
Bina empangan dan kolamair	1	2	1	2
Dinding banjir, benteng, dan benteng	1	2	1	2
Mendalam & meluruskan alur sungai	1	2	1	2
Membina lencungan sungai, alur tambahan	1	2	1	2
Kolamair simpanan, empangan simpanan	1	2	1	2
Memperbaiki sistem saliran bandar	1	2	1	2
Pengurangan banjir(tanaman lindungan di tadahan untuk simpan air banjir)	1	2	1	2
Pindahan/tindakan kecemasan	1	2	1	2
Peninggian tingkat bawah/lantai	1	2	1	2
Pelindungan rumah/bangunan dari air banjir	1	2	1	2
Kawalan guna tanah/rancangan pengezonan	1	2	1	2
Insuran banjir	1	2	1	2
Ramalan banjir & amaran banjir	1	2	1	2
Pembuatan hujan tiruan	1	2	1	2
Penanaman tanaman pelindung(untuk mengurangkan hakisan tanah)	1	2	1	2
Keluarkan sampah apungan dari sungai	1	2	1	2
Sediakan bot/sampan	1	2	1	2
Pindahkan barangan isi rumah	1	2	1	2
Lain, nyatakan__________________	1	2	1	2

(b) Jumlah bilangan strategi untuk kawalan banjir: _________

(c) Jumlah bilangan strategi untuk mengurangkan kesan banjir: ________

23 Adakah anda mengambil apa-apa langkah untuk mengurangkan banjir atau kesannya terhadap keluarga, harta benda dan kandungannya, tanah atau tanaman pada masa lalu?

Ya 1 [KE S24(a)] Tidak 2 [KE S24(b)]

24 (a) Pada masa banjir yang baru lepas, apa telah dibuat oleh anda? (BIARKAN RESPONDEN MENGEMUKAKAN SEMUA STRATEGI SENDIRI. TANYA 'ADA APA LAGI' 3 KALI)

(b) Selain dari apa yang telah dibuat oleh anda untuk mengurangkan bahaya banjir, terdapat juga beberapa strategi lain yang telah dibuat oleh orang lain. Sila nyatakan adakah setiap strategi tersebut baik atau buruk. (TANYA RESPONDEN HANYA STRATEGI YANG TIDAK DIKEMUKAKAN OLEHNYA DALAM BAHAGIAN(a))

(i) Adakah anda fikir strategi itu baik atau buruk?

(ii) Kenapa anda fikir strategi itu baik atau buruk?

	Soalan (a) Ya=1;Tak=2	Soalan (b)(i) Baik=1;TT=-9; Buruk=2	Soalan (b)(ii) Lihat kod di bawah
Tidak buat apa pun	_____	_____	_____
Sembahyang	_____	_____	_____
Guna bomoh	_____	_____	_____
Bersedia untuk pindah	_____	_____	_____
Pindah ahli keluarga ke tingkat atas	_____	_____	_____
Pindah ahli keluarga ke tempat lain	_____	_____	_____
Pindah binatang ternak/rumah ke tempat lain	_____	_____	_____
Pindah kenderaan ke tempat lain	_____	_____	_____
Pindah perabut	_____	_____	_____
Pelindungan rumah/bangunan (tetap)	_____	_____	_____
Pelindungan rumah/bangunan (tak tetap)	_____	_____	_____
Pelindungan rumah/bangunan (kecemasan) [contoh:Cegah air masuk rumah]	_____	_____	_____
Insuran banjir	_____	_____	_____
Memberi amaran kepada orang lain di tapak *banjir & di rumah*	_____	_____	_____
Memberi amaran kepada orang lain (jiran & saudara) di lain tempat	_____	_____	_____
Membeli bekalan makanan	_____	_____	_____
Memadamkan letrik	_____	_____	_____
Mendengar laporan ramalan cuaca	_____	_____	_____
Menelefon bomba, polis, pejabat daerah dan lain-lain	_____	_____	_____
Meninggikan lantai rumah	_____	_____	_____
Tukar pola tanaman/jenis tanaman	_____	_____	_____
Sediakan bot/sampan	_____	_____	_____
Ambil *cuti*	_____	_____	_____
Pasangkan suis di tempat tinggi	_____	_____	_____
Lain, nyatakan____________________	_____	_____	_____

(c) Jumlah bilangan strategi yang digunakan oleh responden: ______________

(JANGAN TANYA. CUBA KIRA JUMLAH INI DALAM BAHAGIAN (a))

25 (a) Apabila banjir berlaku pada masa depan, adakah anda akan membuat sesuatu yang beza dari apa yang biasa dibuat?

Ya	1 [KE S25(b)]
Tidak	2 [KE S26]
Tak tahu	-9[KE S26]

(b) Jika Ya, apa yang akan dibuat? (BIARKAN RESPONDEN MEMBERI JAWAPAN SENDIRI. KEMUDIAN, TANYA 'ADA APA LAGI' 3 KALI)

	Ya	Tak
Tiada buat apa pun	1	2
Sembahyang	1	2
Guna bomoh	1	2
Bersedia untuk pindah	1	2
Pindah ahli-ahli keluarga ke tingkat atas	1	2
Pindah ahli-ahli keluarga ke tempat lain	1	2
Pindah binatang ternak/rumah ke tempat lain	1	2
Pindah kenderaan ke tempat lain	1	2
Pindah perabut	1	2
Pelindungan rumah/bangunan (tetap)	1	2
Pelindungan rumah/bangunan (tak tetap)	1	2
Pelindungan rumah/bangunan (kecemasan sahaja) (contoh:Cegah air masuk rumah/bangunan)	1	2
Insuran banjir	1	2
Memberi amaran kepada orang lain di tapak banjir & di rumah	1	2
Memberi amaran kepada orang lain (jiran & saudara) di lain tempat	1	2
Membeli bekalan makanan	1	2
Memadamkan letrik	1	2
Mendengar laporan ramalan cuaca	1	2
Menelefon bomba, polis, pejabat daerah dan lain-lain	1	2
Meninggikan lantai rumah	1	2
Tukar pola tanaman/jenis tanaman	1	2
Sediakan bot/sampan	1	2
Ambil cuti	1	2
Lain, nyatakan____________________	1	2

(c) Jumlah bilangan strategi baru yang akan dibuat oleh responden: __________
(JANGAN TANYA RESPONDEN. CAMPURKAN JUMLAH BAHAGIAN (b))

IV AMARAN BANJIR

26 (a) Jika anda diberi amaran '2 jam' sebelum banjir lepas berlaku, adakah anda akan membuat sesuatu yang lain dari apa yang telah dibuat?

Ya	1	[KE S26(b)]
Tidak	2	[KE S27]
Tak tahu	-9	[KE S27]

(b) Jika Ya, apakah yang akan dibuat? (BIARKAN RESPONDEN MEMBERI JAWAPAN SENDIRI. KEMUDIAN, TANYA 'ADA APA LAGI' 3 KALI)

	Tak	Ya
Tiada buat apa pun	1	2
Sembahyang	1	2
Guna bomoh	1	2
Bersedia untuk pindah	1	2
Pindah ahli-ahli keluarga ke tingkat atas	1	2
Pindah ahli-ahli keluarga ke tempat lain	1	2
Pindah binatang ternak/rumah ke tempat lain	1	2
Pindah kenderaan ke tempat lain	1	2
Pindah perabut	1	2
Pelindungan rumah/bangunan (tetap)	1	2
Pelindungan rumah/bangunan (tak tetap)	1	2
Pelindungan rumah/bangunan (kecemasan sahaja) (contoh:Cegah air masuk rumah/bangunan)	1	2
Insuran banjir	1	2
Memberi amaran kepada orang lain di tapak banjir & di rumah	1	2
Memberi amaran kepada orang lain (jiran & saudara) di lain tempat	1	2
Membeli bekalan makanan	1	2
Memadamkan letrik	1	2
Mendengar laporan ramalan cuaca	1	2
Menelefon bomba, polis, pejabat daerah dan lain-lain	1	2
Meninggikan lantai rumah	1	2
Tukar pola tanaman/jenis tanaman	1	2
Sediakan bot/sampan	1	2
Ambil cuti	1	2
Anak-anak berhenti pergi ke sekolah	1	2
Lain, nyatakan____________	1	2

(c) Jumlah bilangan strategi yang akan dibuat oleh responden: ________
(JANGAN TANYA RESPONDEN. CAMPURKAN JUMLAH BAHAGIAN (b))

27 Dalam banjir yang baru berlaku, bolehkah anda memberi satu anggaran tentang berapa banyak wang yang telah anda selamatkan akibat amaran banjir diterima.(JIKA TIDAK TERIMA AMARAN RASMI: Berapakah wang yang boleh diselamatkan oleh anda sekiranya amaran banjir diterima sebelum banjir berlaku?) (DAPATKAN SATU ANGGARAN)

($)	
Tidak selamatkan apa-apa pun	0
< 1,000	1
1,000 - 1,999	2
2,000 - 2,999	3
3,000 - 3,999	4
4,000 - 4,999	5
5,000 - 5,999	6
6,000 - 10,000	7
> 10,000	8
Tak tahu	-9

28 Adakah kampung/pekan ini mempunyai sistem amaran banjir rasmi? ('Rasmi' bermasuk amaran yang diberi oleh Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, Polis, lain jabatan kerajaan, penjaga banjir, persatuan petani, ketua kampung dan pihak berkuasa tempatan, dan media massa seperti radio, TV, redifusen dln)

Ya	1
Tidak	2
Tak tahu	-9

29 (a) Tahukah anda yang mana satu organisasi/pihak berkuasa yang bertanggungjawab ke atas ramalan banjir dan pengeluaran amaran banjir di kampung/pekan ini?

Ya	1 [KE S29(b)]
Tidak	2 [KE S30]

(b) Jika Ya, siapakah organisasi/pihak berkuasa tersebut? (DAPATKAN NAMA)

____
____
____

(c) Tahukah mana untuk menghubungi organisasi/pihak berkuasa ini? (DAPATKAN ALAMAT DAN NOMBOR TELEFON ORGANISASI/PIHAK BERKUASA TERSEBUT)

Ya	1
Tidak	2

____
____
____

30 (a) Tahukah anda yang mana satu organisasi/pihak berkuasa yang bertanggungjawab ke atas penyebaran amaran banjir di kawasan (kampung/pekan) ini/di Negeri ini/di Malaysia?

Ya	1 [KE S30(b)]
Tidak	2 [KE S31]

(b) Jika Ya, siapakah organisasi/pihak berkuasa tersebut? (DAPATKAN NAMA)

____
____
____
____
____

(c) Tahukah mana untuk menghubungi organisasi/pihak berkuasa ini? (DAPATKAN ALAMAT DAN NOMBOR TELEFON ORGANISASI/PIHAK BERKUASA TERSEBUT)

Ya	1
Tidak	2

____
____
____

31 Sejak tinggal di kawasan ini, pernahkah anda diberi amaran banjir oleh pihak-pihak berkuasa berikut?
(TUNJUKKAN KAD 3, BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD UNTUK SETIAP ORGANISASI)

	Ya	Tidak	TT
Polis	1	2	-9
Jabatan Parit dan Taliair	1	2	-9
Perkhidmatan Kajicuaca Malaysia	1	2	-9
Lain-lain jabatan kerajaan, nyatakan__________________	1	2	-9
Penjaga banjir	1	2	-9
Pihak berkuasa tempatan/majlis perbandaran dln	1	2	-9
Media (TV/Radio/Redifusion)	1	2	-9
Ketua kampung	1	2	-9
Wakil persatuan petani	1	2	-9
Lain-lain, nyatakan 1______________________________	1	2	-9
Lain-lain, nyatakan 2______________________________	1	2	-9

32 (a) Berapa amaran banjir rasmi telah anda terima sejak anda mula tinggal di sini? _______

(b) Berapa amaran tersebut benar-benar diikuti oleh banjir? ________

(c) Berapa amaran tersebut tidak diikuti oleh banjir? _________

(d) Berapa kali telah anda dibanjiri tetapi tidak diberi amaran sejak anda mulai tinggal di sini?_________

33 (a) Sejauhmanakah anda bergantung kepada sistem amaran banjir rasmi?

100 % bergantung kepadanya	1 [KE S34]
Banyak bergantung kepadanya	2 [KE S34]
Hanya sedikit bergantung kepadanya	3 [KE S34]
Langsung tidak bergantung kepadanya	4 [KE S33(b)]

(b) Jika jawapan ialah 4, kenapa?

Saya tidak percaya sistem tersebut	1
Amaran selalu diberi terlalu lewat	2
Saya hanya bergantung kepada pengalaman/tafsiran sendiri	3
Lain, nyatakan___________________________________	4

BACA KEPADA RESPONDEN: Pada bulan _____ tahun _______, banjir telah berlaku disekitar Sungai _______ di kawasan ini dan sekitarnya.

34 Pada masa itu, adakah milikan/bangunan anda dibanjiri?

Ya	1
Tidak	2

35 Pada masa itu, adakah kampung/pekan ini dibanjiri?

Ya	1
Tidak	2
Tak tahu	-9

36 Pada masa itu, bagaimanakah anda mula sedar bahawa banjir akan berlaku?

(SILA ISI SATU KOD SAHAJA. JANGAN BACA JAWAPAN KEPADA RESPONDEN)

Air memasuki milikan/bangunan	1
Ikut pengalaman sendiri	2
Pesanan dari jiran	3
Pesanan dari saudara-mara	4
Amaran dari Jabatan Parit dan Taliair	5
Amaran dari Perkhidmatan Kajicuaca Malaysia	6
Amaran dari polis	7
Amaran dari lain jabatan kerajaan, nyatakan______________	8
Amaran dari penjaga banjir	9
Amaran dari ketua kampung	10
Amaran dari wakil persatuan petani	11
Amaran dari pihak berkuasa tempatan	12
Amaran dari media massa (TV/Radio/Redifusion)	13
Bila rumah jiran dibanjiri	14
Bila hujan lebat turun beberapa jam	15
Amaran diberi oleh jiran/jawatankuasa menjaga banjir	16
Lain, nyatakan ______________________________	20

37 (a) Semasa banjir ini, adakah anda diberi amaran secara rasmi?

Ya	1 [KE S37(b)]
Tidak	2 [KE S44]

(b) Jika Ya, s apakah yang mula-mula memberi amaran kepada anda?

Polis	1
Jabatan Parit dan Taliair	2
Perkhidmatan Kajicuaca Malaysia	3
Lain-lain jabatan kerajaan, nyatakan______________	4
Penjaga banjir	5
Pihak berkuasa tempatan/majlis perbandaran dln	6
Media (TV/Radio/Redifusion)	7
Ketua kampung	8
Wakil persatuan petani	9
Lain-lain, nyatakan__________________________	10
Semboyan	11
Jabatan Penerangan	12

(c) Adakah anda menghubungi mereka atau mereka yang menghubungi anda?

Saya yang menghubungi mereka	1
Mereka yang menghubungi saya	2

(d) Bilakah anda diberi amaran? **ATAU** Bilakah anda memberitahu mereka?

> 20 jam sebelum banjir berlaku	1
11 - 20 jam sebelum banjir berlaku	2
6 - 10 jam sebelum banjir berlaku	3
0.02 - 5 jam sebelum banjir berlaku	4
0 jam sebelum banjir berlaku	5
0.02 - 5 jam selepas banjir berlaku	6
6 - 10 jam selepas banjir berlaku	7
> 10 jam selepas banjir berlaku	8
Tak tahu	-9

38 Bolehkah anda ingat bagaimana anda diberi amaran?
(TUNJUKKAN KAD 4. BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD SAHAJA)

Melalui telefon	1
Dengan "speaker" berbunyi besar	2
Dengan papan notis/amaran	3
Mereka datang sendiri ke rumah saya	4
Mereka menghubungi saya secara persendirian di tempat lain	5
Semboyan polis	6
Radio/TV	7
Lain, nyatakan________________	10
Tak ingat	-9

39 Selepas amaran pertama, adakah anda diberikan sebarang amaran kemudian?(Iaitu amaran kedua, ketiga dan lain-lain)

Ya	1 **[KE S40]**
Tidak	2 **[KE S42]**
Tak tahu	-9**[KE S42]**

40 Jika Ya untuk S39, apakah amaran-amaran kemudian yang diterima anda? Sila jawap Ya atau Tidak untuk setiap punca amaran berikut, dan juga nyatakan adakah anda yang menghubungi mereka atau mereka yang menghubungi anda (TUNJUKKAN KAD 5 DAN ISIKAN SATU KOD UNTUK SETIAP JENIS AMARAN)

	Terima Amaran		Saya hubung mereka	Mereka hubung saya
	Ya	Tidak		
Pesanan dari jiran	1	2	1	2
Pesanan dari saudara-mara	1	2	1	2
Amaran dari Jabatan Parit dan Taliair	1	2	1	2
Amaran dari Perkhid. Kajicuaca Malaysia	1	2	1	2
Amaran dari polis	1	2	1	2
Amaran dari lain jabatan kerajaan, nyatakan ________________	1	2	1	2
Amaran dari penjaga banjir	1	2	1	2
Amaran dari ketua kampung	1	2	1	2
Amaran dari wakil persatuan petani	1	2	1	2
Amaran dari pihak berkuasa tempatan	1	2	1	2
Amaran dari media massa (TV/Radio/Redifusion)	1	2	1	2
Amaran dari Jabatan Penerangan	1	2	1	•2
Amaran dari semboyan	1	2	1	2
Amaran dari wakil rakyak	1	2	1	2
Amaran dari pihak lain 1______________	1	2	1	2
Amaran dari pihak lain 2______________	1	2	1	2

41 Bolehkah anda ingat bagaimana anda diberi amaran oleh setiap organisasi berikut? (TUNJUKKAN KAD 6. BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD UNTUK SETIAP ORGANISASI)

Jabatan Parit dan Taliair

Perkhidmatan Kajicuaca Malaysia

Polis

Lain Jabatan Kerajaan

Penjaga banjir

Persatuan petani

Ketua kampung

Pihak Berkuasa Tempatan/Pejabat Daerah

Cara Amaran:

Melalui telefon	1	Mereka hubung say di tempat lain	5
Dengan "speaker" berbunyi besar	2	Semboyan polis	6
Dengan papan notis/amaran	3	Radio/TV	7
Mereka datang sendiri ke rumah	4	Lain, nyatak_______________	8
		Tak ingat	-9

42 Di dalam sebarang amaran rasmi oleh Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, Polis, lain jabatan kerajaan, penjaga banjir, persatuan petani, ketua kampung dan pihak berkuasa tempatan, adakah anda diberitahu tentang:

(a) Berapa lama sebelum banjir akan berlaku?

Ya	1
Tidak	2
Tak tahu	-9

(b) Berapa dalam air banjir di setengah tempat?

Ya	1
Tidak	2
Tak tahu	-9

(c) Apa yang anda mesti lakukan jika milikan anda dibanjiri?

Ya	1
Tidak	2
Tak tahu	-9

(d) Apakah nasihat/arahan yang diberikan oleh pihak-pihak tersebut?
(TULIS JAWAPAN SECARA DESKRIPSI)

____
____
____
____
____
____
____

43 (a) Adakah anda puas hati dengan operasi sistem amaran banjir pada masa banjir yang baru berlaku pada _______(bulan) _______(tahun)? (BACA JAWAPAN KEPADA RESPONDEN DAN ISIKAN SATU KOD SAHAJA)

Sangat puas hati	1
Puas hati	2
Tidak begitu puas hati	3
Langsung tidak puas hati	4

(b) Kenapa? (TULIS JAWAPAN SECARA DESKRIPSI)

____
____
____
____
____
____

(BACA KEPADA RESPONDEN): UNTUK MEMBOLEHKAN PIHAK BERKUASA MENINGKATKAN PRESTASI SISTEM AMARAN BANJIR, SILA BERI PENDAPAT ANDA TENTANG APA YANG DIFIKIR SEBAGAI SATU SISTEM AMARAN BANJIR YANG SEMPURNA.

44 (a) Mula-mulanya, bagaimanakah anda ingin diberi amaran tentang banjir? (TUNJUKKAN KAD 7, BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD SAHAJA)

Diberitahu secara persendirian oleh polis, Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, lain jabatan kerajaan dan penjaga banjir	1
Diberitahu melalui tellefon oleh polis, Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, lain jabatan kerajaan dan penjaga banjir	2
"Siren" polis	3
"Speaker" berbunyi besar di sekitar kawasan banjir	4
Semboyan amaran yang dipasangkan di tapak strategi	5
Amaran melalui radio	6
Amaran melalui TV	7
Notis amaran diletak dalam papan notis	8
Diberi nombor telefon pihak-pihak berkuasa untuk orang menghubungi mereka semasa banjir	9
Amaran persendirian disampaikan oleh ketua kampung	10
Lain, nyatakan______________________	11

(b) Selepas amaran pertama telah diberi, bagaimanakah anda mahu amaran disampaikan seterusnya? (iaitu amaran kedua, ketiga dal lain-lain) (TUNJUKKAN KAD 7, BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD UNTUK SETIAP KATEGORI AMARAN)

	Ya	Tak
Diberitahu secara persendirian oleh polis, Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, lain jabatan kerajaan dan penjaga banjir	1	2
Diberitahu melalui telefon oleh polis, Jabatan Parit dan Taliair, Perkhidmatan Kajicuaca Malaysia, lain jabatan kerajaan dan penjaga banjir	1	2
Semboyan polis	1	2
"Speaker" berbunyi besar di sekitar kawasan banjir	1	2
Semboyan amaran yang dipasangkan di tapak strategi	1	2
Amaran melalui radio	1	2
Amaran melalui TV	1	2
Notis amaran diletak dalam papan notis	1	2
Diberi nombor telefon pihak-pihak berkuasa untuk orang menghubungi mereka semasa banjir	1	2
Amaran persendirian disampaikan oleh ketua kampung	1	2
Lain, nyatakan______________________	1	2

45 Pada umumnya, semakin lama masa amaran sebelum banjir maka semakin kurang tepat sesuatu amaran. Memandangkan itu, berapa awal anda ingin menerima amaran sebelum banjir berlaku?
(TUNJUKKAN KAD 8, BACA KEPADA RESPONDEN DAN ISIKAN SATU KOD SAHAJA)

> 12 jam sebelum banjir dijangka berlaku	1
Beberapa jam sebelum banjir dijangka berlaku	2
Bila kemungkinan banjir sangat tinggi, iaitu 2 jam sebelum ia dijangka berlaku	3
Bila kawasan hulu sungai sudah dibanjiri dan banjir sudah pasti berlaku di sini dalam masa 1/2 hingga 1 jam	4
Lain, nyatakan________________________________	5
Tak tahu	-9

46 Adakah isi rumah/perniagaan anda perlukan sesuatu sistem amaran banjir rasmi? Atau Adakah anda sanggup bergantung kepada pengalaman sendiri untuk menentukan kemungkinan banjir?

Saya perlukan satu sistem amaran banjir rasmi	1
Saya sanggup bergantung kepada diri sendiri	2
Tertakluk kepada keadaan tertentu	3

V KEMUSNAHAN

Sekarang, cuba anda ingat kembali tentang banjir yang paling teruk dan banjir yang baru berlaky kebelakangan ini sejak anda tinggal di bangunan ini

47 (a) Berapa tingginya air banjir (dari permukaan jalan) bila ianya mula masuk rumah/bangunan anda?

(b) Berapa tingginya air banjir (dari permukaan jalan) bila ianya mula merosakkan/memusnahkan milikan bangunan anda?

(c) Berapa tinggi air banjir (dari permukaan jalan) bila ianya mula mengancam kehidupan keluarga/perniagaan anda?

Kod untuk S47 (a), (b) & (c)	
1 kaki	1
2 kaki	2
3 kaki	3
4 kaki	4
5 kaki	5
6 kaki	6
7 kaki	7
8 kaki	8
9 kaki	9
10 kaki	10
> 10 kaki	11
Tak tahu	-9

BANJIR PALING TERUK TAHUN ______

48 (a) Semasa banjir paling teruk tahun ____, adakah anda tinggal di alamat ini?

Ya	1 [KE S48(b)]
Tidak	2 [KE S54]

(b) Adakah milikan/bangunan anda dibanjiri semasa banjir paling teruk tahun ____?

Ya	1 [KE S48(b)i]
Tidak	2 [KE S54]

Jika Ya, (i) Berapa tinggi air banjir?
(GUNA KOD SAMA SEPERTI S47)

(ii) Berapa lamakah rumah bangunan anda dibanjiri?

< 1 jam	1	3 - 4 hari	7
1 - 2 jam	2	5 - 7 hari	8
3 - 5 jam	3	8 - 10 hari	9
6 - 12 jam	4	11 - 30 hari	10
13 - 24 jam	5	> 1 bulan	11
1 - 2 hari	6	Tak tahu	-9

49 Adakah banjir paling teruk tahun ____ menyebabkan sebarang kemusnahan terhadap bangunan ini Atau terhadap kandungannya benda-benda dalamnya?

Ya	1 [KE S50(a)]
Tidak	2 [KE S50(i)]

50 Jika Ya, adakah sebarang **kemusnahan/kerosakan** terjadi kepada:

		Ya	Tidak	Kos($)
(a) Bangunan:	Lantai	1	2	____
	Dinding	1	2	____
	Kaki Tiang	1	2	____
	Tangga	1	2	____
	Tingkat bawah tanah (Basement)	1	2	____
	Taman bunga/halaman	1	2	____
	Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan terhadap bangunan: ($)____________

(b) Kandungan Bangunan:	Ya	Tidak	Kos($)
Permaidani	1	2	____
Perabot	1	2	____
Alat letrik	1	2	____
Hawa dingin	1	2	____
Makanan	1	2	____
Binatang jinak rumah	1	2	____
Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan kandungan bangunan: ($)____________

(c) Kenderaan:	Ya	Tidak	Kos($)
Traktor	1	2	____
Lori	1	2	____
Van	1	2	____
Kereta	1	2	____
Motorsikal	1	2	____
Basikal	1	2	____
Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan terhadap kenderaan: ($)____________

(d) Binatang ternak & tanaman:	Ya	Tidak	Kos($)
Tanaman__________________	1	2	____
Lembu	1	2	____
Kambing	1	2	____
Ayam & itik	1	2	____
Babi(Jangan tanya orang islam)	1	2	____
Ikan	1	2	____
Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan terhadap binatang ternak & tanaman: ($)________

(e) Manusia:(BERSOPAN BILA TANYA SOALAN INI)	Ya	Tidak	Kos($)
Terbunuh	1	2	____
Sakit________________	1	2	____
Bimbang & tekanan	1	2	____
Hilang/tak dapat kerja	1	2	____
Tak dapat pergi ke sekolah	1	2	____
Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan terhadap manusia: ($)______________________

(f) Benda-benda ingatan:	Ya	Tidak	Kos($)
Gambar foto	1	2	____
Benda lama/"antique"	1	2	____
Barangan emas/intan dln	1	2	____
Gambar lukisan	1	2	____
Lain, nyatakan______________	1	2	____

Jumlah kos kemusnahan terhadap benda-benda ingatan: ($)____________

(g) Lain-lain kemusnahan:	Ya	Tidak	Kos($)
Pakaian	1	2	____
Kasut	1	2	____
Mesin	1	2	____
Barangan perniagaan	1	2	____

Jumlah kos kemusnahan terhadap benda-benda lain: ($)_______________

(h) Jumlah kos semua kemusnahan akibat banjir paling teruk tahun ____: = $_________
(JANGAN TANYA RESPONDEN. PENEMUDUGA BOLEH KIRAKAN ANGKA INI SENDIRI)

(i) Berapa lamakah diperlukan untuk membersihkan seluruh rumah/bangunan selepas banjir paling teruk tahun ___:

< 1 jam	1
1 - 2 jam	2
3 - 5 jam	3
6 - 12 jam	4
13 - 24 jam	5
1 - 2 hari	6
3 - 4 hari	7
5 - 7 hari	8
8 - 10 hari	9
> 10 hari	10
Beberapa minggu	11
Beberapa bulan	12
Beberapa tahun	13
Tak tahu	-9

BANJIR BARU BERLAKU TAHUN ___

51 (a) Semasa banjir baru berlaku tahun ___, adakah anda tinggal di alamat ini?

Ya	1 [KE S51(b)]
Tidak	2 [KE S54]

(b) Adakah milikan/bangunan anda dibanjiri semasa banjir baru berlaku tahun ___?

Ya	1 [KE S51(B)i]
Tidak	2 [KE S54]

Jika Ya, (i) Berapa tinggi air banjir?

1 kaki	1
2 kaki	2
3 kaki	3
4 kaki	4
5 kaki	5
6 kaki	6
7 kaki	7
8 kaki	8
9 kaki	9
10 kaki	10
> 10 kaki	11
Tidak tahu	-9

(ii) Berapa lamakah rumah/bangunan anda dibanjiri?

< 1 jam	1
1 - 2 jam	2
3 - 5 jam	3
6 - 12 jam	4
13 - 24 jam	5
1 - 2 hari	6
3 - 4 hari	7
5 - 7 hari	8
8 - 10 hari	9
> 10 hari	10
Tidak tahu	-9

52 Adakah banjir baruberlaku tahun ___ menyebabkan sebarang kemusnahan terhadap bangunan ini atau terhadap kandungannya/benda-benda dalamnya?

Ya	1 [KE S53(a)]
Tidak	2 [KE S53(i)]

53 Jika Ya, adakah sebarang **kemusnahan/kerosakan** terjadi kepada:

(a) Bangunan:

	Ya	Tidak	Kos($)
Lantai	1	2	____
Dinding	1	2	____
Kaki Tiang	1	2	____
Tangga	1	2	____
Tingkat bawah tanah (Basement)	1	2	____
Taman bunga/halaman	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap bangunan: ($)______________

(b) Kandungan Bangunan:

	Ya	Tidak	Kos($)
Permaidani	1	2	____
Perabot	1	2	____
Alat letrik	1	2	____
Hawa dingin	1	2	____
Makanan	1	2	____
Binatang jinak rumah	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap kandungan bangunan: ($)____________

(c) Kenderaan:

	Ya	Tidak	Kos($)
Traktor	1	2	____
Lori	1	2	____
Van	1	2	____
Kereta	1	2	____
Motorsikal	1	2	____
Basikal	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap kenderaan: ($)____________________

(d) Binatang ternak & tanaman:

	Ya	Tidak	Kos($)
Tanaman_________________	1	2	____
Lembu	1	2	____
Kambing	1	2	____
Ayam & itik	1	2	____
Babi(Jangan tanya orang islam)	1	2	____
Ikan	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap binatang ternak & tanaman: ($)________

(e) Manusia:(BERSOPAN BILA TANYA SOALAN INI)

	Ya	Tidak	Kos($)
Terbunuh	1	2	____
Sakit_______________	1	2	____
Bimbang & tekanan	1	2	____
Hilang/tak dapat kerja	1	2	____
Tak dapat pergi ke sekolah	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap manusia: ($)______________________

(f) Benda-benda ingatan:

	Ya	Tidak	Kos($)
Gambar foto	1	2	____
Benda lama/"antique"	1	2	____
Barangan emas/intan dln	1	2	____
Gambar lukisan	1	2	____
Lain, nyatakan_______________	1	2	____

Jumlah kos kemusnahan terhadap benda-benda ingatan: ($)______________

(g) Lain-lain kemusnahan:

	Ya	Tidak	Kos($)
Pakaian	1	2	____
Kasut	1	2	____
Mesin	1	2	____
Barangan pern agaan	1	2	____

Jum ah kos kemusnahan terhadap benda-benda lain: ($)________________

(h) Jum ah kos semua kemusnahan ak'bat banjir baru berlaku tahun ____: = $__________
(JANGAN TANYA RESPONDEN. PENEMUDUGA BOLEH KIRAKAN ANGKA INI SENDIRI)

(i) Berapa lamakah d perlukan untuk members hkan seluruh rumah/bangunan selepas banjir baru berlaku tahun ____:

< 1 jam	1
1 - 2 jam	2
3 - 5 jam	3
6 - 12 jam	4
13 - 24 jam	5
1 - 2 har	6
3 - 4 har	7
5 - 7 har	8
8 - 10 hari	9
> 10 hari	10
Beberapa minggu	11
Beberapa bulan	12
Beberap tahun	13
Tak tahu	-9

54 S la nyatakan ketepatan set ap anggaran kemusnahan bagi setiap banjir yang diberikan:

(a) Banj r pal ng teruk:

Sangat tepat	1
Tepat	2
Sederhana tepat	3
T'dak beg tu tepat	4
Sangat tidak tepat	5

(b) Banj'r baru berlaku:

Sangat tepat	1
Tepat	2
Sederhana tepat	3
Tidak begitu tepat	4
Sangat tidak tepat	5

55 Sekarang, berdasarkan skala 0 (T'ada kesan) hingga 10 (Kesan paling serius), cuba memberi darjah "keseriusan" kesan-kesan setiap banjir berikut terhadap kehidupan dalam isi rumah anda secara keseluruhan (TUNJUKKAN KAD 9, BACA KEPADA RESPONDEN DAN ISIKAN DARJAH KESERIUSAN UNTUK SETIAP BANJIR)

0	1	2	3	4	5	6	7	8	9	10
Tiada Kesan										Paling Serius

(a) Banjir paling teruk tahun ____

(b) Banj'r baru berlaku tahun ____

56 Berdasarkan kepada skala 0 (Tiada kesan) hingga 10 (Kesan paling serius), cuba tentukan darjah "keseriusan" setiap kesan yang disebabkan oleh banjir terhadap kehidupan keluarga anda sejak tinggal di sini(TUNJUKKAN KAD 9, BACA KEPADA RESPONDEN DAN ISIKAN DARJAH KESERIUSAN UNTUK SETIAP KESAN)

0	1	2	3	4	5	6	7	8	9	10
Tiada Kesan										Paling Serius

Kesan terhadap kesihatan ahli-ahli keluarga/pekerja

Terpaksa tinggalkan rumah/bangunan

Kemusnahan kepada benda-benda yang boleh digantikan (perabot, alat letrik dln)

Bimbang dan tekanan tentang banjir pada masa depan

Hilang atau musnah benda-benda yang tidak boleh digantikan (gambar dln)

Semua kesulitan & kesusahan akibat cuba memulihkan rumah kepada keadaan asal

Kemusnahan kepada bangunan

Kesan banjir terhadap taman/halaman rumah & bangunan luar

Bau busuk air banjir

Kesulitan yang timbul akibat pembanjiran jaringan hubungan (jalanraya, jalan keretapi dln)

Kesan terhadap perniagaan/tanaman

57 **(UNTUK PENUBUHAN PERTANIAN DAN PERNIAGAAN SAHAJA. LAIN PERGI S58)**
Adakah anda dapat sebarang kerugian dalam hasil tanaman/perniagaan yang tidak dapat digantikan pada tempoh selepas banjir:

(a)(i) Banjir paling teruk tahun ____:

Ya	1 **[KE S57(a)ii]**
Tidak	2 **[KE S57(b)i]**
Tak tahu	-9**[KE S57(b)i]**

(ii) Jika Ya, berapakah % kerugian itu dari hasil/perniagaan biasa?

1 - 10	1	71 - 80	8
11 - 20	2	81 - 90	9
21 - 30	3	91 - 100	10
31 - 40	4	> 100	11
41 - 50	5	Tak tahu	-9
51 - 60	6		
61 - 70	7		

(b)(i) Banjir baru berlaku tahun ____:

Ya	1 **[KE S57(b)ii]**
Tidak	2 **[KE S58]**
Tak tahu	-9**[KE S58]**

(ii) Jika Ya, berapakah % kerugian itu dari hasil/perniagaan biasa?

1 - 10	1	71 - 80	8
11 - 20	2	81 - 90	9
21 - 30	3	91 - 100	10
31 - 40	4	> 100	11
41 - 50	5	Tak tahu	-9
51 - 60	6		
61 - 70	7		

58 (a) Adakah apa-apa kesan banjir jangka panjang terhadap milikan/tanah/perniagaan anda dan kandungannya sejak anda tinggal di sini?

Ya	1 [**KE S58(b)**]
Tidak	2 [**KE S59**]
Tak tahu	-9[**KE S59**]

(b) Jika Ya, nyatakan:

____
____
____
____
____
____
____
____
____
____

VI MAKLUMAT PERIBADI

<u>Soalan-soalan berikut adalah standard di dalam semua kaji selidik dan cuma digunakan untuk pengelasan kami. Jawapan-jawapan anda adalah SULIT.</u>

59 <u>Taraf responden</u>:

Ketua rumah	1
Isteri	2
Anak lelaki	3
Anak perempuan	4
Pengurus syarikat	5
Pekerja syarikat	6
Lain____________	7

60 <u>Jantina:</u>

Lelaki	1
Perempuan	2

61 <u>Umur:</u>

< 21 tahun	1
21 - 30 tahun	2
31 - 40 tahun	3
41 - 50 tahun	4
51 - 60 tahun	5
> 60 tahun	6

62 <u>Bangsa:</u>

Melayu	1
Cina	2
India	3
Lain	4

63 <u>Agama:</u>

Islam	1
Christian	2
Buddhist	3
Hindu	4
Taoist	5
Lain____________	6

64 Pekerjaan:

Profesional	1
Petani	2
Artisan/buruh mahir	3
Peniaga/perkhidmatan	4
Buruh kasar	5
Pendidikan	6
Pekilang	7
Penganggur	8
Persara	9
Suri Rumah tangga	10
Pelajar	11
Nelayan	12
Lainlain	20

65 Pendidikan:

Tiada/buta huruf	1
Beberapa tahun sekolah rendah	2
Habis sekolah rendah	3
Sekolah menegah rendah	4
Sekolah menengah tinggi	5
Maktab/diploma	6
Universiti	7

66 Berdasarkan Kad ini, huruf manakah yang mengandungi pendapatan tahunan kasar anda?

(TUNJUKKAN KAD 10)

HURUF	TAHUNAN ($)	BULANAN ($)	
(L)	< 2100	< 175	1
(Q)	2,100-4,199	175-349	2
(F)	4,200-5,999	350-499	3
(G)	6,000-8,999	500-749	4
(A)	9,000-11,999	750-999	5
(H)	12,000-17,999	1,000-1,499	6
(T)	18,000-23,999	1,500-1,999	7
(C)	24,000-29,999	2,000-2,499	8
(D)	30,000-35,999	2,500-2,999	9
(M)	36,000-47,999	3,000-3,999	10
(X)	48,000-59,999	4,000-4,999	11
(R)	60,000-119,999	5,000-9,999	12
(B)	> 120,000	> 10,000	13
Tidak mahu beritahu			-9
Tidak berkenaan			-8

67 Saiz Keluarga/Jumlah Pekerja: ____________________________

APPENDIX C

MIDDLESEX UNIVERSITY
Flood Hazard Research Centre

FLOOD DAMAGE QUESTIONNAIRE SURVEY FOR PENINSULAR MALAYSIA

For Commercial/Business Establishments

Notes for Interviewer

1 Any statement that is underlined should be read out to respondent

2 Any statement in parentheses is for interviewer's information only

3 All coded answers are for interviewer information only. They should not be read out to respondents unless SPECIFIED so in the question.

4 If any question is not applicable, write in 'NA'

Interviewer Number:__________________ Signature: ____________________

Interview date:____

Time interview started:____

Time interview ended:____

Duration of interview:____Minutes

(TO BE READ OUT TO RESPONDENT)

We are carrying out a survey for the Universiti Sains Malaysia. The aim of the survey is to find out the damage caused by floods on businesses in various parts of Peninsular Malaysia. The survey is also partly supported by the Drainage and Irrigation Department and the Flood Hazard Research Centre at Middlesex University (UK). The survey is completely confidential. Unless permission is given by participants, their names and views will not be revealed to anyone. The results will be published in statistical and unidentifiable form only.

FLOOD DAMAGE

1 Respondent's Identity Number.

2 Respondent's Address..

....

3 When was the last flood here?

4 When was the worst flood here?

5 Type of business..............................

6 Study Area....................................

7 (a) At what height above the ground would the flood water start coming into your property/building?_______________

(b) At what height above the ground would the flood water become damaging to your property/building?____________

(c) At what height above the ground would the flood water become damaging to your family/business?______________

Codes for Q7(a), (b) & (c)

1 feet	1
2 feet	2
3 feet	3
4 feet	4
5 feet	5
6 feet	6
7 feet	7
8 feet	8
9 feet	9
10 feet	10
> 10 feet	11
Don't Know	-9

8 (a) Were you living/in business at this address at the time of the most recent flood in ______?

Yes	1
No	2

(b) Were you flooded at the time of the most recent flood in ____?

Yes	1
No	2

If answer is Yes, (i) What was the depth of the flood waters?

1 feet	1
2 feet	2
3 feet	3
4 feet	4
5 feet	5
6 feet	6
7 feet	7
8 feet	8
9 feet	9
10 feet	10
> 10 feet	11
Don't Know	-9

(ii) How long did the flood last?

< 1 hour	1
1 - 2 hours	2
3 - 5 hours	3
6 - 12 hours	4
13 - 24 hours	5
1 - 2 days	6
3 - 4 days	7
5 - 7 days	8
8 - 10 days	9
> 10 days	10
Don't Know	-9

9 Did the most recent flood in ______ cause any damage, however minor, to this property or its contents?

Yes	1
No	2

10 If Yes, was there any damage, however minor, to your:

(a) Building:		Yes	No	Cost ($)
	Floor	1	2	______
	Wall	1	2	______
	Stilts	1	2	______
	Stairways	1	2	______
	Basement	1	2	______
	Garden	1	2	______
	Others, specify_______	1	2	______

Total cost of damages to building: ($)______________

(b) Contents:		Yes	No	Cost ($)
	Carpet	1	2	______
	Furniture	1	2	______
	Electrical appliances	1	2	______
	Air conditioning	1	2	______
	Foodstuffs	1	2	______
	Pets	1	2	______
	Others, specify______	1	2	______

Total cost of damages to contents: ($)______________

(c) Vehicles:		Yes	No	Cost ($)
	Tractor	1	2	______
	Lorry/truck	1	2	______
	Van	1	2	______
	Car	1	2	______
	Motorbike	1	2	______
	Bicycle	1	2	______
	Others, specify______	1	2	______

Total cost of damages to vehicles: ($)______________

(d) Livestock & crops:		Yes	No	Cost ($)
	Crops	1	2	______
	Cattle	1	2	______
	Goats	1	2	______
	Poultry	1	2	______
	Pigs	1	2	______
	Fish	1	2	______
	Others, specify__	1	2	______

Total cost of damages to livestock & crops: ($)______________

(e) Humans: (PLEASE BE TACTFUL WHEN YOU ASK THIS QUESTION)

	Yes	No	Cost ($)
Killed	1	2	______
Taken ill________	1	2	______
Anxiety, stress, worry	1	2	______
Loss of work	1	2	______
Loss of schooling	1	2	______
Others, specify____	1	2	______

Total cost of damages to humans: ($)____________

(f) Memorabilia:

	Yes	No	Cost ($)
Photographs	1	2	______
Antiques	1	2	______
Jewellery	1	2	______
Paintings	1	2	______
Others, specify____	1	2	______

Total cost of damages to memorabilia: ($)____________

(g) Any other damages?: specify________________Cost ($)________
____Cost ($)________
____Cost ($)________
____Cost ($)________

Total cost of all other damages: ($)____________

(h) Total cost of all damages in most recent flood in ____(year)

= ($)____________

(DO NOT ASK. INTERVIEWER SHOULD SUM UP ALL DAMAGES TO ARRIVE AT THE FIGURE FOR TOTAL DAMAGES)

11 If the height of flood waters is 3 feet (1 metre), how many times would your damage (estimate) be compared to the most recent flood?

12 If the height of flood waters is 6 feet (2 metres), how many times would your damage (estimate) be compared to the most recent flood?

APPENDIX D

Dear Sir,

re: Questionnaire survey on Flood Management in Peninsular Malaysia with special reference to Flood Forecasting and Warning Systems

This is to inform you that I am a staff member of Universiti Sains Malaysia and I am currently pursuing a PhD in Middlesex University (UK). The topic of my research is 'An assessment of policies and strategies of flood hazard management in Peninsular Malaysia, with special emphasis on flood forecasting and warning systems'. I am conducting the above survey as part of my fieldwork programme. Attached with this letter is a set of questionnaires. I hope you will find time to complete the questionnaires and send them to me in the self-addressed and stamped envelope.

Thank you for your kind co-operation.

Yours sincerely,

Chan Ngai Weng
School of Humanities
Universiti Sains Malaysia
Minden, 11800 USM Penang

MIDDLESEX UNIVERSITY

FLOOD HAZARD RESEARCH CENTRE

QUESTIONNAIRE SURVEY ON GENERAL FLOOD MANAGEMENT POLICIES AND STRATEGIES IN PENINSULAR MALAYSIA, WITH SPECIAL EMPHASIS ON CURRENT FLOOD FORECASTING AND WARNING SYSTEMS

For government officers, academics, private practitioners, consultants, environmental groups, and other parties involved with flood management in Peninsular Malaysia

Notes for respondents:

1 Any statement in parentheses is either instruction or for information only.

2 If any question is not applicable, write in 'NA'.

3 The respondent is not obligated to answer any question which he/she does not wish to answer. In such a case, write in 'NC'.

4 The respondent should try to answer all questions whenever possible.

This questionnaire is not numbered and respondents are not required to state their names or positions. Results of this survey are completely confidential and will only be published in statistical and unidentifiable form. Please feel free to express your views. Thank you.

SECTION I: GENERAL

1 In what capacity are you associated with flood management?

Government officer	1
Academic	2
Environmental Group	3
Consultant	4
Others	5 Please specify________________________

2 How much of your time (in your work/research) is involved with flood hazard management (all aspects)?

1 - 10%	1	51 - 60%	6	None	00
11 - 20%	2	61 - 70%	7	Don't know	88
21 - 30%	3	71 - 80%	8	NA	99
31 - 40%	4	81 - 90%	9		
41 - 50%	5	91 - 100%	10		

3 On a scale of 1 (least serious) to 10 (most serious), how would you rate the seriousness of the flood hazard in each of the following States (overall in the State of course) in Peninsular Malaysia ?

(Please circle one answer for each state in the rating scale)

State	Rating	
Perlis	1 2 3 4 5 6 7 8 9 10	No idea
Kedah	1 2 3 4 5 6 7 8 9 10	No idea
Pulau Pinang	1 2 3 4 5 6 7 8 9 10	No idea
Perak	1 2 3 4 5 6 7 8 9 10	No idea
Selangor	1 2 3 4 5 6 7 8 9 10	No idea
Federal Territory	1 2 3 4 5 6 7 8 9 10	No idea
Negeri Sembilan	1 2 3 4 5 6 7 8 9 10	No idea
Melaka	1 2 3 4 5 6 7 8 9 10	No idea
Johor	1 2 3 4 5 6 7 8 9 10	No idea
Pahang	1 2 3 4 5 6 7 8 9 10	No idea
Kelantan	1 2 3 4 5 6 7 8 9 10	No idea
Terengganu	1 2 3 4 5 6 7 8 9 10	No idea

4 On a scale of 1 (least adequate) to 10 (most adequate), how would you rate the Malaysian Government's spending on flood mitigation in the whole country?

(Please circle one answer only)
1 2 3 4 5 6 7 8 9 10 No idea

5 (a) Do you think the spending on flood mitigation has been evenly/fairly distributed throughout the entire country (i.e. each State getting its fair share of flood mitigation)?

(Please circle one answer only)

Very evenly distributed	1
Fairly evenly distributed	2
Fairly unevenly distributed	3
Very unevenly distributed	4
No idea	8

(b) Why is that so? (Please give a short account)

____
____
____
____
____
____
____
____
____

6 On a scale of 1 (least adequate) to 10 (most adequate), how would you rate the overall flood management strategy of the Malaysian Government?

(Please circle one answer only)

1 2 3 4 5 6 7 8 9 10 No idea

7 Here are some statements that have been made about the flood problem in Peninsular Malaysia. Can you please indicate how strongly you agree or disagree with each statement based on the scale below?

(Please give one code for each statement in the appropriate box provided)

1	2	3	4	5
strongly agree	agree	neither agree nor disagree	disagree	strongly disagree

(a) Malaysian flood management policies and strategies are too dependent on structural/engineering approach. ( )

(b) There is a need to incorporate a multi-disciplinary approach to flood hazard management in Peninsular Malaysia. ( )

(c) The likelihood of flooding in many parts of the country is decreasing because the DID and other government agencies can now control flooding through river and coastal management (and other ways). ( )

(d) The likelihood of flooding in many parts of the country is decreasing because of changes in nature (weather and climate, etc.). ( )

(e) The likelihood of flooding in many parts of the country is increasing and becoming worse because of uncontrolled and haphazard development. ( )

(f) The likelihood of flooding in many parts of the country is increasing and becoming worse because of changes in weather and climate. ( )

(g) Not enough studies have been done in the country to really fully understand and tackle the flood problem effectively. ( )

(h) The Drainage and Irrigation Department is adequate enough to tackle the flood problem in Peninsular Malaysia. There is no necessity for incorporating other agencies/departments into managing the problem. ( )

(i) Pressure groups such as environmental groups should leave the government agencies to do their work. Making noise will not solve the flood problems. ( )

SECTION II: FLOOD FORECASTING AND WARNING

(For Government officers whose departments are involved with flood forecasting and warning systems. Others please go to Question 10)

8 In your opinion, is your department's annual budget for 'Flood forecasting and warning' adequate ?

(Please give one answer for each year in the box provided)

1	2	3	4	5	6	7	8	9	10	No idea	NA
least adequate									most adequate		

(a) 1991 ( )

(b) 1992 ( )

(c) 1993 (Projected) ( )

9(a) What is the extent of the areal coverage of flood forecasting and warning systems in the region under your department's control? (If not possible to ascertain, please give an estimate)

(Please circle one code only)

1 - 10%	1	51 - 60%	6	None	00
11 - 20%	2	61 - 70%	7	No idea	88
21 - 30%	3	71 - 80%	8	NA	99
31 - 40%	4	81 - 90%	9		
41 - 50%	5	91 - 100%	10		

(b) Is the extent of the coverage in (a) sufficient?

Yes	1	No idea	8
No	2	NA	9

(c) If no for (b), what percentage of coverage do you think would be sufficient?

(Please circle one code only)

1 - 10%	1	51 - 60%	6	None	00
11 - 20%	2	61 - 70%	7	No idea	88
21 - 30%	3	71 - 80%	8	NA	99
31 - 40%	4	81 - 90%	9		
41 - 50%	5	91 - 100%	10		

10(a) Do you think the present flood forecasting and warning system in your region (For government officers) /Peninsular Malaysia (For non-government officers) is the best current system available?

Yes	1	No idea	8
No	2	NA	9

(b) If no, which then is the best available system for your region/ Peninsular Malaysia? (Please elaborate)

____

11(a) Do you think the current flood forecasting and warning system in your region/Peninsular Malaysia in general needs to be improved?

Yes	1
No	2

(b) Why do you think so? (Please elaborate)

____

(c) If yes, how can it be improved? (Indicate number of ways)

1____________________
2____________________
3____________________
4____________________
5____________________
6____________________
7____________________
8____________________
9____________________
10____________________

(Those not involved with flood forecasting & warning systems, Please go to Question 12 (c))

12(a) In the current flood forecasting and warning system in your region, how much of the actual forecasting and warning work is taken over by automation (telemetry, computer modelling, faxing etc.) ?

(Please circle one code only)

1 - 10%	1	51 - 60%	6	None	00
11 - 20%	2	61 - 70%	7	No idea	88
21 - 30%	3	71 - 80%	8	NA	99
31 - 40%	4	81 - 90%	9		
41 - 50%	5	91 - 100%	10		

(b) In your opinion, are the flood duty officers suitably qualified to handle the current flood forecasting and warning system in your region?

Yes	1	No idea	8
No	2	NA	9

(c) What are the most important qualities/qualifications of a capable flood duty officer? (List the most important quality/qualification first)

1____________________
2____________________
3____________________
4____________________
5____________________
6____________________
7____________________
8____________________
9____________________
10____________________

(d) Given the future advancement in mechanisation such as computerisation and other technologies in flood forecasting and warning, how much of the flood forecasting and warning work do you envisage will eventually be taken over by mechanisation?

(Please circle one code only)

1 - 10%	1	51 - 60%	6	None	00
11 - 20%	2	61 - 70%	7	No idea	88
21 - 30%	3	71 - 80%	8	NA	99
31 - 40%	4	81 - 90%	9		
41 - 50%	5	91 - 100%	10		

(e) Given a the most up-to-date flood forecasting and warning system (fully mechanised), is it possible that a clerical worker (without academic qualifications and knowledge of the local catchment and rivers) might be able to be trained to man a flood forecasting and warning centre effectively?

Yes	1
Possibly	2
No	3

13 Given the existing system in operation in your region, how important do you rate the flood duty officer's experience (of floods, rivers, catchment, and other local conditions) in flood forecasting ? On a scale of 1 to 10 (10 being most important), circle the importance:

1 2 3 4 5 6 7 8 9 10 No idea

14(a) In your opinion, what is the target 'lead time' (time between a flood warning and the commencement of flooding) for issuing flood warnings in your region/Peninsular Malaysia?

______________hours (Urban catchment)
______________hours (Rural catchment)
______________hours (Mixed: 50% urban & 50% rural)
______________hours (Overall in your region/Peninsular Malaysia)

(For government officers only)

(b) What is the average lead time your forecasting system can give (Give the actual average lead time based on past floods).

______________hours (Urban catchment)
______________hours (Rural catchment)
______________hours (Mixed: 50% urban & 50% rural)
______________hours (Overall in your region/Peninsular Malaysia)

(c) Given the current forecasting system in your region, what is the maximum lead time achievable?

______________hours (Urban catchment)
______________hours (Rural catchment)
______________hours (Mixed: 50% urban & 50% rural)
______________hours (Overall in your region/Peninsular Malaysia)

(For all respondents)

(d) Given the current state of forecasting technology in Malaysia, what is the maximum lead time achievable?

______________hours (Urban catchment)
______________hours (Rural catchment)
______________hours (Mixed: 50% urban & 50% rural)
______________hours (Overall in your region/Peninsular Malaysia)

(e) In order to increase the lead time of your forecasting and warning system, what are the necessary improvements?

1____
2____
3____
4____
5____
6____
7____
8____
9____
10____

(For government officers only)

15(a) What percentage of the current flood forecasting work in your region & what percentage of your region is using rain gauged point rainfall?

____________________% of work (Please estimate)
____________________% of region (Please estimate)

(For all respondents)

(b) At a scale of 1 to 10 (10 being the highest), how would you rate the performance/reliability of rain gauge measured point rainfall in flood forecasting? (Circle one answer only)

1 2 3 4 5 6 7 8 9 10 No idea

(For government officers only)

16(a) What percentage of the current flood forecasting work in your region & what percentage of your region is using gauged river levels?

____________________% of work (Please estimate)
____________________% of region (Please estimate)

(For all respondents)

(b) At a scale of 1 to 10 (10 being the highest), how would you rate the performance/reliability of using upstream river levels in flood forecasting for downstream areas?

1 2 3 4 5 6 7 8 9 10 No idea

(For government officers only)

17(a) What percentage of the current flood forecasting work in your region & what percentage of your region is using radar forecasted rainfall?

____________________% of work (Please estimate)
____________________% of region (Please estimate)

(For all respondents)

(b) At a scale of 1 to 10 (10 being the highest), how would you rate the performance/reliability of radar based forecast rainfall in flood forecasting?

1 2 3 4 5 6 7 8 9 10 No idea

(For government officers only)

18(a) What percentage of the current flood forecasting work in your region and what percentage of your region is using satellite forecasted rainfall?

____________________% of work (Please estimate)
____________________% of region (Please estimate)

(For all respondents)

(b) At a scale of 1 to 10 (10 being the highest), how would you rate the performance/reliability of forecast rainfall based on satellite imagery in flood forecasting?

1 2 3 4 5 6 7 8 9 10 No idea

(For all respondents)

19(a) **Accuracy**: Based on your own experience/opinion, please rank the accuracy of each of the following input in flood forecasting in your region (1 = most accurate, 2 = above average, 3 = average, 4 = below average, 5 = least accurate, 8 = No idea).

Satellite forecasted rainfall	( )
Radar forecasted rainfall	( )
Rain gauged point rainfall	( )
Gauged river levels/flow	( )

(b) **Reliability(in terms of availability of data, non-failure of instrumentation, etc)**: Based on your own experience/opinion, please rank the reliability of each of the following input in flood forecasting in your region (1 = most reliable, 2 = above average, 3 = average, 4 = below average, 5 = least reliable, 8 = No idea).

Satellite forecasted rainfall	( )
Radar forecasted rainfall	( )
Rain gauged point rainfall	( )
Gauged river levels/flow	( )

(c) **Timeliness(in terms of the speed at which a forecast can be made)**: Based on your own experience/opinion, please rank the timeliness of each of the following input in flood forecasting in your region (1 = fastest, 2 = above average, 3 = average, 4 = below average, 5 = slowest, 8 = No idea).

Satellite forecasted rainfall	( )
Radar forecasted rainfall	( )
Rain gauged point rainfall	( )
Gauged river levels/flow	( )

(d) **Coverage(in terms of the areal extent that can be covered)**: Based on your own experience/opinion, please rank the coverage of each of the following input in flood forecasting in your region (1 = largest coverage, 2 = above average, 3 = average, 4 = below average, 5 = smallest coverage, 8 = No idea).

Satellite forecasted rainfall	( )
Radar forecasted rainfall	( )
Rain gauged point rainfall	( )
Gauged river levels/flow	( )

20(a) On a scale of 1 (very backward) to 10 (most advanced), how would you rate the current state of flood forecasting technology in Peninsular Malaysia?

(Please circle one answer only)
1 2 3 4 5 6 7 8 9 10 No idea

(b) On a scale of 1 (very undeveloped) to 10 (most developed), how would you rate the state of flood warning systems in Peninsular Malaysia?

(Please circle one answer only)
1 2 3 4 5 6 7 8 9 10 No idea

21 How do you rate the current international standing of Malaysian flood forecasting technology:

(a) in the ASEAN region?:

The best/most advanced	1
One of the best/most advanced	2
Above average	3
Average	4
Below average	5
Poor	6
Very poor	7
No idea	8

(b) in the world?:

The best/most advanced	1
One of the best/most advanced	2
Above average	3
Average	4
Below average	5
Poor	6
Very poor	7
No idea	8

22 How do you rate the current international standing of Malaysian flood warning technology:

(a) in the ASEAN region?:

The best/most advanced	1
One of the best/most advanced	2
Above average	3
Average	4
Below average	5
Poor	6
Very poor	7
No idea	8

(b) in the world?:

The best/most advanced	1
One of the best/most advanced	2
Above average	3
Average	4
Below average	5
Poor	6
Very poor	7
No idea	8

22(a) What developments would you like to see in Malaysian flood forecasting and warning systems in the future?

1____________________
2____________________
3____________________
4____________________
5____________________
6____________________
7____________________
8____________________
9____________________
10____________________

(b) What actual developments do you think is likely to happen in Malaysian flood forecasting and warning systems in the future?

1____________________
2____________________
3____________________
4____________________
5____________________
6____________________
7____________________
8____________________
9____________________
10____________________

This is the end of the questionnaire. Thank you for giving so much of your time in answering the questions.

Chan Ngai Weng
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APPENDIX E THE STUDY REGION AND STUDY AREAS: NATURAL AND HUMAN USE SYSTEMS RELATING TO FLOOD HAZARDS

E.1 Introduction

In Peninsular Malaysia, the flood hazard is caused by a combination of human and natural factors. Early settlements prospered on the banks of major rivers in the peninsula. As they grew, floodplains became more developed and densely populated resulting in floods becoming more and more of a serious hazard. Both the natural/physical use system (monsoon winds, heavy seasonal rainfall, low-lying topography, river characteristics, drainage etc.) and human use system (agriculture, housing, commerce, deforestation, floodplain encroachment etc.) interact in the creation and perpetuation of flood hazards in Peninsular Malaysia.

This appendix discusses the natural and human use characteristics of the study region of Peninsular Malaysia and the four selected study areas (Kuala Lumpur, Pulau Pinang, Pekan and Kelantan) not previously examined in the main text, in relation to the creation and perpetuation of the flood hazard.

E.2 The study region of Peninsular Malaysia

Peninsular Malaysia is geographically located at the southernmost part of the Asian mainland. The peninsula lies just north of the Equator between latitudes 1° 20'N and 6° 40'N, and longitudes 99° 35'E and 104° 20'E. It is bounded on the north by Thailand, on the west by the Straits of Malacca, on the east by the South China Sea and on the south by Singapore. Its longest extent from north to south is about 800 km and its widest extent from east to west is about 320 km. The peninsula covers an area of 131,794 km^2, over half and one-quarter of which are highlands above 152 m and 305 m respectively.

The peninsula experiences a hot, wet humid equatorial climate regime. Temperatures are high all year round with the exception of the highland areas. In the lowland areas, the mean annual temperature seldom dip below 25°C. The most distinguishing feature of its temperature is the small variation in the annual temperature range, usually between 1°C to 2°C. Because of this uniform temperature all year round, the seasons in Peninsular Malaysia are distinguished not by temperature but by rainfall. Basically (although there are small variations between regions), the year is divided into four seasons: (1) the Northeast Monsoon Season (November -March); (2) the Southwest Monsoon Season (May - September); (3) the First Inter-monsoon Season (April/May); and (4) the Second Inter-monsoon Season (October). However, the timing of these four seasons varies slightly between the northern and southern parts of the peninsula.

E.2.1 Winds

Peninsular Malaysia is located in an area in Southeast Asia which is under the influence of about eight or nine main airstreams which originate from places such as Siberia, North India, Tibet, the North Pacific, Australia, the South Indian Ocean and the South Pacific (Ooi 1979 p33). The combined effects of these airstreams have given rise to the region's two dominant surface wind systems, viz. the north-easterlies and the south-westerlies or better known in the country as the Northeast and Southwest Monsoons (Figure E.1). These two predominant wind systems significantly affect the both the physical and human geography of the peninsula. On the positive side, these winds bring forth heavy rains which are needed for seasonal wet

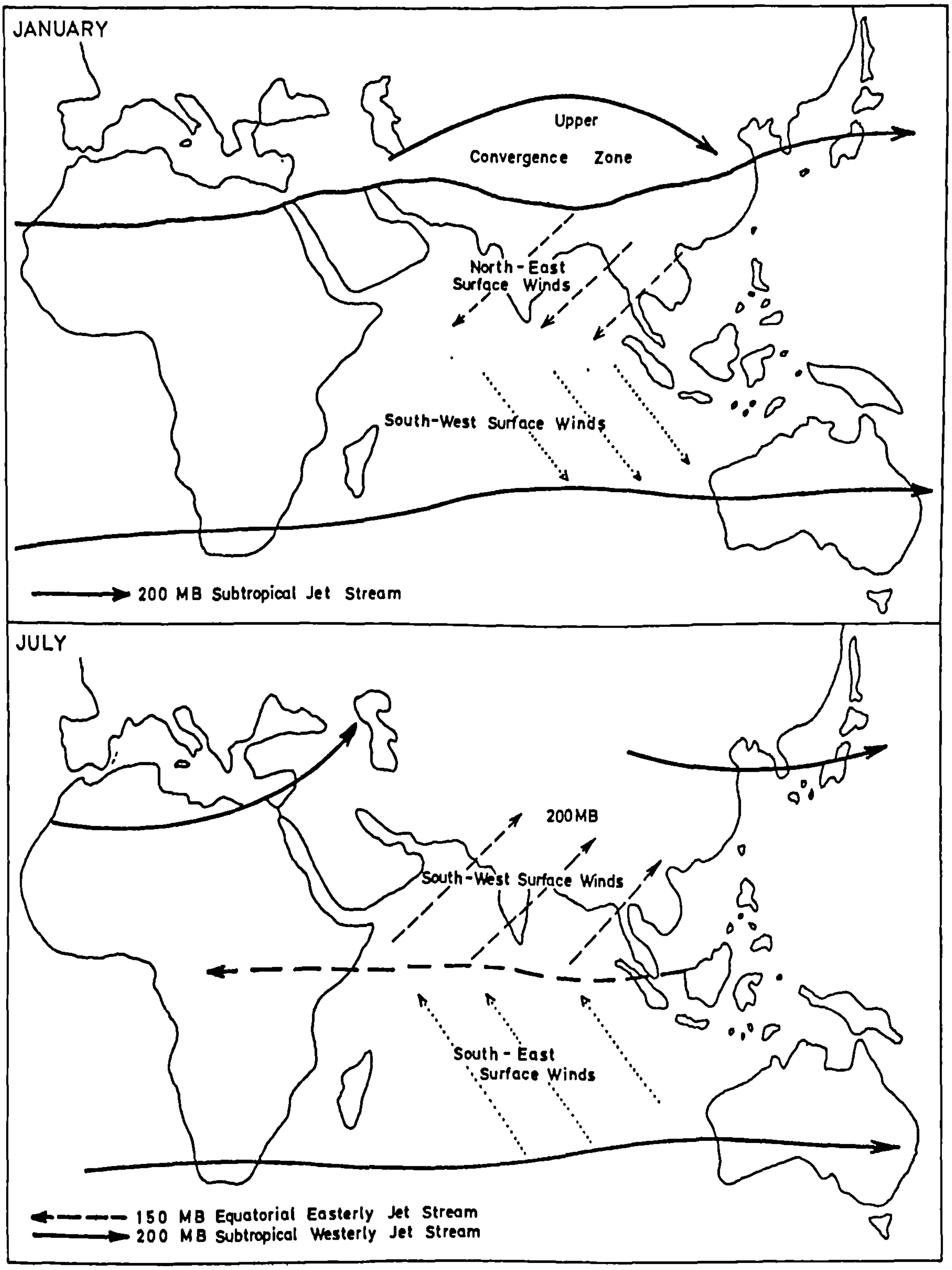
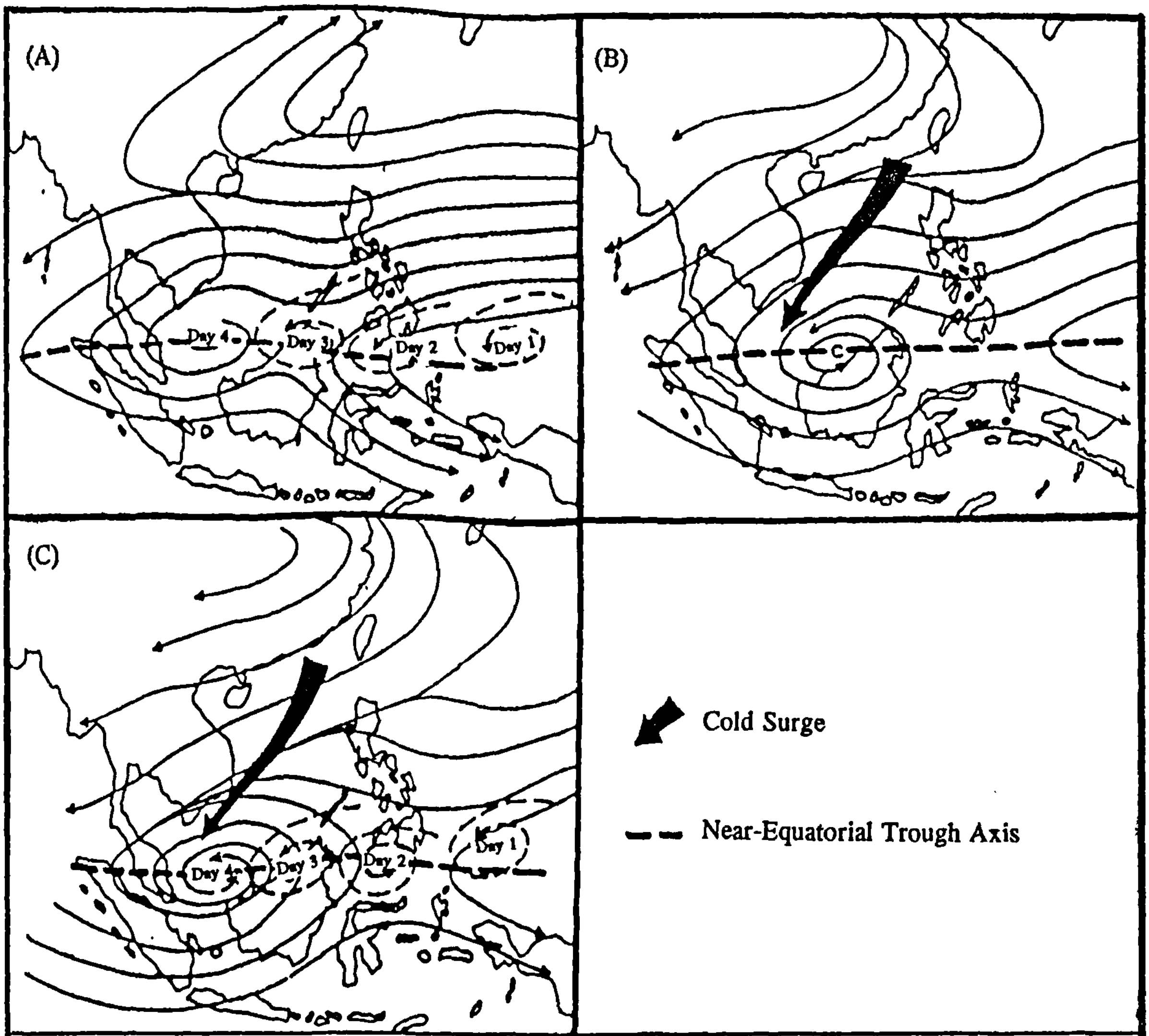


Figure E.1: Surface wind systems over Peninsular Malaysia rice cultivation, water for domestic water supply, and other forms of human use. On the negative side, the winds destroy crops and traditional houses, cause rough seas which stop fishing activities, and worst of all bring heavy rains that often result in hazardous floods. In the East Coast of the peninsula, the Northeast Monsoon winds are responsible for floods which occur every year in one state or another. In many cases, extreme conditions created by the winds have deposited rainfall exceeding 600 mm within a 24 hour period. Furthermore, with the prevailing easterly winds, there is also the likelihood of flood producing rains spilling over the central mountain ranges of the peninsula, thereby flooding many parts of the West Coast as well. This was the case when an a tropical depression was superimposed on the Northeast Monsoon winds (considered an extreme meteorological condition) during the nation-wide 1971 flood.

During the Northeast Monsoon Season, heavy rain spells that last for a few days to a week are often associated with the outbreak of cold surges originating in the continental parts of the Asian mainland (Gan 1963, Cheang 1987). Lim (1979) also found that a heavy rain spell of several days in January 1975 which occurred in the northern parts of the East Coast was due to the activation of a quasi-stationary near-equatorial trough by the converging northeasterlies. This sort of monsoon surge is synonymous with a cold surge. In another study, Chia and Chang (1971) found that a two-day heavy rain spell in December 1969 over the southern part of the East Coast was due to a cold surge coming from a 'polar outbreak'. Another study by Yap et al (1982) indicated that 4-5 day rain spells are due to the interaction of cold surges and westward moving monsoon disturbances. Such cold surges sweep over the South China Sea and picks up moisture before depositing them along the East Coast. Cold surges usually occur at intervals of several days to about 20 days and are most frequent between November and February. The Malaysian Meteorological Service (MMS) uses cold surges as a warning sign of impending heavy rains. According to Cheang (1987), the MMS employs what he calls a 'cold surge and monsoon trough' theory to forecast heavy rains. This forecast will then be relayed to the DID which in turn runs its flood forecasting models on the Kelantan and Pahang river basins. As such, the issuance of a heavy rain forecast is the first point through which the flood warning system in Peninsular Malaysia begins.

Based on the above studies on cold surges and monsoon trough, Sooryanarayana (1988) has summarised that there are three situations which bring about heavy rain spells in the East Coast. First, a monsoon trough disturbance moving from the western Pacific towards the peninsula along the northern near-equatorial trough with a speed of 5-10^{o} longitude per day will bring moderate rains (Figure E.2). Second, a cold surge acting alone can initiate a quasi-stationary disturbance, also bringing with it moderate rainfall. Third, when both a monsoon disturbance and a cold surge develop simultaneously, convective activity is intensified and this may lead to the development of a tropical depression. This depression may stay in the region for several days if its intensification stage is quasi-stationary. It is this third situation that brings about prolonged heavy rainfall which ultimately leads to floods.

The other predominant wind of the region, the Southwest Monsoon, on the other hand, does not normally cause widespread floods because the peninsula is sheltered by the Indonesian island of Sumatra. However, heavy rains do occur in many parts of the West Coast during the period of the southwest monsoon which may lead to localised floods. Also, during this same period, small intense and short-lived squalls called 'sumatras' move across the Melaka and Johor coasts, on the southern parts of the West Coast. These localised winds bring heavy torrential rains but fortunately they are rather localised and do not normally cause large scale floods. However, in many instances, especially in the more developed urban areas, flash floods usually accompany these squalls. Other than the sumatras, there are also strong land and sea breezes which affect the coastal parts of the peninsula. However, these winds do not



(A) Monsoon trough disturbances moving towards Peninsular Malaysia: cloudy with moderate rainfall

(B) Cold surge acting alone, initiating disturbance: cold winds with moderate rainfall

(C) Presence of both monsoon trough disturbance and cold surge: very heavy rainfall, floods

Figure E.2: Monsoon trough disturbances and cold surges moving from the western Pacific towards Peninsular Malaysia along the northern near-equatorial trough bringing heavy rains and floods (after Sooryanarayana 1988) bring about large scale floods. During the two transition periods, long periods of calm conditions exist and there is no dominant wind (Chan 1990a p47). Such conditions encourage the build-up of convectional rain and thunderstorms which frequently give rise to the occurrence of flash floods in the West Coast.

E.2.2 Rainfall and seasonality

The seasons in the peninsula are differentiated by the amount of rainfall received or alternatively by the degree of wetness. In general, the timings of wet and dry seasons vary, depending on Dale's (1974) rainfall regions (Figure E.3). In the Eastern Region, there is one maximum and one minimum rainfall period. The maximum coincides with the rainy season from November to March while the minimum corresponds with the dry season from April to August. During the rainy season floods occur almost every year in one place or another in the East Coast. In some extreme years, the spill-over effects of the Northeast Monsoon rains spread across the central mountain ranges over on to the West Coast, giving rise to widespread floods as well. As a result of the connection between monsoon rains and floods, flooding is often said to be 'predictable' in the East Coast. What is unpredictable, however, is when exactly floods will occur during those five months of the Northeast Monsoon Season.

In the Western Region, there are two maximum and two minimum rainfall periods. The two maxima occur in April and October-November while the two minima occur in February and July. The two maxima coincide with the period of the two short inter-monsoon seasons, two transitional periods where calm conditions prevail for most of the time and there is no distinct or predominant winds. It is during the two maxima that most flooding occur. Unlike the East Coast region, flooding in the West Coast region is not widespread but on a small localised scale. Most flooding are also flash floods caused by convection rain-storms or thunderstorms and/or a combination of such storms and monsoon rain-storms. However, the temporal aspect of flooding in the West Coast region is not as predictable as that in the East Coast region. Although flash floods mostly occur just before the commencement of the Northeast Monsoon Season or during either of the two inter-monsoon periods, they are known to occur any time of the year. In recent years, flash floods have been occurring rather more frequently and there has been no clear identifiable pattern (Friends of Penang Hill 1991 p70; DID 1992).

In the Northwestern Region of the peninsula, the timing of the wet and dry seasons are similar to that of the Western Region. The only difference is that there is a more pronounced dry season from December to February. In the Southwestern Region, the monthly rainfall throughout the year is very evenly distributed and there is no distinct maximum or minimum. Finally, the small Port Dickson-Muar Region experiences a maximum during the Southwest Monsoon and a minimum during the Northwest Monsoon. Owing to the fact that all three regions are sheltered and do not directly come under the influence of either monsoons, flooding is seldom on a large scale as that experienced in the East Coast. The floods that frequently occur are usually that of flash floods and there is no predictable time period when it is most likely to occur. Because of this, all three regions and the West Coast region may be considered as one region, that of the West Coast.

The mean annual rainfall is highly variable from place to place, but ranges from about 1,500 mm to more than 3,500 mm (see Figure 2.1). In general, rainfall decreases from the East Coast to the West Coast (Chia 1975). In the East Coast regions where floods are the most serious and frequent, the annual rainfall in any year can be as high as 5,000 mm. The bulk of this rainfall is deposited during the Northeast Monsoon Season. The West Coast region, however, is shadowed by the Indonesian island of Sumatra from the Southwest Monsoon

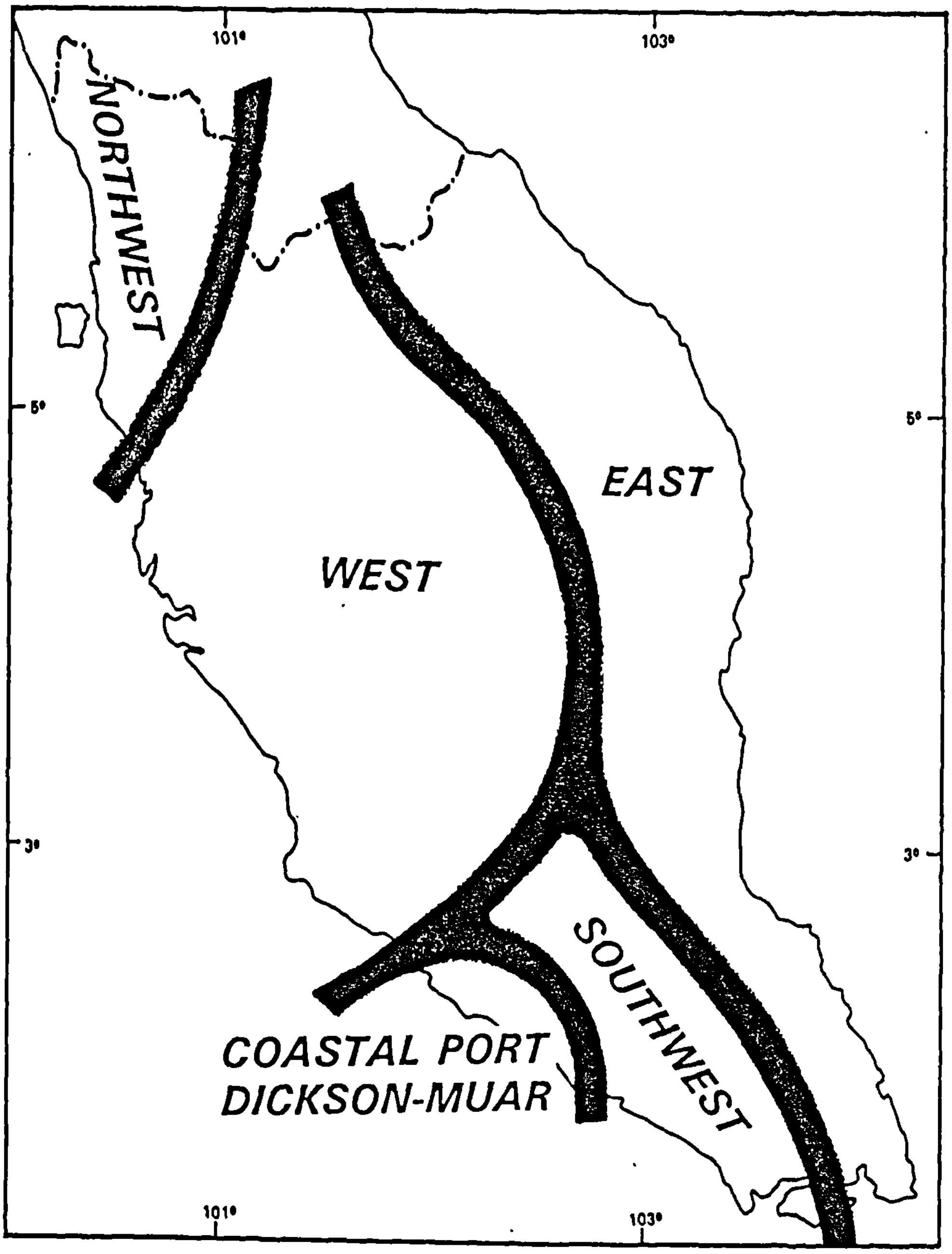


Figure E.3: Rainfall regions in Peninsular Malaysia (After Dale 1974)

Winds and by the Titiwangsa Range of the peninsula from the Northeast Monsoon Winds. As such, most of the rains in the West Coast fall during the two short inter-monsoon seasons in April and October where torrential convectional rains occur. The difference in the mean seasonal rainfall is more distinct between different regions in the peninsula. For instance, while most areas in the East Coast region receive more than 2,000 mm of rain during the Northeast Monsoon Season, areas on the West Coast receive less than 1,000 mm of rain during the same period (Chan 1990b p41). During the Southwest Monsoon Season, however, the variation in rainfall totals between the two coasts are less pronounced, with both regions receiving between 1,000 mm to 1,500 mm of rain.

In Peninsular Malaysia, rain falls all year round and no single month is ever completely dry. In the East Coast region, the wettest months are November and December with an average rainfall over 350 mm. The corresponding driest months are June, July and August with an average rainfall of less than 250 mm for most parts of the region. In the West Coast region, the wettest months coincide with the two inter-monsoon periods in April-May and October-November where at least 300 mm of rain can be expected at most places. The driest months on the West Coast are variable but usually occur in June, July and August. During these months an average rainfall of less than 150 mm can be expected. The extreme north of the Northwest Region, however, experiences a distinct dry season from the months of December to March (Chan 1981a). During these months the average rainfall is less than 100 mm. However, because of its short duration, average monthly rainfall is highly variable and should at best be used only as a rough guide (Chan 1985).

Rainfall intensities in the peninsula are generally high, especially during convectional rainstorms which are of short duration. The intensity of a particular rainfall is important as it determines the rate of splash erosion and the rate of surface runoff (which in turn determines land surface erosion and flooding). In general, average rainfall intensities are around 150 mm per hour. Wycherley (1967) found that the rainfall intensity during an unstable rainstorm in Kuala Lumpur was around 203 mm per hour. With such high rainfall intensities and the subsequent high runoff rates, the occurrence of flash floods are therefore a common phenomenon in the West Coast. In the East Coast, however, rainfall intensities are much lower, about 2.5 mm per hour (Ooi 1979 p71). However, the lower intensities are more than balanced by the much longer duration of the rainfall which often lasts for four or five days continuously. As a result, floods are not flashy but tend to be of the large scale and long duration type, often lasting several days to a few weeks.

E.2.3 Topography

(a) The mountain ranges

Peninsular Malaysia is generally considered hilly with more than one-third of its total land area above 152 m. Most of its mountain ranges are located in the northern parts of its interior and strike northerly with a somewhat NNE trend. There are a total of eight mountain ranges (Figure E.4). The peninsula is dissected by a central mountain range called the Titiwangsa Range. This is the main range and backbone of the peninsula. It runs from Thailand in the north to as far as Negeri Sembilan in the south. It is mostly made up of granite and its highest point is Gunung (Mount) Kerbau (2,183 m). This central mountain range effectively separates the East Coast of the peninsula from the West Coast. Towards the east and west of the Titiwangsa Range are various smaller and lower mountain ranges running almost parallel to it. One in particular, the Gunung Tahan Range, has the highest point in the peninsula, the Gunung Tahan (2,188 m).

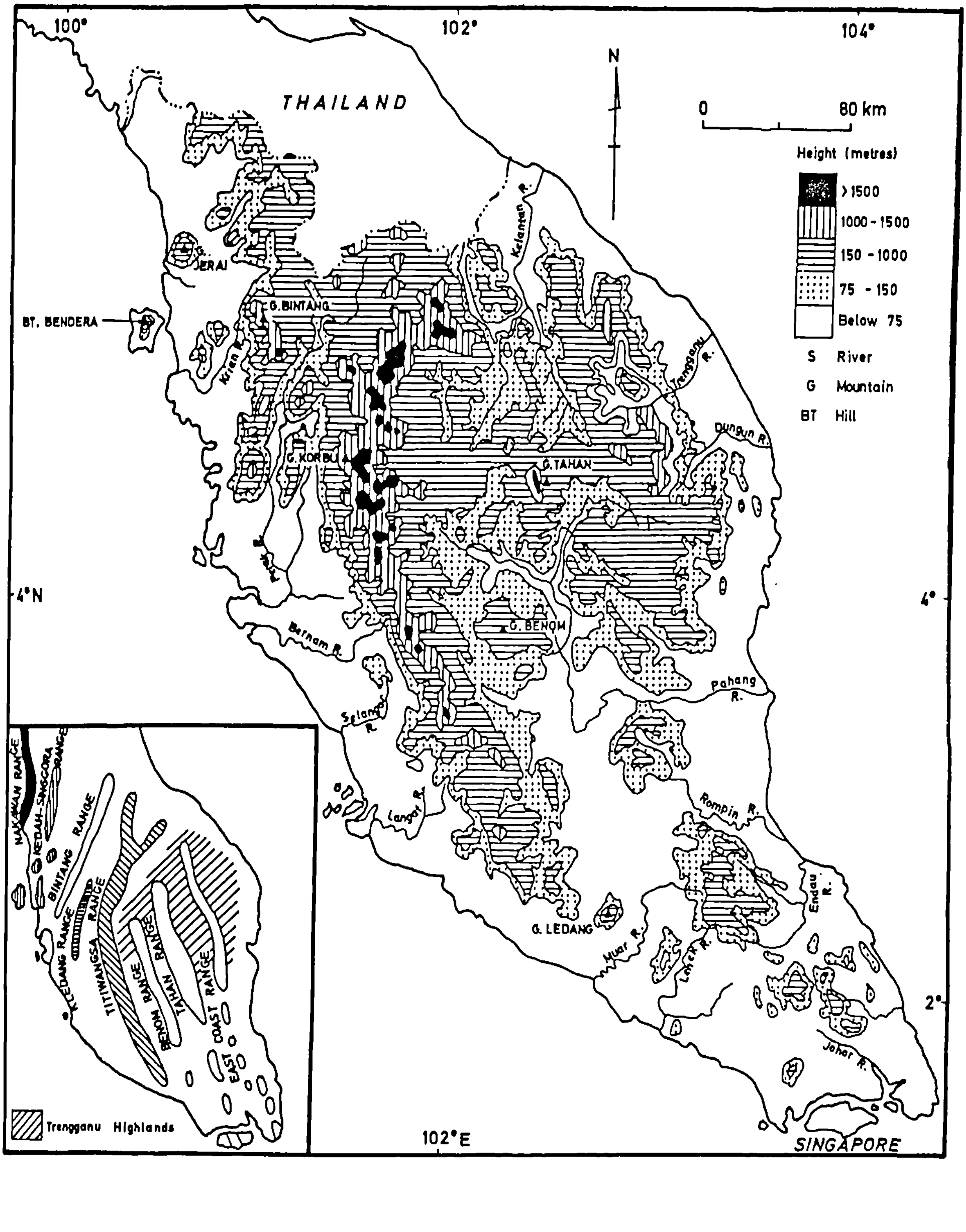


Figure E.4: Peninsular Malaysia - Topography (Inset - Mountain ranges). (After Ooi 1979)

(b) The foothills

Between the East and West coasts and the interior mountain ranges are gently rolling country known as the 'foothill regions'. The elevations of these regions are usually between 76 m and 152 m. On the West Coast, the foothill region is much broader than that of the East Coast. Owing to their good drainage, the foothill regions are suitable for rubber, oil palm and other plantation crops. Many settlements and most of the infrastructure of the peninsula are located on the foothill regions.

(c) The coastal plains

From the foothills to the coasts are flat coastal plains. The coastal plains on the West Coast are generally wider than those in the East Coast. For instance, in the state of Perak, the coastal plain is about 60 km wide. The narrower coastal plains in the East Coast are between 20 to 40 km wide. In the state of Kelantan, there is a fan-shaped delta at the estuary of the Kelantan River. The Pahang River Delta, however, is of the cuspate type. A common geomorphological feature along the East Coast is the 'permatang' or beach ridges which are former shorelines running parallel to the current shoreline. Nearest the shore, a series of permatangs rise about 2 m above the surrounding land and are considered prime land for building houses. Two other series of higher permatangs occur further inland. In general, the average heights of coastal plains in the peninsula are not more than a few metres in most places. Most of these coastal plains coincide with the floodplain regions of the peninsula.

E.2.4 Drainage

Rivers have an important place in the history of Peninsular Malaysia. Historically, rivers have been the life and blood of early Malay civilisation, British colonial rule and modern day Malaysia. In the past, rivers were the only source of communications between the Malay hinterland and the outside world. Furthermore, rivers provided water for both irrigation of crops and domestic water supply, a rich source of food, fertile soils, and in many areas a rich mineral deposit called tin. As a result, most of the major settlements in the peninsula are located near to the rivers. Although modern day use of rivers have been reduced, they are still very important as natural drainage ways, for harnessing hydro-electric power, recreation, fishing, and unfortunately as a convenient means of waste disposal. However, indiscriminate use of rivers and a combination of rapid deforestation, agriculture and uncontrolled urban development of floodplains have disrupted the natural regime of rivers and resulted in the deterioration of rivers as a natural means of drainage. Frequently, this has resulted in an increase in the frequency and magnitude of flooding as well as a corresponding increase in flood losses.

The heavy all year round rainfall in the Malaysian peninsula has given rise to a dense network of rivers and streams, though there is no single large river dominating the drainage pattern. The rivers in Peninsular Malaysia are rather small by world standards. The largest, the Pahang River, with a catchment area of 29,300 km^2 is only about 430 km long. The other major rivers are the Perak (14,000 km^2), the Kelantan (13,100 km^2), the Muar (6,595 km^2), the Terengganu (4,650 km^2) and the Kelang (1,425 km^2). There are more than 100 river systems in Peninsular Malaysia (Figure E.5). The Titiwangsa Range is the main divide which determines whether a river flows eastward into the South China Sea or westwards into the Straits of Malacca. Due to the nature of its topography, the river courses in the peninsula are relatively short. The gradients of the rivers in the upper courses are steep, some drop about 1,200 m in less than 24 km before they emerge on to the coastal floodplains. In the lower

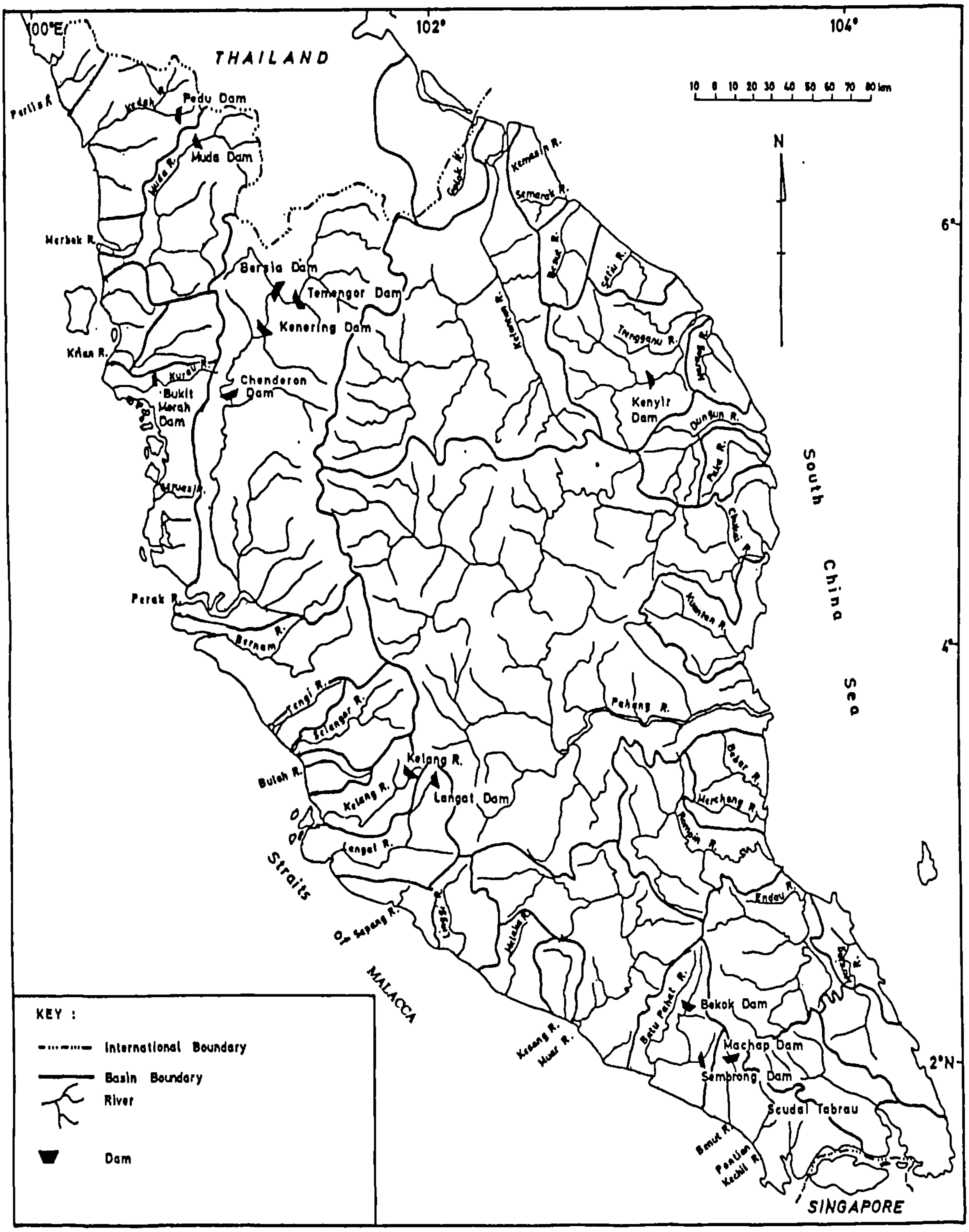


Figure E.5: Rivers and basins in Peninsular Malaysia (After JICA 1982) stretches and the floodplains, the river gradients are gentle and flat, giving rise to widespread meandering patterns. Although the year-round precipitation ensures perennial streamflow and no river course is ever completely dry at any one time of the year, the torrential and localised nature of the rainfall causes rapid fluctuations in the river discharge giving rise to the occurrence of floods. During flooding, flood flows in the upper river stretches are usually transient but increase greatly in duration and intensity in the lower stretches, particularly in the floodplains. As the densities of population, public amenities, infrastructure and property are greatest in cities, towns and other settlement types in the floodplain regions, they are high exposure areas and have the highest flood loss potentials (see Figure 2.5).

In the East Coast, the rivers are more frequently flooded than their counterparts in the West Coast, due mainly to the effects of the Northeast Monsoon. Quaternary changes in sea level and progressive sedimentation have also given rise to most rivers taking on a profile with a typically vertical profile in the upper stretches to a flattened appearance in the middle to lower stretches (Figure E.6). This is because when the river beds were raised, the rivers' erosive and transportation capacities were reduced but its rate of deposition correspondingly increased. As a result, this has given rise to the formation of extensive floodplains with the typical fluvial formations such as meanders, ox-bow lakes, natural levees and swamps. In the estuaries the rivers empty their loads into the sea and cause progressive sedimentation along the coasts. In the West Coast which is sheltered, fluvial deposition has given rise to large tracts of tidal and freshwater swamps which further impede drainage. Many rivers flowing westwards often disappear into such swamps before they re-emerge and flow into the sea. In the East Coast, there are few such swamps (due to the exposed coast-line to the South China Sea) but floodplains are built around the estuarine areas and all along the major rivers. On both coasts, the rapid physical development and occupation of such floodplains have increased human vulnerability and damage potentials of flooding in such plains.

E.2.5 Deforestation

Peninsular Malaysia is a land naturally well endowed with its dense equatorial rainforest which until today is still a commercially important natural resource. The economy of the peninsula is still very much dependent on its forestry products. In 1990, total commercial tree felling in the peninsula amounted to 11 million cubic metres, with sawn timber alone contributing a total value of $2,520.9 million (Government of Malaysia 1991a p93). In the past, uncontrolled logging has given rise to a rate of deforestation which has threatened not only the ecology of the rainforest but more significantly increased runoff and erosion (on the regional scale) and contributed to warming of the atmosphere (on the global scale) (World Rainforest Movement 1991). Due to extensive exploitation of the peninsula's forests either through logging, agriculture and other land use, less than 70.0 per cent of its total land area is now under forest.

Forest cover is a natural form of flood prevention. In Peninsular Malaysia, deforestation is a controversial issue (Shiva et al 1991; Kenyalang 1992; Sahabat Alam Malaysia 1992; Utusan Konsumer 1992; Malayan Nature Society 1992). The dense evergreen equatorial forest of the peninsula protects the top soil from splash erosion and overland flow through its thick, multi-layered structure, undergrowth and litter layer. Natural forest also absorbs part of the rain water during and after a rain event, leaving only a portion of the rain water into the streams. Finally, interception of the rainfall by the forest canopy, tree trunks, branches, undergrowth and leave litter increases the lag time by which the rain water reaches the streams. All the above factors have significant implications for flood occurrences. For instance, forest conversion and logging of commercial trees have been shown to have disastrous consequences on soils and the hydrological regimes (Daniel and Kulasingam 1974;

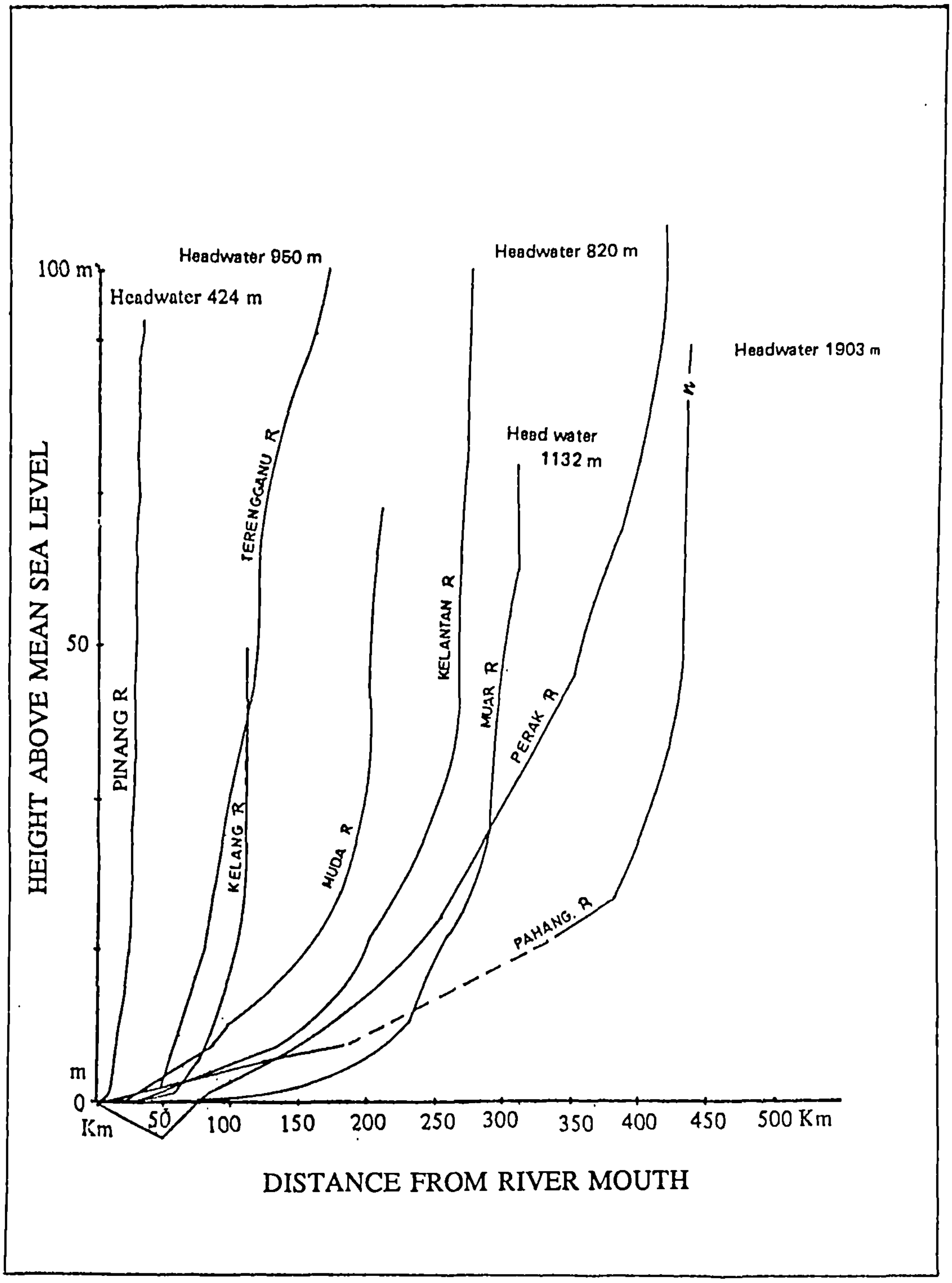


Figure E.6: Profiles of major rivers in Peninsular Malaysia (After Lim 1988)

Kamaruzaman 1990; Friends of Penang Hill 1991; Hamirdin 1992). Research has also revealed that significant water yield increases occur after deforestation (Abdul Rahim 1988, 1990; Abdul Rahim and Harding 1992). For example, Abdul Rahim (1990) showed that logging in the peninsula has substantially increased water yield between 55.0 per cent to 70.0 per cent (unsupervised logging) and between 28.0 per cent to 44.0 per cent (supervised logging with conservation measures). The DID (1986, 1989) has also shown that clear-cutting of dipterocarp forest resulted in a water yield increase of 822 mm (470.0 per cent), 793 mm and 476 mm in the first, second and third years respectively. Zulkifli and Abdul Rahim (1991) found that there is a water yield increase of between 3 mm to 5 mm for every percentage of forest cover cleared. Toebes and Goh (1975 p10) showed that logging activities caused significant changes in flood peaks, flood volumes and flood frequencies.

The government is aware of the importance of its forests both as an economic resource as well as an ecological safeguard against environmental degradation. It is now pursuing a policy of 'sustainable development of natural resources'. In its Sixth Malaysia Plan (1991-1995), the growth rate for sawn logs is estimated at -6.7 per cent. This negative growth rate is in line with its efforts in protecting and regenerating its forest as well as in protecting the environment and control floods. However, despite this policy of sustained yield and conservation, poor enforcement of its policies (resulting in illegal logging) may yet see the trend of uncontrolled deforestation continue in the future (Hani Ahmad 1991).

E.3 The Kuala Lumpur study area

E.3.1 Historical background

Kuala Lumpur is the federal capital of Malaysia. It is the largest city and the single most urbanised area in the whole country. Despite its current premier position, it is still a relatively young city. It was only founded in 1857 by a tin prospecting expedition and developed rapidly into a strategic commercial and administration centre. The name Kuala Lumpur literally means 'muddy river confluence' ('Kuala' meaning confluence and 'Lumpur' meaning mud). Soon, the precious mineral had drawn in thousands of miners who settled in and around Kuala Lumpur. Kuala Lumpur was more than a mining town. It was also a trade centre and was the point of access between the sea and the hinterland. From 1868, a Chinese miner single-handedly ruled Kuala Lumpur until 1880 when the then British resident moved the state capital of Selangor from Kelang to Kuala Lumpur. In 1890, a town council called the Sanitary Board was formed in Kuala Lumpur and in 1896, when the Federated Malay States were formed, Kuala Lumpur became the federal capital. It continued its rapid development into the Twentieth Century when Malaya pushed for independence. In 1972, Kuala Lumpur became a city and in 1974, it became a federal territory, separate from the state of Selangor[1] (Figure E.7).

E.3.2 Population

From a meagre population of a few hundred miners when it was first founded in 1857, Kuala Lumpur's population has grown rapidly over the years. During the 1991 census, its population was estimated at 1,145,075 (Department of Statistics Malaysia 1992 p125). With

[1] After losing Kuala Lumpur to the Federal Government, the state of Selangor moved its capital to Shah Alam.

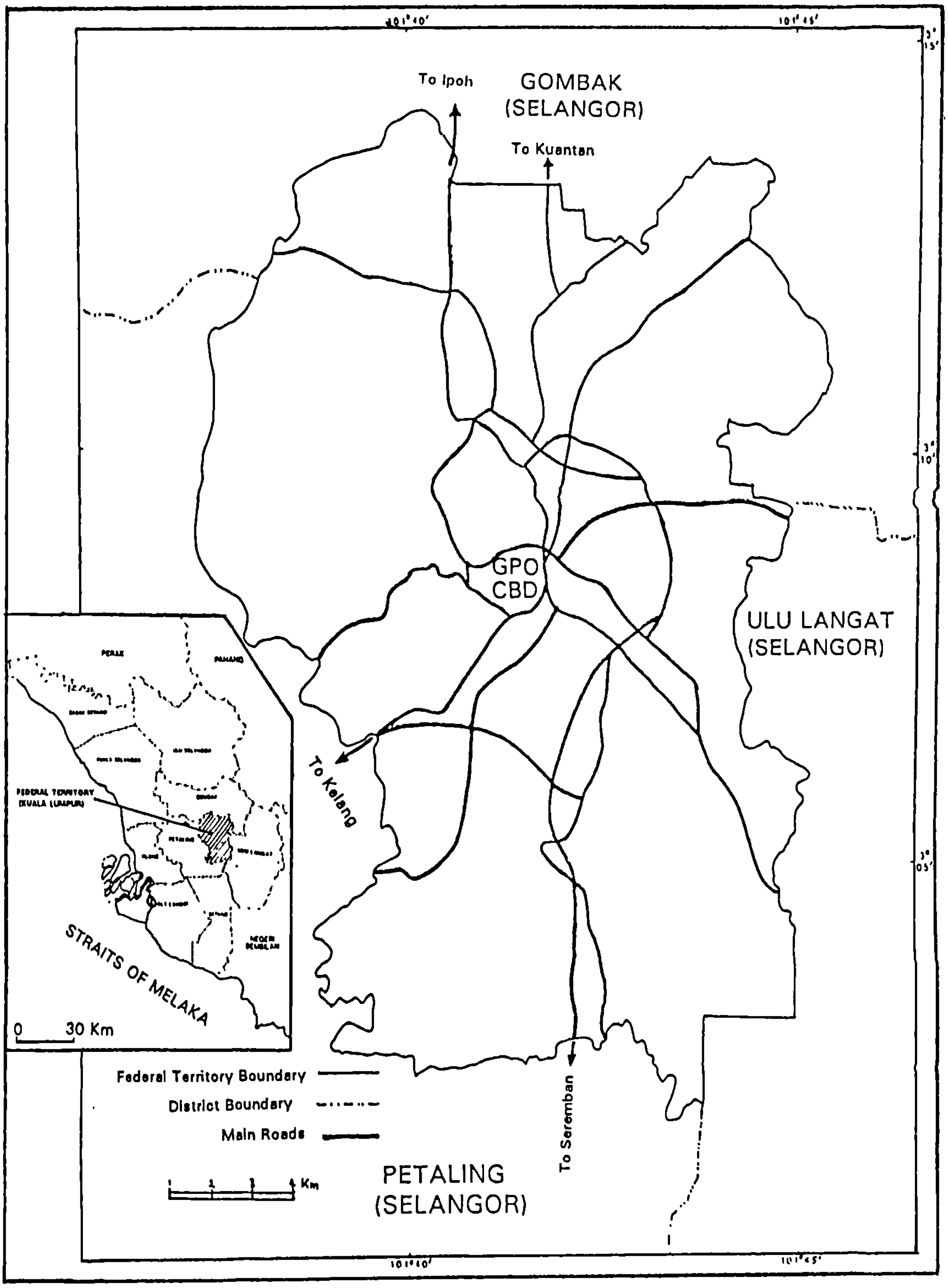


Figure E.7: The federal territory of Kuala Lumpur (Inset - Location of Kuala Lumpur within the state of Selangor) ever increasing development and urbanisation, the federal capital's population is expected to increase further in the near future. Although the government has given an estimated figure of 2.4 per cent (average annual growth rate) over the Sixth Malaysia Plan period (Government of Malaysia 1991a p28), Kuala Lumpur's rate of population increase is expected to be much higher than the national average[2]. According to the Kelang Valley Perspective Plan, the population of the Kelang Valley (of which Kuala Lumpur occupies the middle and part of the lower sections) is estimated to reach 4,760,000 by the year 2000 (JICA 1989 p1). The population in Kuala Lumpur is projected to reach 2.2 million by the year 2000 (Kuala Lumpur City Hall 1984). This will mainly be due to rural-urban migration, better health care in the city and the government's current policy of encouraging population growth towards achieving a 70 million target for the whole country by the year 2095.

E.3.3 Land use

Kuala Lumpur's land use pattern has changed so fast that in the 137 years since its founding, the area still under natural vegetation is now almost negligible (Figure E.8). The majority of the land use is now made up of urbanised settlements and associated non-agricultural areas. The heart of the city is almost devoid of vegetation, except for a few isolated small areas. In a recent study on green space in the federal capital, Teh (1989 p58) found that only 2.2 per cent of the total area is still under primary forest while another 7.4 per cent is under secondary forest. Agriculture land (mostly rubber and oil palm plantations) which used to make up most of the fringe areas surrounding the heart of the city is now fast disappearing. These areas are being replaced by housing estates.

Although the government is now paying attention to preserving and protecting the natural environment, the need for economic progress and development will ensure that rapid urbanisation proceed at least at its present rate in the federal capital. Land is getting scarce in the Capital and housing developers are already opening up the few remaining hills with forested vegetation (Plates E.1 and E.2). The future land use is therefore going to be even more urbanised than the current land use. All these would mean converting more areas with vegetation (either natural or human-made) into areas with artificial surfaces such as concrete, cement, tar and others.

E.3.4 Rainfall

Rain falls all year round in Kuala Lumpur and the mean annual and monthly rainfalls are about 2,640 mm and 220 mm respectively. The annual rainfall regime has two distinct peaks, one from October to December and the other from April to May. The wettest months are the two inter-monsoon periods of October (mean rainfall of 350 mm) and April (mean rainfall of 330 mm), and the beginning of the North-east Monsoon Season (the month of December has a mean rainfall of 330 mm) (Figure E.9). During the inter-monsoon months, convectional rain storms result in heavy torrential rains, usually occurring in the late afternoons. The mornings are usually dry while the afternoons until shortly before mid-night are wet. This is due mostly to convectional rain which falls during the inter-monsoon periods. Despite their normally short duration, these storms are very intense and frequently bring about flash floods.

Monsoon rains occurring during the onset of the Northeast Monsoon Season can also cause

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[2] In the 1980s, the annual average population increase in Kuala Lumpur was about 5.0 percent. In the mid-1990s, it is expected to be not less than 4.0 percent.

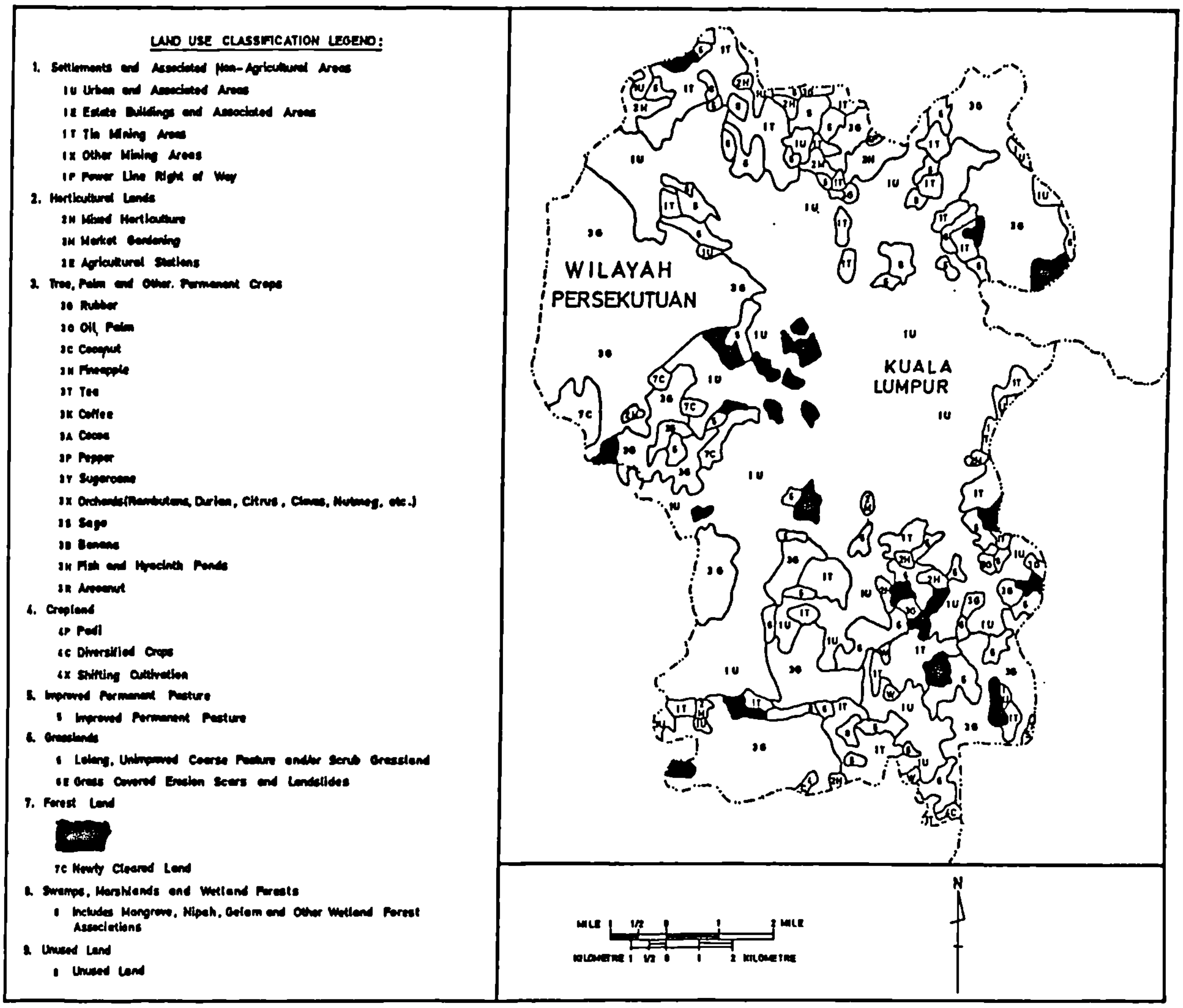

Figure E.8: Land use in Kuala Lumpur

Plate E.1: Clearing the remaining few forested areas in Kuala Lumpur for development: Top - View from the top of Bukit Desa across the Kelang Valley; Bottom - Levelling a forested hill for housing development in Damansara, Kuala Lumpur

Plate E.2: Top - Landslides caused by deforestation; Bottom - Exposed slopes are highly susceptible to landslides in a wet equatorial climate

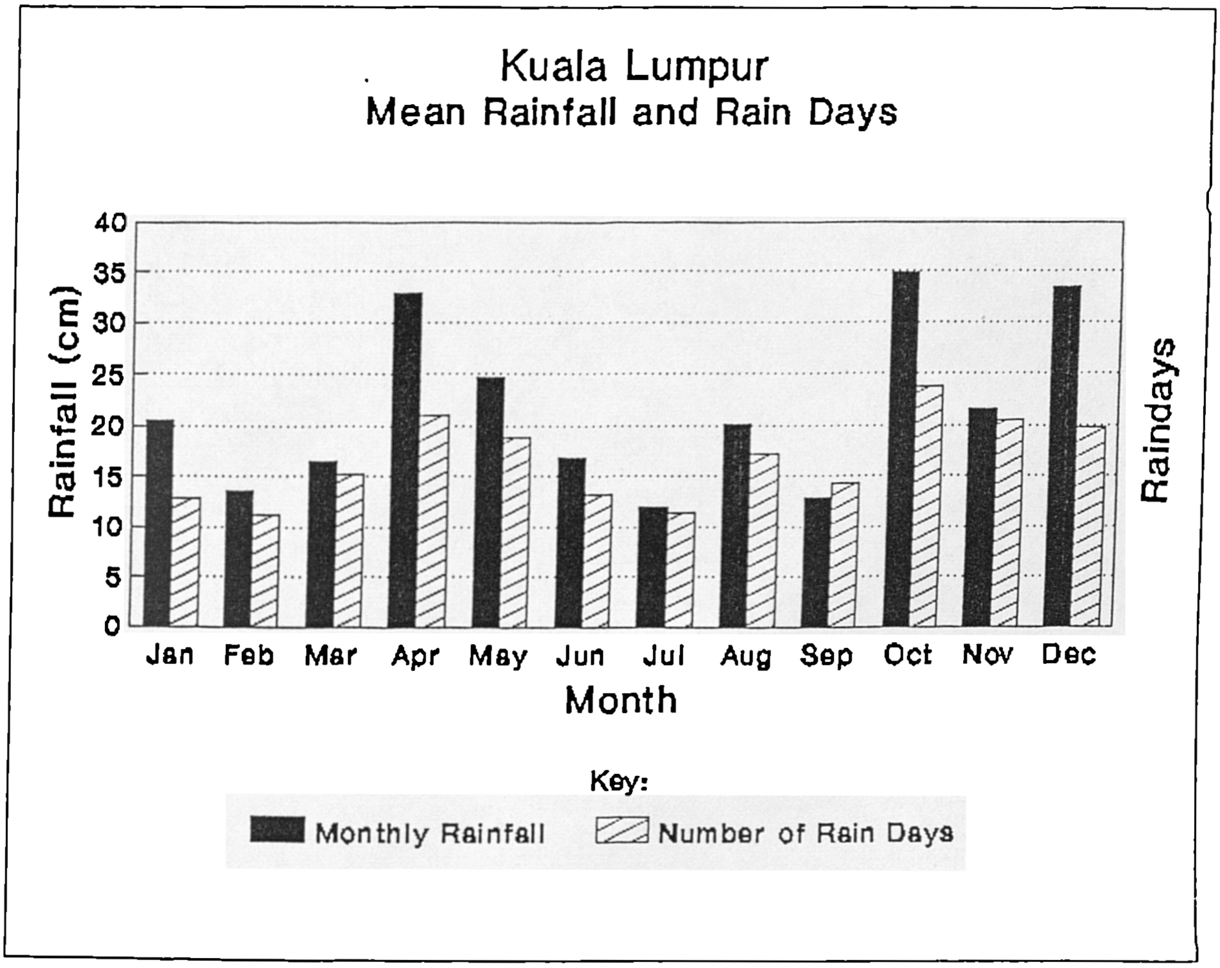

Figure E.9: Mean monthly rainfall and mean number of raindays per month in Kuala Lumpur flash floods as well as widespread floods of longer duration. Such rains are more hazardous because they can occur at anytime and are longer in duration. If the occurrence takes place during the night, the subsequent flooding may incur more damage as people are not aware of it and therefore not able to take evasive action. In the past, floods generally did not occur during the remaining months of the year. However, due to rapid development during the last 20 years or so, the situation has changed, and flooding now occurs frequently outside the peak rainfall periods. The most alarming feature of flooding in the federal capital is that severe floods now occur with the same rainfall (amount) that did not cause any flooding previously (Ferng 1988 p1). According to Sham (1979), higher concentrations of hygroscopic air pollutants (from combustion, automobiles and industries) in the city's atmosphere may have given rise to an increase in the total rainfall amount.

E.3.5 Topography

Kuala Lumpur is located in the middle and upper sections of the Kelang River Basin which extends from the Titiwangsa Range in the east to the Straits of Malacca in the west. It is surrounded by hills in almost every direction except towards the west and south-west. Most of the area in and around the city is below 75 m but a substantial part of it, especially in and around its CBD, is located on the Kelang River floodplain. Towards its north, one has to negotiate the hills on the road to the northern parts of the peninsula. These hills are generally more than 150 m high but many peaks reach above 1,000 m. Within the federal capital, the land is flat but rising gradually away from the river, and in the 1971 flood (a 1 in 100 year event), the inundated zone was rarely more than 275 to 365 m wide (United States Department of the Interior 1981 p11). Further south of the city, about 8 km away, the Kelang Valley broadens to a width of 24 km or more. Here, the terrain is entirely flat with elevations of no more than 15 m and only isolated hills below 150 m are found (Figure E.10).

E.3.6 Drainage

Kuala Lumpur owed much of its early development the Kelang River system, which provided the tin-rich alluvium, communications and transport, domestic water supply and served as a natural conduit for drainage and garbage disposal. Today, however, the Kelang River system is no longer used as a means of transportation[3] or water supply (the water is too polluted), but is still of vital importance to Kuala Lumpur as it is the main drainage conduit. Owing to the nature of its surrounding topography, the majority of the rivers in the Kelang Valley converge in and around Kuala Lumpur. The Kuala Lumpur area is drained by the Kelang River (120 km long) and its two main tributaries, the Gombak (27 km long) and Batu (24 km long) Rivers. All three rivers originate from the foothills of the Titiwangsa Range. Other tributaries are the Keroh, Kerayong, Jinjang, Bunus and Kuyuh Rivers. The entire drainage area is about 464 km^2 at the Market Street Bridge in Kuala Lumpur[4] (Pang 1987 pB6.2). The Kelang River (which drains an area of 1,200 km^2) forms the backbone of Kuala Lumpur's drainage system (Figure E.11). Its general direction of flow is from north-east to south-west. The majority of the other tributaries, however, follow a predominantly north to south direction. In general, the rivers are short and swift flowing in the north of the city. However, when the rivers reach the low-lying city centre, the flow is generally sluggish and slow.

[3] The Kelang River is too shallow but there have been proposals to turn the section of the river from Kelang to Kuala Lumpur into a commuter waterway (to ease the traffic problem faced by commuters between the two cities).

[4] The entire catchment area of the Kelang River Basin is about 1,425 km^2.

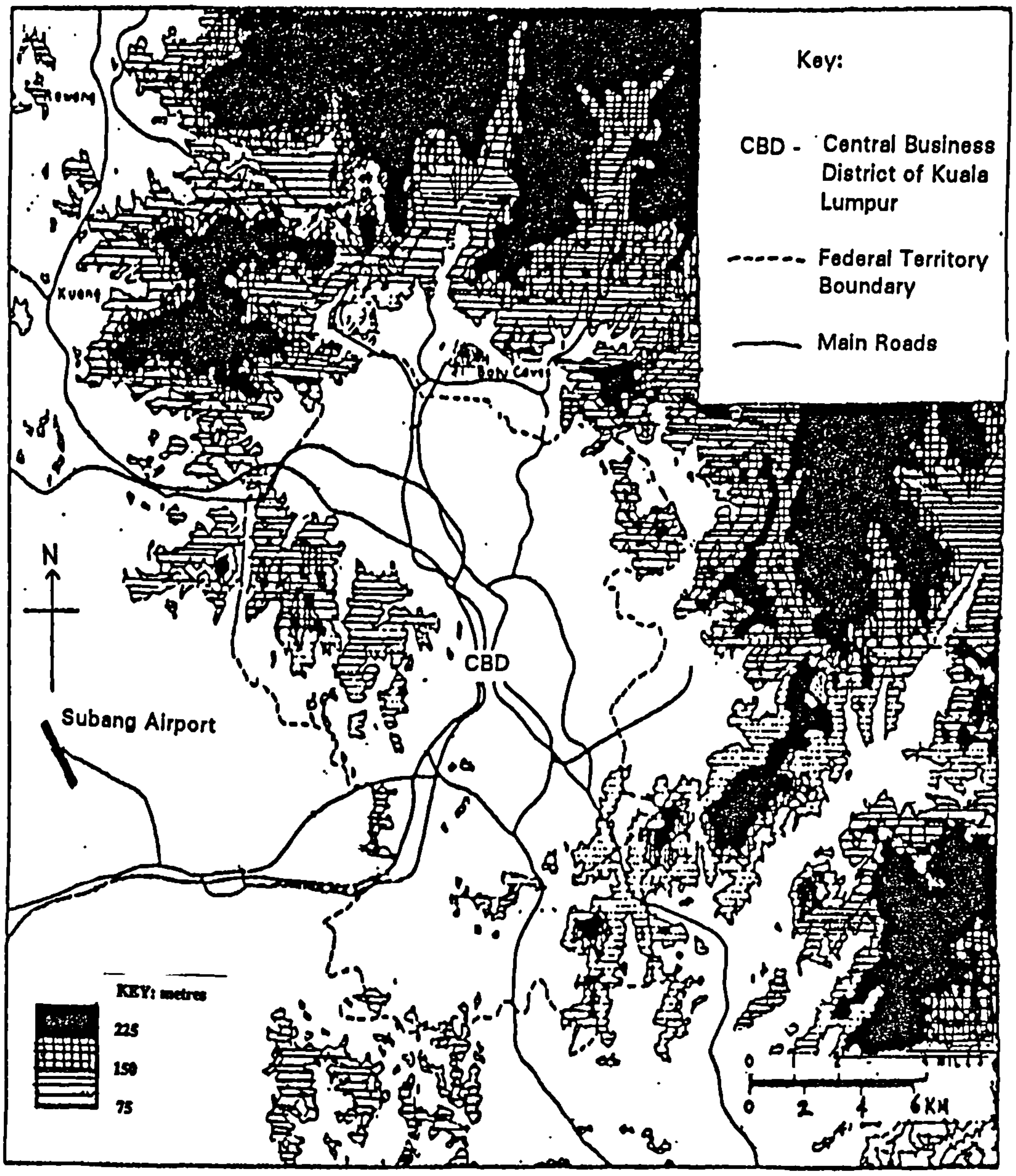

Figure E.10: Relief of Kuala Lumpur (After Sham 1979)

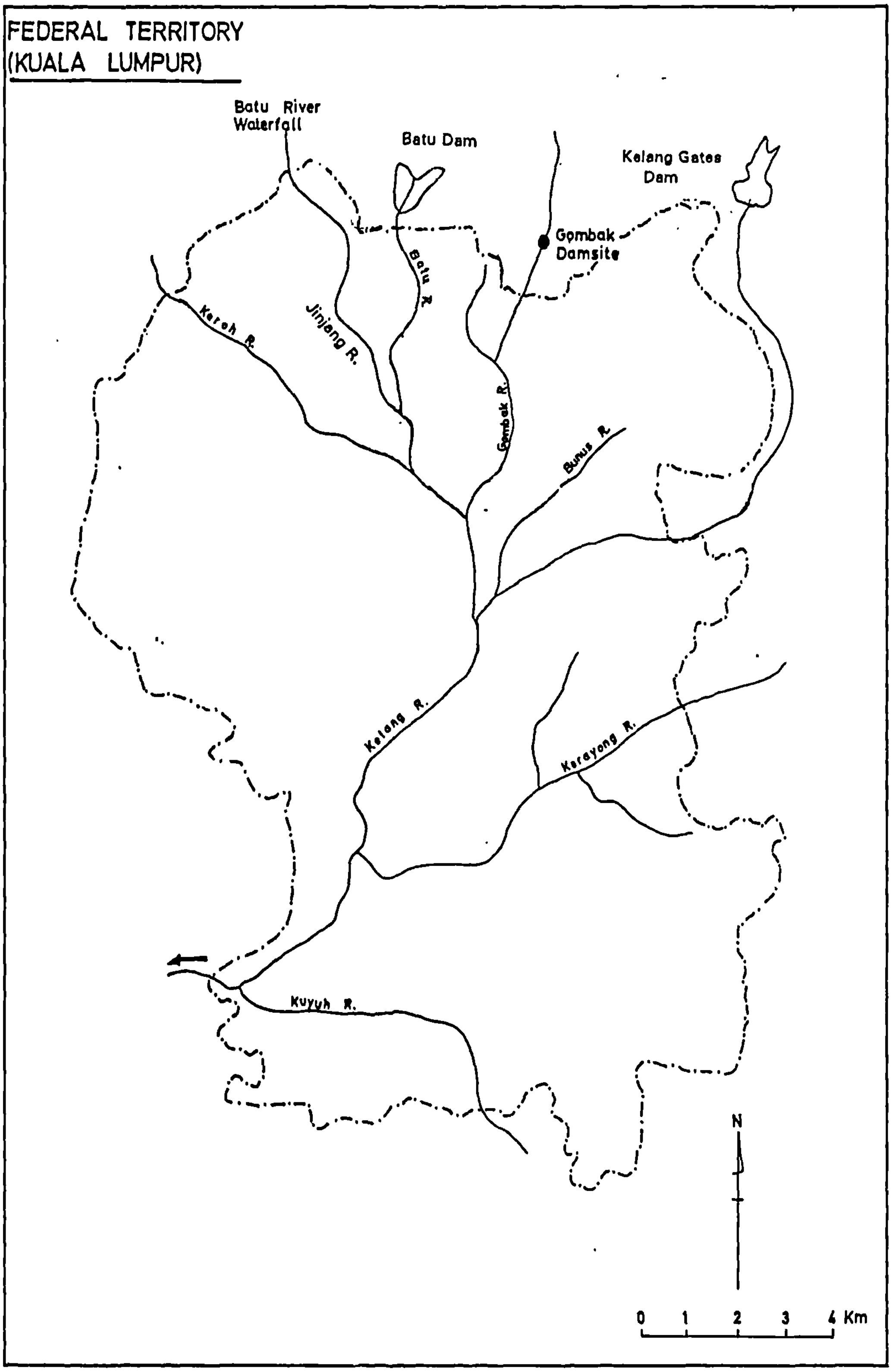

Figure E.11: Rivers in Kuala Lumpur

In the catchment areas, about 80.0 per cent is forested but this percentage is fast decreasing.

E.3.7 The flood hazard

Rapid growth in terms of physical and economic development, and population pressures in recent decades in and around the federal capital have increased the frequency of flash floods, resulting in various problems and unprecedented damages. According to the Malay Mail (April 7, 1982), 'It takes just half an hour of heavy rain to create havoc, traffic jams, stalled vehicles, erosion and damage to housing estates in the federal capital...'. When flash floods occur, communications are cut, industrial activity temporarily stopped, schooling and work disturbed, people are evacuated, crops are destroyed, livestock drowned and human lives are lost. Furthermore, flooding is a danger to public health for sewage, animal carcases and garbage are pollutants in flood areas (Huan et al 1982 p1). In the past, the city has been subject to flooding at irregular intervals. Since independence, major floods occurred in 1957, 1971, 1973, and 1993 but flash floods are a recent phenomenon (see Table 2.1). More recently, however, it has been shown that rapid development within the city has increased both the frequency and magnitude of flood flows (Yaziz and Sulaiman 1985). Floods have also been attributed to rapid socio-economic development when human land use such as housing, industrial, commercial, communications and others replaced the natural vegetation (United States Department of Interior 1981). Much of the natural land surface has gradually been converted to artificial impervious materials such as concrete, tar, cement and others. Such changes have changed the hydrological regime of river systems resulting in increased surface runoff and shortened lag time between rainfall and peak flow. The water retention capacity of the land surface has also been drastically reduced. Furthermore, siltation raised river beds, reducing the rivers' capacity as natural means of drainage. In many areas, the river level may actually be higher than the surrounding floodplain (over-flowing being avoided by a natural levee on both banks). All these lead not only to an increase in the frequency of flooding but also more significantly, to an increase in the flood magnitude. Together with inadequate urban artificial drainage, many parts of Kuala Lumpur has become very flood-prone (Ferng 1988 p1).

When heavy rains occur, either during the two inter-monsoon periods or just as the Northeast Monsoon is about to begin, severe flooding can occur. A good example is the 1971 flood in which a depression-type storm passed over the Kelang Valley and inundated approximately 445 ha of land in the city. During this flood, the total flood damage was estimated at more than $58.6 million (1993 prices). It was also estimated that some 177,000 people living in low-lying areas were affected (Pang 1987 pB6.3). Millions of ringgits have been spent by the government to control flooding in the capital. In the Fifth Malaysia Plan (1986-1990) the government spent $68.8 million (1993 prices) on flood mitigation and another $14.0 million (1993 prices) on drainage improvement in the federal capital. In the current Sixth Malaysia Plan (1991-1995), the government has allocated $496.7 million (1993 prices) for flood mitigation in the federal capital, underlining the seriousness of its flood problems.

Despite the huge amount of money spent and the completion of many flood alleviation schemes, flooding continues to occur and do not seem to have diminished. Although the CBD has not been hit by a big flood since the 1971 event (as river dredging is a continuous process in the heart of the city), many low-lying parts in the city such as Brickfields, Kampung Baru, Kampung Dato Keramat, Old Kelang Road, Pantai Dalam, and Sungai Besi Road experience flash floods frequently. Due to the shortage of land within the city, further encroachment of flood-prone areas is expected. This in turn may lead to further increases in flood damage. Each year, more and more people from all over the country flock to the federal capital to seek their fortune. This puts a strenuous demand for housing and other social amenities. As a result, more and more housing schemes are developed. More roads are built, more industries are set up and more buildings are erected. All these add on to further deplete whatever remaining green space there is in the city.

People get a false sense of security when flood alleviation schemes are politicised in flood-prone areas. A good example is the Kuala Lumpur Flood Mitigation Project which was initiated after the disastrous 1971 flood which severely disrupted life in the city. The project was much politicised as a solution to the city's flood woes. It was begun in 1976 with an estimated cost of $465 million (1993 prices) (Pang 1987). Up to the end of the 6th Malaysia Plan in 1995, a total of $295.4 million is expected to be spent under this project. This project has convinced residents in the city that floods are now well under control, and given the notion that people tend to forget extreme past events and are more pre-occupied with day-to-day demands, they turn a blind-eye to the threat of floods and continue to inhabit hazardous flood-prone areas (which usually offer cheap housing). As a result, the scene resembles that of a 'vicious circle' (Figure E.12). This is known as the 'levee effect' whereby flood protection schemes are erroneously perceived to render part of a floodplain safe for development (Smith 1992 pp231-2). And as long as there are freak thunderstorms, there will be floods. When politicians claim that Kuala Lumpur has not been flooded since the 1971 floods, they are really only referring to the CBD of the city. Many low-lying areas are still flooded many times a year. Flood defence in the CBD are essentially based on the 1971 event (a 1 in 100 year event) and as Kuala Lumpur moves forward into the 21st Century, this level of defence may be breached. Even if an event of the 1971 magnitude were to occur in the 1990s, it has been estimated that flood damages would increase many folds because of new developments and increased values of properties, contents and infrastructure.

E.3.8 Future development trend

Being the premier region in the country, the federal capital is expected to develop at a much faster pace than other regions. There are plans to merge the four urban centres of Kuala Lumpur, Petaling Jaya, Shah Alam and Kelang into a continuous conurbation stretching the entire length of the Kelang River Valley by the year 2020. As such, the direction of expansion from Kuala Lumpur is expected to be moving towards the west and southwest (see Figure 2.6). In the Kelang Valley Perspective Plan, the estimated rate of increase of urbanised area from 1985 to 2005 in and around Kuala Lumpur is about 32.3 per cent. Consequently, the percentage of forest, agriculture and mining land will correspondingly decrease. This will have serious implications as more and more of the hitherto unused and undeveloped flood-prone sites in and around the city will be occupied either by individuals (housing), private corporations (businesses) and public agencies (government buildings and other structures). Its population is expected to reach 2.2 million by the year 2000. Together with rapid social and economic development accompanied by modernisation and further commercialisation of the city area, the incidence of flooding, which is already a major problem (Pang 1987 pB6.2), is expected to increase in the future.

E.4 The Pulau Pinang study area

The state of Pulau Pinang[5] comprises the island of Pulau Pinang (previously Penang) and the mainland portion of Seberang Prai (previously Province Wellesley). The total area in Pulau

[5] The study area chosen for this research is the island of Pulau Pinang. To avoid confusion and for all practical purposes, the name 'Pulau Pinang' will be used to refer only to the island, unless stated otherwise.

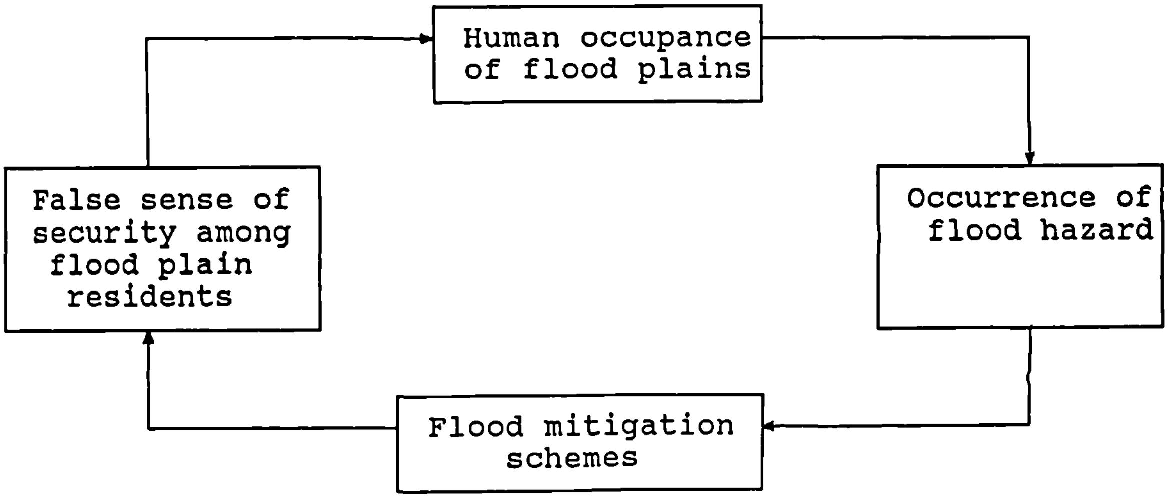

Figure E.12: The 'Vicious circle' of floodplain occupance in Peninsular Malaysia

Pinang is about 295.3 km^2. The island is located between latitudes 5°7'N and 5°35'N and longitudes 100°9'E and 100°32'E.

E.4.1 Historical background

Pulau Pinang was the earliest trading post to be colonised by the British in Malaya. In 1786 Francis Light, an ex-Royal British Navy captain, established a supplies station on the island as a midway stopping point for the East India Company merchant ships sailing between India and China. Owing to its strategic position, the island post soon began attracting other merchant ships and traders such as Indians, Chinese, Javanese and other European traders. In 1826, Pulau Pinang became part of the British Straits Settlements which also comprised Melaka (previously Malacca) and Singapore. Of the three, Singapore's more favourable location and deep port made it the premier port. Nevertheless, Penang continued to thrive on its trade of betel nuts, camphor, rattan, bird's nest and opium. Later, when the tin rush in Perak and other Malay states began, Pulau Pinang served as a port to export the metal. The introduction of rubber into the Malay states also helped Pulau Pinang's trade. Indians who came from South India to work in the rubber estates usually made Pulau Pinang their first port of call. Rubber was also exported via Penang. In all, the port of Pulau Pinang became the northern outlet for the north Malayan states of Kedah, Perak and Penang itself. By the turn of the 19th Century, Pulau Pinang's population was a mixture of Chinese, Malays, Indians, Ceylonese, Punjabis and Europeans. When Malaya achieved its independence in 1957, Pulau Pinang continued to progress and served as the northern 'growth pole' of the peninsula (Lim 1978).

Since the 1970s, the Pulau Pinang state government has embarked on a two-pronged development programme of industrial development and tourism. The current state government has grand plans to transform the island economy into an industrial power by the turn of the century and into a post-industrial society by 2020. To the foreigner, such plans may seem over-ambitious and out of proportion. Yet, Pulau Pinang's growth in recent years is nothing short of phenomenal. Its semiconductor factories (located in the Free Trade Zone - a rapidly expanding industrial region) and other electronic industries have made Pulau Pinang the 'silicon valley of Southeast Asia'. Thanks to Pulau Pinang, Malaysia is the world's largest computer chip exporter and is only behind the United States and Japan in terms of chip production. Multi-national computer giants such as Intel, Advanced Micro Devices, Hewlett-Packard, Robert Bosch, Hitachi, Toshiba and Motorola already have huge plants in Penang and are still competing to out-do each other in terms of both qualitative and quantitative production of chips.

Pulau Pinang is renowned in the world, especially amongst the English speaking, as 'the pearl of the orient'. To the foreign tourist, Pulau Pinang offers everyone almost everything. From the budget traveller to the 5-star hotel guest, from rickshaws to limousines, from the sunny beaches to the hill-top resorts, from hawker food to elaborate banquets, from Chinese opera to discotheques, and from typical Malay kampung huts to skyscrapers. All the above attractions are many times enriched by the cultural uniqueness and colour of each ethnic group from the multi-racial communities. Tourism is a big business in Pulau Pinang. In 1992, the number of tourist arrivals to the island was about 2.15 million (80.0 per cent being foreign arrivals). The state government has plans to further develop the tourism business. There are plans to develop the Penang Hill area into a tourist resort, programmes to clean up the beaches and the city, efforts to maintain historical buildings, and plans for a bigger international airport.

Currently, Pulau Pinang is growing at a very fast rate. Since 1988, its gross domestic product

(GDP) has been expanding at more than 10.0 per cent per annum, much higher than the corresponding national figure of 8.5 per cent per annum. In 1991, its GDP grew at the rate of 11.0 per cent per annum. From 1992 onwards, the government has estimated an annual growth rate of 7.0 per cent to 8.0 per cent until the end of the century. By the turn of the century, it is also estimated that the current per-capita GDP of $4,000 would be doubled (the corresponding GDP for Malaysia is $2,800). The Pulau Pinang state government has firmly set its aim of turning the state into an industrial power in ten years within the 'Northern Growth Triangle' linking it with the other three north Malaysian states of Perlis, Kedah and Perak (Asiaweek 27.11.92 p60). With the formation of this growth triangle, Pulau Pinang hopes to become the centre of trade and commerce for northern Peninsular Malaysia as well as for the Indonesian island of Sumatra and Southern Thailand. The government's long term plan is to see that Pulau Pinang recaptures the position as the region's leader in entrepot and trade (which it lost to Singapore). Despite Singapore's overall superior infrastructure, financial system and expertise, many feel that Pulau Pinang has a good chance of catching up as operating costs are much lower than Singapore's. Certainly, the Pulau Pinang leaders have no doubts that it will.

E.4.2 Population

Pulau Pinang has one of the highest population densities in Malaysia. Until 1947, its urban centre of Georgetown was the largest town in the peninsula. In 1921, it had a population of 123,000 compared to only 80,000 for Kuala Lumpur. By 1957, Kuala Lumpur had overtaken it as the largest town. In 1991, the state of Penang had a population of 1.1 million and although it is the smallest state in the country, it is ranked eighth out of thirteen states in terms of population. The most distinct feature of its population is that it is the only state in Malaysia where the Chinese (52.8 per cent) have a clear majority over the Malays (34.6 per cent) and the Indians (11.5 per cent).

Historically, the sheltered east coast of the island (which is adjacent to mainland Peninsular Malaysia) is much more heavily populated than the isolated west coast (which is used mostly for agriculture). Georgetown, located on the northeastern portion of the island is the most densely populated while the west coast and central highlands are the least densely populated (Figure E.13). Owing to the rapid expansion of its industries and tourism, the population of Pulau Pinang is expected to rise sharply in the near future.

E.4.3 Land use

Unlike the evolution of Kuala Lumpur's landscape which has been largely due to tin mining and commercialisation, Pulau Pinang's present landscape has been largely the result of its port, tourism and industries. Of the total area of 295.3 km^2, only about less than 30.0 per cent remains forested (25.0 per cent under natural forest and 5.0 per cent under secondary forest). The forested area is located in the northwestern and northern parts of the island where the land elevation is above 300 m. The total area under natural forest cover has gradually diminished and replaced by crops or secondary forest (Figure E.14). Due to population and development pressures, even this remaining natural forest refuge is being threatened. The new town of Air Itam is currently expanding into the forested foothills and there are now proposals to develop about 364 ha of the Penang Hill area into a tourist attraction (Friends of Penang Hill 1991). The forested area is the main water catchment area in Pulau Pinang. Besides the highland forest, mangrove and nipah forests are found on a thin stretch along the west coast.

By far, the area under agriculture is the largest, accounting for about 40.7 per cent of the

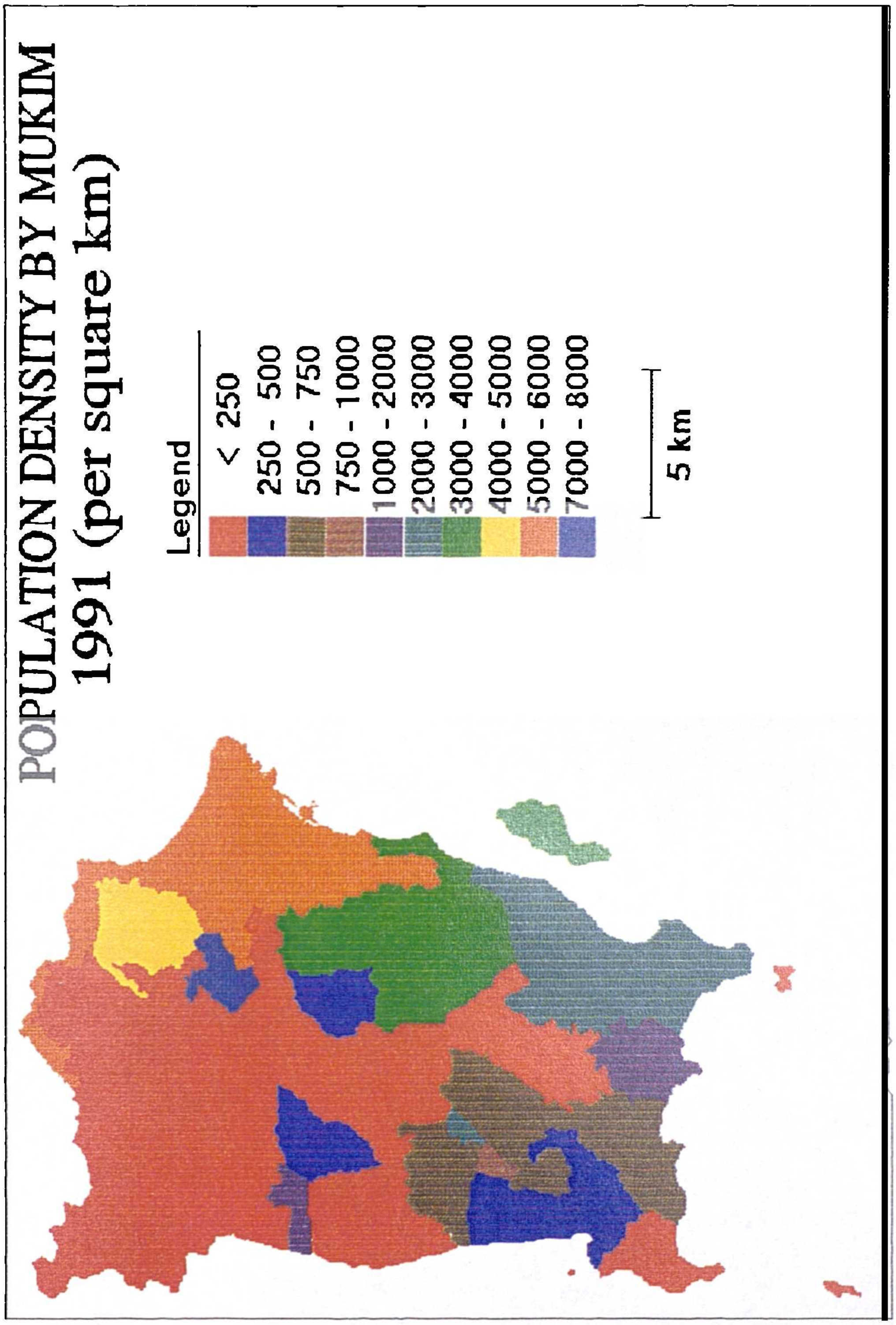

Figure E.13: Population density by mukim in Pulau Pinang

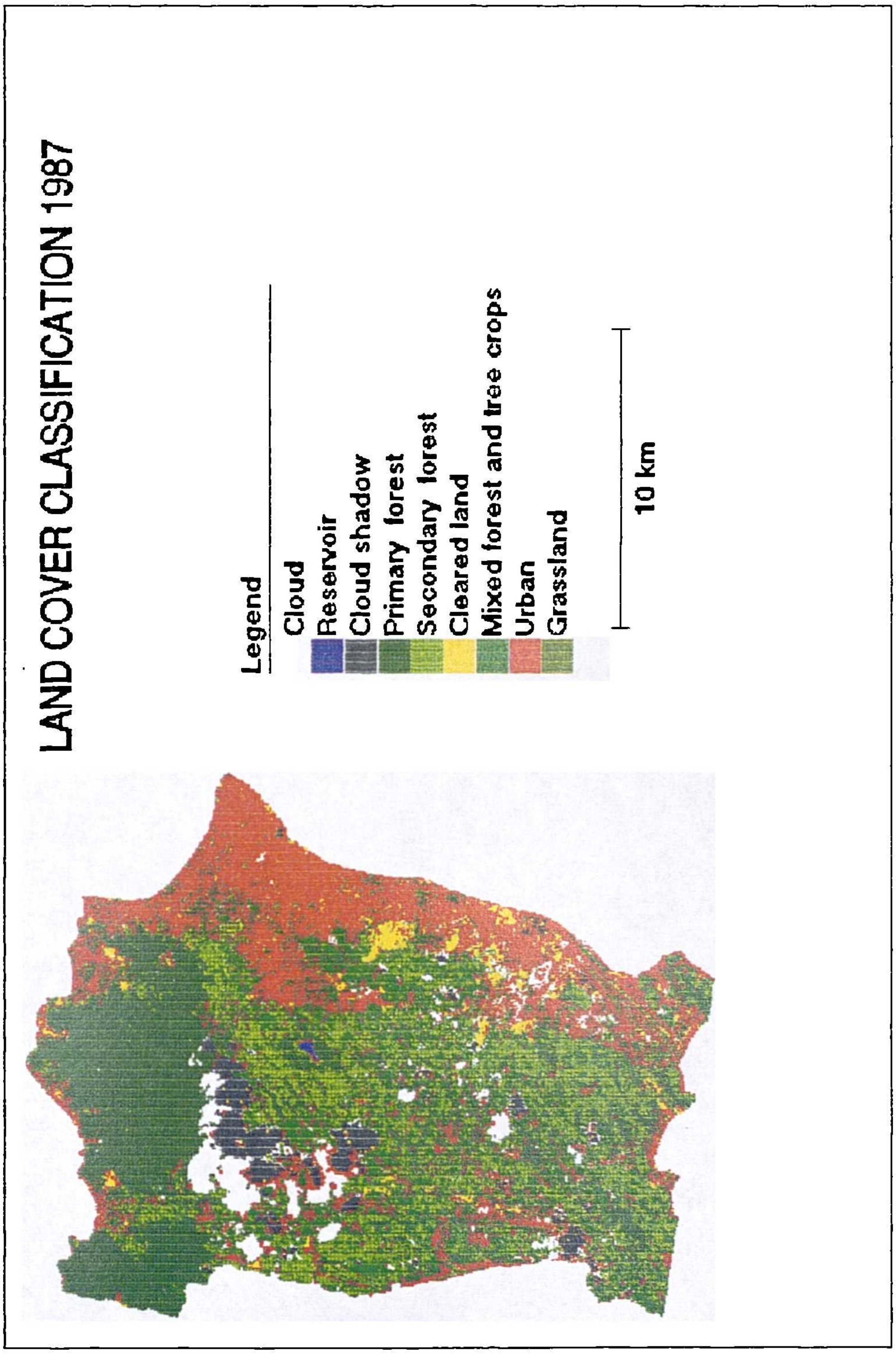

Figure E.14: Land use in Pulau Pinang in 1987 based on land use classification of satellite imagery (Source: Remote sensing unit of Universiti Sains Malaysia) total land area (Figure E.15) (JICA 1991 pC-1). Of this, about 32.4 per cent is under rubber, 18.6 per cent under orchards, 15.8 per cent under coconut, 9.4 per cent under padi and the remaining area under mixed horticulture, vegetable and nutmegs. Most of the agriculture land is located towards the central foothills, the southern and western parts of the island. In particular, the relatively undeveloped western part of the island is occupied with padi fields, rubber and coconut plantations and orchards. Pig farming and rearing of other livestock such as chicken, ducks and goats are also found in the agricultural areas.

Together with the federal capital, Pulau Pinang (particularly Georgetown) is one of the most intensively developed areas in the peninsula. The built up areas, with its locus around Georgetown expands in three directions, northwards to the tourist belt of Tanjung Bunga and Batu Feringghi (where all the major hotels are located), southwards along the entire east coast towards the Free Trade Zone (where all the industries and the new town of Bayan Baru are located) and Bayan Lepas (where the airport is located), and finally westwards to the new town of Air Itam and into the Paya Terubong valley. In all, the current total built-up area takes up 22.2 per cent of the total land area in the island.

The future land use of Pulau Pinang is expected to change to accommodate the state government's desire to make it the Northern Regional Growth Centre. Under the Draft Structure Plan of the Pulau Pinang Municipal Council, the total built up area is to increase to about 48.0 per cent by the year 2010. The main increase would be in terms of housing, industries, commercial and tourism. Current agricultural land (mostly rubber and coconut plantations and orchards) is under severe pressure for conversion into housing or commercial land. The majority of the expansion of the built-up area is expected to be from Georgetown southwards until the southeastern coast where many of the proposed new towns are located (Figure E.16). In this area, much of the built-up area will be for industrial and commercial development. Industrial development is also featured on the northern coast (for tourism) while the inland valleys are for housing. Hill-tops are not spared either and are targeted for recreation and tourism. Based on the Draft Structure Plan, the Japan International Cooperation Agency (JICA 1991 pC-6) has concluded that the current urban area of 39.0 per cent in the Pinang River catchment (which encompass Georgetown) will increase to about 46.0 per cent by the year 2010. Their study of land use change within catchment areas of the major rivers in Pulau Pinang has also indicated that the percentage built-up area in the eastern coastal belt, which is now between 12.0 per cent to 46.0 per cent (depending on specific area) will increase to between 44.0 per cent and 93.0 per cent by 2010. Along the northern coastal belt, the current urban area of between 7.0 per cent to 14.0 per cent will reach 30.0 per cent to 70.0 per cent by 2010. Even the southern coastal belt which is relatively undeveloped will experience a rapid urban growth rate (with many proposed new towns) owing to the proximity of the airport and the expansion of the Free Trade Zone.

E.4.4 Rainfall

Pulau Pinang is a tropical island with an equatorial climatic regime which is, in general, not very different from that experienced by other parts of Peninsular Malaysia. However, its northern location, maritime nature and exposure to the Southwest Monsoon all affect its rainfall regime. The seasons in the island are defined by variations in rainfall. Generally, average annual rainfall is between 2,000 mm to 3,000 mm (Chan 1991c). In general, the highland areas in the centre and western parts of the island receive the highest rainfall averaging between 2,600 mm to 3,000 mm annually. The west coast receives the highest annual rainfall because it is exposed to the Southwest Monsoon winds from May to September. During these months the rainfall received is between 900 mm to 1,300 mm. The average monthly rainfall is between 250 mm to 500 mm but unlike the other areas in the

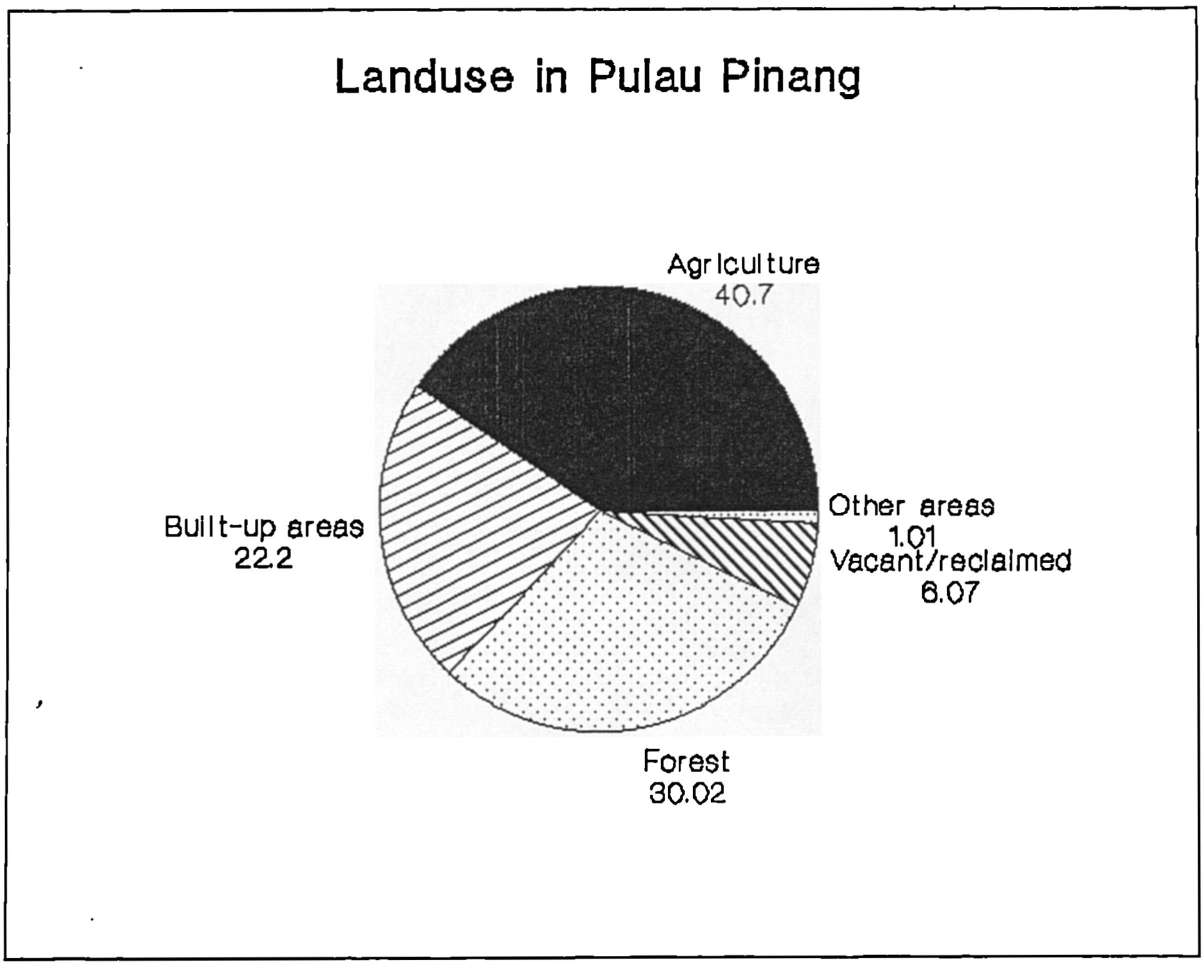

Figure E.15: Categories of land use and their proportions in Pulau Pinang

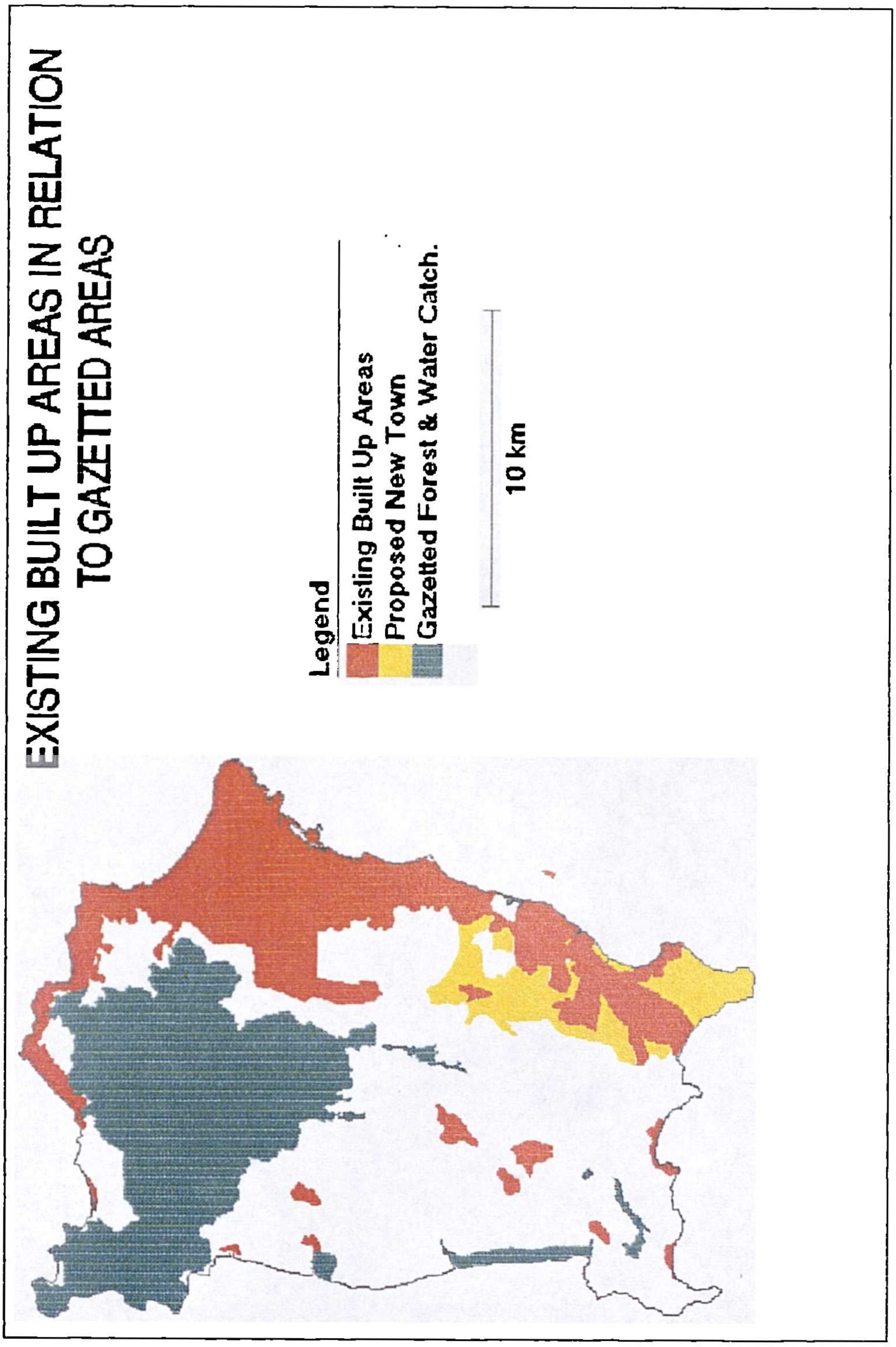

Figure E.16: Proposed future expansion of Pulau Pinang (Source: Remote sensing unit of Universiti Sains Malaysia)

peninsula, Pulau Pinang experiences a distinct dry season from the beginning of December to the end of March. There are, however, two distinct rainfall peaks during the two inter-monsoon periods of April/May and October. Short torrential convectional storms of 3 to 5 hours duration (usually localised and confined to one or two catchments) during these two short periods can give rise to flash floods. Such storms usually cause severe damage to small streams. Rainfall intensities during such storms are generally high, as seen by the average probable rainfall in the Pinang River basin (Table E.1).

Table E.1: Average probable rainfall intensities in the Pinang River Basin

Return Period (Year)	2	5	10	20	30	50	100
Average Probable Rainfall (mm/day)	124	178	213	247	266	291	423

(Source: JICA 1991 pG-8)

Depression-type monsoon storms of longer duration (2 to 3 days) are more widespread over the whole island and can cause severe damage to large catchments. Such storms usually occur just before the onset of the Northeast Monsoon (usually in September and October when the highest rainfall peak is experienced).

E.4.5 Topography

The topography of Pulau Pinang can be broadly divided into two main geomorphic units, the lowland coastal plains and the interior hills (Figure E.17). The hills are mainly confined to the central and northern parts of the island. The terrain in the hills is usually rugged and is steep, with slopes more than 30.0 per cent. The most well known is Penang Hill which is made up of a complex of peaks and spurs. In general, the elevation ranges from 300 m to 800 m.

The lowlands occupy the coastal regions on the island. Its east and west coasts are made up of floodplains with elevations usually not exceeding a few metres. In the Pinang River basin, many areas near the river estuary are just one metre above sea level. There are even small depression areas where the elevation is below sea level. On its west coast, the low elevation has given rise to large tracts of swamps. Swamps are scarce on its east coast mainly because many of them have been reclaimed for human land use. It is on these lowland plains that flooding occur frequently. Overall, the lowlands occupy about 40.0 per cent of the total land area on the island.

E.4.6 Drainage

The rivers in Pulau Pinang are generally short (not more than a few kilometres long) and swift flowing, due to the small size of the island and the short distance between the hills (catchment) and the sea. In the lowland areas, however, the low elevation and flat terrain have caused the rivers to flow slowly. Erosion and sediment run-off (caused by development and other human related activities such as mining, housing, quarrying and agriculture) in many of the upper stretches have significantly increased siltation of river beds and consequently reduced the capacities of rivers in down stream areas as drainage outlets. Many rivers in Pulau Pinang are heavily affected by siltation. The more notable of these rivers being the Pinang, Balik Pulau, Fettes and Keluang. In the Pinang River, the siltation depth is under 80 cm and the quantity of silt is estimated at about 10,000 m^3 of which 80.0 per cent

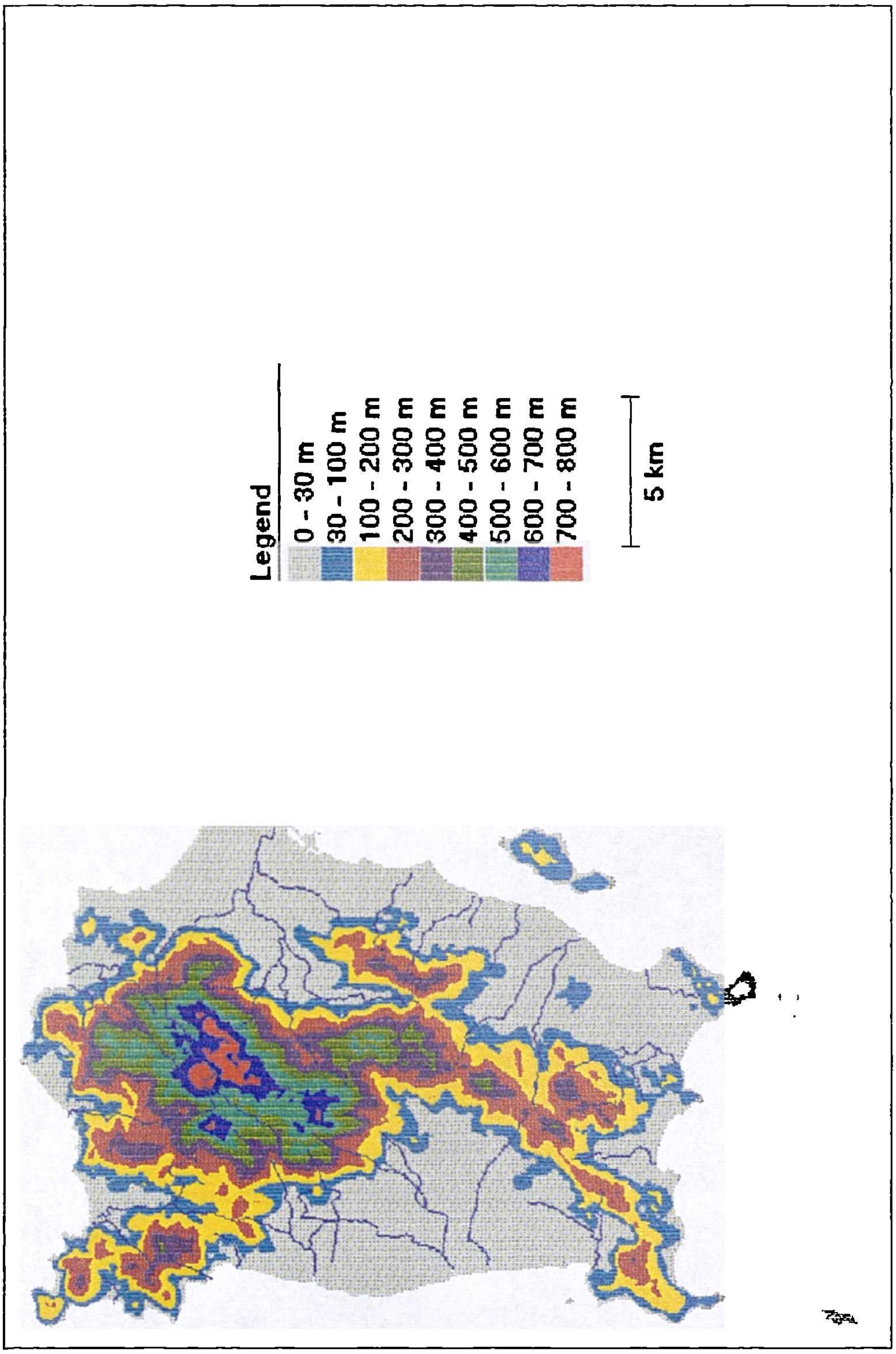

Figure E.17: Topography of Pulau Pinang

is deposited in the estuary (JICA 1990 p2-5). Because of this, the lower stretches of the Pinang River are very flood-prone.

There are altogether 31 main river systems in Pulau Pinang (see Figure 2.11). The largest of these is the Pinang River system with a catchment area of approximately 50 km^2. The upper stretches of the Pinang River system is made up of several tributaries such as the Air Terjun River, Air Puteh River, Air Itam River and Tat's Stream. All these tributaries have their headwaters in the Penang Hill area and are therefore swift flowing. Two other tributaries of the Pinang River are the Jelutong and Dondang Rivers. The Pinang River eventually flows eastward and discharges into the South Channel. The importance of the Pinang River system is not so much in its rank as the largest river system but in that it flows through densely populated and built-up Georgetown. Currently, 94.5 per cent of its catchment consists of built-up areas. And because of this, the occurrence of floods in the Pinang River basin can result in heavy damages. In recent years, flooding has occurred in the older parts of Georgetown along the Pinang River and along its tributaries such as the Air Itam, Dondang and Jelutong Rivers.

Owing to the fact that Pulau Pinang is a relatively small island with centrally located highlands, the rivers follow a radial drainage pattern and flow outwards from the centre of the island in all directions. On its east coast, almost all rivers discharge into the South Channel but on its west coast the rivers discharge into the Straits of Malacca. Other than the Pinang River system, the other important river systems on its east coast are the Keluang and Gelugor River systems. Both drain into the South Channel. All river systems, other than the Pinang River system, have catchment areas less than 25 km^2. Other major river systems on its west coast are the Pinang (West), Nipah, Burong, Kongsi and Pulau Betong River systems. Some parts of these rivers are flood-prone but because the built-up area is small (average built-up area is only about 12.0 per cent) and most of the land is agricultural, the potential damage is not serious. In general, drainage on the west coast is poor because of the existence of large tracts of mangrove swamps.

E.4.7 The flood hazard

Floods in Pulau Pinang are predominantly 'flashy' in nature. The island is sheltered from the Northeast Monsoon and partly from the Southwest Monsoon. As such, unlike the East Coast states, the threat from seasonal monsoon flooding in the island is small. Before independence in 1957, floods were rather uncommon in Pulau Pinang. Most of the island, with the exception of Georgetown, was then covered with lush green forest. Even the 1926 flood, supposedly the worst flood to affect Peninsular Malaysia, did not affect Pulau Pinang. However, rapid development in industry, housing and commerce since the 1960s has resulted in forested areas being cleared for human use. Since the beginning of the 1970s floods have become increasingly frequent (Table E.2).

In Pulau Pinang, floods are caused by depression-type monsoon storms, thunderstorms and high tides. Depression-type monsoon storms are of a few days duration and are generally of low intensity but because they are widespread in extent, they cause severe damage to large catchments (JICA 1990 p2). Such storms usually occur during the Southwest Monsoon Season or just before the onset of the Northeast Monsoon Season. In 1980 heavy and continuous rainfall gave rise to widespread floods which inundated Georgetown to a depth of 1.0 m for two days. On the other hand, convectional thunderstorms which normally occur in the afternoons, are of much shorter duration of between two to five hours. The rainfall intensities are, however, very high. A 50 mm depth of rain falling within a 15-minute spell is not uncommon during these thunderstorms. Because of this, the rainfall intensities experienced

Table E.2: Flood history of Pulau Pinang

Year	Magnitude	Damage (1993 prices)	No. of evacuees	Lives lost	Return period
1971	Severe*	NA	NA	0	1:100
1972	Minor	Slight	0	0	NA
1974	Minor	NA	0	0	NA
1975	Minor	Slight	0	0	NA
1976	Severe	$993,500	NA	0	NA
1977	Minor	NA	NA	0	NA
1978	Minor	Slight	0	0	NA
1982	Minor	NA	0	0	NA
1983	Minor	NA	0	0	NA
1984	Minor	$1.2m	41	1	NA
1985	Minor	$17,200	21	0	NA
1986	Minor	$23,500	100s(est)	0	NA
1987	Moderate	$93,000	0	0	NA
1988	Severe	$1.3m	NA	0	1:12
1989	Minor	Slight	0	0	NA
1990	Moderate	$175,800	NA	0	NA
1991	Severe	$124,800	NA	0	1:30
1992	Minor	NA	NA	0	NA
1993	Minor	Slight	0	0	NA

* The definition of severe, moderate and minor is given by the DID and depends on the extent, duration and amount of damage caused by each flood.
NA Not available.
est Estimated.
m million.

(Source: Drainage and Irrigation Department Malaysia; various newspapers).

during thunderstorms are considered potentially high in terms of erosivity. According to Jackson (1977), a rainfall intensity of 25 mm/hour is considered erosive. Thunderstorms have been responsible for the occurrence of landslides and flash floods in Pulau Pinang, the former in the hilly areas while the latter in the lowlands. In June 1991, one such storm caused widespread flooding in almost the whole of Georgetown and many other low-lying parts of the island (New Straits Times 10.6.91). High tides also cause flooding in estuarine and low-lying areas. In particular, spring tides which occur twice a month also flood some parts of Georgetown. However, tidal flooding by itself is not serious as the depth is seldom more than 0.5 m. Usually, only the roads are flooded. Most buildings in the vicinity of tidal flooding have been flood proofed (either by stilts, raised floors or higher door thresholds). It is the simultaneous occurrence of depression-type monsoon storms, thunderstorms and spring tides that increase flood peaks. Any combination can give rise to severe and widespread flooding. Flood-prone areas in Pulau Pinang are shown in Figure 2.11.

E.4.8 Future development trends

Pulau Pinang is currently about 20.0 per cent richer than Malaysia as a whole, and the gap is likely to grow (The Economist 22.5.93 p73). With its desire to become the centre of development in the northern region of the peninsula, Pulau Pinang is set to develop at an even faster rate than its present. Although the island has been a traditional strong-hold for trade, commerce and tourism, it has now added industries to its economy. Besides expanding the current Free Trade Zone, the state government has recently embarked on a rural industrialization programme. This will not only enhance growth but will also convert rural into urban areas. The aim of this programme is to transform the rural areas into planned urban settlements by introducing modern urban facilities (housing, commercial space, social amenities and recreational facilities) to the rural areas, increase employment opportunities in the rural areas and curb rural-urban migration. New townships such as Bayan Baru will become the nucleus of future development in these areas.

In terms of commercial development, Georgetown will remain as the centre but houses and old buildings located in the fringe areas around the city will be converted into modern shop-houses and offices. While most of the buildings in the inner city area are of mixed use (as housing quarters on the upper floors and as shop-houses on the ground floor), there is a tendency for conversion into solely commercial usage because of the increasing demand and high rentals. Such conversions will no doubt increase flood damage potentials in and around the city. In terms of residential development, there is an increased demand within the environs of Georgetown. This has given rise to the redevelopment of underdeveloped properties in the city as well as an increased rate of development of new housing schemes. New housing schemes are predominantly located in the new townships of Air Itam, Bayan Baru, Paya Terubong, Gelugor, Sungai Nibong, Sungai Ara, Batu Uban and Tanjung Tokong. Agricultural development in the future will still be predominantly in the west coast plains. It will involve the provision of better infrastructure in agriculture areas. However, much agricultural land is expected to give way to housing, commercial and industrial land use. In the field of tourism the state government has plans to further develop the northern coastal belt around Tanjung Bungah, batu Feringghi and Teluk Bahang. Future development plans include more hotels, infrastructure facilities, residential resorts, tourism facilities and other touristy attractions. The city of Georgetown is also to be developed in specific areas for encouraging tourism.

With the current and future trend of development, more and more areas on the island will be built-up leading to a corresponding decrease in the area under forest, secondary vegetation or plantation crops. This will have many significant effects on the environment, not least those associated with flooding. The increase in built-up areas and decrease in vegetation cover, if not properly compensated by flood management measures, can only lead to an increase in flood frequencies and magnitudes. And as flood damage potential increases following the increase in commercialisation and investments, the current flood problems in many of the river catchments are expected to be exacerbated. Population growth and rural-urban migration from nearby states to seek employment in Pulau Pinang's industrial parks is likely to force many to occupy hazardous floodplains, thereby aggravating encroachment and increasing exposure and vulnerabilities. In the state government's anxiousness to make the state the 'Growth Centre in the north', care and caution must be taken seriously (in terms of flood management consideration) in all its development programmes. In this context, the concept of sustainability must be applied.

E.5 The Pekan study area

The Pekan study area encompasses Pekan District in the state of Pahang (the largest state in Peninsular Malaysia) and is located at the estuary of the Pahang River, the largest river in Peninsular Malaysia. The district has a total area of 3,846 km^2 of which a significant portion is flood-prone. The flood-prone mukims are Pekan[6] (the town), Penyor, Lepar, Pulau Manis, Temai, Ganchong, Pahang Tua, Langgar and Pulau Rusa. The most severely affected is Pekan as it is located on the bank of the Pahang River and is nearest to its estuary on very low-lying land (see Figure 2.14).

E.5.1 Historical background

Literally translated, Pekan means town. The town itself is not just an ordinary town, even though in terms of physical size and population it is small in comparison to the other towns in Pahang. Rather, Pekan is a royal town, the seat of the Pahang Sultan. Historically, it is an important early place, having been established as a fishing and agricultural settlement. In the early days, it also served as the entry point of all trade between Pahang and the outside world. Yet, despite those advantages and its relatively earlier beginnings, its growth has been severely restricted and hampered by frequent floods (almost yearly). Economic, commercial and housing activities in the town have not progressed as rapidly as in some other towns such as Kuantan, Bentong and Raub.

The majority of other mukims in the district are agriculture based. The most important crops are padi, coconut, rubber and mixed horticulture (bananas, fruit trees, tapioca, sweet potatoes, ground nuts, sugar cane, maize, vegetables and spices). More recently, in the last two decades, oil palm has been introduced to replace old rubber trees because of its better price on the international market. But owing to the frequent flooding, agricultural expansion has been restricted to some extent. Large foreign and local corporations which own large tracts of rubber and oil palm plantations in the West Coast are generally reluctant to invest in the district of Pekan. As a result, until today, most crops are planted by smallholders on a rather small scale. In recent years, significant migration of rural youth to the large urban centres (either in the West Coast or in the East Coast) has retarded agricultural development. In fact, it is increasingly difficult to convince the younger generation to take up a job in agriculture. Farming is unrewarding (in terms of remuneration), hazardous and full of other

[6] Hereafter when Pekan is referred to, it is taken to mean the mukim of Pekan (which is basically the town of Pekan) unless otherwise stated.

uncertainties in comparison to a wage earning job in the city (Shahnon Ahmad 1972).

Besides agriculture, fishing is also an important source of livelihood, especially in the coastal and riverine mukims such as Pahang Tua, Langgar, Pekan and Lepar (Plate E.3). However, due to the rough seas during the Northeast Monsoon Season, fishing activities have to be temporarily stopped during those few months of the monsoon, usually between November to March. As such, the fishing industry in the East Coast has never developed as fast as that in the West Coast. Frequent flooding of roads has also delayed and in many cases destroyed fishing products due to be transported to markets.

E.5.2 Population

In 1970, the town of Pekan only had a population of 4,700 as compared to Kuantan (43,400), Bentong (22,700), Raub (18,400), Mentekab (11,300), Kuala Lipis (9,300) and Temerloh (6,000). In 1980, its population was 18,904 and by 1991, the figure had increased to 21,768 (Department of Statistics Malaysia 1992 p71). In 1991, Pekan town's population was a quarter of the total population of Pekan District which had a population of 85,120 in 1991. The majority of the population in Pekan District are Malays, who make up about three-quarters of the total population. Outside the mukim of Pekan, the proportion of Malays is even higher, reaching more than four-fifths of the total population. In the rural areas of Pekan District, the Malays are usually padi farmers, smallholders of rubber plots, land scheme settlers, fishermen, labourers and agricultural workers. In the towns, they are usually attracted to the government service while some set up small businesses such as restaurants, coffee shops, sundry retail outlets, and others.

The Chinese are mostly businessmen and artisans. As such, they are mainly found in the larger towns, such as Pekan. However, unlike the other large towns in Pahang such as Kuantan, Mentekab, Temerluh and Raub where the Chinese form the majority of the population, Pekan town only has a small percentage of Chinese. This is not surprising as business opportunities in Pekan are not as good as in the other towns. Moreover, frequent flood damage to properties, goods, business and health is not conducive to business. As a result, the proportion of Chinese in Pekan is still small, making up less than a fifth. Other ethnic groups such as the Indians and others make up the remainder of the population.

E.5.3 Land use

The land use of the lower Pahang river basin is shown in Figure E.18. Swamps, marshlands and wetland forests occupy the major portion of the basin. On the fringe of the river banks the land use is mostly agriculture, the majority of which is under rubber and wet padi. This is followed by mixed horticulture. Compared to the Kuala Lumpur and Pulau Pinang study areas, the percentage of built-up urban area in the Pekan study area is small. The only urban area is found in Pekan town itself.

E.5.4 Rainfall

The mean annual rainfall in Pekan District is between 3,000 mm to 3,500 mm. The area experiences only one maximum and one minimum period of rainfall. The maximum occurs during the Northeast Monsoon but the minimum varies from April to August (Chan 1989). More than two-thirds of the annual rainfall is deposited during the Northeast Monsoon Season, a quarter during the Southwest Monsoon Season and the remainder during the Inter-Monsoon Seasons. During the Northeast Monsoon Season, a mean rainfall of between 1,500 mm to 2,500 mm can be expected. Despite its low intensities, between 2.5 mm/hour to 5.0

Plate E.3: Top - A fishing village in Pekan town by the bank of the Pahang River. Bottom -Traditional wooden houses (with stilts) built on the banks of the Pahang River

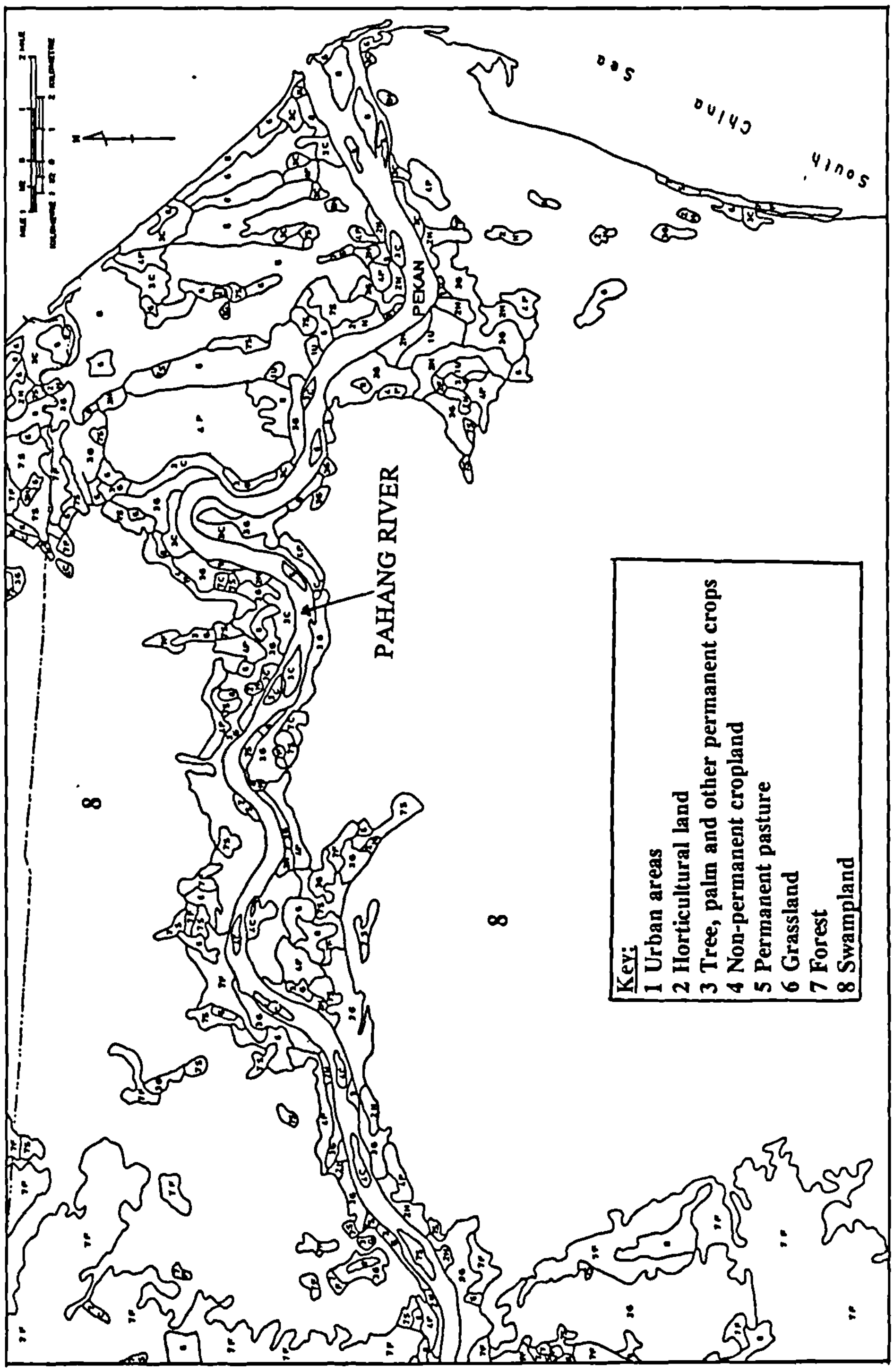

Figure E.18: Land use in Pekan District

mm/hour, rainfall during the northeast monsoon can be highly hazardous because of its duration. Usually, depression type monsoon storms last anything between four days to a week. Such a long duration in rainfall will cause the catchments to be saturated and rivers to overflow their banks. As Pekan is situated at the estuary of the river, the combined volume of river discharge reaching it after a rain spell of five days or more is enormous. Due to siltation of the estuary, the occurrence of high tides, and other reasons, the probability of flood occurrence in the area during the Northeast Monsoon Season is very high.

E.5.5 Topography

The mukim of Pekan is situated just on the southern bank of the Pahang River. The town itself, however, is entirely in the floodplain of the Pahang River. Therefore, the land on which Pekan is built is very low and flat. In most parts of the town, the land elevation varies between 1 and 5 m above mean sea level. Along the coastal areas of Pekan are a series of beach ridges ('permatangs') running almost parallel to the shore. These beach ridges (mainly of sand) are said to have been formed by tectonic movements and eustatic changes to the sea level (Ooi 1979 p25-26). In between the beach ridges are swales or depressions. It is the swales that are seasonally flooded because of their low elevations. In many places, the swales are covered by mangrove swamps. And near the estuary of the Pahang River, along the tidal reaches, are mud flats. Because of this, drainage is extremely poor in such places and flooding occurs frequently. In the lowest areas in the town, towards its north and beside the river, flooding occurs at least once in two years. In the two major floods in 1971, Pekan was flooded for two to three weeks, to depths of up to 1.5 m. In the outskirts of the town, lower lying areas such as the mukims of Ganchong and Pahang Tua were inundated to depths of more than 3 m.

E.5.6 Drainage

The Pahang River is the main river that flows through the mukim of Pekan. It has its origins in the central mountain ranges of the peninsula. The Pahang River has to flow a long way from its source to Pekan on its estuary. Its main tributaries which contribute significantly to flood flows are the Tembiling River, the Semantan River, the Lipis River, the Teriang River and the Tanum River (see Figure 2.14). In the highlands of the interior, the Pahang River flows from a north to south direction. On reaching Temerloh, the river takes a sharp turn to the east and flows into the South China Sea off the town of Pekan. On the Pekan floodplain the Pahang River is in its old age as evidence such as meanders, ox-bow lakes, braided streams, islands, swamps and levees are abundant.

E.5.7 The flood hazard

Owing to its exposure to the Northeast Monsoon winds, its proximity to the Pahang River and its low-lying elevations, the Pekan floodplain is subject to seasonal flooding of various magnitude almost every year. Pekan floodplain occupants living in flood-prone locations for a long time are, in many ways, well adjusted to the seasonal floods. To them, flooding during the monsoon season is almost a certainty. It is just a matter of how high the flood waters will be and the how long the duration of the flood. It might seem illogical for the floodplain occupants to remain in such hazardous areas. Most Malay families are very attached to their land and are very reluctant to relocate. Furthermore, close family ties and friends in the same kampung where one grew up are also responsible for their reluctance to shift elsewhere. Consequently, people living in the Pekan floodplain have developed various coping strategies. Usually, floodplain inhabitants can cope reasonably well with the normal seasonal floods in which the flood waters do not exceed stilt height and the duration of which do not last more than a few days. However, major severe and large scale floods with flood waters exceeding stilt height (often reaching roof level) and the duration of which exceeds a week render most people helpless. Most people have to evacuate during major floods.

Historically, many such large and severe floods have occurred which seriously crippled the social and economic aspects of settlements on the floodplain. The largest documented floods occurred in 1886, 1926, 1931, 1967, December 1970 to January 1971, December 1971, 1979, 1983, 1987 and 1988. The 1926 flood was the largest flood ever recorded. However, damages during this flood was not particularly high by today's standards because of the relatively undeveloped nature of the lower Pahang River basin at that time (which was mostly swampland) (Plate E.4). The 1970 flood which stretched into January 1971, is considered the second largest flood ever experienced in the Pekan area (see Plate 6.3). During this flood, damages were severe as much development had occurred since the 1926 flood. For the entire Pahang River Basin, tangible losses were estimated at around $38 million. Furthermore, 24 people drowned and 153,000 people were temporarily relocated. The December 1971 flood was also severe, causing flood losses at an estimated $16 million, 10 deaths and 43,000 evacuees. During the 1972 flood, the damage was $6 million and 7,000 people were evacuated. The concurrent occurrence of the January and December floods in 1971 (both of which lasted for two to three weeks) made both the government and floodplain inhabitants realise that severe large scale floods were not really isolated extreme events that occur once in a long time. Because of significant damages and loss of life, these floods demonstrated that the risk of such flooding was more serious than was previously perceived. People became more aware of the flood hazard and the government took positive steps to provide more comprehensive flood reduction measures to ensure that a recurrence of the 1971 event in the future would not result in such high losses.

Other than the severe floods discussed above, floods of various other magnitudes have also occurred in Pekan District during the years 1954, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1973, 1975, 1977, 1978, 1982, 1984, 1986, 1991 and 1992. In general, these are the regular seasonal floods where flooding is localised and damages are not significant. However, that is not to mean that these floods are without their effects. On the contrary, such floods also occasionally entail temporary evacuation of floodplain occupants in the worst hit areas. Furthermore, these floods also damage crops such as padi, maize, tapioca, vegetables and other short-term cash crops.

On the whole, despite the frequent occurrences of normal seasonal floods as well as the severe ones, the Pekan area does not suffer economic damages on the same scale as that suffered by the large urban centres on the West Coast states. There may be several reasons for this. First, the number of commercial properties is low. Second, population density is also low. Third, most private properties are built on stilts or 'flood proofed' in some way. Fourth, people are well adapted to the normal floods and because they expect them to happen during certain times of the year (during the monsoon season), they are well prepared for them. Fifth, the Northeast Monsoon Season is generally considered as an off-season in the Pekan area. By this, it is meant that business, trade, agriculture, fishing, transportation and other economic activities are at their lowest. However, as Pekan town expands, population increases, and more agriculture and commercial activities develop, potential flood damages is expected to rise in the future.

Although urban flood damages in the Pekan area may not approach a fraction of that suffered by the federal capital of Kuala Lumpur during the same flood in 1971, rural damages in the former area are severe. Generally, floodplain inhabitants comprise the poorest sections of Malaysian society. The majority of these people are either farming on marginal lands or

Plate E.4: The 1926 flood in Pekan town

fishing under subsistence conditions. The 1971 floods destroyed the entire main-season padi crop, which provides the main income of peasant farmers, as well as other cash crops. For the entire Pahang river basin, the total crop losses for the two 1971 floods (January and December) and the 1972 flood were $9.0 million, $5.1 million and $1.65 million respectively (Australian Engineering Consultants 1974b p51). Besides crop losses, damages to housing and property were also substantial. Overall, there were also intangible losses such as loss of life, dislocation, stress, health effects on the old and weak, isolation, interruption to routine activities and others.

E.5.8 Future development trends

Future developments in Pekan District are not expected to be as rapid as that targeted in other areas in the country. The town is expected to further expand towards the south, east and west but the rate of development will only be moderate. Agriculture will continue to be the main focus of development as there are currently few other commercial opportunities in the area. The swamps towards the south will inhibit developments as will the swamps north of the Pahang River. As such, agriculture expansion will take place in and around existing agricultural areas along both banks of the Pahang River. According to official sources in the Pekan District Office, future expansion north of the Pahang River will be northwards towards Kuantan town. In the south of the river, the expansion will be towards existing agriculture areas. Further inland, towards the extreme west of Pekan District, existing lowland forest is expected to be cleared for more agricultural land schemes. In this context, the most likely crop to be planted will be oil palm. This crop is expected to take on more importance as many of the old rubber trees will be felled to give way for the new crop. In some areas, reclamation of swamp lands will further increase the area under agriculture. However, the land use change is not expected to be large and there is currently no reason to believe that such changes will alter the existing hydrological regime significantly. Nevertheless, such increases in developments will naturally expose more crops, properties, infrastructure and people to the flood hazard. In this context, future flood damage potential is expected to rise.

E.6 The Kelantan study area

Kelantan, literally translated, means 'Land of lightning'. This probably has its origins from the frequent occurrences of lightning during rainstorms, which occur throughout the Northeast Monsoon Season. It is located on the northeastern corner of Peninsular Malaysia and is bordered by Thailand in the north. The state of Kelantan is unique in that there are three levels of administrative units compared to two levels in the other states in Peninsular Malaysia. Kelantan is divided into ten jajahans of which only two, Jeli and Gua Musang are relatively flood free (Figure E.19). All the other jajahans are flooded to some degree. The worst affected jajahan is Kota Bharu which is located on the Kelantan River estuary where the land is almost entirely on the floodplain. Each jajahan is subdivided into smaller administrative units called districts.

The study area comprises the three sample sites in and around the three towns of Kota Bharu, Kuala Krai and Pasir Mas. Kota Bharu[7] is located on the estuary of the Kelantan River, Pasir Mas slightly further inland on the banks of the same river and Kuala Krai at the confluence of the Kelantan and Lebir Rivers. All three sample sites are flood-prone to certain degrees and are located within the Kelantan River Basin which discharges into the South China Sea.

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[7] Hereafter, the term Kota Bharu shall refer to the town of Kota Bharu unless specified otherwise.

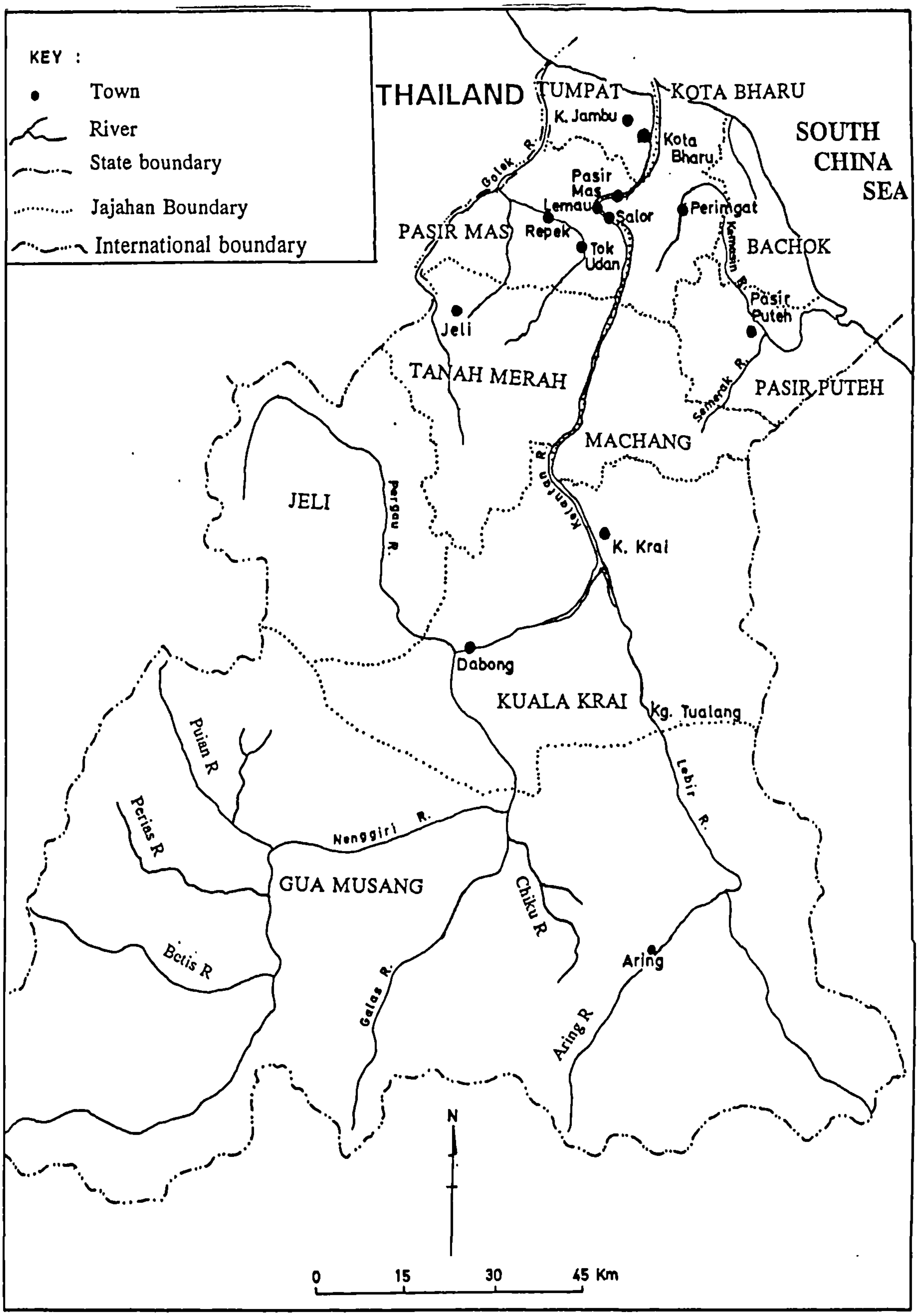

Figure E.19: Administrative jajahans and rivers in Kelantan

E.6.1 Historical background

Historically, Kelantan is unique because of early Siamese influence. In fact, even today a significant percentage of its people are of Siamese origin. Before the westerners arrived, Kelantan was one of the more prominent and powerful Malay states under Siamese rule and influence. As a result, Siamese culture can be identified in many Kelantanese customs. Kelantanese are steeped in tradition and consider their state a veritable seat of Malay culture. The influence of Islam is particularly strong in Kelantan.

Early British colonial influence did not spread to Kelantan because it did not have rich tin deposits and its terrain and climate were unsuitable for rubber planting. Frequent flooding also hampered development as infrastructures such as roads and other communication lines were constantly damaged. Few early immigrants such as the Chinese and Indians settled in Kelantan and the state was left very much to the hands of local Malay rulers. Because of this, economic development was slow and Kelantan's economy mostly depended on traditional agriculture (padi), fishing and local handicraft. As a result, it lagged far behind other states in terms of economic development and until today remains one of the poorest states in Peninsular Malaysia (Faaland et al 1990 pp122-3).

E.6.2 Population

Although Kelantan is one of the poorest states, it is the most densely populated state on the East Coast. In the 1991 census, Kelantan had a population of 1.18 million. It was ranked seventh (out of 13 states) in the whole of Malaysia. Of the 10 jajahans in Kelantan, Kota Bharu is the most densely populated with 366,849 people. This is more than twice the number of the second ranked jajahan in Kelantan. More significantly, the Kelantan delta where Kota Bharu is situated, is the most densely populated with more than 600 people per km^2. Because of this, annual monsoon floods bring extensive economic losses and human sufferings to occupants in the delta area.

Kelantan is a predominantly Malay state. Malays comprise more than 90.0 per cent of the total population. In fact, in the rural areas where traditional padi planting, fishing and other agriculture activities prevail, the population is almost entirely Malay. Non-Malays in Kelantan are usually confined to the major towns. For instance, the percentage of non-Malays is about 32.0 per cent in Kota Bharu (29.0 per cent Chinese; 2.0 per cent Indians; and 1.0 per cent others).

E.6.3 Land use

Because Kelantan is agriculture based, the predominant land use is agriculture. Padi planting dominates much of the riverine and coastal low lands, especially around the Kelantan Delta. Due to the high frequency of flooding, wet padi is the most suitable crop. In fact, many padi varieties are of the flood resistant type. All along the coastline are fishing villages. Such villages also act as centres of the Kelantanese cottage industry where a variety of traditional handicrafts are produced. The cottage industry becomes important during the Northeast Monsoon Season when fishing activities cease.

Further inland on the hill slopes where drainage is better, rubber and oil palm become more dominant. Other crops such as coconut, vegetables, pineapple, tea, coffee, cocoa, pepper, sugar cane, banana and local fruits are also cultivated on higher grounds. Most of these crops are planted by smallholders although the Kelantan government has initiated many land schemes involving plantation agriculture. Because of the effects of the monsoons and the high incidence of floods, plantation agriculture in Kelantan has never developed in the same breadth as it has in the West Coast.

Towards the interior lies the forest reserves and high land forests. In this area, logging is still important and contributes significantly to the state's revenue. Shifting cultivation is also carried out by aboriginal people. More recently, the completion of the east-west highway has changed the land use in the interior.

Other than Kota Bharu town, urban expansion and economic development has not affected floods in other parts of Kelantan. Urban expansion and economic development in Kota Bharu is not expected to have the same effect on exacerbating the flood hazard as in Kuala Lumpur or Georgetown but further encroachment of floodplain, especially in and around the Kelantan Delta is expected to increase flood damage potential in the future.

E.6.4 Rainfall

The Kelantan study area is situated on the East Coast and is therefore subject to the influence of the Northeast Monsoon winds. However, being located further north in the peninsula, the winds reach the state of Kelantan earlier, usually in mid-October. Likewise, the winds die off earlier, around the end of February. Because of this timing, the DID of Kelantan has designated the period from 15th October to 15th January as the 'flood season' in the state. The beginning of the Northeast Monsoon Season is usually marked by the arrival of strong easterly winds and the occurrence of intermittent rains over a week or two. In the case of the former, the occurrence of typhoon magnitude winds (between 65 to 100 knots) is not uncommon (Sunday Times 3.12.72). Winds of such magnitudes have destroyed crops, houses, uprooted trees and damaged roads, telecommunications and other structures. In the case of the latter, experience tells the Kelantanese that such intermittent rains when followed by subsequent continuous rains are a sure sign that floods will follow soon. As a result, even while the floods have yet to occur, the people living in flood-prone areas would make contingency plans to face the impending floods. Fishermen will stop going out to sea as their small boats and light engines cannot cope with the rough seas caused by the monsoon winds. In fact, as soon as the winds commence, fishing activities cease. Most fishermen would then beach their boats or anchor them far inland along the irrigation canals or tributaries of the Kelantan River to avoid being damaged.

The average annual rainfall of the Kelantan River Basin varies from 2,800 mm on its northernmost coast to about more than 3,600 mm in the foothill region in the centre of the basin. The bulk of this rain (more than 60.0 per cent) falls during the Northeast Monsoon Season. As is common on the East Coast, rainfall intensities during the Northeast Monsoon Season are usually low, about 2.5 mm/hour (60 mm/day) but rain spells last for a few days to more than a week. For instance, it has been estimated that a rain spell of 8 days duration with a 1,200 mm volume of rain will have a return period of 15 years. A similar rain spell with a 500 mm volume of rain will occur every two years (Government of Malaysia Undated pD2). The occurrence of an 8-day rain spell with 1,200 mm of rain will give rise to flooding in many parts of Kelantan. Most seasonal floods during the Northeast Monsoon are caused by such rain spells. During the Southwest Monsoon Season, however, flooding seldom occurs. When it does, it is usually localised and of short duration. However, flash floods occur frequently in Kota Bharu and other towns as a result of inadequate urban/artificial drainage.

E.6.5 Topography

Kelantan may be divided into three topographical regions: (1) the mountains in the interior; (2) the coastal and floodplains; and (3) the rolling country in between the two. In the mountainous interior, covering the jajahans of Jeli and Gua Musang, the land is made up of steep slopes and mountain peaks, averaging between 1,000 m and 1,500 m (Figure E.20). It is from this region that the majority of the rivers in Kelantan have their origins. In the coastal and floodplains, the land elevation is low, seldom more than 15 m above sea level. The jajahans within this region are Kota Bharu, Tumpat, Bachok, Pasir Puteh and Pasir Mas. Most areas hugging the Kelantan River and those near its estuary are seldom more than a metre or two above mean sea level. In fact, the existence of many permatangs in parallel formation have given rise to swales, many of which are below sea level. It is in the coastal and floodplains that floods are most frequent and serious. Kota Bharu town, which is located near the estuary of the Kelantan River has very low elevations and is very vulnerable to seasonal floods (due to the Kelantan River overflowing its banks) as well as flash floods (due to poor urban drainage). The rolling country is found in the central parts of Kelantan, comprising the jajahans of Machang, Tanah Merah and Kuala Krai. Generally, the land elevation in this region varies from about 15 m to 1,000 m. The region is made up of narrow floodplains, dissected river valleys and isolated hills. This region is also subject to flooding, especially in the narrow floodplains. For instance, Kuala Krai town is located at the confluence of the Galas and Lebir Rivers (both tributaries of the Kelantan River) and is therefore very easily flooded during the Northeast Monsoon Season.

E.6.6 Drainage

The natural drainage pattern in Kelantan is dominated by one major river system, that of the Kelantan River. The rivers in the interior mountains form the origins of the Kelantan River system. They include the Nenggiri, the Galas, the Lebir and the Pergau Rivers. The Nenggiri and Pergau essentially flow eastward to join the Lebir and Kelantan Rivers which flow in a predominantly northwards direction. Most other tributaries of the Kelantan River flow either eastward or westwards towards the main river. Because the coastal plains are seldom more than 15 m above sea level, land drainage is generally inadequate and rivers tend to be sluggish and meandering. These combine to promote widespread flooding whenever heavy rain falls, especially during the Northeast Monsoon Season. During this season, flood frequency is also further increased by a temporary rise of the sea level by some 30 - 40 cm, due to water stowage in the South China Sea (Tilmans 1991 p89).

Owing to this interrelated drainage network, it has helped flood warning operations somewhat. The Kelantan River flood warning system is based on a flood routing network of rivers comprising the Nenggiri, Pergau, Galas, Lebir and Kelantan rivers. For instance, flood levels at Kuala Krai will depend on river levels at gauging stations on the upper stretches of all four of these rivers. As such, experience and correlation techniques have shown that when certain levels are reached upstream at various gauging stations along these rivers, the likelihood of Kuala Krai being flooded will be high. Similarly, flood levels at Kuala Krai are used to estimate or predict flood levels at Kota Bharu. Experience indicates that flood waters of the Kelantan River at Kuala Krai take about 12 to 15 hours to reach Kota Bharu. Flood warning boards are set up at strategic points by the side of the Kelantan River to indicate the river level at Kuala Krai and its corresponding level at the place of the board. Corresponding 'alert', 'warning' and 'danger' levels between the two points are shown on the board (see Plate 5.3). Floodplain occupants are expected to be aware of changes in the river level at Kuala Krai to decide whether or not to evacuate. Because nearly all rivers in the state drain into the Kelantan River at some stage or another, the discharge of the Kelantan River at its

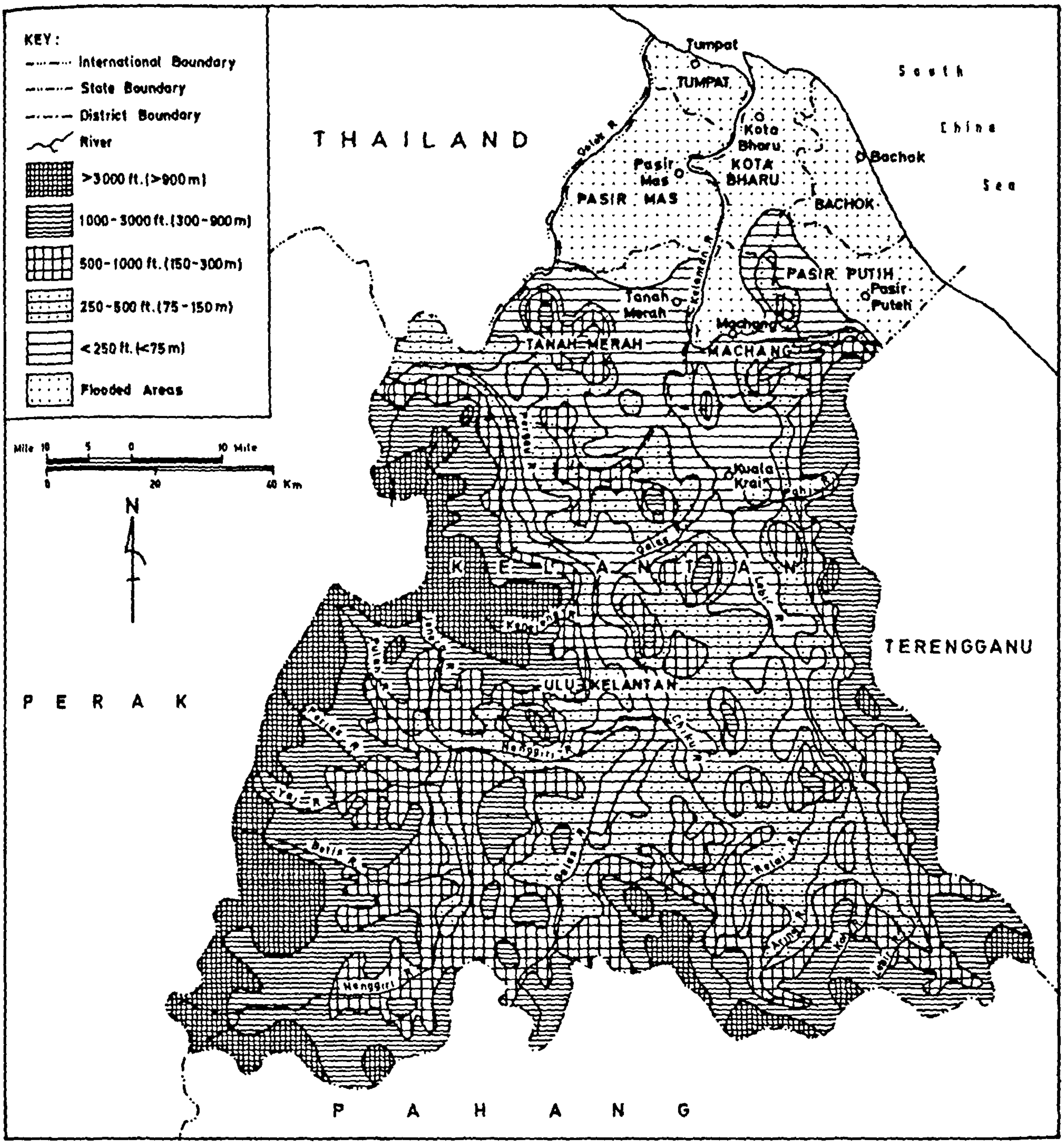

Figure E.20: Topography of Kelantan (metres).

lower stretches is overloaded, often causing extensive flooding.

Another major problem with the Kelantan River system is the high rate of siltation at its lower stretches, particularly the estuary. The problem has become so acute that it is now a problem even for fishing boats to negotiate the narrow river mouth to go out to sea. Because of this, the capacity of the river to discharge its water into the sea is very much reduced. In fact, this has been as much a cause of frequent flooding as has the Northeast Monsoon. The opening of new agricultural land schemes in the central and interior parts of the state, logging, as well as the growth of new towns and the building of the East-West Highway and other roads have also compounded the problem of flooding.

E.6.7 The flood hazard

The Kelantan River is the focal point of Kelantanese life. It has been for centuries and still is. There is no doubt that the Kelantan River has brought many benefits to the people in terms of transportation, fishing, hydro-electric power, water supply, irrigation, drainage and so on. Unfortunately, the river is also the bane of the Kelantanese as it brings about seasonal floods which until today, are as serious a threat as ever. In the East Coast of Peninsular Malaysia, Kelantan is probably the state which is most severely affected by flood hazards. This is because, unlike Pahang and Johor where a greater portion of the flood-prone areas are swampland or jungle (Terengganu seems to have overcome flooding somewhat with the completion of the Kenyir dam), the flood hazard in Kelantan affects most of its major towns and the main agricultural areas. Kelantanese are also highly exposed to flood hazards because a significant proportion live on floodplains. The state has the highest percentage of poor and hard-core poor households (The Star 24.8.94 p11), making it one of the most vulnerable states to flood hazards.

According to Takenada (1988 p1), annual floods of the Kelantan River bring not only extensive economic losses and human sufferings, but also negative psychological effects on farmers who are reluctant to adopt modern agriculture technology and potential industrialists who avoid the Kelantan floodplain. Almost each year, many parts of the state are flooded, the damage being worse in Kota Bharu because of its dense population and compactly built-up urban areas. To say that the flood hazard is a major problem faced by the people of Kelantan would be an understatement. During the flood season, almost everything that is done or is being done has the flood hazard or its possible effects in mind. Even though the Northeast Monsoon inevitably causes floods in Kelantan almost every year, Kelantanese living in low-lying areas become apprehensive whenever rains occur continuously for a couple of days or more during the season. In fact, many people go about making preparations to face the impending floods irrespective of whether they will occur or not. A survey by a local newspaper showed that many floodplain occupants start to pack and store away important documents and expensive household contents to prevent flood damage. Residents of Kampung Hujung Tanjung near Kota Bharu built a bund made of coconut tree trunks and sand bags in anticipation of flood waters threatening their houses (New Straits Times 21.11.89).

In the past, flood losses in Kelantan have been significant. Three of the worse floods hit Kelantan in 1967, 1973 and 1988. In the 1967 flood (a 1 in 50-year event), there were 39 deaths and official figures quoted damages at $44.6 million (1993 prices). The entire coastal region north of Kuala Krai, totalling 300,000 ha or 20.0 per cent of the total area of Kelantan, was flooded (see Figure 2.13). Almost half of the entire population of the state of Kelantan were evacuated. In the 1988 flood, 19 people lost their lives and damages totalled $33.8 million (1993 prices) (Table E.3).

Table E.3: Historical floods in Kelantan

Year	Magnitude	Damage (1993 prices)	Number of Evacuees	Lives lost
1926	Severe	Extensive	NA	NA
1931	Severe	NA	NA	0
1949	Minor	NA	NA	0
1958	Minor	NA	NA	0
1959	Minor	NA	NA	0
1960	Minor	Negligible	NA	0
1961	Minor	Negligible	0	0
1962	Minor	Slight	0	0
1963	Minor	Negligible	0	0
1965	Severe	$4.5m	NA	Several
1966	Minor	Slight	0	0
1967	Severe	NA	NA	0
1968	Minor	Negligible	0	0
1969	Minor	Negligible	0	0
1970	Minor	Negligible	0	0
1971	Moderate	Negligible	0	0
1972	Severe	$196,000	21,667	3
1973	Severe	$14.8m	18,323	4
1974	Moderate	$619,500	1,806	3
1975	Severe	$7.0m	12,296	3
1976	Moderate	$1.1m	NA	0
1977	Minor	Negligible	NA	0
1978	Minor	Negligible	0	0
1980	Severe	NA	200	3
1981	Severe	$6.7m	NA	0
1982	Severe	$2.5m	4,890	0
1983	Severe	$12.7m	0	0
1984	Moderate	$3.7m	7,177	9
1986	Severe	NA	7,968	0
1987	Moderate	$4.8m	402	4
1988	Severe	$33.8m	36,789	19
1990	Moderate	NA	514	4
1991	Minor	$1.5m	572	2
1992	Minor	NA	NA	4
1993	Severe	NA**	15,854	16

* The definition of severe, moderate and minor is given by the DID and depends on the extent, duration and amount of damage caused by each flood.

** A total of 113,000 school children missed school for several days as 200 schools were closed.

NA Not available.

est Estimated.

m million.

(Source: Drainage and Irrigation Department Malaysia; various newspapers).

E.6.8 Future development trends

With its tropical sunny climate, crystal clear seas, golden sandy beaches and enchanting cultural uniqueness, Kelantan is a popular tourist destination (both local and foreign) in Peninsular Malaysia. Indeed, climate also has a strong influence on almost every other aspect of Kelantanese life ranging from the timing of the padi cycle, padi yield, other agricultural crops, fishing activities, commercial activities and of course, response to the flood hazard. Even the number of marriages are influenced by the seasons (in terms of good or bad yields as well as traditional beliefs relating to the weather and climate). The close affinity between climate and life in Kelantan was shown by Monteiro (1962). More than anything else, unfavourable climate during the Northeast Monsoon Season (and human occupation of floodplains) has produced a flood hazard that has profound effects on almost every facet of Kelantanese life. Every end of the year around the months of October and November, Kelantanese from all walks of life (especially the state government) brace themselves for yet another season of monsoon assault. During this season, it would be normal for the Kelantan River to overflow its banks in low-lying areas such as Pasir Mas, Kuala Krai and Kota Bharu and a real bonus if nobody drowned.

APPENDIX F SURVEY METHODS AND SAMPLING

F.1 Survey methods

A wide range of survey methods are available to hazard researchers and other social scientists in investigating social phenomena. In this thesis, the selection of appropriate research methods depends on the time frame as well as the scope and resources available in this research.

F.1.1 The quantitative structured questionnaire

The quantitative structured questionnaire survey is a widely used method in the social sciences. It is a universally recognised method and is scientifically based. In the hazards research literature, it is the predominant investigative tool of the dominant hazards paradigm where individuals/households are surveyed and the results aggregated. Its usefulness and accuracy is based on sound sampling techniques and on the asking of unbiased questions. Detailed discussion of this method can be found elsewhere (Marsh 1982).

In this research, careful attention was given at various stages of the survey. For instance, the form, content, wording, order and context in which questions were asked in each questionnaire were carefully planned. They were revised accordingly after the pilot survey. Interviewers were carefully chosen and trained. Their performance and credibility were monitored closely. During the main survey, interviewer bias and human error when administering the questionnaire were minimized by close supervision and counter-checking. Random checks were constantly carried out on both interviewers and respondents. The author also carried out a significant portion of the interviewing himself (see Section F.3 below).

F.1.2 The self completion/mailed questionnaire

In contrast, the self completion or mailed questionnaire is an impersonal survey method. Because of the nature of the questionnaire, the response rate can be poor. Furthermore, if a respondent is unclear over a question, there is no avenue for clarifying the ambiguity. This may lead to unclear answers. Because there is no direct contact, only simple and direct questions can be asked. There is no opportunity for probing beyond the given answer, which may result in a shallow account. Because of its limitations, such self completion questionnaires have only been used to a limited extent in Britain (Bateman et al 1991 p42). Nevertheless, self completion questionnaires are cheaper and quicker to administer than either personal or telephone surveys. They are also capable of reaching even the most remote or otherwise inaccessible parts of a survey region. Furthermore, documents such as maps, diagrams and pictures can also be mailed out to the respondents if necessary. Given a conscientious respondent, the greater anonymity may result in the eliciting of a more truthful response.

In this research, the self completion questionnaire was sent to officers of flood hazard organisations and other selected respondents outside of the four study areas. Respondents within the four study areas were interviewed by the author with the same set of questionnaires.

F.1.3 The telephone interview

The telephone interview method has gradually become a very practical and popular form of survey since the 1980s. This is especially so in the developed world where more than 90.0

per cent of households have telephones. Technological improvements in telephone communications have also made telephone interviewing more convenient and easier. It is now possible to draw a random sample of telephone numbers by a process called random-digit-dialling (RDD) (Frankfort-Nachmias and Nachmias 1992). Telephone interviews also have the advantage of being capable of reaching a survey population which is geographically dispersed. Furthermore, when such interviews are assisted by a computerised format such as the computer-assisted telephone interviewing (CATI), the effects and errors of inexperienced interviewers may be greatly reduced. However, the most obvious advantages are that of speed, cost and the semi-personal nature of the interview. However, the disadvantage with this survey method is that only a limited amount of information can be conveyed over the telephone at any one time. As such, they are generally not suitable for surveys in which the respondent has to read or identify certain maps, pictures or show cards. Furthermore, there is a greater chance for the respondent to turn down or terminate an interview when not in the presence of the interviewer. Interviewers also cannot describe the respondent's characteristics and environment in detail.

In this research, telephone interviews were conducted by the author with relevant government officers, academics, consultants (whose work is related to the flood hazard). This method of survey was only resorted to when personal interviews could not be arranged or when the respondents were not located within the four study areas.

F.1.4 In-depth interviews

In-depth interviews are a variation of the structured questionnaire. This method can either be conducted by means of a structured questionnaire (with in-depth accounts within the questionnaire) or by a non-structured questionnaire (whereby only key questions are asked and respondents are encouraged to give detailed accounts of events and phenomena). This method has the advantage of being able to obtain detailed accounts of the events or phenomena under study. However, quantification is often difficult as no two accounts of events or phenomena can be easily quantified. The method may be used as a back-up or supplementary for the structured questionnaire interview.

On the whole, personal interviews using the structured questionnaire appear to be the most appropriate research methodology for the section on individual household survey in this study. The method is quantitatively based and detailed accounts of flood events can be obtained by supplementary in-depth qualitative interviews on selected households. Furthermore, interviewers can motivate respondents to participate, research their preferences, ensure that all questions and other information are understood, and develop a close rapport with respondents (which will enhance the respondent's confidence in the interviewer and thereby provide free flowing answers). Similarly, both the remaining two surveys on flood damage to business establishments and the survey on government officers and other experts are best tackled by the quantitative questionnaire approach. On the other hand, the evaluation of flood hazard institutions is best tackled by the qualitative research methodology.

F.2 Selection of case study areas

In this thesis, four case study areas, each representing a geographically different flood hazard zone in Peninsular Malaysia were selected. The selection of the study areas is essentially based on the criteria below:

(a) Geographical location on the East or West Coast of the peninsula

Historically, and for a variety of reasons, vast differences exist between the East and West coasts of Peninsular Malaysia (Figure F.1). In the East Coast, most of the floods experienced are predominantly caused by heavy orographic rainfall (which can persist for up to a week) brought by the monsoon winds, particularly the Northeast Monsoon winds (November to March). As such, flooding in the East Coast is seasonal in nature and relatively predictable. On the other hand, the West Coast is located in a rain-shadow area, being sheltered by the peninsula's Main Range from the Northeast Monsoon winds and the Indonesian island of Sumatra from the Southwest Monsoon winds. However, this does not imply that floods are any less frequent than those in the East Coast. Flooding in the West Coast can occur all year round as rain falls throughout the year (there is no distinct dry season) and is predominantly caused by torrential convectional rainfall[1]. Nevertheless, the significance of the influence of the monsoon winds in the West Coast should not be totally discarded. During certain years where the rainfall is extremely high (as in a 1 in 100 year event), there is an 'overspill' effect where heavy monsoon rainfall is brought into the West Coast causing floods. A good example is the major flood in Kuala Lumpur (located on the West Coast) in 1971 (Pang 1987). As a result, there are wide differences in flood causes and their subsequent predictability between the East and West Coasts. Consequently, the warning lead time[2] and responses are likely to be different.

Flood magnitudes over space and time are also likely to be different between the East and West Coasts. While the floods in the former are usually extensive and last longer, those in the latter are flashy and of short duration. East Coast floods also commonly cause deaths because of the greater magnitude of flood peaks and river flows whereas West Coast floods seldom account for deaths. Despite that, the amount of economic loss from floods is likely to be higher in the West Coast because of the higher densities of built-up properties and infrastructure.

The West Coast and East Coast are also different in terms of social, economic and political development. East Coast states are predominantly populated by Malays and are the seat of Malay culture. Much of economic livelihood in the East Coast is based on peasant padi farming, fishing and other agriculturally based occupations. While the former had prospered during British colonial rule (Kennedy 1967) and subsequently after independence (Ooi 1979; Government of Malaysia 1991a), the latter has been largely neglected and today lagged far behind the former. As such, the East Coast is underdeveloped and has traditionally been the poorer half of the peninsula. These differences are envisaged to have significant influences on vulnerability to flood hazards and government flood management between the two coasts.

(b) Flood type

Although most of the flood prone areas in Peninsular Malaysia are affected by river floods, there are many places, particularly those areas located near to estuaries and the coast, that are affected by tidal flooding. Besides the differences in flood characteristics, the effects of tidal floods are more damaging mainly because of the salinity of the flood waters. However,

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[1] While heavy convectional rainfall can occur all year round in the West Coast, it occurs most frequently during the two short inter-monsoon periods of April and October (though the exact timing of these two transitional periods varies from place to place) (Dale 1974).

[2] 'Lead time' is defined as the time between a flood warning and the occurrence of the flood (Penning-Rowsell and Chatterton 1977).

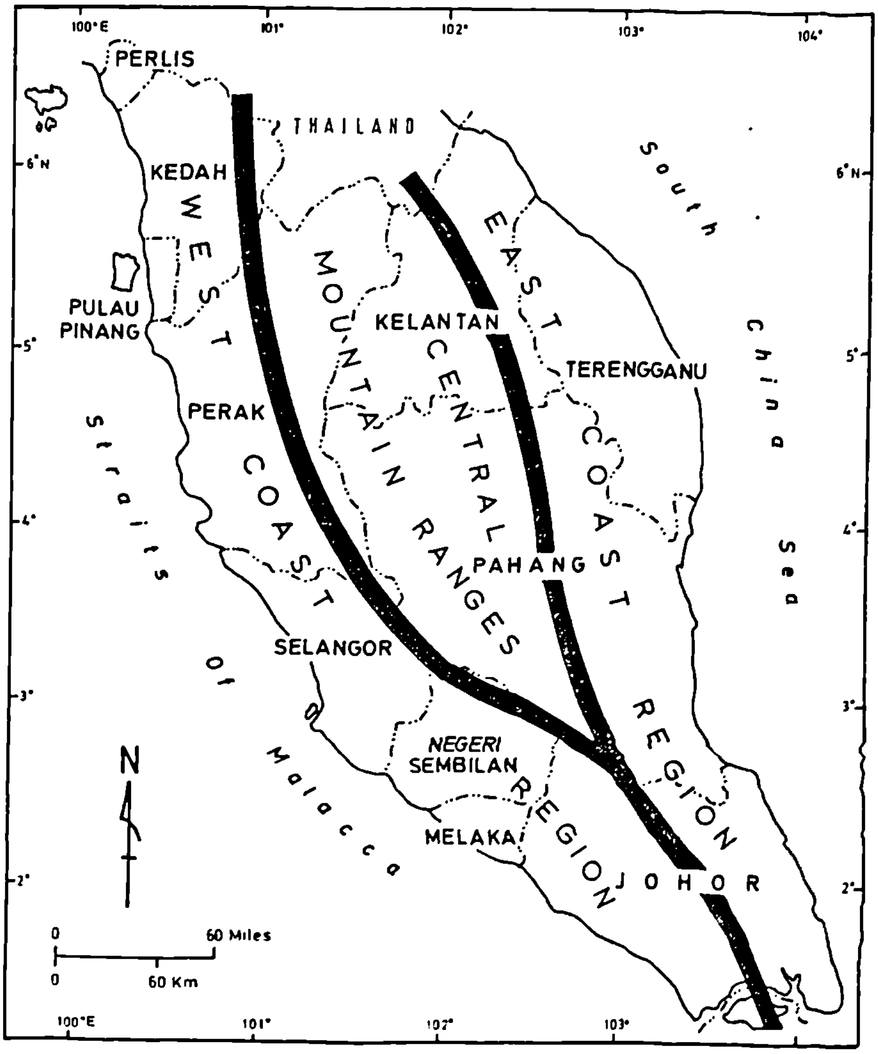

Figure F.1: Geographical regions of Peninsular Malaysia because of its 'predictability', people may have been well adapted to tidal floods. A third type of floods is a combination of both river and tidal floods. People living in riverine areas near the coast experience flooding when heavy rains coincide with high tides.

Floods can be seasonal as in 'monsoon floods' or perennial as in 'flash floods'. The former occurs mainly in the East Coast and can last for a duration of a few days to more than a month. The latter usually occurs in the heavily developed urban areas on the West Coast and usually lasts not longer than a day. However, the onset for flash floods is sudden and usually no warning can be given. On the other hand, seasonal monsoon floods are expected and people (at least those in the East Coast) are apparently well adapted to them. Because of the different types of floods, a comparison of how government and people respond to them is necessary to give a more complete picture of the flood hazard in the peninsula. All flood types may be classified as 'normal' or 'major' according to the severity (see Chapter 2).

(c) Urban and rural areas

In general, vast differences exist between urban and rural areas in Peninsular Malaysia. Malaysia is a rapidly developing country with an economy that grew at an annual rate of 6.7 per cent over the 5th Malaysia Plan Period (1986-1990) and an expected annual growth rate of around 7.5 per cent over the 6th Malaysia Plan Period (1991-1995) (Government of Malaysia 1991a). In 1990, 35.6 per cent of households lived in urban areas in Peninsular Malaysia. As a result of expected rapid development in rural areas as well as rural-urban migration, this figure is projected to reach 49.8 per cent by 1995 (Government of Malaysia 1991a). Besides the obvious benefits in the development of rural areas and the uplifting of rural standards of living, one of the adverse effects of rapid urbanisation is the increased frequencies of flooding (particularly of flash floods) as a result of the increased rate of runoff. Another difference between the two areas is that of the income level and therefore, the ability to adopt strategies towards flood hazard mitigation. Urban areas are also better protected in terms of more flood protection schemes in view of the damage potential. On the other hand, rural riverine areas, particularly padi farming areas that need water for irrigation of crops, are at a higher risk to flooding than urban areas which are usually located on higher ground within the floodplain. Finally, there are also differences such as occupational characteristics, educational level, infrastructure, amenities and others between the urban and rural areas, all of which will have a bearing on perception and adoption of flood mitigation strategies and policies.

(d) Areas with and without formal flood warning and evacuation systems

Another criterion in which the selection of study areas in this study has taken into account is the presence or absence of formal FWESs[3]. As one of the objectives of this study is to use the flood warning and evacuation segment to examine links between contexts, it is important that both areas with and without the benefits of such systems are selected. Individual perception and flood hazard management are likely to differ between people living in areas with formal FWESs and those without. The extent to which people rely on formal FWESs is likely to influence their perception and decisions to adopt mitigation strategies.

(e) Ethnicity

In Peninsular Malaysia, to merely say that ethnicity is an important aspect of Malaysian

[3] These are official flood warning and evacuation systems.

society would be an under-statement. In fact, a harmonious and tolerant inter-relationship between the various ethnic groups is vital in promoting social development and fostering national unity. It was precisely due to a breakdown in this relationship that resulted in the racial riots of May 1969. In general, all three major ethnic groups come from a varied background of rich ethnic tradition and customs. While the Chinese have traditionally settled in the major cities and towns[4], the Malays have traditionally been padi farmers contented with their rural way of life (Sendut 1961) and the Indians have always located in the vast expanse of rubber estates in the peninsula (Ooi 1979). Because of cultural and economic differences, it is likely that the different ethnic groups may have developed different strategies in flood hazard mitigation. For example, Malay houses with traditional architectural design built on stilts are well adapted to floods. The Chinese and Indians may have also developed their own flood proofing strategies.

Based on the above criteria, four case study areas, two each in the East and West coasts of the peninsula were chosen (see Figure 2.5). Within these four basic areas are sample sites, some of which are urban while some are rural. Furthermore, some of the samples sites are affected by river floods, some by tidal floods and others affected by a combination of both types of floods. The two East Coast areas are predominantly affected annually by seasonal monsoon floods while the two West Coast areas are mainly affected by flash floods. Some sample sites are equipped with formal FWESs while some are not. Flood magnitude and frequency also vary between different sample sites in each study area. Finally, some sample sites are dominated by Malays, some by Chinese and some by Indians. The characteristics of the four case study areas are described below.

F.2.1 The Pulau Pinang Study Area

Pulau Pinang is an island located in the northwestern part of Peninsular Malaysia (on the West Coast). This study area is divided into three samples, an urban sample in the city of Georgetown (70 interviews) and two rural samples in Bayan Lepas (44 interviews) and Sungai Pinang (58 interviews) (see Figure 2.11). The urban sample is predominantly occupied by Chinese with Malay and Indian minorities. It is mainly affected by river flooding with some tidal flooding occurring near the Pinang River estuary. An automatic warning siren is in operation and is located at the Pinang River bank in the vicinity of Jalan Perak. On the other hand, the rural sample is predominantly occupied by the Malays. There is no formal FWES at this site and it is only affected by river flooding.

F.2.2 The Kuala Lumpur Study Area

Kuala Lumpur is the federal capital of Malaysia. It is situated on the West Coast of the peninsula. It is the largest city in the country and is the single most highly urbanised area in Malaysia. The area is highly susceptible to flash floods caused by torrential convectional or monsoon rains. With the exception of the 1971 flood, so far the flood magnitudes in Kuala Lumpur tend to be small and the duration limited to not more than a day. However, flood frequencies are high, especially in low-lying riverine areas. Within this study area are samples drawn from the Dato Keramat-Kampung Baru site (37 interviews), the Pantai Dalam

[4] The Chinese initially came to Peninsular Malaysia from South China (notably Kwangtung Province) towards the end of the 19th century to work in the tin mines. Subsequently, business opportunities in the towns and drop in tin prices (also due to exhaustion of the tin reserves), caused them to migrate to nearby towns. Today, the major cities and towns in Peninsular Malaysia are predominantly occupied by the Chinese.

site (28 interviews), the Brickfields site (21 interviews) and the Old Kelang Road site (28 interviews) (see Figure 2.12). The first two sites are predominantly occupied by Malays, the second site by Indians and Chinese, and the last site is a predominantly Chinese area. A formal FWES is in operation in the Dato Keramat site. This is an automatic solar powered siren located on the bank of the Kelang River. The other sample sites have no formal FWESs.

There are also other reasons for selecting this area. Secondary data and an insight into the management of floods were readily available. Floods in Kuala Lumpur are well documented and the author spent time on attachment to the DID which permitted access to its ongoing flood mitigation projects and support for this research. The author also spent time at the MMS which is responsible for forecasting heavy rains.

F.2.3 The Kelantan Study Area

Politically, the Kelantan Study Area is unique as Kelantan is the only state in Peninsular Malaysia which is currently governed by an opposition party, viz. the Pan Islamic Party (PAS). The town of Kota Bharu is the capital of the state and is located at the northernmost part of the East Coast of Peninsular Malaysia. It is dissected by the Kelantan River which periodically overflows its banks and floods many parts of the town. Seasonal monsoon floods are a norm and flood magnitudes are high. Severe floods inundating almost the entire district are not uncommon. The area is mostly affected by riverine floods and a combination of riverine-tidal floods. In comparison with the other states in Peninsular Malaysia, Kelantan is one of the poorer states in the country. Kota Bharu town is littered with slums and squatter areas. The area is affected by riverine and tidal floods well as a combination of both. Because of the seasonal nature of the floods, various formal FWESs are in operation in this study area. The Ministry of Information employs the media (mostly radio and television) to convey warnings to the people. At the level of the village, local DID officials, the police and ketua kampungs play important roles in the formal FWESs. In the selection of sample sites within the Kelantan Study Area, four sample sites were chosen: Kota Bharu town (urban, 61 interviews), Kuala Krai (rural and urban, 31 interviews), Pasir Mas (rural, 63 interviews) and Kemubu (rural, 37 interviews) (see Figure 2.13). All areas are dominated by Malay occupants. Within each sample site, households experiencing different flood frequencies were surveyed so as to obtain a cross-section of samples.

F.2.4 The Pekan Study Area

The Pekan Study Area is located on the estuary of the Pahang River, the largest river in Peninsular Malaysia. The area is located within the East Coast state of Pahang. It is divided into four sample sites, Pekan town (51 interviews), Pulau Pekan Baru (22 interviews), rural Pekan (37 interviews) and Ganchong-Pahang Tua (30 interviews) (see Figure 2.14). All areas are affected by a combination of river and tidal floods. Pekan town comprises a mixture of Malays and Chinese but rural Pekan is a predominantly Malay area. Both areas have formal FWESs in operation (radio and television announcements). The Pekan Study Area is chosen mainly because it is one of the most hazardous flood risk areas in the peninsula. Flood magnitudes are high and the area floods almost every year. Despite that, not much has been documented about flooding in the area.

F.3 Sampling

Within the constraints of resources and time in this research, a target of 600 households was decided upon. This gives a breakdown of about 150 households in each of the four sample areas, a sufficient number for common statistical tests to be carried out. The sampling structure is designed to be as representative of the national flood-prone population as possible (see below for a detail discussion).

F.3.1 Pilot surveys

The pilot surveys for individual households, business damage and government officers and other professionals were carried out during the month of October 1992 (while the author was still under attachment at the DID and the MMS). The author spent a few days each at the four study areas and carried out sample pilot surveys and visited the state DIDs and other state level flood hazard organisations. During the pilot surveys at each study area, cadastral and street maps were obtained for the purpose of sampling for the main survey. Potential sampling sites were visited, sketches[5] made and notes taken. Based on the pilot survey, the original questionnaires for all three surveys were subsequently modified (they were shortened and some questions either dropped or rephrased). The training of interviewers was carried out during the first week of November 1993[6]. The main surveys were carried out from the second week of November 1992 to the first week of February 1993. Data processing and entry was carried out from March 1993 to August 1993. Data analysis commenced from August 1993.

F.3.2 Sampling selection of case study areas

In the structured questionnaire survey, probability sampling of all households within the floodplains of Peninsular Malaysia would appear to be the ideal approach. However, this was not possible for a number of reasons. Firstly, although flood risk areas are identified through past flooding (see Figure 2.5), the total number of flood risk properties or the total number of people living in flood risk areas is unknown.

As such, it is not possible to construct a sampling frame which consists of the total number of households living in flood risk areas in the peninsula[7]. Thus, without a proper sampling frame, it is not possible to adopt a sampling design based on a strictly quantitative probability sampling design[8] (though this would have been the ideal sampling design). Thirdly, even if the population of the flood risk households was known, the limited time frame and limited resources available in this individual research project would not have made it feasible to attain a sample size that is statistically representative of the entire flood risk population of the peninsula. Fourthly, the peninsula covers an area of about 18.4 million hectares of which many areas (some of which are flood risk areas) are inaccessible.

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[5] Sketch maps often had to be made in some of the remote villages because cadastral maps were not up-to-date and squatter settlements not shown (see Figure 2.18).

[6] Several other training sessions had to be held for new recruits as some interviewers from the first batch were either dropped (due to incompetence) or resigned.

[7] To identify the exact flood risk population in Peninsular Malaysia would entail mapping all flood risk areas and superimposing them on existing population data. This, in itself, is a major exercise beyond the scope of this dissertation.

[8] A probability sampling design is one in which the total population that is being surveyed is a known entity. In this kind of design, one can specify for each sampling unit of the population the probability that it will be included in the sample. In other words, each unit has the same probability of being included in the sample.

In view of the above limitations, using a probability sampling design was clearly not possible. Nevertheless, in order to maintain some form of scientific conformity, sample areas were not selected haphazardly. The non-probability sampling design was used. In non-probability sampling, there is no way of determining the sampling frame. As such, there is also no way of specifying the probability of each unit's inclusion in the sample, just as there is no assurance that every unit will have some chance of being selected. Although accurate estimates of the population can only be made from probability sampling, social scientists do employ non-probability samples. The major reasons for this practice are convenience and economy, which, under certain circumstances (e.g. exploratory research), may outweigh the advantages of using probability sampling. Non-probability sampling is also used when a sampling population cannot be precisely defined and when a listing of the sampling population is unavailable (Frankfort-Nachmias and Nachmias 1992 p175). In as much as probability sampling is not feasible, the usage of non-probability sampling must be made as scientifically sound as possible in order that selected sample areas do give a fairly accurate estimate of the population characteristics. In this research, quotas and percentages which reflect regional divisions between East and West Coasts, rural and urban populace, flood type, and areas with and without formal warning systems were used. The proportion of households of different ethnic origins were also selected to reflect the national composition.

F.3.3 *Individual household survey*

In studying how individuals (households) perceive and plan strategies towards flood hazard mitigation, the quantitative research methodology employing a structured questionnaire was used. To supplement this approach, some households (about 10.0 per cent of total households selected) were chosen at random for in-depth interviews in order to get a more detailed account of their flood experiences. *This is based on the qualitative research methodology* where accounts of past flood experiences are recorded. This serves to give a more detailed insight into the flood hazard which is not captured by the quantitative survey.

Within each study area, sample sites were chosen based on qualitative non-probability sampling. However, the selection of individual households within each sample site was strictly based on probability sampling. Standard procedures for sampling households were adhered to (Kish 1965; Moser and Kalton 1971). Although sampling frames are also available in the form of electoral register, postcode address file, lists of telephone subscribers and farmer registers, they were found to be problematic and unsuitable. In the present study, up-to-date cadastral maps showing property lots in the flood risk areas (produced from records of previous floods by the DID), street maps and sketches obtained during the pilot survey (in the case of squatter houses and other properties not identified on cadastral or street maps) were used to select the households. As such, each household within a sample site has an equal chance of being selected.

The sampling frame for each case study area is represented by the total of all flood risk properties within each specific sample site respectively. In the case of certain study areas containing squatter dwellings where property lots do not exist, a current street map or a sketch map drawn during the pilot survey to the area was used as the sampling frame. In most cases, a combination of two or more data sources were consulted to form a sampling frame. After the sampling frame has been identified for each study area, the selection of individual households for interviewing was based on simple random sampling. This was done by numbering all the property lots in all sample sites in a study area and drawing the required number of samples from a random number table. In each study area, a target sample of 5.0 per cent of flood risk properties was taken. However, refusals and damaged questionnaires have reduced the sample size slightly but is not envisaged to have a significant effect. A total of 618 households were interviewed from the four study areas (Table F.1).

During the structured questionnaire interview, interviewers were told to record accounts of flood experiences as some individuals had more unique flood experiences and were more responsive than others. This was necessary because the structured questionnaire survey did not allow for such qualitative recordings of in-depth accounts of human experience. In-depth interviews were also carried out (mostly done by the author) with selected households. The qualitative approach was used in such interviews.

F.3.4 Survey of government officers, academics, consultants and other professionals

This is a perception survey on how the experts on various aspects of flood hazard management perceive existing flood hazard management strategies and policies in Peninsular Malaysia. As the number of government officers, academics, consultants and workers of voluntary organisations whose work is related to the flood hazard is not large, an attempt was made to interview all of them based on a list of names obtained by the author. Respondents based in the four study areas were interviewed by the author but those working in other states were sent a copy of the questionnaire and requested to fill it in by themselves. The author also carried out qualitative interviews with individual respondents and had group discussions with employees of some organisations. Telephone interviews were carried out only when respondents were not available for direct interview. A total of 21 respondents were interviewed and a total of 28 self-completed questionnaires were returned. The total of 49 respondents represented 59.8 per cent of the 82 potential respondents on the author's list.

While the in-depth interviews with key planning flood officers at the headquarters of the various federal agencies will provide an insight of the overall Malaysian policies of flood hazard management employed by the federal government on the national level, in-depth interviews with officers at the various state agencies will uncover disagreement with those policies. Furthermore, policies employed by the local district government, municipalities and village committees may also differ. Strictly speaking, federal policies should be adhered to by lower level authorities at all times but variations do occur. This may be due to variations in various aspects of the flood hazard itself, or it may be due to political, social, economic and other regional differences. Thus, respondents selected for this survey represents a cross-section of government officials at all administrative levels as well as independent experts such as private consultants, academics and workers of voluntary organisations such as the Red Crescent, the St. John's Ambulance Brigade, Belia (a youth organisation), and others.

F.3.5 Business damage survey

Although reports on flood losses by business establishments have been regularly reported in the press, there have been few studies on such losses. The only notable exceptions are the flood damage estimation reports by JICA (1982; 1991) and an unpublished study by Smith (1985). In the present study, an attempt was made to discover the scale of flood losses experienced by businesses located in flood-prone areas. This is a supplementary quantitative survey on flood damages to business establishments carried out in each of the four study areas. The questionnaire is a brief two page record of different types of losses suffered by businesses as a result of flooding. It is a brief record of actual flood damage to property, goods, business and other related losses due to floods. Non-probability sampling was used in this survey as every fifth business along pre-selected roads was sampled. The first sample was usually located in the heart of the business district of each of the four study areas. Only the urban areas in each study area were surveyed. The four sample sites chosen for this survey were Georgetown (Pulau Pinang Study Area), Kota Bharu Town (Kelantan Study

Table F.1: Number of households interviewed in selected study areas in Peninsular Malaysia

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Residential	121(70.4)	72(37.5)	90(79.0)	53(37.8)	336(54.4)
Farming	18(10.4)	79(41.2)	0(0.0)	48(34.3)	145(23.5)
Commercial	32(18.6)	30(15.6)	24(21.0)	10(7.2)	96(15.5)
Fishing	1(0.6)	11(5.7)	0(0.0)	29(20.7)	41(6.6)
Total	172(100.0)	192(100.0)	114(100.0)	140(100.0)	618(100.0)

Figures in parentheses are percentages

Area), Kuala Lumpur City (Kuala Lumpur Study Area) and Pekan Town (Pekan Study Area). In this survey, a total of 273 businesses were interviewed (Pulau Pinang = 52 businesses; Kota Bharu = 76 businesses; Kuala Lumpur = 55 businesses; Pekan = 90 businesses).

F.3.6 Evaluation of flood hazard institutions

In many countries, especially in the developed countries in the west, the role of flood hazard institutions (see Chapter 5) is vital in flood hazard management. In the United Kingdom, for instance, researchers have found that flood hazard institutions and not individuals are more influential in flood hazard management (Penning-Rowsell et al 1986). Likewise, flood hazard institutions are also envisaged to play an important role in flood hazard management in Peninsular Malaysia. As such, the evaluation of the adequacies of flood hazard institutions warrant a separate investigation from that of the individual response (as represented by the household survey).

In the evaluation of flood hazard institutions and flood hazard organisations, a qualitative research methodology using the cultural insider (i.e. the author) was adopted. Flood hazard institutions in Peninsular Malaysia are assessed based on a pre-determined 'ideal' set of criteria. In-depth interviews with high ranking government officials of flood hazard organisations regarding the objectives, statutory duties, functions and policies and other aspects of flood hazard management were also carried out. The 'criteria approach' method of evaluation used by some British geographers in researching flood hazard institutions in the United Kingdom (Penning-Rowsell et al 1986) was adopted. In this method, a list of four criteria deemed to be representative of the ideal flood hazard organisation was selected. Malaysian flood hazard organisations were assessed based on this list of criteria.

F.3.7 Collection of secondary data

The collection of secondary data is an important input in this study. Secondary data such as flood reports, annual expenditure on flood mitigation, rainfall and streamflow records, departmental annual reports (those of flood hazard organisations), theses, newspaper reports on floods, historical archives on floods, and other relevant material related to the flood hazard were obtained from the relevant authorities and used as background material in the write-up of this thesis.

APPENDIX G CONCEPTS AND TERMINOLOGIES IN HAZARDS RESEARCH

This appendix defines the key concepts and terminologies used in this thesis.

G.1 Hazards and disasters

The term 'natural hazards research'[1] has been commonly and widely used, particularly amongst geographers during the infancy of such researches. However, it has the connotation that hazards are 'entirely' of natural origins, which is a common misconception (Jones 1991 p28). Thus Burton and Kates (1964) have defined 'natural hazards' as

> 'those elements of the physical environment harmful to man and caused by forces extraneous to him'.

When hazards research first came to prominence in the 1940s, natural hazards were viewed as 'acts of God'. For instance, 'droughts' were seen as 'acts of God' although the losses arising from them were viewed as 'acts of man' (White 1935). This perspective seems to imply that humans do not have any part to play in the creation of such hazards. Gradually, however, results from researches in hazards, particularly in the flood hazard, indicated that humans do play an important role in the creation of such hazards mainly through the choice of 'location' (Burton et al 1978). It is only when humans choose to locate properties and live in areas affected by extreme natural processes that hazards exist. For instance, flooding in an uninhabited swamp is not considered a hazard (unless it gives rise to substantial ecological or other environmental effects). Thus, Blaikie et al (1994) assert that '...there is no risk if hazard and vulnerability do not coincide'[2] (see definitions in Section G.2). Generally, it is often difficult to distinguish a hazard that is attributed to nature from one that is attributed to humans. In fact, the same hazard in one area may be more directly attributable to nature but can be largely created in another area by humans. For instance, seasonal flooding during the monsoon months along riverine mangrove forests in the East Coast of Peninsular Malaysia is considered a natural cause but the occurrence of flash floods in urban areas is considered a human cause (due to rapid development, inadequate drainage, poor planning and others). Yet, it is not uncommon to see the prefix 'natural' being conveniently attached to hazards (disasters or catastrophes) in the current literature, particularly in the media and political publications. This is because the very use of the term 'natural' implies that the hazard associated with it has a natural origin and this thereby exonerates humans from any blame. This, it has been suggested, is an ideologically-based argument in favour of consensus and denies conflicts in the community arising from socially constructed inequalities of power and control (Burgess 1978).

In natural hazards research terminology (particularly that emanating from the Chicago School of Hazards Study), a natural hazard carries with it an inherent element of human

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[1] The term 'natural hazards research' is used throughout this thesis to mean that sub-branch of geography initially uncovered by Gilbert F White in the 1940s and subsequently developed into the so-called 'Chicago School of Hazard Studies'. The term is also used synonymously with 'hazards research' although some geographers have preferred the term 'environmental hazards research' (Parker 1991a p4).

[2] Some researchers are convinced that hazards and disasters are not natural but largely created by human activities (Cannon 1993).

involvement. It includes all those elements in the geographic environment that potentially affect humans, their structures, or their activities adversely (Department of Regional Development and Environment 1990 p7). In the tradition of hazards research, a natural hazard is viewed as the outcome of an interaction between the natural physical system and the human-made system. Thus, Kates (1971) has defined a natural hazard[3] as:

> '....an interaction of man and nature, governed by the coexistent state of adjustment of the human use system and the state of nature in the natural events system.'

In terms of the flood hazard, Kates's (1971) 'General System Model' clearly underlines this distinction and realistically links together the human and the physical world (see Figure 3.1). In this man-nature interaction, the physical world is represented by the 'Natural Events System' which produces the flood and the various characteristics which describe it. These include flood magnitude, frequency, duration and temporal spacing. On the other hand, the human world is represented by the 'Human Use System' which involves human occupance of the floodplain that encompasses human-made activities such as housing, agriculture, recreation and other damageable material wealth that turn the physical flood into a flood hazard.

Burton et al (1978) view natural hazards as occurring within an ecological framework. The resultant interaction between the natural events system and the human use system does not necessarily produce a hazard. In many cases, a flood may be productive and be considered as a resource. For instance, flood waters deposit rich alluvial soils on the floodplains of many river basins making them fertile farm lands. Based on this model, the authors suggest that hazards exist at the interface between the natural and human use systems and that human response to such hazards may modify both the systems. This model thereby distinguishes between natural events and their interpretation as natural hazards (or resources). Nevertheless, the authors persist with the use of the term natural hazards which, by itself is imprecise.

Despite similar explanations and clarifications in the literature on natural hazards research (Kates 1971; White 1974; Burton et al 1978), the term natural hazards has been criticised as being misleading, inappropriate and erroneous as it suggests that the flood event is solely the result of natural phenomena (Ball 1975; Fordham 1992). Yet, others have contended that natural hazards and natural disasters are in no way 'natural' as they can not be dissociated from human society, particularly those which are marginalized and impoverished by years of colonialism and are therefore most vulnerable to them (Wisner et al 1976; Susman et al 1983; Winchester 1992). As human society becomes more affluent and sophisticated, people are not satisfied with the explanation that floods are naturally occurring events. In the quest for a more practical explanation, they look for someone to blame and floods have recently been looked upon as a result of the mismanagement of the state or the misapplication of technology (Penning-Rowsell et al 1986). In the light of the above discussion, floods may be seen at best as 'quasi-natural hazards'. Taken to its extreme, floods have even been regarded as 'acts of man rather than acts of God' (Smith 1979 p7). The term natural becomes even less appropriate when applied to disasters - the sometimes catastrophic outcome of hazards (Fordham 1992 p12). In poorly developed Third World countries where the capacity and

[3] Kates (1971 p444) has acknowledged that the notion of natural hazard as a joint probability of states of natural events and human adjustments was initially developed together with Russell and Arey (Russell et al 1970).

technology to cope with disasters are wanting, the occurrence of such events is usually associated with vulnerability, dependence and marginalization all of which arise because of socio-economic rather than natural factors (Davis 1978; Susman et al 1983; Winchester 1992). Blaikie et al (1994) assert that the social, economic and political processes of human society are the 'root' causes of hazards and disasters.

More recently, the term 'environmental hazard' has been also introduced in hazards research. According to Parker (1991a), environmental hazards are defined as

> '...those hazards that result from the interaction of the environment and human society and are processes and events which are harmful and damaging to society.'

The term does not carry any implication of bias towards either the natural or human dimensions and it has the added advantage of being able to accommodate both, but some ambiguity is caused as some entirely human-made hazards such as pollution and fire has been included in this classification. Environmental hazards may also be viewed as 'costs' to society as they inflict death, destruction, damage and disruption as a result of the intricate interrelationship between nature and society (Jones 1991 p27). Smith (1992 p14) has noted that the term also implies a spectrum of hazard types ranging from largely natural to largely man-made, from intense to diffuse and from involuntary to voluntary. Yet, he has also noted that it is essentially because of its wide applications that has led to impossibly wide definitions. For example, Kates (1978) has defined environmental hazards as

> '...the threat potential posed to man or nature by events originating in, or transmitted by the natural or built environment.'

As a result, this definition can almost include anything from long-term environmental deterioration to all forms of social hazards which have diverse and different origins. The usefulness of such a definition is therefore rather limited. In his quest for a more focused and manageable definition, he has restricted environmental hazards to 'events which directly threaten human life by means of acute physical or chemical trauma'. However, by so doing he has excluded environmental hazards affecting natural ecosystems. Because of the intertwined nature of the natural ecosystem and human society, any damage to the former will also indirectly affect the latter. For example, oil spills which severely damage marine ecosystems also deprive coastal fishing communities of a source of livelihood. The occurrence of an oil spill such as that of the Exxon Valdez may be termed an 'environmental disaster'.

In order to avoid confusion and misunderstanding when referring to researches in the field of hazards, the term 'natural' has often been dropped. Thus, some researchers such as Fordham (1992) have merely used the term 'hazards research' instead of the more conventional 'natural hazards research'. Without the problematic pre-fix 'natural', the term would theoretically encompass all types of hazards, whether naturally created, human-made or a combination of both. Broadly defined, it is taken to encompass that field of research which is concerned with 'the totality of factors which generate, sustain, exacerbate, or mitigate those characteristics of natural and man-made environments that threaten human safety, emotional security, and material well-being' (Mitchell 1984). It is the term 'hazards research' which is therefore adopted throughout this thesis. However, when referring to research pertaining to the behavioural paradigm (see Chapter 3), the term 'natural hazard' which is a central theme (viewed in an ecological framework) employed by those working within this paradigm is retained.

G.2 Floods

The term 'flood' has been variously defined by researchers from different fields. As the study of floods falls in a common research frontier where many disciplines have made relevant contributions, it is thus not surprising to find just as many definitions of floods in the literature. Basically, the definition of a flood is dependent on the objective in which it is coined. Some of the common definitions of floods are as follows:

(1) ...a relatively high flow which overtaxes the natural channel provided for the runoff (Chow 1956).

(2) ...any relatively high flow that overtops the natural or artificial banks in any reach of a stream (Chow 1964).

(3) ...any high streamflow which overtops natural or artificial banks of a stream (Ward 1978).

(4) ...a body of water which rises to overflow land which is not normally submerged (Ward 1978).

(5) ...water on land not usually submerged (Handmer 1991).

In many parts of the world floodplain dwellers distinguish between 'normal high flows' or 'normal high waters' and 'floods'. This is the case in many parts of Peninsular Malaysia, particularly in its East Coast, where seasonal monsoon rains cause the rivers to overflow each year. The problem of defining a flood becomes more problematic here as many traditional Malay houses are built on stilts and flooding to 1 metre above ground may be considered as a form of seasonal high water and not as a 'flood'. Such seasonal flooding, the flood mark of which is below stilt height of the houses and the duration of which is short, is considered normal and floodplain occupants are quite used to them (see Chapter 2). Water levels above stilt height and the duration of which is a week or more is considered a flood. However, many houses with stilts also have a back portion which has no stilts. This section of the house is usually either the kitchen, a spare room or a store room. Occupants of houses with such a design will naturally consider that a flood has occurred when the back portion is flooded even though the main living room and bedrooms are not. Moreover, flooding of any height, irrespective of whether any part of the house is flooded or not will result in temporary dislocation in terms of accessibility, loss of work and income, disruption to schooling, loss of business, loss of crops and livestock and other damages. In the case of the West Coast, normal seasonal inundation of the type occurring yearly in the East Coast would be considered floods. This is because the majority of houses in the West Coast, mostly of the modern type, do not have stilts. In order to provide a workable definition which can be applied in all areas in the peninsula, a flood in this thesis is defined broadly as

> '...any substantially large body of water inundating a previously unsubmerged spatial entity over a definite period of time causing some form of disruption or damage.'

Because floods are a physical phenomenon, all the above definitions (except the last) epitomise the physical perspective on floods. Yet, floods have more often than not been wrongly misconstrued by the public and the press as being synonymous with hazards or disasters. This is very true indeed in Peninsular Malaysia where flood events are notoriously played up by the press even though many flood events may not have affected humans in any significant way. Floods will always be present in areas where physical conditions such as monsoons, low-lying topography and an abundance of water resources favour their creation. However, excess water, even that which inundates places not normally submerged, cannot be considered as hazardous unless it has harmful effects on humans and society. This is because, a flood which occurs in an unpopulated area is strictly by itself a physical event that can only be classified as a 'natural phenomenon'. A flood or any high water in itself is certainly not a threat to humans if the affected area is not occupied by humans or used to conduct human activities. Swamps have always been flooded but such flooding (whether perennial or seasonal) have never been or ever will be considered as a hazard. While one flood may be considered as an 'extreme event'[4] displaying a relatively high variance from the mean (White 1974 p4), another flood of lesser magnitude may be considered as 'normal' in a particular locality. For example, an intense rainstorm in a semi-desert environment which causes a 'flash-flood'[5] is considered an extreme event. However, a similar occurrence in the wet equatorial tropics would be considered quite normal (though it may still be considered by some affected businesses as a hazard). Nevertheless, the occurrence of a flood in the physical world would not automatically qualify it as a 'natural' hazard. It is human occupance of floodplains that has made a normally harmless flood into a 'hazardous flood'. Thus, according to Parker (1991a p4), whilst floods are transmitted through the physical environment (for example, through river systems or tidal surges), it is the action of society that exacerbates the phenomenon. In more ways than one, human societies have been made more fragile and vulnerable to the flood hazard by inadvertent and haphazard floodplain encroachment.

Finally, while hazards research has been mostly dominated by geographers, disaster research has been dominated by sociologists. Similarly, hydrologists, engineers, anthropologists, and others have also made relevant contributions to such researches. As such, there may be as many different definitions to the above terms as there are different disciplines involved in such studies. To complicate the matter further is the peculiarity of the English language which creates confusion when different terms are used interchangeably to mean the same thing. For instance, to the average person the terms hazard and disaster may be synonymous and used interchangeably. Furthermore, both the terms disaster and catastrophe are often used interchangeably as well. However, in the context of scientific enquiry, it is required that such terms be clearly defined. Different terminologies have been applied to floods of different magnitudes or levels of severity. This include floods being described as a 'risk', 'threat', 'hazards', 'crisis', 'emergency', 'disaster' and 'catastrophe' (not necessarily in a hierarchy). Although many of the above terms have been used extensively in a variety of contexts by geographers, sociologists and economists, it is rather unfortunate that neither consistency nor agreement are found in their usage. For instance, the term 'disaster' has been a source of much debate (Britton 1986; Green 1989). Suffice to say that these terms are inherently problematic when it comes to definition because they differ not only quantitatively but also

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[4] An 'extreme event' is considered as a naturally occurring physical phenomenon which (for the sake of differentiating between a natural hazard) is isolated from human society and therefore does not affect humans and society (Burton et al 1981 p288). However, an extreme event may be a hazard if it has damaging effects on the natural environment. This is because of the close relationship between society and the environment and any effect on the latter would affect the former in the long-term.

[5] A flash-flood is defined as a flood event characterised by rapid response to runoff. It is usually of short-duration lasting not more than a few hours. In Peninsular Malaysia, it is most frequently associated with violent convectional storms of short duration (often lasting minutes instead of hours) which are typical of the humid equatorial climatic regime.

qualitatively as well. Furthermore, one definition may be acceptable to the geographer but may at the same time prove totally unacceptable to a sociologist. Indeed, it would be almost impossible to find one definition for the term disaster that fits every researcher's requirements (not to mention the common person's definition as well). While it might prove useful to conduct a literature review of the definitions of hazards research terminologies, it is not within the scope of this research. Nevertheless, in the context of this research, the definitions for each terminology used are carefully considered and subsequently distinguished from one another in order to avoid any misunderstanding and confusion over their usage.

In relation to the flood hazard, the following definitions have been adopted:

(1) Flood risk - The term risk by itself denotes a measure of probability of the occurrence of a hazard. It can also mean the quantified, conditional probabilities that the consequences of a hazard will be harmful (Harris et al 1978 p379). A flood may be considered as a risk if it poses potentially negative effects on human beings and their activities. Risk is absent when there are hazards but no vulnerability, or when there is a vulnerable population but no hazard event (Blaikie et al 1994 p21). The term is used synonymously with 'Flood Threat'.

(2) Flood exposure - The term exposure is a measure of the human population and/or land use at risk from floods. It is similar to the 'unsafe conditions' which are the specific forms in which vulnerability of a population is expressed in time and space in conjunction with a hazard (Blaikie et al 1994 p25).

(3) Flood vulnerability - Vulnerability may be defined as 'the characteristics of a person, household, group, community or state in terms of their capacity to anticipate, cope with, resist and recover from the impact of hazards and disasters' (Blaikie et al 1994 p9). It is the likelihood that a person (and the others) will fail to mobilise sufficient resources to meet the challenge posed by the hazard (Green 1992 p178).

(4) Flood hazard - The key distinction between a 'flood' and a 'flood hazard' is that the former is an event in which flood water inundates an otherwise dry land area, whereas the latter is ever-present in floodplains, i.e. it is not event-based and is continuous. Individuals which make up floodplain communities are therefore constantly threatened by the flood hazard. The term hazard by itself may be regarded as a pre-disaster situation in which some risk of flood disasters exists in a locality. The Royal Society (1983 p22) defines a hazard as 'a situation that in particular circumstances could lead to harm'. A flood may be viewed as a hazard only if it occurs in a populated area and thereby has the potential to inflict damages on property, harmful effects on health and the loss of human life. As such, a natural phenomenon such as a flood which occurs in a populated area is considered a 'hazardous event'[6].

(5) Flood disaster - The main difference between a flood hazard and a flood disaster is that the former is a perceived natural event which threatens life and property whereas the latter is the realisation of the hazard (Whittow 1980 p19). A flood will be considered as a disaster when whole human communities are seriously maimed or crippled (at least temporarily) as a result of an unacceptably large number of fatalities and/or property damage which exceed local coping capacity. Although this definition

[6] See Department of Regional Development and Environment (1990 p7).

is adopted by some researchers who need to quantify disasters (Hewitt and Sheehan 1969), the number of fatalities is not a necessary pre-condition for a disaster. A disaster is still deemed to have occurred when 'the overall damage to an entire community is so severe that most or all public and private facilities no longer provide essential social or economic services (even though no one may be killed)' (Torry 1979b p370). Keller et al (1990) defines a disaster as 'an event which afflicts a community the consequences of which are beyond the immediate financial, material or emotional resources of that community'. In a disastrous flood, the effects is such that emergency managers may themselves become victims and outside assistance is required to deal with it. A disastrous flood will lead, at least temporarily, to massive disruption of function for community and individual (Raphael 1986 p5). Furthermore, recovery (comprising the psychological and physical recovery of victims, the replacement of physical resources and the social relations required to use them) is unlikely without external aid (Blaikie et al 1994 p21).

(6) Flood catastrophe - Taking it to the extreme, a flood will be considered as a catastrophe when almost entire human societies (people and property) are wiped out leaving only few survivors and buildings and infrastructure in ruins. Compared to a flood disaster, a flood catastrophe is of greater magnitude and severity, and the time frame needed for recovery is much longer.

(7) Flood emergency - An emergency refers to a sudden or unexpected situation or event which disrupts society and which requires immediate action and response. An emergency is a threat to the normal flow of life in society and implies the existence of hazards. An emergency situation may progress into an accident or disaster if it is not put under control. A flood emergency is a general term used collectively to refer to a 'flood crisis', a 'flood disaster' or a 'flood catastrophe' (Handmer and Parker 1992). It refers to a flood event in which the medical, welfare, police and other personnel are severely overtaxed.

APPENDIX H SOME UNIQUE QUALITATIVE ACCOUNTS OF MALAYSIAN FLOOD EXPERIENCES

This appendix examines individual cases of flood experiences based on in-depth qualitative interviews with flood victims. Although some cases appear to be quite extraordinary, they are not uncommon amongst floodplain occupants living in the flood zones. In fact, many such experiences may not be perceived by the flood victims as being extraordinary or even unique. To them, these experiences are part and parcel of everyday life on floodplains. They are risks that floodplain inhabitants have to take as the majority are fully aware of the hazardousness of the areas they are living in. It is not uncommon to find that many older inhabitants have so many unfortunate experiences that it may be difficult to single out the worst experience. Often, it is a case of too many experiences that render floodplain occupants finding it difficult to single out the worst flood ever experienced by them. Nevertheless, the following accounts serve to illuminate the range of flood experiences of the floodplain occupants in the peninsula.

Case 1: Makcik (Aunty) Mabee, an urban squatter from Georgetown, Pulau Pinang (Interview date -10 November 1992)

Makcik Mabee is a West Coast urban squatter occupying a small piece of land on the bank of the Air Itam River in Georgetown, Pulau Pinang. She is 60 years old and lives with her retired husband, 5 children and 7 grand children in a house on that small piece of land (Plate H.1). Of the 14 occupants in her house, only her two sons and three daughters are working. Of her 7 grand children, 3 are in school. Makcik Mabee was born in the same house and has always lived there all her life. Structural forces of poverty and landlessness have forced Makcik Mabee's late father to build the house during the 1920s when the area was largely forested and undeveloped. The land on which the house was built was subsequently bought by a Malaysian Chinese, thereby making Makcik Mabee and her family squatters. The Chinese has since tried to develop the land but has been unsuccessful because of its proneness to floods. To recover his investment, the Chinese is charging rent on those squatter families occupying his land. And he has forbidden any renovation, repairs or additions of structure of any kind to their squatter houses. Makcik Mabee's house is made entirely of wood but has since been renovated or rebuilt several times because of damages caused by flooding. Today, the ground floor section is reinforced by a 0.5 metre high brick foundation which supports the back section. In the front section, four 0.75 metre high wooden stilts prop up the floor. Because of this type of structure, a flood depth of 0.6 metres would flood the back portion (kitchen) of the house but only a flood depth of more than 0.75 metres will flood the front section (living and dining rooms). The bedrooms are located slightly higher in a form of split level about another 0.5 metres above the dining and living rooms. Thus, only a flood depth of more than 1 metre will flood the bedrooms. With the height of the beds another 0.5 metres high, only a flood depth of more than 1.5 metres will flood the beds as well.

However, flood depth is not the only danger that affects the house and family of Makcik Mabee. When a flood occurs the velocity of the river current is very strong and this poses a very dangerous hazard to the structure of the house. In two separate incidents, the front portion of Makcik Mabee's house had collapsed during flooding because of the erosive force of the river current. In view of this, a separate storage barn with a built-in chicken coop was constructed just in front of the house to reduce the velocity of the river current during flooding. This barn is a flood loss reduction measure and has served to protect the family house from the direct force of the river current. Nowadays, Makcik Mabee and her family only has to repair damages that occur to the barn instead of that which would occur to her house. Nevertheless, during times of large and severe floods such as the flood in June 1991

Plate H.1: (a) Makcik Mabee during one of the many floods that affect her house. (b) One of Makcik Mabee's daughters cooking in a flooded kitchen. (c) Makcik Mabee's son Rus' returning home from work in a sampan. (d) Makcik Mabee's family enjoying a swim during a 1990 flood. (e) Makcik Mabee and her daughters and granddaughters during a flood in 1990. Flood depth was about 1.5 metres. (f) Makcik Mabee's wooden house which has been repaired beyond recognition over the years (a 1 in 30 year event), even the barn cannot protect the house from being threatened by the current. During this flood, the awning and porch of the house had collapsed.

When she was a child Makcik Mabee had briefly recalled the occurrence of floods every once in a while (she estimated that flooding then occurred once every few years) but it was always fun then because the flood waters were rather shallow and did not cause a lot of problems. She remembers with a tinge of nostalgia of how she would play in the flood waters with her father and other children in the same locality. In the last decade, particularly in the last few years, she recalled that flooding had become much worse (in terms of magnitude and frequency). She attributes this to rapid housing and town development, especially in the Air Itam town area on the upstream stretches of the river. Today, flooding (flooding is taken to mean the river overflowing its banks and subsequently flooding the adjacent floodplain even though the flood waters may not enter the house) occurs at least 7 times a year. In fact, every time when heavy rains occur continuously for more than an hour and they coincide with high tides, the river will overflow its banks. However, not every flooding of this kind will result in the flood waters entering her house. Nevertheless the stress and worry caused by such flooding is immense. According to Makcik Mabee, continuous heavy rains during the night almost always cause her to lose sleep because she instinctively wakes up to check on the river levels for fear of serious flooding of the type in June 1991.

Makcik Mabee's plight and those of others living in the vicinity of her neighbourhood is often covered in the newspapers. Come every heavy rain spell Makcik Mabee and her family fear they may be swept away by the flood waters. According to Makcik Mabee,

> '...I do not fear so much for myself. But I am very worried for my grandchildren. They are very small. My youngest grandson is only two months old....I remember the flood last year. The water rose more than 5 feet (1.7 metres). I had to get a rescue boat to take my grandchildren to the relief centre. When we came back after the water had receded, I found our furniture, clothes and household items were all destroyed'. (New Straits Times 6.11.86).

Makcik Mabee had contemplated flood proofing the house by building upwards, viz. raising the lower floor levels and the bedroom levels. However, when she approached the land owner she was told in no uncertain terms that nothing is to be done to the present property. This was because the owner had intentions of selling the land. Incidentally, the owner today is the descendant of the original owner. According to Makcik Mabee, the original owner was a close friend of her father and had never given them her family any trouble. He was very understanding and gave them a free hand to do what they liked with their house. However, the present owner had other ideas. Due to the increase in land prices in the past few years, because of limited land for housing on Pulau Pinang, the owner had wanted to sell the land on which Makcik Mabee's house is built. Many prospective buyers had been to her house to see the piece of land but on each occasion had decided against buying because of the high risk of floods. Still, the owner is hopeful and is adamant about selling. Because of this, Makcik Mabee and her family cannot flood proof their house even though they want to.

The family's main strategies on flood hazard reduction includes: (1) keeping electrical appliances on shelves fixed high on the walls; (2) flood watching by Makcik Mabee and her husband during the rainy season (they take turns to sleep during the day and to stay awake when it rains at night); (3) all children sleep in the upper floors; (4) electrical mains are switched off during floods; (5) motorbikes and bicycles are parked on higher ground; (5)

telephone the police as soon as waters from the Air Itam River flood overflows its banks; (6) warn relatives and friends nearby. Curiously enough, listening to the nearby automatic solar-powered siren (set up by the DID) is not one of the family's strategy. They do not trust it and think that it is a 'joke' as it goes off many times before an actual flood occurs.

During the floods of June 1991[1] in which the height of the flood waters almost reached 3 metres and lasted 24 hours, Makcik Mabee suffered unprecedented losses. Repairs to the structure of the house alone cost $650. Another $700 was spent on replacing or refurbishing the damaged contents of her house. This includes carpets, furniture, crockery, cooking utensils (floated away in the flood waters), foodstuffs (mainly rice and salted fish), and electrical appliances which included a washing machine, an electric kettle, two table fans, an iron and a hair dryer. In terms of vehicles, her family had to spend $1,000 to overhaul and repair her husband's car, another $400 was also spent to repair her son's motorbike. However, her greatest loss was the drowning of a total of 30 heads of goats during the flood. With each head fetching $300 in the market, she had lost $9,000, almost her entire fortune. Loss of work to the whole family amounted to about $500 while medical expenses incurred as a result of sickness caused by the floods (either directly as a result of over exposure to the cold and wet flood waters or indirectly as a result of stress) amounted to $100. Obviously, the effect of stress and worry cannot be gauged in terms of ringgits. Finally, some losses were suffered in terms of damage to memorabilia such as photographs, old collector items and inherited antiques. All in, Makcik Mabee lost a total of $12,650 which was a lot of money considering her husband's pension was only $400 per month and her entire family income was less than $2,000 per month. This is a moderate household income by Malaysian standards but it should be viewed in the perspective that there are three families in this household and fourteen mouths to feed.

During the most recent flood (0.75 metres high and lasted 4 hours) which occurred in October 1992 (a few weeks before this interview), Makcik Mabee only suffered minor losses amounting to $200. The bulk of this loss was due to the loss of livestock such as chicken and repairs to the lower floor of her house.

Makcik Mabee's family wants to move but is unable to do so because it would be difficult if not impossible to find a cheaper place where the whole family can live. There is talk about relocating her family and other squatter families by the authorities to nearby government flats but so far nothing has materialised. The problem is compounded by the fact that the authorities are only willing to allocate one flat to the family even though Makcik Mabee's family is an extended one with three separate families (two of her children are married with children of their own but are forced to continue to live with Makcik Mabee because of high rents elsewhere). Structural contextual forces, therefore, are largely responsible for keeping the Mabee family and the majority of squatters on hazardous urban floodplains.

Case 2: **Zaini Abdullah, a clerk from Air Itam, Pulau Pinang (Interview date - 8 November 1992)**

Zaini works as a clerk in Georgetown but lives with his 60 year old mother in Kampung Happy Valley on the outskirts of Air Itam town. It is located in a depression bordered by the Sungai Dondang which is a tributary of the Sungai Pinang. The residents in Zaini's kampung

[1] No photographs were taken by makcik Mabee's family during the June 1991 flood because the flood was too severe. The height of the flood waters reached roof level and everybody had to be evacuated.

blame intensive large scale housing developments and agriculture on the slopes of previously forested hills around Paya Terubong as the main causes of the increased flood threat (see Plate 5.1). While the environmental effects of forest clearing, especially on hill slopes, are varied, the incidence of floods have been especially well documented (Friends of Penang Hill 1991). Before the new town of Bandar Baru Air Itam was developed, the flood frequency at Zaini's house was about once in a few years. After the construction of the housing estate and infrastructure began in the 1980s, the frequency and magnitude of flooding had increased substantially. Now, every time it rains heavily for more than a few hours, flooding occurs. In 1992, Zaini claimed that floods of varying magnitudes had occurred four times. Although a religious man, Zaini firmly believes that floods in his kampung are not an 'Act of God'. Rather, he blames the housing developments on the hill slopes of the Paya Terubong Hills as the sole cause of his flood woes.

During the widespread June 1991 flood, the flood waters in his house reached a height of 2.5 metres. As a result of the nearby bushes and forest being flooded, there was the additional danger of snakes, especially Malaysian cobras, taking shelter in his house. Zaini recalled that he found four such reptiles in the kitchen and the chicken coop. For safety (from floods and snakes), both he and his mother had to evacuate to a relative's house elsewhere in Pulau Pinang for two days. He considers the June 1991 flood to be the worst ever experienced. During this flood, his total loss was $1,300. This included damage to household items, poultry and personal belongings. Although Zaini seems quite calm about floods (even though he bears a grudge against the housing developers), his mother is quite hysterical about it. She claimed that floods in the past few years have caused a lot of stress and worry. She is affected psychologically as she cannot sleep properly whenever it rains. Furthermore, during times of flood she invariably falls sick because of over-stress. Zaini has considered moving elsewhere but financial considerations and his obligation to his mother have prevented him from doing so. His mother does not want to move as all her relatives and friends are in the kampung. She does not like living in a flat in the city and insists that she would want to die in the kampung and be buried beside her late husband in the cemetery nearby.

Case 3: Mohd Isa Wadi, a flood survivor from Kemubu, Kelantan (Interview date - 17 November 1992)

Mohd Isa Wadi is now 8 years old (Plate H.2 Top). He goes to school in Kemubu and is in a government primary school. He is a normal and healthy child just like all the other kampung boys in Kampung Arun Naka in the Kemubu Irrigation Scheme area. However, had fate not been on his side, he could have easily been one of the unlucky victims of the disastrous flood which devastated most of Kelantan in 1988. More precisely, had it not been for the timely intervention of his neighbour Pakcik (uncle) Hassan Harun, Mohd Isa Wadi would have been washed away and drowned in the flood waters. During the 1988 flood Kampung Arun Naka was under between 1 to 2 metres of water. The road in front of Mohd Isa's house is the highest ground and was only submerged under a foot or so of water. He was only 4 years old then. Apparently, he was trying to get to his friend's house across the narrow road which separated their house. It was raining heavily and Mohd Isa was carrying an umbrella. Being a small boy he only stood at about slightly under three feet. As such, half his body was submerged as he walked along the road. At about the same time, possibly around 4.00 pm Pakcik Hassan Harun was having his regular afternoon smoke of Indonesian 'keretek' cigarette on the stairs of his kampung house (Plate H.2 Bottom). He saw Mohd Isa struggling along the road and was not at all alarmed as all the other kampung boys knew the road well and knew exactly what they were doing. As he turned to request a cup of tea from his wife he took his eyes off the little lad. In that split moment of time Mohd Isa had stepped into the huge drain that lined both sides of the road. As Pakcik Hassan turned around, Mohd

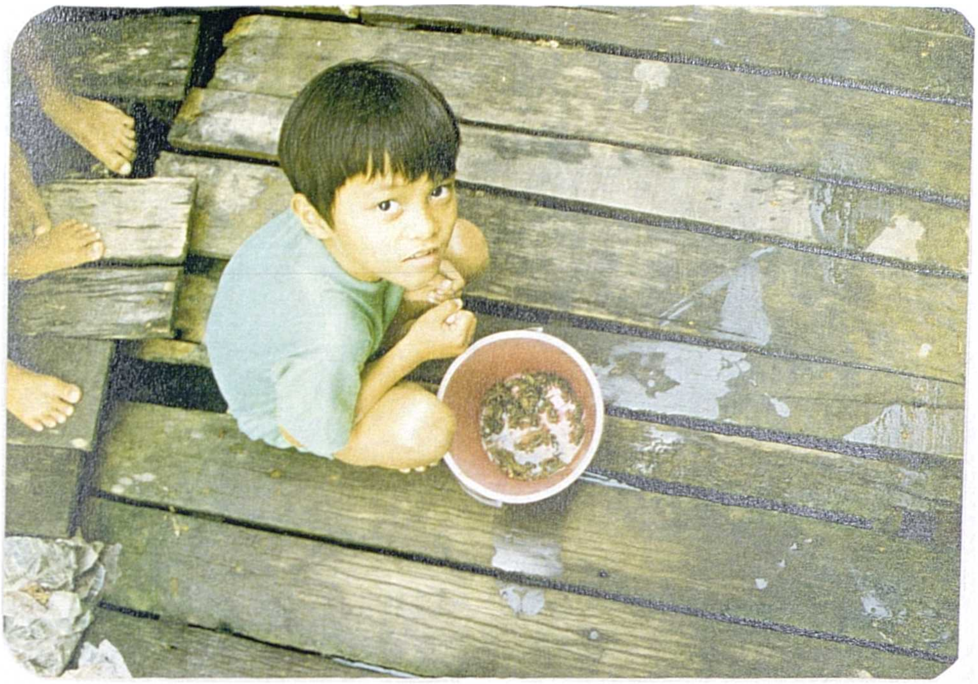

Plate H.2: Top: Mohd Isa Wadi with his catch of crabs from the padi fields. Bottom: Pakcik Hassan's house after a normal convection storm in the afternoon

Isa had disappeared. Only the umbrella was visible. Soon, even the umbrella was being dragged below by the strong flood waters. The strong current was due to the presence of an underground monsoon pipe that lay under the road. Water from Pakcik Hassan's side of the road was flowing through the monsoon drain over to Mohd Isa's house. Then, the umbrella disappeared! Pakcik Hassan jumped up immediately followed by screams from his wife who also saw part of the incident.

The old man (Pakcik Hassan was 53 then) dived into the muddy flood waters and took a deep breath before he went down groping for the boy. Hassan was born and bred in the same kampung and had grown up learning how to swim in the nearby Kelantan River. He was a good swimmer and diver during his younger days. Apparently, he could stay under water for almost 3 minutes at any one time. He had learned to hold his breath under water because of his fishing days. Whenever his line was stuck in the water he had to dive into the water to try to retrieve it. During those days fishing hooks were expensive and he had a few favourite ones which he did not want to lose. But those were the days. He had not swum nor dived for a long time now. But this was an emergency. When there was no sign of Mohd Isa in the area around the drain, Hassan knew instinctively that the boy must have been dragged by the underwater current into the monsoon drain under the road. Taking another deep breath he went under for the third time but this time he went straight for the monsoon drain. He could not see anything in the muddy waters but he was used to this type of diving as the Kelantan River water was just as muddy when he dived for his hooks. Then he had to hold his line and follow it down to the bottom of the river to free his hook. Now, all he had to do was just grope around and he found the opening and went straight into the drain. There was still no sign of the boy. When he was half way through, he was pricked by something sharp. It was the umbrella! Then he found the boy! He got hold of the boy's head and pushed the boy until he was out of the pipe on the other side of the road. Finally Hassan got himself out. He was still holding the boy's head. Instinctively he dragged himself and the boy on to the shallow part on the road. Then he held the boy's legs with one hand and massaged the boy's throat and stomach with his other hand. Water came squirting out of the boy's nose and mouth. Then there was a cough. Then more coughs and then the cry. Mohd Isa was saved. Hassan took him back to the boy's parents who were oblivious of the entire incident. The boy's father was apparently in the padi fields and his mother was busy cooking. Mohd Isa was not even sent to hospital for a check-up. It is not uncommon for such accidents to happen to children who play in the muddy flood waters during the flood season. He had a narrow escape. So what? He is alive now and crying like any normal boy. There was no need to go to the hospital! Besides, they may have to row his father's sampan (small wooden canoe) about 5 miles to the district hospital which may have been flooded during that time as well. Such is the attitude of kampung folks. His father also earn a meagre income barely enough to support the family. According to Mohd Isa's mother, the household income fluctuates between \$200 to \$400 per month, depending on the season. There is no way the family can afford to move elsewhere. The official agricultural authorities also do not encourage farmers to move as there is currently a severe shortage of farm labour as youngsters are being attracted to the cities. During floods, the family depend on the authorities for help and subsidies.

Case 4: Siew Kim Choon, a shop-owner from Kuala Krai, Kelantan (Interview date - 19 November 1992)

Siew Kim Choon is a politically active member of the Chinese community in Kuala Krai. He owns a sundry shop in Kuala Krai town selling household provisions. According to him, floods are a common hazard in Kuala Krai (Plate H.3). During his 30 odd years living in Kuala Krai he had experienced many floods. He cannot recall which flood was the worse but

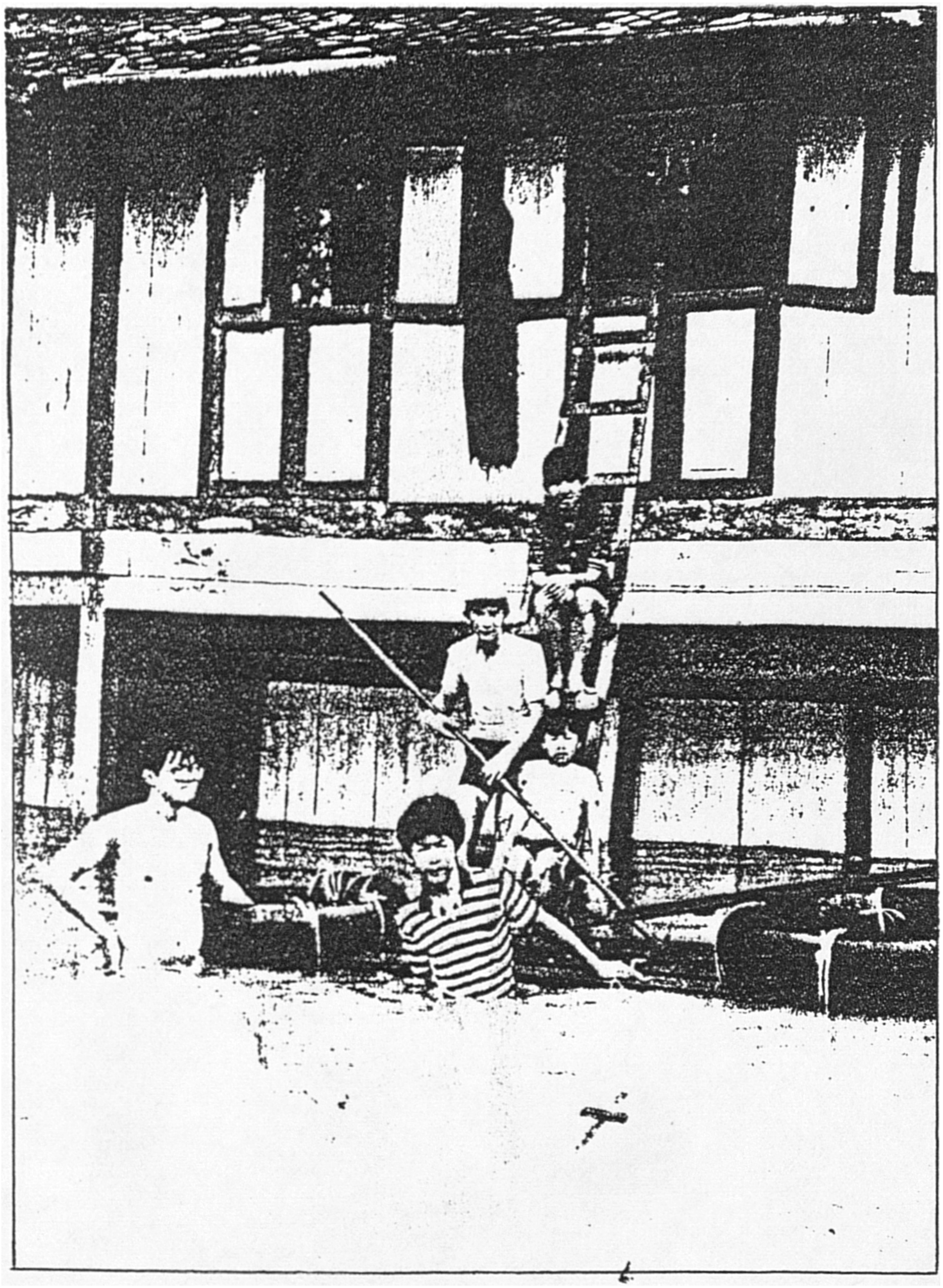

Plate H.3: Siew with his family after evacuating his old mother to a nearby village which was not flooded. Note the ladder going into one of the upstairs windows. The ground floor is almost completely flooded and the main door cannot be used some accounts of his grievances are outlined here. As chairman of the Hakka[2] Association, it was his responsibility to see to it that flood victims of Hakka and other Chinese origins get their fair share of government aid during times of floods. In the 1983 flood, Siew recalled that the first time he realised that a flood was coming was when he saw the red balloon[3] raised over the police headquarters in Kuala Krai town. The raising of the red balloon was shortly followed by the Kelantan River overtopping the 'Bradley Steps'[4], now renamed 'Tangga Krai' (Plate H.4). The first to be flooded was the police headquarters as it was located just beside the river. The flood waters rose swiftly. Within half a day, the whole of Kuala Krai town was flooded. Siew's shop house was flooded to a depth of 1.5 metres. He managed to shift most of his goods upstairs. With that kind of flood depth, his own losses were minimal. To minimize losses, Siew stores all the expensive provisions and goods on the upper shelves in his shop. He orders only the bare minimum of stock during the Northeast Monsoon months. Finally, he gets his boat ready which is capable of moving people as well as goods. Thus, losses are kept to a minimum during times of floods.

Siew's main task during the floods was to liaise with the government officials over the amount of food, clothing and other rations to be given to the Chinese community (who were mostly Hakkas). He recalled having to row his sampan a few miles to get all the allocated provisions such as sardines, rice and clothes from the government. He argued that there is too much official bureaucracy even during times of floods. He is of the opinion that the government should make it easier for flood victims to obtain relief and that such aid should not be politically motivated. Had it not been for his initiative, then the Hakka people would certainly not have received the food aid from the government. This would have created a grave situation as the floods lasted more than a week. He had expected the government to come to the victims and give them the provisions, just as they have done so in the various kampungs on the outskirts of Kuala Krai town. Perhaps this overlooking of Kuala Krai town by the authorities was a deliberate one as other kampungs in low-lying areas were worse hit than the town. Kuala Krai town was just one isolated case in which the government may have overlooked, considering the thousands of communities threatened by the floods then. Yet, Siew is critical of the authorities and his opinion of the government in terms of flood relief is very low. He is also sceptical about the effectiveness of formal FWESs. He has no plans for relocation even though he has the means to. He believes he is well attuned to floods and can cope reasonably well. He thinks that flooding is an acceptable risk that is not too 'risky'. He continues to live in Kuala Krai town largely because of his business and his association with the Hakka Association, but he believes in relying more on himself than others during times of floods. Perhaps, all occupants in flood-prone areas should adopt his attitude of self-reliance but certainly not his attitude towards official flood relief operations.

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[2] In Malaysia, the Chinese community consists of three major clans, viz. the Cantonese, Hokkien and Hakka.

[3] Balloons of different colours were used to warn people living in the vicinity of Kuala Krai town of impending floods. A green balloon was raised over the police headquarters high in the air for everyone to see when the river level at a certain upstream location had reached the alert mark. Similarly, a yellow and red balloon was raised when the river level had reached the warning and danger marks respectively.

[4] The Bradley Steps, the brainchild of an English expatriate, were constructed during the colonial era. They are a flood monitoring device based on a series of steps from the highest point on the bank of the Kelantan River to the river level at Kuala Krai. The rise and fall of the river level is measured by a number of calibrated poles along the steps.

Plate H.4: The Bradley Steps in Kuala Krai town. Note the measurements on poles from the top of the steps to the bottom where the Kelantan River lies. As the river level rises, the measurements can be read on the poles. The steps are used as a form of flood warning not only to residents of Kuala Krai and its vicinity but more importantly for the capital town of Kota Bharu located downstream

Case 5: Kak (Sister) Atikah, a fisherwoman from Pulau Pekan Baru, Pahang (Interview date - 22 November 1992)

Political pressures were originally responsible for Kak Atikah's arrival in Malaysia. She is a Cambodian refugee who came to Malaysia together with other Cambodian refugees when war broke out in her country in the 1970's. Most of these refugees settled on small islands off the Pahang River near Pekan in 1975. Initially they were denied entry but they built wooden huts on stilts and stayed on. Almost all of them made their living by fishing. Gradually, as the years went by they became accepted by their Malaysian neighbours across the river bank. Many of their children who were born after their arrival have been granted Malaysian citizenship. Today, most of the Cambodians have been given some form of civil rights whereby they can continue to stay. Some have been given red identity cards. This means that they can stay permanently but they are not citizens of Malaysia. Yet, some lucky ones have been given outright blue identity cards which entitles them to apply for citizenship. Kak Atikah's eight children (Plate H.5) are all Malaysian citizens but it has been tough bringing them up on her own. Her husband went to look for a better job in the town of Kuantan, and never returned.

Kak Atikah depends on fishing and harvesting plant products from mangrove and fresh water swamp forests for a livelihood. Her combined monthly income is less than $200, well below the poverty line. During the Northeast Monsoon months, fishing activities cease because of the dangerous conditions and Kak Atikah is forced to work as a part-time labourer in every odd job she can find. Friends invariably try to help her but they are also in the same situation. Poverty and other structural constraints prevent Kak Atikah and the other Cambodians to move elsewhere. And because they are 'illegal aliens', their plight is of low salience on official agendas.

Due to their poor economic condition, Kak Atikah and most of the Cambodians are still living in the river mouth area off the river bank. These areas are most vulnerable to seasonal floods during the monsoon season. Almost every year they are forced to evacuate to higher grounds because of the flood hazard. There are 24 houses in Pulau Pekan Baru and many more on other adjacent islands. The Cambodians only occupy houses on Pulau Pekan Baru. Houses on other islands mainly belong to Chinese and Malay nationals. The houses are built on stilts and are linked to each other by wooden pathways. As the houses are in the path of the Pahang River, the current is swift and strong when the river is in spate. During times of high flow and flood flow, many houses on the fringes have been either partly or completely destroyed. To counter this problem, the Cambodians have reinforced the structure by linking their houses together with planks. For instance, Kak Atikah's house is linked to four of her neighbours' houses by wooden planks which also double up as pathways or bridges as the ground is always below the water level of the river. However, the wood used is of poor quality and a lot of the wooden pathways were rotting. In fact, the residents admitted that they constantly have to replace broken and rotted planks. Furthermore, the constant erosional force of the river current also contributes to the destruction of the building structure. According to the residents, almost all houses in Pulau Pekan Baru have had some parts destroyed or washed away during one of the many floods.

Besides the above flood loss reduction measure, many other strategies have evolved. These include: (1) teaching the children to swim as soon as they are able to walk. Despite growing up in a water environment, there have been cases where children have been swept away by swift currents during severe floods; (2) using their fishing boats as means of evacuation; (3) evacuate as soon as the order is given by the authorities (some evacuate even before the official order); and (4) move out temporarily to live with relatives and friends during

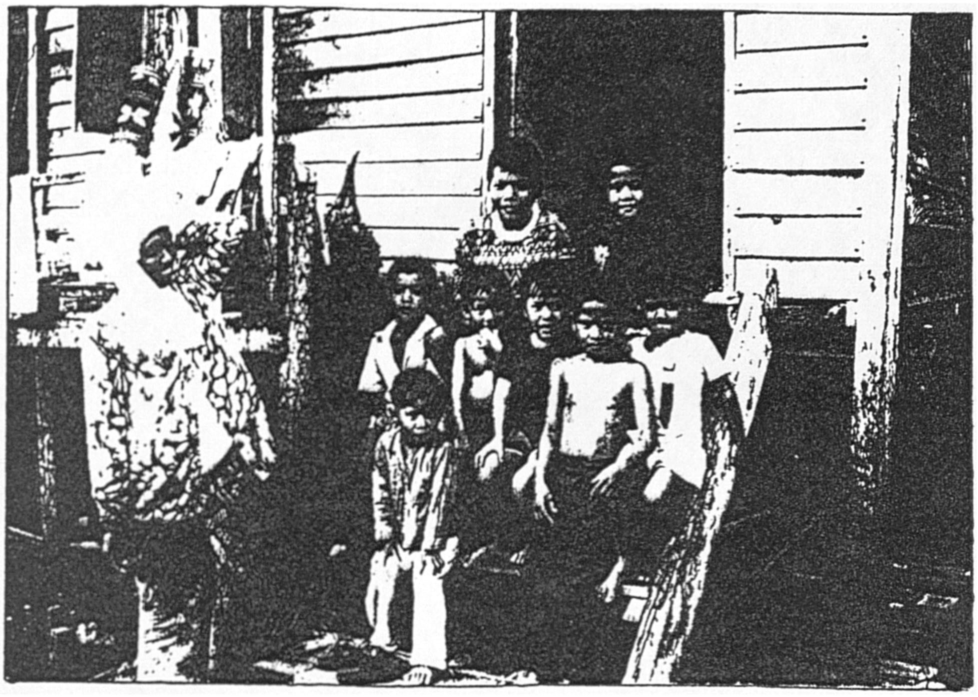

Plate H.5: Kak Atikah and her eight children. Note the rotting stilts and stairs. The houses in her kampung are all built on stilts. Wooden planks link and bind the houses together. The planks also serve as walk-ways. More importantly they serve to strengthen the house structure against the force of the flood waters the flood season.

Pulau Pekan Baru has since been supplied with electricity but there is no piped water. For drinking and cooking, the Cambodians draw groundwater from beneath the river bed by means of an electric pump. For bathing and washing purposes, they use the river water. Sewage is directly discharged into the river. The Cambodians have built their houses on land belonging to a Malaysian. For each house, they have to pay about $96 a year as rent. Considering the fact that their average monthly household income is $348 (below the poverty line), the rent is a substantial amount. Due to the proposed construction of a flood embankment along the river bank adjacent to Pekan, the government has decided to relocate some of the people whose houses are in the way. Work on the project is scheduled to commence in 1993. Many of these people have been given a piece of land near Paloh Inai (5th mile) to build their new houses. Each household has to pay about $850 to secure that piece of land. Even so, there are still many Cambodians who, like Kak Atikah, are living 'from hand to mouth'. Therefore, they are constrained by structural contextual forces and cannot afford to move. The Cambodians are also reluctant to move because moving will mean an end to their livelihood. They will have to give up fishing, the only job they know, and take up new jobs. For many of the older generation such as Kak Atikah, learning a new trade may be difficult. Many are afraid of relocation. So unless the authorities provide some form of concessions such as loans, and guarantee these people some jobs they can handle, it is unlikely that the inhabitants of Pulau Pekan Baru will ever 'evolve' on to dry land.

Case 6: Ismail Bin Midun, a moderately well-off East Coast padi farmer from Kampung Keladi, Pekan, Pahang (Interview date - 27 November 1992)

Ismail bin Midun is 53. Like most of his neighbours, Ismail is a padi farmer but he is more fortunate in that he has inherited 10 relongs (5.3 hectares) of padi land from his father. Being from a more well-off family, Ismail attained secondary education and is considered very well educated in his kampung. Besides working on his 10 relongs of padi land, he serves as a part-time teacher in a religious school. His income is, therefore, higher than most of his neighbours. His monthly income from farming is highly variable because of the nature of farming and the many hazards affecting his crops. It varies between $300 to about $500 per month. As a part-time teacher his salary is at least assured, about $300 per month. Ismail has a family of four children. Because of his 'double-income' he is considered one of the better-off farmers in Kampung Keladi. He has some savings which helps him recover from floods and other hazards. Unlike his poorer neighbours his situation is not as heavily controlled by structural forces such as poverty, illiteracy and low occupational mobility. He has the option and means of moving elsewhere. Yet, Ismail is strongly affected by other structural forces, largely of the socio-cultural kind. Although his children have long since migrated to live in the cities (and have tried incessantly to persuade him to leave), Ismail's attachment to his inherited land, his love for his kampung (at the time of the interview Ismail is the ketua kampung), his close ties with his relatives and friends and his religious pursuits have strongly affected his decision to stay. And despite his relative well-being, he is often badly hit when major floods occur. For example, in the 1971 flood he lost his entire crop, and his car (an old Morris Minor), was damaged beyond repair. His property was also severely damaged requiring repairs running into thousands of ringgits. But he has always been able to recover sufficiently to resume farming because of his extra income from teaching and his savings.

Ismail was born and bred in Kampung Keladi, a small kampung about 2 km from Pekan town. Kampung Keladi is famous not because of its farming nor its closeness to the royal town of Pekan. Rather, it is famous because it was the birth place of Malaysia's second Prime Minister, the late Tun Abdul Razak. Today, the house in which the late Tun was born has been reconstructed and is used as a show piece of the Pekan Museum (Plate H.6). Tourists from all over the country visit Kampung Keladi throughout the year except during the monsoon months of between late November to the end of March. During these months Kampung Keladi is subjected to serious flooding almost every year. What varies is not whether the floods will come or not but rather how bad the flood will be.

The inhabitants of Kampung Keladi are very attuned to the normal seasonal floods when the Pahang River spills its waters on to the adjacent floodplain. People have built houses on stilts that are high enough to stop the flood waters from entering their premises during normal floods. Yet, during extreme major floods, even the stilts cannot keep out the flood waters. For example, during the 1971 flood when it rained continuously for 5 days and 5 nights, the waters rose 2 metres within 11 hours and another 1.5 metres in the next day. Ismail recalled that his house was flooded up to roof level and he had to evacuate his family to a relief centre 15 kilometres away. During this flood, even the best adapted inhabitants of Kampung Keladi had to be relocated. Thus, although rural people are well attuned to normal floods, they are highly vulnerable to major floods. This is especially so in the case of the poor, aged, very young and handicapped. Studies have shown that rural-urban migration have resulted in mass exodus of rural youth into cities, leaving behind the aged and the very young (Muhammad Razha 1978; Rajmah A Samad 1978; Chan 1991a). This is largely due to 'push' factors such as land fragmentation, landlessness, low productivity in farming, higher educational attainment amongst the young and 'pull' factors such as the attraction of city life, education, employment and business opportunities. Thus, the aged, very young, handicapped, and unwell are the ones left behind and they are the most vulnerable to flood hazards. According to Ismail, thousands of people were stranded for several weeks in make-shift relief centres during the 1971 flood, most of them children and the aged. There was widespread cholera due to the shortage of drinking water and the medical authorities could not cope with the number of people affected.

According to Ismail, the flood waters in 1971 started coming in at around 6.00 pm and it rose to 2 metres around 5.00 am the next morning. Ismail jumped out of his bed and rowed his sampan to the village head's house to inform him. Together they went to inform the DO (District Officer) at his house. By the time the DO rounded his men who came with two empty trucks it was already about 11.00 am. Fortunately the roads to Kampung Keladi were still passable. The trucks negotiated some of the shallower stretches of flooded roads and managed to evacuate about 100 kampung folks to the Sekolah Tengku Ampuan Fatimah, a school located on relatively higher ground in Pekan. By 6.00 pm the next day, all the roads going to Kampung Keladi were impassable. According to Ismail's estimation, the flood waters rose to a height of between 3.5 to 4 metres. He recalled that only 0.5 metres of the telephone pole by the side of a road was visible. Many of his poorer neighbours' houses with low stilts were completely submerged. The flood waters stayed in Kampung Keladi for almost a month although many of the kampung folks went home to stay after the flood waters had subsided to about 2 metres. This was about two weeks after their evacuation.

After this flood, the government was convinced that Kampung Keladi was much too unsafe for its residents and that all its residents should be permanently relocated elsewhere. A place called Kampung Dato Shah Bandar was earmarked for the relocation. Each family was given a house on a piece of land measuring a quarter of an acre. Each family had to pay the government $2,817 for the house and land. Eventually, a total of 20 families were relocated. Another 10 families from Kampung Keladi were offered places in a FELDA land development scheme near Bentong. Now, only 16 families are left in Kampung Keladi. Ismail's is one of them. Most of these families were the original inhabitants of Kampung Keladi before the 1971 flood. Many have left their new houses in Kampung Dato Shah

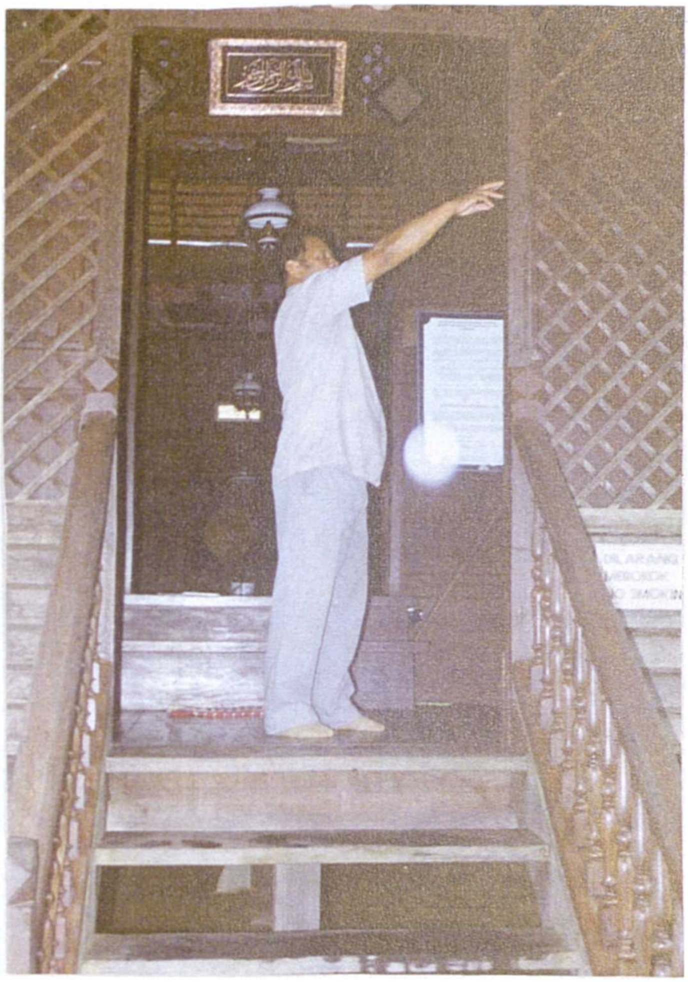

Plate H.6: Ismail Bin Midun indicating the flood depth during the 1971 flood in the house in which the late Tun Razak (Malaysia's second Prime Minister) was born

Bandar to their grown-up children and they themselves have returned to their beloved kampung of birth. Ismail is one such person. Besides padi farming, he plants vegetables, fruit trees and has a smallholding of rubber inherited from his father. Because of the high incidence of floods, losses are high but he is not bothered. His way of life is simple and his needs are limited. Furthermore, he can always fall back on his income as a part-time teacher. When Ismail was posed the question as to whether he thought another big flood like the 1971 flood would come again, his answer was a definite 'Yes'. Yet, he has no qualms about staying on. For him, as is for most muslims, fate lies in the hands of Allah (God).

Case 7: Maliveloo, a barber from Kampung Haji Abdullah Hukum, Kuala Lumpur (Interview date - 17 January 1993)

Maliveloo is a barber running his business in his own house. He is 50 years old and has been living in Kampung haji Abdullah Hukum for 24 years. His kampung is located on the west bank of the Kelang River and is very flood-prone. According to him, it floods at least two to three times a year (Plate H.7 Top). Flooding is due to a combination of inadequate artificial drainage and rubbish dumping into the Kelang River. Like most of his neighbours, Maliveloo has flood proofed his house (Plate H.7 Bottom). Because of this, Maliveloo's perception of a flood is somewhat different. Unless water enters his house, Maliveloo will not consider it as a flood. In 1992, there were two occasions in which flash floods have occurred in his kampung but on both occasions, water did not enter his house because of the high concrete thresholds across all his doors. As a result, Maliveloo did not consider the two events as floods. According to him, his business has not been affected by the floods. Although the residents in his kampung have been warned by policemen during flooding, they are highly sceptical about the formal flood warning system. They report that the warning always come too late. In many instances, officials of the Kuala Lumpur City Hall were the first to warn the people and not the police. Maliveloo is of the opinion that flooding in the past was worse than the present. He is aware that the Drainage and Irrigation Department is dredging the Kelang River all year round and that big floods have since been under control. He believes that a flood of the 1971 magnitude will not occur again.

Case 8: Anbalagan, a motorcar mechanic from Kampung Haji Abdullah Hukum, Kuala Lumpur (Interview date - 1 February 1993)

Anbalagan is an automobile mechanic who lives in a house which he also uses as a garage. This is, of course, strictly illegal as his house is of residential status and not to be used for commercial/business purposes. He is a small time operator in an obscure kampung and has so far been able to avoid being charged for wrongful use of the premises. At most times he has four to ten cars parked in his garage, all under repair. During the major flood in 1971, Anbalagan was still in secondary school. He remembers how many of the houses in his kampung were destroyed. Most of the houses then did not have stilts but after that flood, many of the residents decided to rebuild their houses on stilts. Anbalagan's house was rebuilt by his father. It has stilts about 1.75 metres high but his garage is an extension built at ground level. During the last big flood in 1978 Anbalagan's losses were great. Equipment in his garage was damage and his estimated cost was $2,600. Fortunately, he managed to drive away all but one of his clients' cars to higher ground. Otherwise, his loss would have been greater. As it was, he only had to repair the damaged car and it cost him about $2,500. He is unwilling to move elsewhere because the present premise is rent free (being his own house) and he has built up a sizeable clientele in the kampung and its nearby neighbourhood. It is also very accessible to the federal capital of Kuala Lumpur. However, he has ambitions to buy a house in a posh neighbourhood once he has earned enough money. Even so, he is not likely to relocated his business elsewhere, unless being ordered by the authorities or if

Plate H.7: Top: Flooded houses in Kampung Haji Abdullah Hukum (Kuala Lumpur) during a 1981 flash flood. Bottom: The front section of Maliveloo's house. Note the high threshold in the front door and the concrete wall which is built all around the bottom section of the house. This is a common form of flood proofing as it prevents flood waters (up to 0.5 metres) from coming into the house a severe flood makes him bankrupt. In terms of flood management, he is of the opinion that the government is successful in controlling the flood hazard through river dredging and improvement of drainage networks.

Case 9: Abdullah, a squatter from Kampung Bumiputera, Kuala Lumpur (Interview date - 3 February 1993)

Like most of the inhabitants of Kampung Bumiputera, Abdullah is a squatter. He was born in a small kampung in Tanjong Karang, Perak. He is of peasant heritage as his parents are both padi farmers. But like most of his peers (the younger generation), padi farming did not appeal to him. A farmer's life was tough and the remuneration hardly lucrative. There were simply too many hazards associated with padi farming and through his childhood experiences Abdullah remembers vividly how his family always lived in poverty. He was determined to get out of it even though generations of his family had been farmers. After he failed his Lower Certificate of Education Examinations (Form Three), he packed his bags and went to stay with his uncle in Kampung Bumiputera, hoping to learn a trade and make his fortune in the federal capital. He had hoped that he would soon make enough money to move out to a rented place of his own and thereafter to buy his own house. This remains a distant dream as with his poor education, Abdullah could not find gainful employment. All he could find were odd jobs in construction sites, hawking, and selling cheap goods at night markets. As a result, he has never made enough to move out of his uncle's house. Abdullah is not the only nephew staying with his uncle. There are two other distant cousins from remote kampungs in Terengganu also trying their luck in the federal capital. All three of them share a room. Nevertheless, Abdullah and his two cousins refuse to admit defeat and return home to a sedentary peasant life as this would spell shame and disgrace. Instead, they stay back and join the thousands of unemployed rural youngsters in the federal capital hanging on to the dream that one day they will strike it rich.

Kampung Bumiputera is full of Abdullahs and they keep coming from the rural areas. This wave of rural-urban migration became especially pronounced during the past five years or so as Malaysia enjoyed an economic boom. As the squatter population swell the number of squatter huts also increase. Elsewhere, in the federal capital, many new squatter settlements grow unnoticed. Squatter huts are often erected at a rate faster than the speed at which the authorities can tear them down. The lack of low cost housing and social, political and economic considerations may also have prompted the authorities to close a blind eye on the squatter problem. Other than erecting new huts, many of the existing squatter huts are also extended or partitioned into more rooms. Kampung Bumiputra is only one of hundreds of squatter settlements in the federal capital and other major cities in the peninsula. They are prime targets for squatters as the land on which their huts are built are the most flood-prone land which are deliberately avoided by developers. Hence, squatter settlements like Kampung Bumiputra are intricately linked to flood hazards and have become a major social problem for the authorities. Because of their origins and riverine location, these settlements are high risk flood zones. Increasingly dense populations in squatter settlements, the weak house structures of 'makeshift' wooden huts and the high incidence of poverty have increased the squatters' vulnerability to flood hazards.

Kampung Bumiputra has been described by one respondent as 'highly flood-prone' as floods occur as frequently as it rains. It is subject to frequent flash floods because of its low elevation and its proximity to the Kelang River. A solar powered automatic siren belonging to the DID is located near the bridge linking Kampung Bumiputera and Kampung Datuk Keramat (Plate H.8). But according to Abdullah, the siren breaks down rather frequently and no warning is given during times of flood. Another problem is that there have been too many

Plate H.8: Location of solar powered automatic flood warning siren on the bank of the Kelang River in Kampung Datuk Keramat

false alarms. Apparently, the alarm is set at three levels, viz. alert, warning and danger. It is only when the river level has exceeded the danger level that flooding occurs. Usually, the alarm goes off at the alert level. It becomes increasingly louder and the tones more rapid as it reaches the warning and danger levels. But in many instances, the river level falls back to normal after only exceeding the alert level. As such, no flooding occurs. Because of this, many residents are not too worried whenever the siren goes off. In fact, most people are so used to it going off that they are oblivious of it and carry on their usual business as if nothing has happened. Moreover, the sound of the siren is similar to that of a factory siren nearby. The factory siren goes off many times a day signalling the beginning and end of a shift. During the 1988 floods the siren sounded but not many people paid any attention to it. When the second pitch went off Abdullah had the sense to drive his old car to higher ground. As a result, his damage was minimal when the flood came. There were two flash floods in 1988 but the damage was minimal. Minor flash floods now occur about twice a year but the residents in Kampung Bumiputera are so used to it that it is not a big problem. The floods also do not stay long, usually lasting a day or less. Abdullah's dream is not diminished by the atrocious living conditions he has to endure. He sees some of his friends making it and feels that his turn will come. As he hangs on to his dream, scores of other Abdullahs have arrived and are still arriving, or are making plans to arrive. They make competition for jobs ever more keen. More and more become trapped on urban floodplains just as those who stay behind in rural kampungs are trapped on rural ones.

Case 10: Wan Hassan, a poor East Coast padi farmer from Kampung Ganchong, Pekan District, Pahang (Interview date - 27 November 1992)

Wan Hassan is aged 46, married and has six children aged between four and twenty. The eldest daughter is married and lives with her husband in another kampung. Four are in school. He and his wife Hasnah work on their small plot of inherited padi land of about 6 relongs (3.18 hectares). His two sons Badrul (aged 17) and Jamil (aged 15) also help out in the farming after school. The small hectarage is hardly economical and he has to fish and engage in part-time work elsewhere to supplement his income. State irrigation has allowed him to crop twice a year but his income from padi farming is highly variable. During a good season, his income totals $2,000 for the main season and $1,500 for the off-season. This averages to less than $300 a month, well below the poverty line. His off-farm income is not much. The catch from his fishing is for home consumption although on some good days he may sell part of it. He tries to get whatever part-time job he can get in the kampung. This include repairing houses, painting, plucking coconuts, and making sampans. The supplementary income seldom exceeds $100 per month. Thus, his total monthly income is about $400 which hovers just above the poverty line. Fortunately, education is provided free by the state. Badrul and Jamil are also given free books. Wan Hassan's family can just about survive during a good season. When the floods come, the family is severely affected. During normal floods, crops are usually partly destroyed but severe floods often completely wipe out a season's crop. For example, during the 1988 flood, his entire main season crop was destroyed and he had to depend on government subsidies to help him recover.

The Hassan family is too poor and does not have the resources nor the know-how to move elsewhere. The family is firmly bound to a farming existence in their kampung by exogenous contextual forces such as poverty, low occupational and residential mobility and low educational attainment. It was fine during his father's time when the family land was about 18 relongs (9.54 hectares). His father always had enough to provide for the family but the land has to be divided between Wan Hassan and his two brothers who are also in the same impoverished situation. The Hassan family has little choice but to carry on. Wan Hassan himself dreads what would happen to his land when he dies. Each of his six children will get only a relong (0.53 hectares). He secretly hopes that all his children will receive a good education and escape from the poverty they are in now. Structural forces have trapped the family in Kampung Ganchong. The family's flood loss reduction strategies include: (1) planting flood-resistant padi varieties; (2) removal of floating debris from the padi fields during floods; (3) engaging in supplementary income activities; (4) use of sampan for evacuation; (5) flood watching; (6) responding quickly to official warnings and evacuation; and (7) depending on the government for flood aid and other subsidies.

APPENDIX I HISTORICAL FLOOD EVENTS IN PENINSULAR MALAYSIA

This appendix is based on an evaluation of the annual flood reports of the DID (both federal and state), archived documents, newspaper reports, and various official unpublished articles and reports. While the physical accounts of each flood is fairly accurate, the reported damages are at best crude estimates. There are several reasons for this. According to officers in charge of compiling the annual flood reports, there is no systematic survey on flood damage after each flood. The flood damages are only roughly estimated. The estimates only include damages to public utilities and crops. Damages to private sector industries, commerce and business and private properties are seldom reported. In the case of the annual flood reports of various states, direct damages might be overestimated to attract federal aid. This is often a strategy employed by state governments (via personal communication with DID officers). On the other hand, indirect damages will most certainly be underestimated because they are too difficult to isolate and measure. Finally, estimates of deaths are likely to be underestimated because there are thousands of remote flood-prone kampungs where death by drowning is not reported. The number of evacuees is also most certainly underestimated as only official figures at government relief centres are used. For every few families evacuated to government relief centres there is likely to be one who has evacuated itself to a relative or friend's house. The absorbing of disaster victims by the extended family and close friends is a well documented local response to disasters (Davis 1977). Thus, despite every attempt being made to project as accurate a picture as possible, the accuracy and reliability of the flood damage figures should be treated with caution.

Although floods have occurred regularly in most parts of Peninsular Malaysia in the past, there have been no written records until the 1930s onwards. Although the DID has identified major (severe) floods from moderate and minor floods, no definition has been given for the various categories. According to officials involved with the flood hazard, the differentiation is mostly arbitrary and is based on a number of criteria such as flood magnitude, duration, areal extent and the population affected. In the following account on the historical occurrence of flood events, a major flood is defined as one which affects at least one state severely, the geographical extent of which covers a greater part of the state, the population evacuated substantially large and the duration lasts at least a week. More importantly, major floods usually over-stretch the capacities of the emergency, relief and other operations. Moderate floods refer to floods of a few days duration, of moderate intensity and extent (affecting one or two districts) and with the population evacuated not exceedingly large. Emergency and relief agencies usually have no problem coping with such floods. Minor floods are usually of one or two days duration and only a few people are evacuated, if any. The affected areal extent is localised, usually a few villages. Emergency and relief services are usually not needed but may be put on stand-by. Finally, flash floods are of a few hours to one day duration. The flooding is very localised and may affect only the low-lying areas in a town or village. Flash floods are most frequent in the more developed and urbanised areas on the West Coast states. A chronological order of various flood occurrences in all states in the peninsula is given in Table 2.1.

1886 - Major flood

This is the earliest flood event where some patchy records are available. This flood occurred in the East Coast, in which the worst hit was the state of Kelantan. It was known as 'The storm forest flood' because it destroyed hundreds of square kilometres of lowland forest on the floodplains of the Kelantan and Besut rivers. Records showed that the flood was accompanied by gale force winds. Besides the damage to the forest, the flood also caused extensive damages in the Kelantan plain.

1925 - Minor flood
This flood mainly affected the West Coast. In Perak, flooding occurred along the Kinta River. In Selangor, although severe flooding occurred in the Kelang River, the Selangor River and the Bernam River, the extent of the flooding was mostly localised.

1926 - Major flood
According to the Drainage and Irrigation Department, this flood was considered 'the biggest flood in living memory' in Peninsular Malaysia. The flood affected almost the entire length and breadth of the peninsula, causing extensive damages to the natural environment. As a result of this flood, severe erosion occurred, hill sides were scarred, river beds silted, residual lakes created and lowland forests destroyed. Although records on damages to humans and structures were not available, it is estimated that such damages were substantial. Most of the East Coast states were affected by this flood. The worst hit were Pahang and Terengganu, especially in the border region between the two states. The royal town of Pekan suffered severe damages as houses were inundated up to roof level (see Plate E.4). In Terengganu, the most severe flooding occurred in the town of Kemaman. There were extensive damages to communications and property. The 5-day rainfall for Kemaman was between 180 cm and 190 cm. Further north in Kelantan, severe flooding with extensive damage also occurred. The capital town of Kota Bharu was under 1 to 1.5 metres of water.

Several West Coast states were also affected. In Kedah, severe flooding occurred in the southern parts of the state. In Perak, severe flooding occurred along the Perak River and great damage was caused. In Selangor, severe flooding occurred in the Kelang, Langat and Selangor rivers.

1931 - Major flood
The states of Perak and Kelantan were worst hit in this flood, especially the border areas between the two states. In Perak, the lower Perak River floodplain and the Kinta Valley were the most severely affected. In Kelantan, there was substantial damage as a result of the flooding. The state of Negri Sembilan on the West Coast was also affected, particularly along the Linggi River.

1936 - Moderate flood
This flood mainly affected the two West Coast states of Perak and Selangor. In Perak, flooding occurred along the Kinta and Batang Padang rivers. In Selangor, flooding occurred along the Bernam River.

1947 - Major flood
This flood affected mainly the northern parts of the West Coast, including the states of Perak, Kedah and Perlis. Severe flooding occurred in North Perak, particularly in Krian District. In Kedah, the valleys of the Muda and Padang Terap rivers were flooded. Flooding also occurred in Perlis. In the East Coast, only Terengganu was affected. The flooded areas were along the lower parts of thee Besut River.

1948 - Minor flood
In Perak, flooding occurred in Krian. In Selangor, flooding occurred along the Kelang River.

1949 - Moderate flood
In Kedah, flooding occurred in the southern parts of the state. In Terengganu, flooding occurred along the Besut and Terengganu rivers. In Kelantan, flooding occurred in the Kelantan River.

1950 - Minor flood
Only the state of Perak experienced some flooding. Minor floods occurred along the Bidor River but no damage was reported.

1951 - Moderate flood
This flood mainly affected the West Coast states. In Kedah, floods occurred in the district of Kulim. In Perak, the Perak River overflowed its banks. In Selangor, flooding occurred along the Kelang and Langat Rivers and in Negri Sembilan, parts of the Linggi River were flooded. In Johor, flooding occurred along the Muar and Segamat rivers. In Terengganu, flooding occurred along the Besut River.

1952 - Minor flood
This flood only affected the West Coast states. In Pulau Pinang, flooding took place along the Muda River. In Kedah, Kulim District was flooded. In Perak, the Kerian River overflowed its banks. In Selangor, flooding occurred on the Langat River. In Melaka, stretches of the Kesang River were flooded. In Johor, flooding occurred along the Muar and Segamat rivers.

1953 - Minor flood
In Perak, three rivers were affected, viz. the Perak, the Bidor and the Batang Padang rivers. In Selangor, minor flooding occurred along the Langat River.

1954 - Major flood
This flood affected both the East and West Coast extensively. In the West Coast, there was some localised flooding for short duration in Kedah but no severe damage was reported. In Pulau Pinang, the Kulim River inundated parts of Tengah District. In Perak, flooding also occurred in the Bidor River catchment for three days but no damage was reported. In Negri Sembilan, Tampin District was flooded for five days and 40 ha of padi were reported damaged and another 20 ha totally destroyed. There was also substantial damage to structure and canals. In Melaka, more than 100 ha of padi were destroyed and Melaka Town was submerged under water for five days.

The southern state of Johor was severely affected. In its eastern coast, severe flooding occurred for three to four days. In its central region, the floods lasted seven days and two persons drowned. Damage to structures, communications and other property were severe but no estimate was made. In the southern parts of the state, flooding lasted twelve days. Many towns were flooded and damages were severe. In its west, flooding lasted between five to seven days. Two soldiers taking part in rescue operations drowned and there was severe damage to agriculture crops.

In the East Coast, only two states were affected. In Pahang, some local flooding which gave rise to minor damages was reported. But in Terengganu, severe flooding occurred along a 32 km coastal belt, centring around Besut. The town of Besut was flooded for a week.

1955 - Minor flood
In the federal capital of Kuala Lumpur, low-lying areas were flooded for a short duration. No damage was reported. The state of Melaka was also flooded for one day but no damage was reported. In Perak, the Bidor, Behrang and Kinta rivers caused minor flooding.

1956 - Minor flood
Minor flooding in Perak and Selangor. In Negri Sembilan, the Tampin area was flooded for two days but no damage was reported. In Johor, there was also minor flooding for three days

but damage was minimal. In Terengganu, flooding occurred but no serious damage was reported.

1957 - Major flood
Minor flooding occurred in Perak. In the Kelang Valley, however, severe flooding forced the evacuation of about 4,000 people. Tin mines were flooded and life was lost. Although the total area flooded was relatively small, damages were estimated to be significant as flooding took place in densely populated areas. In Terengganu, the floods lasted eleven days and almost all roads in the state were flooded to a depth of between 1 to 3 metres. In Johor, 202 ha of padi were flooded in the Sri Menanti area between four to twenty days. Severe damage to the crop was reported.

1958 - Minor flood
Minor flooding lasting three days occurred in the Krian, Batang Padang and Manik rivers in Perak. There was also minor flooding in Selangor, Pahang and Kelantan. Slight damage was reported in Kelantan.

1959 - Minor flood
Minor flooding occurred in Pulau Pinang and Perak. No damage was reported in either state. Similarly, minor flooding of short duration also occurred in Selangor, Pahang, Terengganu, Kelantan (mainly Pasir Puteh District), Negri Sembilan and Johor. Only the flooding in Johor resulted in the destruction of 85 ha of padi and slight damage to another 65 ha of padi in the Assam Bubok area.

1960 - Moderate flood
In Kedah, flooding damaged 24 ha of padi. Perlis was also flooded for four days but no damage was reported. Pulau Pinang experienced minor flooding of short duration. No damage was reported. In Perak, flooding lasting between two to six days resulted in slight crop damage and loss of poultry. In Selangor, the floods lasted ten days with slight damage to vegetable crops. In Negri Sembilan, minor flooding lasting between six to ten days was reported but without damage. In Melaka, there was also minor flooding. The East Coast states of Pahang, Terengganu and Kelantan all experienced only minor flooding. Only slight damage was reported in these states.

1961 - Moderate flood
During this flood, most states were affected but the magnitude and extent of flooding were not severe. Minor flooding occurred along the West Coast. In the state of Kedah, Perlis and Johor only minor flooding was experienced. No damage was reported in all three states. In Perak, the flooding resulted in slight damage to padi and kampung land. Most places in Perak were flooded for a few days but some of the lowest lying areas were flooded for more than twenty days. In Selangor, the flooding lasted between three to four days with slight damage to crops and structures. In Negri Sembilan, flooding occurred in Linggi, Rembau and Pedas districts resulting in damage to two bridges. In Melaka, the Melaka Valley was flooded resulting in slight damage to 49 ha of padi crop. In the three East Coast states of Pahang, Terengganu and Kelantan, only minor flooding occurred. No damage was reported.

1962 - Minor flood
In Kedah, flooding occurred in scattered areas damaging 2,400 ha of padi crop. In Perlis, the capital town of Kangar was flooded but no damage was reported. In the other West Coast states of Pulau Pinang, Perak, Selangor, Negri Sembilan and Johor, minor flooding resulted in slight damages. Similarly, the East Coast states of Pahang, Terengganu and Kelantan also experienced minor flooding with slight damage.

1963 - Moderate flood
In Kedah, some 560 ha of padi crop was damaged to varying degrees by flooding which lasted about ten days. There was minor flooding in Pulau Pinang with slight damage. In Perak, minor flooding affected the Krian, Slim and lower Perak rivers resulting in slight damage. In Selangor, minor flooding lasting between one to ten days occurred but no damage was reported. However, flooding due to the breakage of a mining bund resulted in the death of 14 persons and loss of property and livestock. There was also some minor flooding in Negri Sembilan and Johor but no damage was reported. In the East Coast, only Kelantan experienced minor flooding.

1964 - Minor flooding
Floods lasting 19 days affected 850 ha of padi. In Pulau Pinang, parts of Seberang Perai and the major town of Georgetown was flooded. However, only slight damages were reported. In Perak, Krian District was flooded for seven days and two children lost their lives. In Dindings District, there was damage to 2,428 ha of crops and livestock. The other West Coast states of Perlis, Selangor, Negri Sembilan and Johor suffered minor flooding. In the East Coast, only the state of Pahang experienced minor flooding without damage.

1965 - Major flood
This flood mainly affected the East Coast. Extensive flooding occurred in the Kelantan and Besut river basins. Some 11,048 ha of padi were totally damaged and another 6718 ha partially damaged. About 650 ha of other feed crops were also damaged. In addition, several lives were lost. The damage to the Drainage and Irrigation Department's structures and equipment was estimated at about $1.6 million[1]. In Terengganu, major flooding occurred in the Besut and Terengganu river basins. About 5,342 ha of padi and another 89 ha of other crops were damaged. Total damages to the DID's structures were estimated at $500,000. In Pahang, flooding occurred in scattered areas resulting in closed roads and minor damage to crops.

In the West Coast, the worst affected state was Perak. The royal town of Kuala Kangsar was flooded. The Trans-Perak agricultural scheme was also flooded and damage to crops and structures were reported. In Kedah, minor floods occurred throughout the state. The worst affected area was the Muda River valley in which 243 ha of padi were damaged. In Pulau Pinang, flooding in the Muda River damaged 98 ha of padi. Damages to rubber nursery and livestock were also reported. The other West Coast states of Perlis, Selangor, Negri Sembilan and Johor reported only minor flooding with slight damage.

1966 - Minor flood
All states were affected by minor flooding. With the exception of one death in Perlis, there was little loss in terms of property, structures and crops.

1967 - Major flood
This was arguably the most severe flood experienced in the states of Kelantan, Terengganu and Perak because great damages were caused. In the lower stretches of the Perak River, flooding lasted about 20 days. In the Kelantan River basin, flooding was severe and lasted for a week and damages were estimated at well over $78 million (approximately $208 million at 1993 prices) and 320,000 people were evacuated. The total number of affected people was estimated as 430,000. In the Kemasin-Semerak River basin (Kelantan), total damage was estimated at $18 million (approximately $48 million at 1993 prices). Of this total, damage to

[1] Damage figures are given at prices during that particular year, unless specified.

rural industries amounted to $8.5 million, damage to properties and structures amounted to $7.9 million and indirect damages amounted to $1.6 million. The total number of evacuees from the Kemasin-Semerak Basin was 75,000 people. For the whole of Kelantan, a total of 39 people lost their lives in the floods. In the Terengganu River basin, severe and widespread flooding lasted for 10 days. In Pahang, moderate to severe flooding occurred on three occasions. In the southern state of Johor, severe flooding occurred on two occasions and minor flooding on one occasion. Elsewhere, the flooding was from minor to moderate. All states were flooded to some degree during this flood.

1968 - Minor flood
Minor flooding occurred in Selangor and Negri Sembilan on the West Coast. In the East Coast, minor flooding also occurred Terengganu and Kelantan.

1969 - Minor flood
During this flood, only the southern state of Johor was severely flooded. Damages were not estimated. Perak, Terengganu and Kelantan experienced minor flooding but the rest of the peninsula was flood-free.

1970 - Major flood
This flood mostly affected the East Coast states. In Pahang, flooding of catastrophic proportions, second only to the 1926 flood, hit many parts of the state. The floods came in December and extended into January 1971. In Terengganu, there was moderate flooding but Kelantan experienced only minor flooding. In the West Coast, localised and minor flooding affected Kedah, Perak and Selangor. The other states were flood-free.

1971 - Major flood
Although the 1971 flood is not comparable to the 1926 flood, its effects were severe. Almost all parts of the peninsula suffered damage to some degree. The worst hit was the federal capital of Kuala Lumpur and the state of Pahang. Losses and damages suffered were on an unprecedented scale.

In Pahang, there were two major floods in 1971, viz. the January 1971 flood (an extension of the December 1970 flood) and the December 1971 flood. In the January 1971 flood, the total flood damage was estimated at $29.6 million. Of this total, damage to rural industries accounted for $6.3 million, damage to structures and properties amounted to $15.6 million and indirect damages accounted for $7.8 million (JICA 1982 p-94). In the December 1971 flood, the total damage was estimated at $13.5 million of which damages to rural industries accounted for $4.0 million, damage to structures and properties accounted for $5.3 million and indirect damages accounted for $4.2 million. During the January and December 1971 floods, the number of flood victims evacuated were 153,000 and 43,000 respectively. The royal town of Pekan was again severely affected as not only private properties were destroyed but also public buildings and amenities (Plate I.1).

During the January 1971 flood in Kuantan (Pahang), total flood damage was estimated at $3 million. Of this total, damages to rural industries accounted for $0.6 million, damages to structures and properties accounted for 1.8 million and indirect damages accounted for $0.6 million.

During the January 1971 flood in Kuala Lumpur, total flood damage in the federal capital was estimated at $34.2 million, of which the entire amount was for damages to structures and properties.

Plate I.1: The 1971 flood in Pekan: Top - The office of His Royal Highness The Sultan Of Pahang in deep waters; Bottom - The Police Headquarters in Pekan town

1972 - Moderate flood
This flood mainly affected the East Coast states. In Pahang, total estimated flood damage amounted to $5.5 million. Of this total, damage to rural industries accounted for 1.6 million, damage to structures and properties accounted for $2.0 million and indirect damages accounted for 1.9 million. The number of evacuees totalled 6,900 people. In Terengganu, widespread flooding occurred in low-lying areas along all the major rivers. The estimated damages to irrigation structures alone totalled $163,000. In Kelantan, major flooding cause an estimated total damage of $78,000. The total number of people evacuated was 21,667. There were three deaths due to drowning. In the West Coast, minor to moderate flooding occurred. In Kedah, there was minor flooding in the northern parts, accounting for damages to 1,214 ha of padi. In its southern parts, flash floods also occurred. In Pulau Pinang, minor flooding occurred along the Muda River resulting in the evacuation of 1,177 people. There was no estimate of any damage. In Perak, moderate flooding occurred from Kuala Kangsar to Kampung Gajah, resulting in an estimated damage amounting to $289,400. 102 people were evacuated. In Selangor, minor flooding caused a total damage of $6,000 and the evacuation of 547 people. There was no flooding elsewhere in the West Coast.

1973 - Moderate flood
Again, moderate to severe floods hit the East Coast states but only minor floods occurred in the West Coast states. In Kelantan, this flood was estimated to be the biggest since the 1967 flood. The estimated damage was about $6.5 million (Jabatan Pengairan dan Saliran Kelantan 1991 p2). 18,323 people were evacuated and four persons drowned. There was also widespread flooding in Terengganu resulting in an estimated $110,000 damage to irrigation structures and a total of 13,213 people evacuated. In Pahang, the banks of the lower Pahang and Kuantan rivers were topped and estimated damages amounted to $206,000. 2,652 people were evacuated and 1 person died. In the West Coast, minor flooding occurred in Kedah, Perlis, Perak, Selangor, and the federal capital. 3,338 people were evacuated in Kedah while another 6,325 people were evacuated in Perak. In the latter, there was an estimated damage of $90,000. Flash floods also occurred in the southern parts of the peninsula in the states of Negri Sembilan and Johor.

1974 - Minor flood
During this flood, the worst hit state was Kelantan. Moderate to severe flooding occurred along the Kelantan, Semerak, Kemasin and Golok rivers resulting in an estimated damage to irrigation works amounting to $320,000. 1,806 people were evacuated and 3 persons lost their lives. In Terengganu, flooding occurred along the coastal areas of the main rivers resulting in an estimated damage to irrigation works totalling $134,300. In the West Coast, only minor flooding occurred in the states of Kedah, Perak and Negri Sembilan. In Perak, the estimated damage was $27,500. Flash floods also occurred in the Pulau Pinang, the federal capital and Kajang in Selangor.

1975 - Moderate flood
Again, Kelantan was badly affected. In January, floods caused a total of 11,025 people to be evacuated and three persons lost their lives. The worst affected areas were the coastal parts of Kota Bharu town. In December, flooding again occurred along the Kelantan, Semerak, Kemasin and Golok rivers. Estimated damage to drainage and irrigation works and crops were $300,000 and $3.5 million respectively. 1,271 people were evacuated. In Terengganu, estimated flood damage to irrigation works was $80,000. In Pahang, flash floods in Kuantan, Temerloh and Pekan and minor floods elsewhere caused an estimated damage to irrigation works amounting to $86,000. 1,627 people were evacuated. In Perak, flooding in Trans-Perak damaged 1,700 ha of crops. Elsewhere, minor flooding occurred in Kedah, Pulau Pinang, Selangor, Negri Sembilan and Johor.

1976 - Minor flood

Moderate floods in the Golok, Semerak, Kemasin and Kelantan river basins caused estimated damages to irrigation works and crops amounting to $200,000 and $400,000 respectively. In Pulau Pinang, flooding in Georgetown, Bayan Baru, Butterworth, Seberang Jaya and Perai resulted in damages to crops (estimated at $275,000), industries and houses (estimated at $275,000). Police rescue boats had to be employed to move residents in parts of Jalan Perak (Georgetown) which were deeply inundated, although in many parts of the city the flooding became a carnival (Plate I.2). In Terengganu, minor flooding in some coastal areas damaged irrigation works estimated at $55,000. In Kedah, minor flooding occurred in Padang Terap and Kubang Pasu. In Johor, minor flooding also occurred in the Batu Pahat, Johor, Sedili, Segamat, Tenglu Besar and Tenglu Kecil river basins. Flash floods also occurred in Selangor in Ulu Langat (May) and in the federal capital in Kassipillai and Segambut (October). No damage was reported.

1977 - Minor flood

Only minor and flash floods were observed. In Kedah, flooding in Padang Terap, Kubang Pasu, Pendang and Baling damaged 32 ha of padi. In Pulau Pinang, there was some minor flooding in riverine areas in Georgetown, Bayan Baru, Butterworth, Seberang Jaya and the Prai metropolitan area. No damage was reported. In Selangor, flash floods occurred in Ulu Langat, Kuala Langat, Sepang, Ulu Selangor, Petaling and Gombak. There were no report on damages. In Terengganu, minor flooding also caused an estimated damage to irrigation works at $55,000. In Pahang, there was also minor in Bentong. In Kelantan, the Kemasin and Banggu river basins were affected by minor floods. Damages were estimated as negligible. In Johor, several villages along the Batu Pahat, Bekok, Sembrong, Endau, Segamat and Permandi rivers were flooded.

1978 - Minor flood

Johor was the worst hit. Severe flooding in South Johor gave rise to an estimated damage of $652,000. 6,090 people were evacuated and the death toll was 5. In Terengganu, severe flooding also resulted in losses amounting to $138,000. In Kelantan, minor flooding occurred along the Kelantan, Golok, Semerak and Kemasin rivers. Do damages were estimated. Similarly, minor flooding occurred in the eastern part of Pahang. In the federal capital, flash floods in December in Kampung Baru, Kampung Kasipillai, Kampung Siam Tiong Nam forced the evacuation of 1,000 residents. In Selangor, flash floods occurred in January and again in December. In Kedah, minor floods caused damage to 20 ha of padi. In Pulau Pinang, minor flooding also occurred in Georgetown, Pulau Betong and Butterworth. No damages were reported.

1979 - Minor flood

Severe flooding again occurred in Johor. Areas flooded were Rantau Panjang, Kota Tinggi, Segamat, Buloh Kasap and Bukit Kepong. A total of 10,059 people were evacuated and the resulting damages were estimated at $293,201. In Terengganu, flooding in Kuala Terengganu, Dungun, Kemaman and Besut forced 4,262 people to be evacuated. In Pahang, severe flooding also took place in Kampung Sungai Lembing and minor flooding in Jerantut, Temerloh, Kuala Lipis, Sungai Lembing and Pekan. Elsewhere, no floods were reported.

1980 - Minor flood

During this year, only the two states of Kelantan and Johor were flooded. In the former, flooding in the Kemasin, Semerak and Golok riverine areas damaged 24 ha of padi and forced 30 families to be evacuated. There were three deaths. In the latter, flooding occurred in the upper catchment of the Muar River, the Muphur River and in the town of Kota Tinggi. There were no evacuees and no reported damages.

Plate I.2: The 1976 flood in Georgetown, Pulau Pinang: Top - A Police rescue team moving residents in deeply affected areas along Jalan Perak to relief centres by boat; Bottom - Children having a carnival in parts of the city flooded to a shallow depth (From the Star archives)

1981 - Minor flood
Again, only the two states of Kelantan and Johor were flooded. In the former, flooding occurred in the Golok, Semerak, Kemasin and Kelantan river basins. Flood damages were estimated at $4.946 million of which damage to padi accounted for $4.39 million, damage to cash crops accounted for $0.32 million and damage to tree crops accounted for $0.236 million. In the latter, serious flooding in the Endau and Kecil areas and localised flooding in Kota Tinggi and Johor Bahru and Simpang Renggam areas caused flood damages amounting to $84,000. 2,599 people were evacuated.

1982 - Minor flood
Floods only occurred in the East Coast. In Kelantan, the Golok, Kelantan and Kemasin rivers topped their banks and the resultant floods caused an estimated total damage of $1.98 million. Of this total, damage to crops was estimated at $265,000 and damages to public utilities at $1.235 million. A total of 4,890 people were evacuated. In Terengganu, the riverine areas of the Besut, Terengganu, Kemaman, Nerus and Dungun rivers were flooded. Damages were estimated at $1.66 million. There were 5,371 evacuees and the death toll was six. In Pahang, only minor flooding occurred in Temerloh, Kuantan and Jerantut. 30 people were evacuated.

1983 - Moderate flood
This flood mainly affected the East Coast states. In Kelantan, serious flooding with two peaks occurred in the Kelantan, Kemasin, Semerak and Golok rivers. Areas affected include Kuala Krai (see Plate H.3), Tanah Merah, Macang, Pasir Puteh, Pasir Mas, Bacok, Tumpat, and Kota Bharu. Damages to crops were estimated at $3.50 million and damages to public facilities estimated at $6.45 million. Other damages were estimated at $0.347 million. In Terengganu, serious flooding occurred in Besut, Kuala Terengganu, Hulu terengganu, Marang, Dungun,and Kemaman. Damages were estimated at $3.266 million. 21,356 people were evacuated and there were three deaths. In Pahang, flooding took place in Kuantan, Temerloh, Pekan, Maran and Jerantut. A total of 977 people were evacuated and there were two deaths. In Johor, minor flooding occurred in Johor Bahru, Kota Tinggi, Segamat and Mersing. A total of 1,593 people were evacuated. In the West Coast, flooding occurred along the Perlis River causing damages estimated at $27,000 and the evacuation of 45 people.

1984 - Moderate flood
During this year, minor to moderate floods occurred throughout the peninsula. On the West Coast, minor flooding in Kedah forced the evacuation of five families. In Pulau Pinang, flash floods forced the evacuation of 41 families and the death of one person. An estimated flood damage of $983,000 was also caused. In Perak, minor flooding forced the relocation of 52 families. Minor flooding in Selangor also caused damages amounting to $10,000. In Negri Sembilan, flooding in the Jelai, Kenaboi and Gemenchih valley caused an estimated damage of $143,000. In Melaka, severe floods occurred along the Melaka and Kesang rivers. A total of 2,358 people were evacuated. Damages were estimated at $523,673 of which damage to agriculture amounted to $190,362, damage to commercial establishments accounted for $90,370, damage to public facilities accounted for $213,478 and damage to domestic properties accounted for $29,463. In Johor, minor flooding occurred in Kota Tinggi, Johor Bahru and Segamat for three days. A total of 143 people were evacuated but no damage was estimated. In the federal capital, flash floods occurred twice but no damage was estimated. In Pahang, minor floods occurred in Kuantan, Temerloh, Pekan and Kuala Lipis. No damages were reported. In Kelantan, flooding in the four major rivers caused 7,177 people to be evacuated and the death of nine people. The total flood damage was estimated at $3.116 million.

1985 - Minor flood
This year, the East Coast was not affected at all. In the West Coast, flash floods and minor floods were frequently observed. In Kedah, flash floods in Kuala Muda, Pendang, Gurun, Baling, Sik and Kulim caused the evacuation of 3,641 people. One person died. In Pulau Pinang, minor flooding occurred along the Kulim, Perai, Pertam, Rawa, Kilang Ubi, Rambai and Kubang Ulu rivers. Damages were estimated at $14,500. There were 21 evacuees. In Georgetown, flash floods caused damages to commercial and industrial properties and created massive traffic jams and disruption to life (Plate I.3). In Selangor, there were several occurrences of minor flooding and flash flooding resulting in damages estimated at $37,000. Minor flooding also took place in Negri Sembilan and Melaka but no damage was reported. However, 68 people were evacuated in Melaka. In Johor, flooding along the Kesang, Paloh, Juaseh, Johor and Batu Pahat rivers forced the evacuation of 468 people but no damage was reported. In the federal capital, flash floods along the Gombak, Batu and Kelang rivers also forced the evacuation of 5,591 people.

1986 - Moderate flood
In the East Coast, moderate to severe floods occurred. In Kelantan, severe floods along the four major rivers forced the authorities to evacuate 7,968 people. In Terengganu, severe floods described as the 'biggest' since the 1967 flood caused damages totalling $3.26 million. All major rivers in the state overflowed their banks. There were eight deaths. In Pahang, however, only minor flooding occurred and no damage was reported. In the West Coast, flooding was mainly of the minor and flash flood types. In Kedah, flash floods damaged crops totalling an estimated $262,000. 177 evacuees and another 34 families from two sites were evacuated. Five people also lost their lives. In Perlis, minor flooding occurred. Damages to crops were estimated at 70 ha and damages to facilities estimated at $80,000. In Pulau Pinang, flash floods caused an estimated damage amounting to $20,000. In Perak, minor flooding in Larut and Matang resulted in damages to public facilities estimated at $25,000. In Selangor, only minor flooding occurred. In Johor, severe flooding occurred in Segamat, Kluang, Muar and batu Pahat. Total damage was estimated at $592,400.

1987 - Moderate flood
In general, severe flooding in the East Coast and flash flooding in the West Coast. In Kelantan, flooding due to monsoon rains lasted for about two weeks. Damages were estimated at $4.1 million. A total of 401 people were evacuated and there were four deaths. In Terengganu, there was long duration flooding in all the major rivers lasting for more than ten days. Damage to the DID's projects was estimated at $1.044 million. 1,748 people were evacuated and there were four deaths. In Pahang, monsoon rains also caused floods in the Kuantan and Pahang river basins resulting in 2,328 evacuees and four deaths. Damages to public facilities and agriculture were estimated at $79,000 and $348,000 respectively.

In Johor, severe flooding occurred in January and December. In the former, damages were estimated at $470,000 and total number of evacuees was 9,625. There was one death. In the latter, flood damages totalled $10,000 and a total of 832 people was evacuated. In Kedah, minor floods along the Pendang River lasted for three days. No damage was reported. In Perlis, floods occurred in the Tasoh and Padang Terap river basins resulting in damage to 36 ha of padi and 111 metres of irrigation canals. In Pulau Pinang, flash floods occurred in Pulau Betong, Genting, Permatang Damar Laut and Georgetown. Floods were also reported along the Muda and Prai rivers. Damages were estimated at $83,000. In Perak, flash floods were reported in the vicinity of Ipoh town (especially along the Pari and Pinji rivers), and also along the Kampar, Bidor, Sungkai, Bikam, Slim, Berof, Cheroh and Kelawar rivers. In Krian District, damage was estimated at $5,000. Flash floods in Central Perak also caused damage to oil palm plantations estimated at 61 ha or $750,000. In Selangor, minor flash

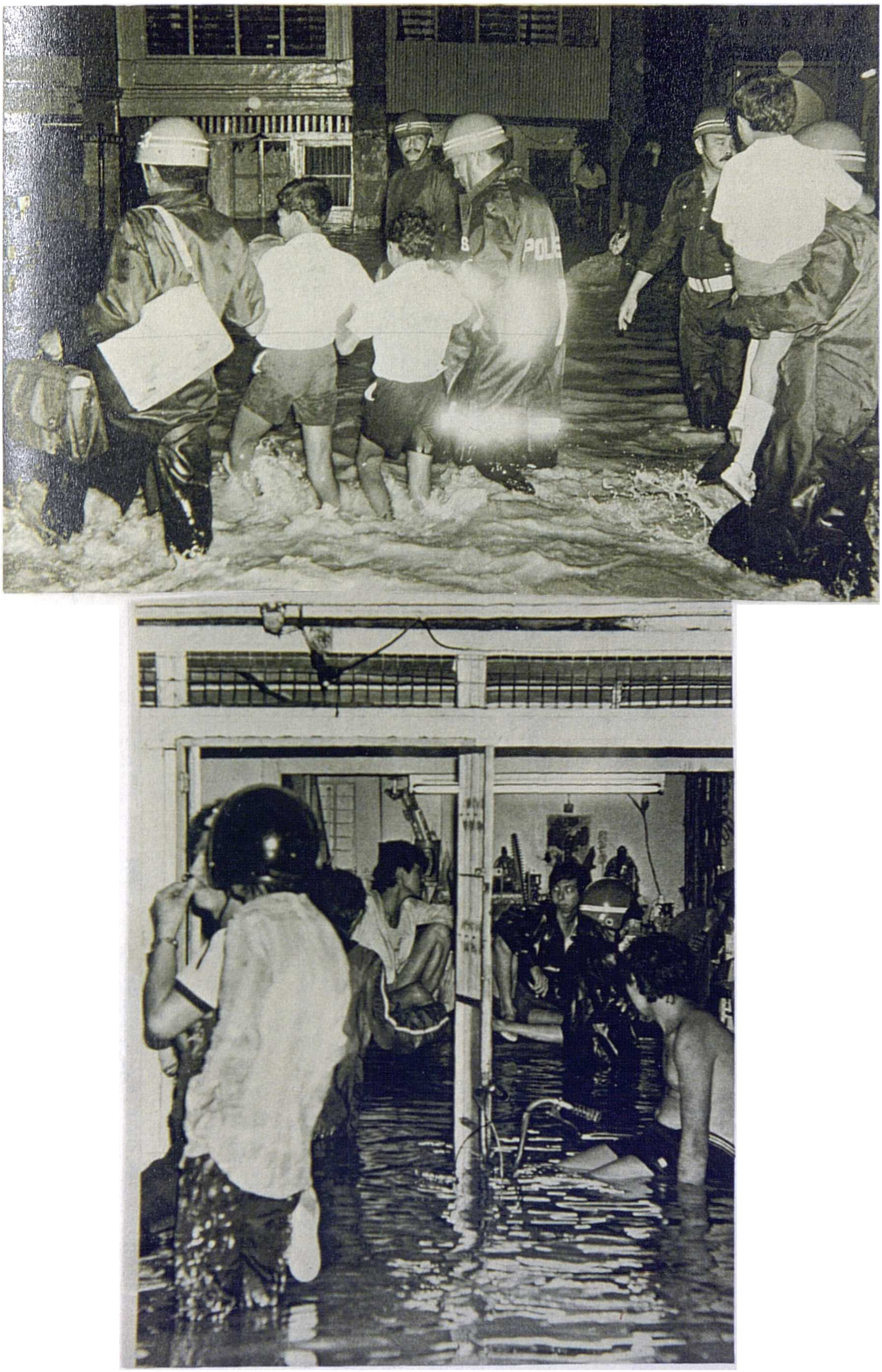

Plate I.3: The 1985 flood in Georgetown: Top - A Police warning and rescue team escorting school children back to their homes; Bottom - Workers in a motorbike repair shop taking an extended break (From Pulau Pinang DID archives) floods also occurred and crop damage was estimated at $7,000. A total of 70 people were also evacuated. Finally, in the federal capital, there were many occurrences of flash floods along the Kelang River but no damage was reported.

1988 - Major flood
Many parts of the peninsula were flooded but the worst affected areas were the East Coast states. In Kelantan, sever flooding in the Kelantan River Basin caused the deaths of 19 persons. A total of 36,789 people were evacuated and total damage was estimated at $29.83 million (Plate I.4). In Terengganu, there were two floods, one in November and the other in December. The total number of people evacuated was 15,608. There were six deaths and damage was estimated at $10.05 million. In Pahang, severe flooding occurred in the Districts of Lipis, Temerloh, Pekan and Kuantan. The total number of people evacuated was 23,269. There were six deaths and damages were estimated at $5.84 million.

Severe floods also affected many of the West Coast states. In Kedah, severe flooding occurred along the Muda, Ketil, Padang Terap, Baru, Temin and Anak Bukit rivers resulting in the evacuation of 20,849 people and four deaths. The estimated damage was $10.5 million. In Perlis, severe flooding affected the Perlis River Basin. 519 people were evacuated and one person died. The flood damage was estimated at $2.14 million. In Negri Sembilan, several kampungs along the Serting and Gemenceh rivers were flooded. They are Kampung Sri Rompin, Kampung Peti, Felda Jelai 4, Kampung Ladang and Kampung Londah. A total of 276 evacuees were temporarily relocated. Flood damage was estimated at $1.15 million. In Melaka, minor flooding occurred along the Melaka River causing 86 people to be evacuated. No damage was reported. In Johor, the Districts of Segamat and Kota Tinggi were flooded. A total of 412 people were evacuated and there was one incident of death. The flood damage was estimated at $1.09 million. In the federal capital, flash floods occurred six times during the year. A total of 3,000 people were evacuated. There was no report on damages.

1989 - Minor flood
With the exception of Pulau Pinang and Johor, flooding in the peninsula in 1989 can be described as minor. In Pulau Pinang, severe floods with depths of between 0.5 to 1.1 metres of one to two days duration occurred in the Muda, Jarak, Dua, Lahar Tiang, Lokan and Lahar Endin rivers. A total of 109 people were evacuated and damage to agriculture was estimated at $66,780. Flash floods also occurred in Georgetown along the Pinang River. In Johor, floods of three to six days duration occurred along the Muar, Endau, Johor and Batu Pahat rivers. Flood depths generally varied between 0.5 to 1.0 metre but some of the lowest lying areas have flood depths of 2 metres. The total number of flood victims evacuated was 1,525 people. About 65.0 per cent of those evacuated were from the Kota Tinggi area. Several stretches of trunk roads were inundated between three to six days at depths between 0.3 to 1.2 metres. Total flood damage was estimated at $561,000 of which damage to agriculture and public facilities were estimated at $411,000 and $150,000 respectively. Another 340 ha of agricultural land were damaged.

Other than the above two states, Perlis, Perak and the federal capital were also flooded but the flooding was minor. In Perlis, there were three flood events. Areas flooded were Arau, Ulu Pauh, Kampung Padang Telela, Katong, Kampung Paloh, Kaki Bukit and Tasoh. A total of 870 ha of padi fields were inundated but no damage was estimated. In Perak, minor floods occurred in several villages in Kinta and Batang Padang Districts. Most areas were flooded to depths of between 1.0 to 2.0 metres for a duration of four to seven days. There was no estimate of damage. In the federal capital, flash floods occurred twice along the Kelang and Bunus rivers. Areas flooded were Kampung Pantai Dalam, Kampung Limau, Kampung Pasir Baru, Kampung Pasir Lama and Kampung Sentosa. Flood depths varied between 0.25 to 1

Plate I.4: The 1988 flood in Kota Bharu, Kelantan: Top - An aerial view of the Kota Bharu stadium and the General Hospital (with buildings built in a semi-circle); Bottom - An aerial view from another part of the town around Jalan Pengkalan Chepa (From Kelantan DID archives) metre and the floods lasted for about two hours. No damage was estimated.

1990 - Minor flood

In general, despite seven states reporting flood occurrences, the floods in 1990 were minor. In Perlis, areas inundated were Balai Baru, Beseri, Padang Melangit, Kampung Repoh, Kampung Bakau, Abi Kubang Badak and Bintong. No damage was reported. In Kedah, moderate floods forced the evacuation of some 2,055 people from the districts of Sik, Baling, Kulim and Kuala Muda. There were damages to crops, land and private properties but no estimate was made. Floods also occurred in the island of Langkawi. In Gurun town, flash floods inundated 12 villages and 20 families were evacuated. In Pulau Pinang, floods occurred along the Muda, Jarak, Dua, Lahar Tiang, Lokan and Lahar Endin rivers. A total of 1,759 inhabitants were relocated temporarily. Damages to crops was estimated at \$160,000. In Perak, minor and flash floods inundated nine villages along the Perak River near Parit town. About 10,000 people were stranded when the wooden bridge linking their villages to Parit town was washed away by the flood waters. In Krian District, 51 people were evacuated. No damage was reported. In Johor, flooding along the Segamat, Johor and Batu Pahat rivers resulted in 1,280 people being evacuated. In Terengganu, minor floods along the Dungun, Besut and Kemaman rivers forced the evacuation of 1,300 people. Finally, in Kelantan, two flood events took place in Kuala Krai District and Kota Bharu District. In the former, flood depths of between 0.19 to 2 metres were reported in Kampung Tualang, Kampung Guchil, Manik Urai Lama and Masek. A total of 517 people were evacuated. In the latter, several villages along the Kelantan River were flooded but no damage was reported. Four persons lost their lives in the floods in Kelantan.

1991 - Moderate flood

The most seriously affected state was Johor. Flooding along the Muar, Johor, Segamat and Batu Pahat rivers resulted in the evacuation of 3,000 people. Unfortunately, no estimates of the damages were made. In the three East Coast states of Terengganu, Pahang and Kelantan, the floods were not severe. In each state, the number of evacuees was less than 1,000. In Kelantan, there were two deaths due to drowning. Total estimated flood damage was \$1.4 million (Jabatan Pengairan dan Saliran Kelantan 1991 p8). In Pulau Pinang, especially Georgetown, flash floods caused havoc in terms of traffic jams, damage to properties, commercial and industrial losses and damage to public facilities. The flood event of June was a 1 in 33 year event. The flooded extent of the Pinang and Air Itam river basins were 20 km^2 and 16 km^2 respectively. Flood depths were between 0.70 to 2.75 metres. The duration of flooding was one day (see Plate H.1). A total of 42 people were evacuated and the estimated damage to public facilities was \$680,012. Damages to commercial and industrial plants were deemed to be substantial but no estimate was made. Damage to crops and other public facilities was estimated at \$562,048. Flash floods also occurred in Selangor and the federal capital but estimates on damages were not available.

1992 - Minor flood

Although this flood is classified as minor, there were a total of 12 deaths. Of this total, four were in Kelantan. In Johor, flooding in January forced the evacuation of 1,252 people in Segamat and Batu Pahat districts. Another flood occurred in Kota Tinggi, Mersing and Kluang districts in November. During this second flood, a total of 900 people were evacuated. In anticipation of more flooding, 500 sacks of rice worth \$41,335 and 21,264 tins of sardines worth \$35,000 were sent to the forward bases (The Star 12.11.92 & 13.11.93). In Perlis, floods hit several low-lying areas in Arau and 60 people were evacuated. In Pulau Pinang, many parts of Bukit Mertajam were flooded to about 1 metre of water. More then 1,000 residents in Taman Sri Rambai fled their homes. 50,000 residents were affected by the flood. Household damages worth \$180,000 were reported (The Star 30.10.92). In Melaka, a total of 335 people were evacuated when flash floods hit Alor Gajah District. The floods, described as the worst since 1971, also destroyed large areas of padi fields, maize and banana plantations. In the federal capital, 500 residents in Puchong were evacuated when a flash flood hit the area. Damage to properties was estimated at $150,000 (The Star 2.1.92). In another flash flood, about 1,000 residents of Kampung Segambut experienced losses estimated at $1 million (Berita Harian 8.1.92).

1993 - Major flood

In its annual flood report, the DID emphasised that floods in 1993 are not confined to the East Coast are widespread on the West Coast as well. The flood season in 1993 began at the end of October and terminated at the end of December. Flood peaks were observed in many states from 24th December to 29th December. The DID flood report confirms that the 1993 flood was similar in magnitude to the 1988 flood, and therefore it can be classified as a major flood. States which were badly affected were Kelantan, Terengganu, Pahang and Johor. The federal capital also experienced severe flash flooding on many occasions. A total of 22 deaths were reported, of which 16 were from Kelantan and three from Pahang. The number of evacuees totalled 23,355 and damage to properties, public utilities, roads, bridges and crops were estimated roughly at millions of ringgits (unfortunately the DID could not give an exact figure).

In Kedah, the flooding was minor but serious enough to cause the evacuation of 291 people. Damage was minimal. In Negri Sembilan, 122 people were evacuated but flooding was generally not severe. In Melaka, 40 people were evacuated and school children missed a day of school because many roads were flooded. In Pulau Pinang, flood depths of between 0.6 to 2.0 metres were recorded. The 1993 rainfall on 21 November was a 1 in 30 year event. The Pinang River basin was flooded to an extent of 20.0 km^2 and the Air Itam River basin flooded to about 16.0 km^2. Damage to crops totalled $5,500 but generally the flooding was not severe. In Kelantan, the flooding was severe as the flood level was almost as high as the 1988 major flood. A total of 113,000 school children missed school for several days as 200 schools were either flooded of the roads leading to them were impassable. There was a total of 16 deaths and 15,854 evacuees. In Pahang, there were 2,644 evacuees as many towns and villages were inundated for several days to a week. The worst hit was Pekan with 1,398 evacuees and the closure of 16 schools. In Johor, a total of 132 people were evacuated but flooding was localised. Three villages (Kampung Puting, Kampung Lubuk and Kampung Roban) were cut off for ten days. In Kuala Lumpur, there were a total of four flash floods during the year. The flood on 7 June was the 4th largest flood since 1951. A total of 4,272 people were evacuated to relief centres. The floods caused massive traffic jams in the federal capital and inconvenience but no estimate of damage was made.

APPENDIX J: INFLUENTIAL FACTORS IN PREVIOUS HAZARDS RESEARCH FINDINGS

FACTORS	INFLUENTIAL	NOT INFLUENTIAL
GENDER	Men more likely to determine family response to flood hazard (James 1974). Males take a more optimistic view of the likelihood and nature of flooding but more aware of flood risk (Fordham 1992). Males felt more positively that flood relief schemes could enhance the environment and not spoil the view (Fordham 1992). Women are more vulnerable to hazards and disasters due to limited access to resources (Blaikie et al 1994).	Gender not related to awareness of flood risk Kates 1971; Mileti et al 1975). Gender not related to flood hazard perception (Parker 1976).
LENGTH OF RESIDENCE	Longer residence, more aware (Waterstone 1978). People living in new houses for shorter periods of time are more likely to adopt insurance against earthquake (Palm and Hodgson 1993). Those in residence longest generally show a lower level of flood hazard perception (Fordham 1992).	Length of residence not related to expectation of future flooding (Kates 1962).
TENURE	Home owners more likely to mitigate (Waterstone 1978). Urban home owners more sensitive to hazard characteristics; rural = opposite (Burton et al 1978). Tenants were prepared to live with a larger range of risks than property owners (Fordham 1992). Respondents who make adjustments are mostly house owners while tenants are not bothered to do anything at all (Jamaluddin and Ismail 1983). Land owners have better access to resources and can adapt better to hazards and disasters (Blaikie et al 1994). The landless are forced to occupy 'hazardous' land and are more vulnerable (Davis 1978).	Tenure not related to flood hazard perception (Parker 1976). Tenure has no significant effect on hazard evaluation, expectation of future hazard occurrence, or attitude toward hazard damage prevention (Baker and Patton 1974). Tenure has no significant association with number of adjustments (Harding and Parker 1974). Tenure has no significant relationship with flood awareness, perception of flood frequency, causes of floods, risk of future floods, awareness of flood alleviation schemes, advantages and disadvantages,

FACTORS	INFLUENTIAL	NOT INFLUENTIAL
		and willingness to move (Leigh and Low 1983).
EDUCATION	The more educated tend to have a positive attitude towards hurricane damage prevention (Baker and Patton 1974). Those with more years of school completed tended to insure against earthquake occurrences (Palm and Hodgson 1993). Hazard awareness increases with higher education but college graduates are less prepared than those with some college education (Turner et al 1979). Perceived changes of flood frequency is significantly influenced by education level (Leigh and Low 1983). The higher the education level, the higher the degree of flood hazard perception (Fordham 1992).	Education not significant in future flood expectation (Kates 1962). Literacy has no significant effect on hazard evaluation or expectation of hazard recurrence (Baker and Patton 1974). Education not influential in respondents' perception of storm hazards Islam 1974). There is no significant relationship between education level and flood awareness, perception of flood frequency, flood causes, awareness of flood alleviation programmes, advantages and disadvantages of living in the area, and willingness to move (Leigh and Low 1983).
AGE	Age associated with perception of importance of flood and knowledge of local flood problem: younger respondents more aware (Handmer 1979). Age associated with hazard awareness: younger respondents more aware (Waterstone 1978). Older respondents (55+) have a low level of flood hazard perception but more aware of past floods. Young respondents (18-34) display a high level of uncertainty and tendency to disagree but middle-aged respondents (35-54) showed the highest flood hazard perception (Fordham 1992). Aged respondents tend to deny the existence of hazard (Baker and Patton 1974). The very young and the aged are more vulnerable to disasters (Blaikie et al 1994). Young farmers more versatile in adopting more drought reduction strategies than old farmers (Chan 1981a).	Age has no significant effect on expectation of future hazard occurrence and attitude toward damage prevention (Baker and Patton 1974).

FACTORS	INFLUENTIAL	NOT INFLUENTIAL
FAMILY/ HOUSEHOLD STRUCTURE	Single family structure more likely to take action; but homes with school age children are less aware of earthquake hazard than those without children (Turner et al 1979). Families with children under 16 less aware of a flood problem (Parker 1976). Those with children take a more cautious view of the flood hazard and households with older members have a low flood hazard perception (Fordham 1992).	
GROUP MEMBERSHIP	Group membership has a positive association with attitude to structural solutions (James 1974).	Organizational membership support did not give a clearly interpretable pattern (Fordham 1992).
ETHNICITY	Different ethnic groups showed significant differences in their degree of prior awareness of the flood hazard and awareness of types of flood alleviation programmes (Leigh and Low 1983). Specific ethnic groups are often prejudiced and are denied access to resources and information and are, therefore, more vulnerable to disasters (Blaikie et al 1994).	There is no significant relationship between ethnic group and perception of flood frequency, causes of floods, risk of future floods, their estimation of advantages and disadvantages and willingness to move (Leigh and Low 1983).
SOCIO-ECONOMIC INDICATORS	Socio-economic class associated with greater knowledge of flood protection structures (Roder 1961). Lower income groups believe flooding to be less likely than higher income groups (Fordham 1992). Importance of hazard to income or locational interest influences hazard perception and estimation (White 1974). Wealthier peasants more likely to experiment with more adjustments (Burton et al 1993). Low income families are less likely to adopt strategies since the risk of unforeseen disaster weighs lightly against everyday needs (Davis	Socio-economic indicators not associated with attitudes to future flooding (Burton 1961). Income has no significant association with number of adjustments (Harding and Parker 1974). There are few significant relationships between hazard perception and expectation and socio-economic variables (Parker and Harding 1979).

FACTORS	INFLUENTIAL	NOT INFLUENTIAL
	1981). The poor have less access to resources and are more vulnerable to disasters (Varley 1994; Blaikie et al 1994).	
DISTANCE FROM RIVER/LOCATION	Nearer the river, more aware of flood hazard (Waterstone 1978). Those living closest to river have lower flood hazard perception than those living further away (Fordham 1992). Those nearest river tend to show less support for flood relief schemes (Fordham 1992). Farmers from dry areas more perceptive of recent moisture conditions than those from wet areas (Chan 1981a).	Adoption of earthquake and windstorm insurance does not vary by geographic location (Palm and Hodgson 1993).
HAZARD PERCEPTION	Respondents who are more aware of the hazard are more likely to make adjustments (White 1973, 1974; Burton et al 1978, 1993). Perception of adjustment availability and perceived linkages with other people influences adjustment choice (White 1974).	
PAST EXPERIENCE	Past experience influences the choice of adjustment (White 1973, 1974; Burton et al 1978, 1993). Past experience influences hazard awareness and level of adjustment, measured in terms of the number of adjustments (Harding and Parker 1974). Expectation of future minor flooding is highly related to experience of past flooding (Jamaluddin and Ismail 1983).	There is no direct link between awareness of past experience and the decision to settle and maintain settlement in a hazard zone (Islam 1974). Expectation of future major flooding is not significantly related to past flooding experience (Jamaluddin and Ismail 1983). The number of flooding experiences does not affect adoption of adjustment (Jamaluddin and Ismail 1983). Past experience bore no relationship to perceived seriousness of flood hazard (Chua 1972).
HAZARD AWARENESS	More awareness leads to less support for flood relief schemes	There is no clear correspondence between

FACTORS	INFLUENTIAL	NOT INFLUENTIAL
	(Fordham 1992).	perception of cyclone hazard and adoption of specific adjustments (Islam 1974).
HAZARD RECENCY	Recency of hazard experience accounts for variations in hazard perception (Kates 1962). Hazard recency is associated with flood hazard awareness (Harding and Parker 1974).	
HAZARD FREQUENCY	Frequency of hazard personal experience determines hazard perception and estimation, with intermediate frequency generating greatest variation in hazard interpretation and expectation (White 1974). Flood frequency is associated with flood hazard awareness (Kates 1962; Harding and Parker 1974).	
HAZARD MAGNITUDE/ SEVERITY	Respondents' evaluation of hurricane hazard and expectation of hazard recurrence vary strongly with sites having different magnitudes of risk (Baker and Patton 1974). Severity of hazard experience accounts for variations in hazard perception (Kates 1962).	Difference in hazard magnitude has no significant influence on awareness of hazard, respondents from all hazard zones show a similar level of high unawareness of the flood hazard. There was also no association in future expectation of floods between sites having different flood magnitudes (Harding and Parker 1974).
PERSONALITY TRAITS	Influences hazard perception and estimation (White 1974). Exert strong influence on certain choices of adjustments in the face of severe intensive events (Burton et al 1993).	No statistically significant associations are found between personality traits and hazard perception and expectation (Parker and Harding 1979).

APPENDIX K SURVEY OF FLOOD LOSSES INCURRED BY RESIDENTIAL, COMMERCIAL AND INDUSTRIAL ESTABLISHMENTS IN VARIOUS PARTS OF PENINSULAR MALAYSIA

K.1 Introduction

There is now a considerable volume of literature on flood damage assessment (White 1945; Parker and Penning-Rowsell 1972; Penning-Rowsell and Chatterton, 1977; Smith et al 1979; Parker and Penning-Rowsell 1984; Parker et al 1987). Flood damage in terms of losses are direct or indirect, and both categories include tangible and intangible losses. While the assessment of tangible losses is fairly straight forward, the evaluation of intangible losses can be problematic. Despite this, there have been attempts to quantify intangible flood damages so that they can be included in cost-benefit analysis (Green et al 1983a, 1988).

In Peninsular Malaysia, floods can cause a range of damages to residential and commercial properties located on rural and urban floodplains. While the damages in rural areas are usually confined to residential properties (with farm properties usually doubling up as residential premises) resulting in the loss of livestock and crops, and damage to building structure and contents, urban flood damage involves both damage to residential and commercial properties. And because of the high density of residential and commercial properties, infrastructure and public utilities in urban areas, urban flood damage is expected to be much higher than in the rural areas. Flood damage records have been and are still being collected by government departments and agencies on an ad hoc basis, i.e. whenever a flood occurs. As such, damage statistics are incomplete, irregular, and only covers government owned properties and utilities, the only exception being crop damage. Based on these records the estimated flood damage in Malaysia is of moderate extent compared with other neighbouring countries but this could largely be due to the underestimation of damages (JICA 1982 pP-6). Three examples of estimated flood damages during various flood events in several states are given in Table K.1[1].

There have been few attempts to determine the extent of flood damages to different types of privately owned properties in the peninsula, the exceptions being Smith (1985) and JICA (1991). Even so, both these above studies have focused on identifying potential flood damage rather than actual flood damage. In the current research, two separate surveys on flood damage were carried out. One was the main survey of 618 households which encompasses a section on 'actual'[2] flood damages. The other was a survey of actual flood damages of 273 businesses. The latter was a preliminary survey of flood damage to private commercial properties. As it serves only as a supplementary survey to the main household survey (its results complement the findings of flood damage to residential properties surveyed in the main household survey), it is not intended to be a comprehensive survey of commercial

[1] Figures given in this table should be treated with caution as they are crudely estimated. For example, damage to roads and vehicles are not included. Intangibles (see Section K.3.2) are also not included. The main criticism of this table is that it focuses only on those flood losses which can be measured in Ringgits. Other reasons for the crude estimates are previously examined in Appendix I.

[2] Actual flood damage includes all damages suffered during a particular flood event. This is opposed to potential flood damage which is calculated based on flood depth, building characteristics and other theoretical assumptions (Smith 1985).

Table K.1: Estimated flood damages in past major floods in Peninsula Malaysia

Type of damage	Pahang-1971		Kelantan-1967		Kuala Lumpur-1971	
	Damage	%	Damage	%	Damage	%
1. Rural industries:						
a. Crops	10,000,000	23.2	24,850,000	31.5	-	-
b. Livestock	240,000	0.6	6,390,000	8.1	-	-
c. Forests	20,000	0.05	-		-	-
d. Fisheries	45,000	0.1	-		-	-
Sub-total	10,305,000	23.9	31,240,000	39.6	-	-
2. Structures & Properties:						
a. Utilities & Facilities	5,470,000	12.7	9,287,000	11.8	17,492,000	51.0
b. Public buildings	2,425,000	5.6	1,368,000	1.7	Incl. in 2a	-
c. Housing	12,450,000	28.9	16,340,000	20.7	13,712,000	40.0
d. Industrial Facilities	570,000	1.3	-	-	3,063,000	8.9
Sub-total	20,915,000	48.5	26,995,000	34.2	34,267,000	100.0
3. Indirect damages:						
a. Activities Interrupted	10,130,000	23.5	12,305,000	15.6	10% incl. in 2	-
b. Rescue & Relief	1,800,000	4.2	8,350,000	10.6	-	-
Sub-total	11,930,000	27.6	20,655,000	26.2	-	-
Total Damage	43,150,000	100.0	78,890,000	100.0	34,267,000	100.0
(Price level)	(1974)		(1976)		(1977)	

(Source: JICA 1982)

properties in the peninsula. **Both surveys are aimed at answering Research Question 1 (Chapter 1), i.e. to determine how important the flood hazard is in Peninsular Malaysia.** The surveys covered flood damage suffered by residential households, commercial properties and businesses, and industries during the most recent flood. As a comparison, flood damage suffered during the worst flood was also covered in the household survey. It was not carried out in the commercial survey as many businesses are relatively new and the owners are unwilling to be drawn into lengthy interviews.

K.2 Types of flood damage

In the flood damage assessment literature, damages or losses have been categorised as direct or indirect. Such damages are further categorised as tangible or intangible (White 1945; Parker and Penning-Rowsell 1972; Penning-Rowsell and Chatterton 1977; Higgins and Robinson 1982; Parker and Penning-Rowsell 1984; Parker et al 1987). A typology of flood damage is given in Figure K.1.

K.2.1 Tangible flood damage

Tangible flood damage refers to those effects of flooding which can be assigned monetary values. They can be direct as in the case of damage to building structures or indirect as in the case of the loss suffered as a result of drop in business volume.

(a) Direct damage

Direct flood damage results from the contact of flood water and its contents (sediment, oil etc.) with buildings and their contents, vehicles, livestock and crops, humans, memorabilia, etc.. For residential properties, the pressure and contact of flood water may give rise to adverse effects on building structure (walls, floors, stilts etc.), damage to garden and house contents such as furniture, electrical appliances, household utensils, carpets, wiring system and sockets, etc. In the case of commercial properties, additional effects may include damage to shop fittings, goods, raw material, machinery, etc. The costs of clean-up after a flood may also be included as direct damage.

(b) Indirect damage

Indirect damages usually occur at the time of, or in a period after, a flood. In Peninsular Malaysia, as flood events can last for several weeks, such damages may be substantial. Also, the post-flood period can extend for several weeks or months. In the case of residential properties, indirect damages include alternative accommodation, costs of transportation (of family members and household contents), loss of income through disruption to work, costs of treatment to illness resulting from floods (especially children and the elderly being exposed to the cold waters), loss of schooling and subsequent costs of extra lessons to catch up with the syllabus, etc. In the case of commercial properties, such damages may include loss of production, reduced output due to inability of worker to commute to working premise, transportation of goods and raw materials to alternative location, loss of trade due to temporary closure of business outlets, loss of business orders, increase in costs of transportation caused by disruption to usual traffic, the devaluation of the property value in the market, etc.

K.2.2 Intangible flood damage

Intangible flood damage refers to those effects of flooding to which it is not currently possible

		Measurement	
		Tangible	Intangible
Form of Damage	Direct	Damage to buildings and contents	Stress and loss of life
	Indirect	Loss of production and work	Inconvenience of flood

Figure K.1 A typology of Flood Damage (After Parker et al 1987 p2) to assign acceptable monetary values (Pearce 1976). The only common property shared by 'intangibles' is that they cannot be evaluated for one reason or another (Parker et al 1987 p10). As with tangible damages, it is possible to have both direct and indirect intangible damages. The damage of historical buildings by flooding is a direct effect but it would be difficult to evaluate the loss in monetary terms. This is then an intangible direct loss. On the other hand, the inconvenience caused by a flood is difficult to measure in monetary terms. This is then termed an intangible indirect loss.

According to findings by Green et al (1988), the non-monetary (intangible) impacts of flooding are far more important to the households affected than the value of the damages done. Physical damage to building and their contents is the most visible but not always the most serious effect of flooding (Green et al 1983b p6). Among the notable intangible damages are disruption to the household's life caused by a flood, the stress of the flood event itself; subsequent health damage; loss of memorabilia or of other irreplaceable and non-monetary goods; and possible evacuation. Furthermore, stress and worry about the risk and consequences of future flooding may also damage a person's health.

K.3 Reported household flood damage

In the household survey, 539 households (87.2 per cent) were flooded during the most recent flood in their area. The majority experienced their most recent flood between 1988 and 1992. Of those flooded, 234 households (43.4 per cent) reported that they suffered some losses as a result of their most recent flood experience. For comparison, households were also surveyed on the most severe flood experienced by them. This ranged from 1926 to 1992, the most common being the 1991, 1988, and 1971 floods in that order. During the most severe flood, 593 households (96.0 per cent) were flooded and of these, 485 households (81.8 per cent) suffered some form of damage.

Damage estimates for the most recent flood are reasonably accurate with 83.8 per cent of affected respondents reporting so (Table K.2). However, figures for the most severe flood must be treated with caution because about 36.7 per *cent reported experiencing their most* severe flood before 1982 (more than 10 years ago). Furthermore, 35.4 per cent of respondents have also openly admitted that they vaguely remember the damage and that their damage estimates may be inaccurate.

K.3.1 Reported tangible flood damage

(a) Reported direct damage

In Peninsular Malaysia tangible direct damages appear to be the most significant affecting households. This appears to contradict Green et al's (1988) findings which suggest that intangible impacts are far more important to households in the United Kingdom (UK). This may be explained by a combination of exposure to flood hazards, cultural differences and the level of affluence between the two societies. It is most certainly true that floods in the UK are not as severe as those in Malaysia. Malaysians are also more experienced and attuned to floods than their UK counterparts. They are hardened by years of flood experience, some of which are so severe that entire villages (houses) are washed away (e.g. the 1926 flood, see Appendix I and Winstedt 1927). Thus, seasonal floods are a way of life to Malaysians, as common as the cold wet UK winter. Malaysians are, therefore, less likely to consider stress,

Table K.2 Accuracy of damage figures during the most severe and most recent floods

Level of accuracy	Most severe flood		Most recent flood	
	Frequency	Percentage	Frequency	Percentage
Very accurate	11	2.3	17	7.3
Accurate	103	21.2	97	41.5
Moderately accurate	199	41.0	82	35.0
Inaccurate	148	30.5	33	14.1
Very inaccurate	24	4.9	5	2.1
Total	485	100.0	234	100.0

worry[3], the loss of memorabilia and other intangibles as highly significant as their UK counterparts would[4]. Malaysian floodplain occupants are also largely poor (see Chapters 6 and 7) and can ill afford to lose their entire crop, spend on expensive house repairs and replacement of house contents caused by flood damage. When food and shelter is the main priority in life (which is often lived on a day by day basis), then it is almost certain that tangible flood loss will be the main concern. Thus, in Peninsular Malaysia, damage to building contents appeared to be the greatest damage for both the most recent and worst floods (Figure K.2). This is followed by damage to livestock and crops and building structure respectively. Although flood damages for different categories of damages are relatively low for both floods, ranging from $39 to $459, total damages are quite substantial. Bearing in mind that 46.9 per cent of households in the current survey have monthly incomes below $500, the total damage estimates of $1,393 (most recent flood) and $1,837 (worst flood) becomes significant. Furthermore, it should be put in perspective that the damage figures for the worst flood are estimated at prices many years ago depending on the year of occurrence (37.2 per cent of respondents indicated that they suffered their worst flood more than 10 years ago).

Table K.3 gives the breakdown of different types of damages to building contents for the most recent and the worst flood. In both cases household appliances appear to contribute the most amount of damage, amounting to 40.5 per cent and 34.8 per cent respectively[5]. This is followed by damage to furniture which accounted for 29.6 per cent and 34.0 per cent respectively. In terms of different types of properties, residential households appear to suffer the bulk of the damage, accounting for 63.6 per cent and 63.1 per cent of total damage to contents respectively. However, the average damage for commercial households was highest, amounting to $1,416 and $1,311 respectively.

In terms of damage to building structure, the most affected structures are the floors, walls and stilts (Table K.4). The majority of households suffered only minor damage of less than $500 for both floods. The average damage suffered by each flooded household was small, being only $180 and $373 respectively. Commercial households suffered the highest average damage for both floods while damage to fishing households was the smallest. This is mainly due to the fact that the majority of fishing households build their properties on stilts and regularly replace worn-out or rotting stilts. Another reason could be the fact that the fishermen do not consider the replacement of stilts as a kind of flood damage but rather as

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[3] Nevertheless, stress and worry are still important effects felt by many Malaysians living in the more hazardous flood zones, especially the aged and the young (see Section K.3.2).

[4] Perhaps a hypothetical comparison would highlight the difference in importance given to intangibles between the two societies. A lady in the UK loses her beloved dog which drowned during a flood and another woman (farmer) in Malaysia loses her water buffalo. It is likely that the former will be highly stressed as no other dog would be considered as able replacement to the one she lost. Thus, the intangible loss is much more important than the actual cost of the dog. In the case of the latter, her source of livelihood is lost. She is therefore only concerned about the tangible loss (cost of the buffalo) as she would not be able to plough the land and farm in the next season. To her, any replacement buffalo would do. Even a mechanical tractor, considered a windfall, would be a more than appropriate substitute.

[5] As the text discusses both the most recent and the worst flood simultaneously, the first figure refers to the former while the second figure to the latter in all subsequent cases.

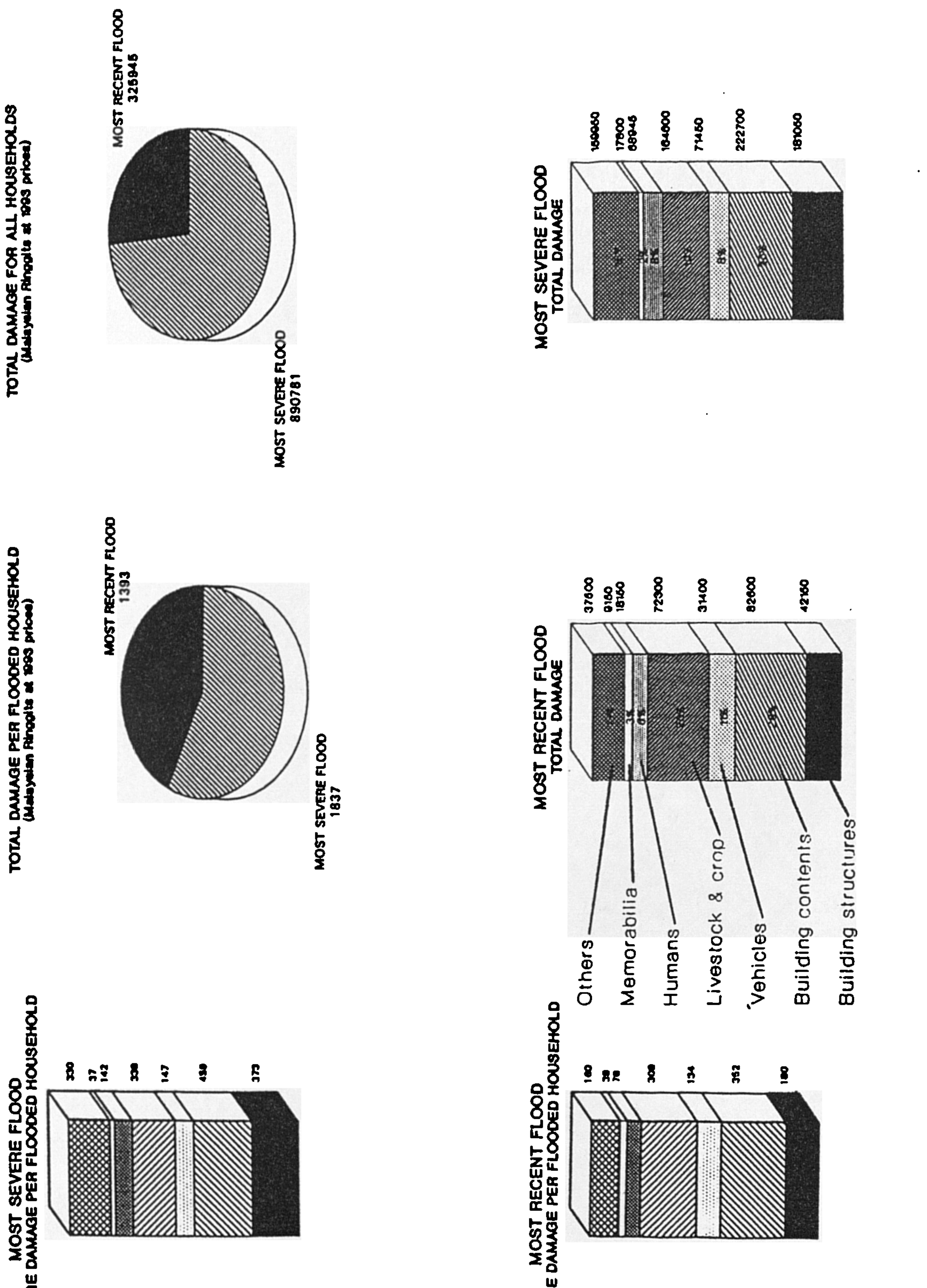

Figure K.2: Types of reported flood damage experienced by households during the most recent and most severe floods

Table K.3 Reported damage to building contents

(a) During most recent flood: N=234

Item	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Carpet	1	11	1	0	0	0	0	13	5.3
Furniture	3	52	12	3	0	0	0	69	29.6
Appliances	0	21	7	5	0	2	1	36	40.5
Air cond.	0	2	2	0	0	0	0	4	2.4
Foodstuffs	1	19	0	1	0	1	0	22	8.2
Pets	3	6	0	0	0	0	0	9	0.9
Others	0	6	1	3	0	1	0	11	13.1

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $52,550
Total damage incurred by farming households = $3,150
Total damage incurred by commercial households = $26,900
Total damage incurred by fishing households = $0
Total damage incurred by all flooded households = $82,600
Average damage incurred by each flooded household = $352

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(b) During the most severe flood: N=485

Content	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	10,000+	Total	% of Total
		Amount of damage ($)								
Carpet	2	45	1	1	0	0	0	0	49	5.9
Furniture	5	169	32	5	1	0	0	0	212	34.0
Appliances	0	71	22	8	3	2	1	1	108	34.8
Air cond.	0	11	7	4	1	0	0	0	23	8.4
Foodstuffs	3	59	1	1	0	1	0	0	65	6.2
Pets	12	8	0	0	0	0	0	0	20	0.2
Others	1	22	8	5	0	1	0	0	37	10.5

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $140,500
Total damage incurred by farming households = $15,100
Total damage incurred by commercial households = $65,550
Total damage incurred by fishing households = $1,550
Total damage incurred by all flooded households = $222,700
Average damage incurred by each flooded household = $459

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Table K.4: Reported damage to building structures

(a) During the most recent flood: N=234

Structure	DK	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	Total number affected	% of Total Damage
Floor	3	44	4	5	1	57	53.1
Wall	6	40	4	3	0	53	32.7
Stilts	0	10	0	0	0	10	5.0
Stairs	0	6	0	0	0	6	1.8
Basement	1	1	1	0	0	3	0.5
Garden	1	10	0	0	0	11	2.9
Other areas	0	7	0	0	0	7	4.0

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $30,400
Total damage incurred by farming households = $3,400
Total damage incurred by commercial households = $8,300
Total damage incurred by fishing households = $50
Total damage incurred by all flooded households = $42,150
Average damage incurred by each flooded household = $180

(b) During the most severe flood: N=485

Structure	DK	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	3,001-7,500	Total number affected	% of Total Damage
Floor	8	158	14	9	3	0	192	35.3
Wall	12	143	13	6	1	0	175	27.1
Piles	5	46	3	3	1	0	58	9.6
Stairs	3	32	1	1	1	0	38	5.6
Basement	2	5	0	0	0	0	7	0.4
Garden	4	23	1	0	0	0	28	1.7
Other areas	0	20	5	6	1	3	35	20.3

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $113,050
Total damage incurred by farming households = $27,250
Total damage incurred by commercial households = $36,800
Total damage incurred by fishing households = $3,950
Total damage incurred by all flooded households = $181,050
Average damage incurred by each flooded household=$373

more of a maintenance to the building.

Damage to vehicles for both the most recent and most severe floods are not high (Table K.5). This is because most people would park their vehicles on higher ground or they may move the vehicles just as the flood waters are about to rise. However, the main reason is that not many floodplain households have expensive vehicles such as a car or a van. Most would have motorbikes and bicycles, the repairs of which are relatively cheap.

Damage to livestock and crops can be very significant, especially amongst rural households. Although the average damage for both floods is relatively small at $309 and $339 respectively, the average damage suffered by farming households during both floods is $366 and $778 respectively (Table K.6). This level of damage is highly significant when damage totals are compared with monthly incomes. The average monthly incomes of farming households in the current survey is $382. Damages to livestock and crops during the two floods are about 95.8 per cent and 203.7 per cent of their average monthly income respectively.

Flood damage to humans can either be tangible (such as loss of work) or intangible (such as stress and illness[6] caused by flooding). The average tangible flood loss to humans in the most recent and most severe floods are not large, i.e. $78 and $142 respectively (per flooded household). Table K.7 illustrates the types of flood loss to humans for both floods. Loss of work is the main component of flood loss to humans, making up 83.4 per cent and 70.9 per cent of the total flood loss to humans in the most recent and worst floods respectively. Although illness caused by the effects of flooding is difficult to quantify, many respondents have reported some loss due to medical expenses. However, total medical expenses reported due to the two floods are not large. For those households with reported illness due to flooding amongst household members, the average medical expense for the most recent and worst floods are $110 and $103 respectively. Again, these amounts must be seen in relation to the average incomes of the households concerned. Households with low incomes would have difficulty finding the extra money for medical expenses during floods as they need the money for other expenses in recovery and rehabilitation. Some households have also reported loss of medical expenses as a result of stress and worry. This is translated into monetary loss when medical help is sought. However, the expenses are small. Finally, a rather unique flood loss to humans is that incurred by households with school children, especially those who are taking government examinations. For both the most recent and worst floods, a small percentage of households reported such loss. School children who have registered for government examinations and who subsequently fail to attend their examination because of floods, lose their examination fees. More significantly, however, is the fact that they will lose one year of their academic career as they will have to do a re-sit the following year. The effects of seasonal flooding on government examinations is so serious that a commission was set up to identify flood seasons all over the country so that examination dates could be arranged to avoid the most frequent flood dates. Subsequently, annual end of the year examinations in November-December (usually the peak of the flood season in the East Coast) has been re-scheduled for an earlier date in October (Sooryanarayana 1988).

Although damage to memorabilia reported by respondents for both the most recent and worst

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[6] Some illness would have occurred without flooding. Hence, the difficulty of isolating flood-related illness from the rest. However, great caution was exercised when asking the question related to illness and in depth probing was used. Respondents were asked about their health history and whether or not they thought the illness was related to floods.

Table K.5 Reported damage to vehicles

(a) During most recent flood: N=234

Type of vehicle	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Tractor	0	0	0	0	0	0	0	0	0.0
Lorry/truck	0	0	0	0	0	0	0	0	0.0
Van	0	2	0	1	0	0	0	3	7.5
Car	0	9	3	0	1	0	2	15	73.1
Motorbike	0	25	2	0	0	0	0	27	17.8
Bicycle	0	9	0	0	0	0	0	9	1.5
Others	0	1	0	0	0	0	0	1	0.1

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $16,800
Total damage incurred by farming households = $1,350
Total damage incurred by commercial households = $13,250
Total damage incurred by fishing households = $0
Total damage incurred by all flooded households = $31,400
Average damage incurred by each flooded household = $134

(b) During the most severe flood: N=485

Type of vehicle	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Tractor	0	4	1	0	0	0	0	5	2.9
Lorry/truck	0	1	1	0	1	0	0	3	5.0
Van	0	3	1	3	0	0	0	7	9.4
Car	0	33	10	2	1	0	2	48	56.1
Motorbike	0	56	3	1	0	0	0	60	20.2
Bicycle	1	30	1	0	0	0	0	32	4.6
Others	0	2	1	0	0	0	0	3	1.8

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $39,450
Total damage incurred by farming households = $3,850
Total damage incurred by commercial households = $26,200
Total damage incurred by fishing households = $1,950
Total damage incurred by all flooded households = $71,450
Average damage incurred by each flooded household = $147

Table K.6 Reported damage to livestock and crops

(a) **During most recent flood: N=234**

	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Crops	3	43	9	6	5	1	1	68	71.5
Cattle	0	1	4	0	0	0	0	5	4.6
Goats	1	6	2	0	0	0	1	10	16.5
Poultry	1	51	0	0	0	0	0	52	5.2
Pigs	1	1	0	0	0	0	0	2	0.1
Fish	0	3	0	0	0	0	0	3	0.7
Others	0	6	0	0	0	0	0	6	1.4

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $13,650
Total damage incurred by farming households = $53,050
Total damage incurred by commercial households = $3,100
Total damage incurred by fishing households = $2,500
Total damage incurred by all flooded households = $72,300
Average damage incurred by each flooded household = $309

(b) **During the most severe flood: N=485**

	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Crops	3	61	36	13	6	2	1	122	61.4
Cattle	0	4	4	7	1	1	1	18	19.0
Goats	0	17	3	2	0	0	0	22	5.6
Poultry	0	158	1	0	0	0	0	159	8.6
Pigs	0	3	1	0	0	0	0	4	1.2
Fish	0	15	1	0	0	0	0	16	3.2
Others	0	8	1	0	0	0	0	9	1.0

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $29,250
Total damage incurred by farming households = $112,850
Total damage incurred by commercial households = $2,200
Total damage incurred by fishing households = $20,300
Total damage incurred by all flooded households = $164,600
Average damage incurred by each flooded household = $339

Table K.7 Reported damage to humans

(a) During most recent flood: N=234

Nature of damage	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
		Amount of damage ($)							
Killed	0	0	0	1	0	0	0	1	8.0
Illness	23	18	0	0	0	0	0	41	5.9
Stress	76	2	0	0	0	0	0	78	0.5
Loss of work	18	41	2	3	0	0	1	65	83.4
Schooling	27	4	0	0	0	0	0	31	2.2

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $4,300
Total damage incurred by farming households = $1,250
Total damage incurred by commercial households = $12,200
Total damage incurred by fishing households = $400
Total damage incurred by all flooded households = $18,150
Average damage incurred by each flooded household = $78

(b) During the most severe flood: N=485

	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-15,000	Total affected	% of Total Damage
		Amount of damage ($)							
Killed	0	0	1	0	0	0	0	1	1.1
Illness	64	45	0	0	0	0	0	109	3.8
Stress	204	13	0	0	0	0	0	217	1.0
Loss of work	41	130	11	5	1	1	1	190	70.9
Schooling	94	25	0	0	0	0	0	119	4.6
Others	0	0	0	0	0	0	1	1	18.6

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $16,295
Total damage incurred by farming households = $6,800
Total damage incurred by commercial households = $43,500
Total damage incurred by fishing households = $2,350
Total damage incurred by all flooded households = $68,945
Average damage incurred by each flooded household = $142

floods is relatively low, being $39 and $37 for each flooded household respectively, there are many others who could not give a value for their loss. Such 'unquantifiable' loss is examined under Section K.3.2. The most common memorabilia loss or damaged during floods are photographs, antiques, jewellery, paintings and other family 'treasures' (Table K.8).

Table K.9 illustrates other damages suffered by households during the most recent and worst floods. Goods appear to be the most common item to suffer damage. This is followed by damage to machinery. Most households reporting such damages are business households. However, the average damage reported was not large amounting to $160 and $330 for both floods respectively.

Finally, in terms of tangible damage, the total cost of all flood damages suffered by households is shown in Table K.10. The average total lost per flooded household is not large, even by Malaysian standard, being $1,393 and $1,837 for the two floods respectively. However, once again, the total flood loss must be seen in relation to the average incomes of the households concerned. For example, out of 69.8 per cent of respondents with incomes less than $350 who reported flood loss during the most recent flood (therefore considered poor households) suffered losses of more than $500. Furthermore, 22.5 per cent of these respondents suffered losses greater than $2,000. For the most severe flood, 40.7 per cent of respondents reporting flood losses suffered losses greater than $500. For those in the marginal income group earning monthly incomes between $350 and $499, 66.7 per cent of those reporting flood losses suffered losses greater than $500 in the most recent flood. For the most severe flood, there were 36.6 per cent of respondents who suffered this level of loss. The percentages of respondents appear lower in the most severe flood because there are fewer respondents who remember their actual flood loss. Furthermore, the most severe flood may have been experienced a long time ago when the price level is not the same. For example, a flood loss of $500 in 1980 would be equivalent to approximately $743 in 1993. If the flood loss of $500 was in 1970, then the equivalent loss in 1993 would be approximately $1,316. Thus, the flood loss for the most severe flood for respondents in Kuala Lumpur (most of the households reported that the 1971 flood was the most severe) becomes highly significant. However, it must be cautioned that the flood loss reported for such a distant flood may not be very accurate and should be treated as an estimate.

In terms of the type of households, commercial households appear to suffer the greatest flood loss. In the most recent flood, these households suffered an average loss of $1,023 as compared to $435 and $383 for farming and residential households respectively. Fishing households suffered the lowest loss of only $79 per household. This is due to the fact that commercial households have damaged goods and machinery as compared to other households. Furthermore, commercial households also suffer loss of production or trading during the duration of the flood. During the most severe flood, commercial households suffered an average loss of $3,099 per household as compared to $1,303 and $1,099 for farming and residential households. Fishing households again suffered the lowest loss averaging $751 per household. As a comparison, squatter households suffered an average flood loss of $1,346 and $1,319 per household for the most recent and worst flood respectively.

K.3.2 Reported intangible flood damage

'Intangibles' are those factors that are often left out of a benefit-cost analysis (Green and Penning-Rowsell 1988 p101) simply because they are unquantifiable. There are many factors which fall into this category. For instance, previous studies have shown that some of the impacts of flooding, notably health damage, may be intangible over the short period but the damaging effects can surface years after the flood (Emery 1987). Although techniques are

Table K.8 Reported damage to memorabilia

(a) During most recent flood: N=234

	DK	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	Total affected	% of Total Damage
Photographs	10	3	1	0	0	0	0	14	15.9
Antiques	0	5	1	1	1	0	0	8	74.2
Jewellery	0	1	0	0	0	0	0	1	2.0
Paintings	2	3	0	0	0	0	0	5	6.0
Others	1	1	0	0	0	0	0	2	1.9

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $8,800
Total damage incurred by farming households = $350
Total damage incurred by commercial households = $0
Total damage incurred by fishing households = $0
Total damage incurred by all flooded households = $9,150
Average damage incurred by each flooded household = $39

(b) During the most severe flood: N=485

	DK	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	Total affected	% of Total Damage
Photographs	20	24	1	0	0	0	17.0
Antiques	1	18	2	0	1	22	45.5
Jewellery	0	6	0	0	0	0	10.1
Paintings	3	11	0	0	0	14	14.1
Others	3	8	1	0	0	12	13.3

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $15,900
Total damage incurred by farming households = $350
Total damage incurred by commercial households = $1,550
Total damage incurred by fishing households = $0
Total damage incurred by all flooded households = $17,800
Average damage incurred by each flooded household = $37

Table K.9 All other flood damages reported

(a) During most recent flood: N=234

Damaged items	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	Total affected	% of Total Damage
		Amount of damage ($)						
Machinery	0	2	1	1	1	1	6	27.6
Goods	0	6	3	5	4	0	18	58.0
Others	1	41	1	0	0	0	43	14.4

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $2,200
Total damage incurred by farming households = $550
Total damage incurred by commercial households = $34,450
Total damage incurred by fishing households = $300
Total damage incurred by all flooded households = $37,500
Average damage incurred by each flooded household = $160

(b) During the most severe flood: N=485

Damaged items	DK	1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-15,000	Total affected	% of Total Damage
		Amount of damage ($)							
Machinery	0	12	1	3	1	1	2	20	21.6
Goods	0	12	9	7	9	2	2	41	48.0
Others	12	155	5	4	1	2	1	180	30.4

DK - Don't know or unable to give an estimate
Total damage incurred by residential households = $14,800
Total damage incurred by farming households = $22,700
Total damage incurred by commercial households = $121,750
Total damage incurred by fishing households = $700
Total damage incurred by all flooded households = $159,950
Average damage incurred by each flooded household = $330

Table K.10 **Total estimated and reported cost of all damages suffered by households**

(a) During most recent flood:

	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-5,000	5,001-10,000	10,000+	Total affected
Frequency	120	32	32	18	22	7	3	234
Percentage	51.3	13.7	13.7	7.7	9.4	3.0	1.3	100.0

Total damage incurred by residential households = $139,797
Total damage incurred by farming households = $80,500
Total damage incurred by commercial households = $102,948
Total damage incurred by fishing households = $2,700
Total damage incurred by all flooded households = $325,945
Average damage incurred by each flooded household = $1,393

(b) During the most severe flood:

	Amount of damage ($) 1-500	501-1,000	1,001-2,000	2,001-3,000	3,000-7,500	5,001-10,000	10,000+	Total affected
Frequency	150	98	92	57	75	5	8	485
Percentage	30.9	20.2	19.0	11.8	15.5	1.0	1.6	100.0

Total damage incurred by residential households = $380,400
Total damage incurred by farming households = $185,496
Total damage incurred by commercial households = $290,598
Total damage incurred by fishing households = $34,287
Total damage incurred by all flooded households = $890,781
Average damage incurred by each flooded household = $1,837

being developed to measure intangible damage, the very fact that no market prices can be attached to them restricts the development of such techniques. Although intangible flood damage is difficult to measure, their effects on households are identified to include:

(a) **Reported damage to building structure over the long term**

The discussion on direct damage to building structures in Section K.3.1 (a) refers only to expenditure spent during the two floods. It does not include long term effects which are difficult to estimate and are therefore treated here as an intangible damage. Although many traditional Malaysian houses are built on stilts, this does not mean they are completely flood proof. In fact, the majority of the stilts (41.2 per cent) are built of wood which will rot over time. In such cases, houses may collapse and this is by no means uncommon (Plate K.1). Walls, floors, stairs and other structures may also experience wear and tear over the long term (Plate K.2, Plate K.3 and Plate K.4). Unfortunately, such wear and tear is not easily measured or estimated. However, detailed interviews with house owners in flood-prone areas indicate that such intangibles may be substantial.

(b) **Reported fall in property values**

Furthermore, properties in flood-prone areas loose their residential attractiveness and experience sharp drops in property values. For instance, house owners in the Jalan P Ramli area (Pulau Pinang) and the Kampung Baru, Dato Keramat and Tiong Nam areas (Kuala Lumpur) have mentioned that the values of their houses have not increased vis-a-vis houses in other residential estates nearby. Although the current research does not take into account property values, indications (from discussion and interviews with house owners and estate agents) are that such intangible losses can be substantial.

(c) **Reported long term effects on vehicles**

Undoubtedly, regular flooding of vehicles inevitably results in rusting of parts and damage to the engine and the body-work. As such, it was not surprising to note that many cars, motorbikes, bicycles and other modes of transportation in flood-prone areas bear the mark of rusting (see Plate 7.2). Although no count was taken in this research, the number of such vehicles is noted to be significant.

(d) **Reported inconvenience caused by flooding**

This is not normally mentioned as a flood loss or damage by respondents in this research. Floodplain occupants in Peninsular Malaysia accept the consequences and risks of flooding and do not consider flooding as an inconvenience that can be measurable in terms of monetary loss. Such an item is difficult, if not impossible to measure in monetary terms. Studies elsewhere have indicated that very large scale flooding will disrupt whole communities, thus reducing the degree of social support available and subsequently causing further disruption (Erikson 1976; Blocker and Rochford 1986; Green and Penning-Rowsell 1988).

(e) **Reported stress of the flood event**

Stress caused by the flood event is rated highly amongst respondents of two studies in the United Kingdom. Based on a scale from 0 (no effect) to 10 (most severe effect), a maximum severity of 10 was given by respondents in Swalecliff while a value of 6.5 was reported by respondents in Southgate (Green and Penning-Rowsell 1988 p105). In the current research,

Plate K.1: Top: A collapsed house in Kelantan due to structural damage resulting from repeated flooding over a long period of time. Bottom: A stilt house in Pekan almost on the verge of collapsing due to repeated flooding and eroding of the stilts

Plate K.2: Damage to walls of building as a result of repeated flooding. Top: An example from Pulau Pinang. Bottom: An example from Kuala Lumpur.

Plate K.3: Damage to the building floor as a result of repeated flooding. Top: An example from Pulau Pinang. Bottom: An example from Pekan.

Plate K.4: Damage to the other building structures as a result of repeated flooding. Top: An example of damage to stairs from Pekan. Bottom: An example of damage to stilts from Kelantan

although stress accounts for only a small percentage of tangible flood damage in terms of medical expenses (see Table K.7), the intangible effects can be severe and have long term effects on a person. The percentage of respondents mentioning stress as a flood related problem is significant. For the most recent flood, 12.6 per cent of all respondents reported that stress was a problem. During the most severe flood, the figure is even higher at 35.1 per cent of all respondents. In fact, of all the effects to humans reported by respondents, stress is mentioned by the highest number of respondents.

Question 56 in the household survey examines the respondents' rating of various flood effects on their households on a scale of 0 (no effect) to 10 (very serious effect). For the stress variable, respondents gave a relative severity rating of 5.0 (Figure K.3). This is a very high rating compared to the relative severities of other impacts. Only disruption to transport or communications is ranked higher than stress. Furthermore, stress and worry about the risk and consequences of future flooding may also damage a person's health, although this relationship my be difficult to prove.

(f) **Reported health damage**

In Peninsular Malaysia, damages to health (other than stress and worry) do not appear to feature highly on respondents' evaluation of flood impacts. The mean score of 2.4 suggests that floodplain occupants have grown 'used to' floods and are well adapted to them. In fact, 232 respondents (37.5 per cent) rated flood effects on health as 0, i.e. no effect at all. Only a small proportion of respondents, 12.2 per cent rated health effects with a score of 6 and above. However, based on the chi-square test, it was found that there were significant differences in rating between respondents from the East and West Coasts. There was a higher proportion of respondents from the East Coast (76.5 per cent) rating health effects with a severity of less than 4 than there were in the West Coast (61.9 per cent). On the other hand, the corresponding figures for a severity ranking of 7 or more were 5.4 per cent and 13.7 per cent respectively. This could be due to the fact that East Coast inhabitants have more flood experiences and may perhaps be more adapted to disruption and other conditions arising from flooding. A high proportion of East Coast respondents (78.0 per cent) perceive flooding to be a normal part of their livelihood and because of that it is unlikely that they will consider flooding to be harmful to their health. On the other hand, West Coast inhabitants are generally less able to cope with disruption caused by floods as such events are not so common. They are, therefore, more susceptible to suffer health effects resulting from floods.

There are also significant differences when rating health damage between the various ethnic groups. Indians (31.9 per cent) seem to have the lowest proportion rating health effects as 0. This was followed by the Malays (36.2 per cent) and the Chinese (42.8 per cent). On the other hand, the Malays (6.7 per cent) appear to have the lowest proportion rating health effects 7 or more. This could be due to the fact that Malays form a greater proportion of East Coast respondents (66.6 per cent) and thus are more experienced when it comes to floods. On the other hand, health is very important to the Chinese. The Chinese would spend more of their income on 'good' food than would the other ethnic groups. Because of this, the Chinese are envisaged to assess health effects rather more seriously than the Malays or Indians.

When households with a flood frequency of 1 in 5 or less are considered, 86.2 per cent of Malays rated health effects as minor (a rating between 0 and 3) as compared to 69.2 per cent and 62.1 per cent of Chinese and Indians. Conversely, only 3.4 per cent of Malay respondents rated health effects as severe (a rating between 7 and 10) as compared to 7.7 per cent and 10.3 per cent of Chinese and Indian respondents respectively. This is due to the fact

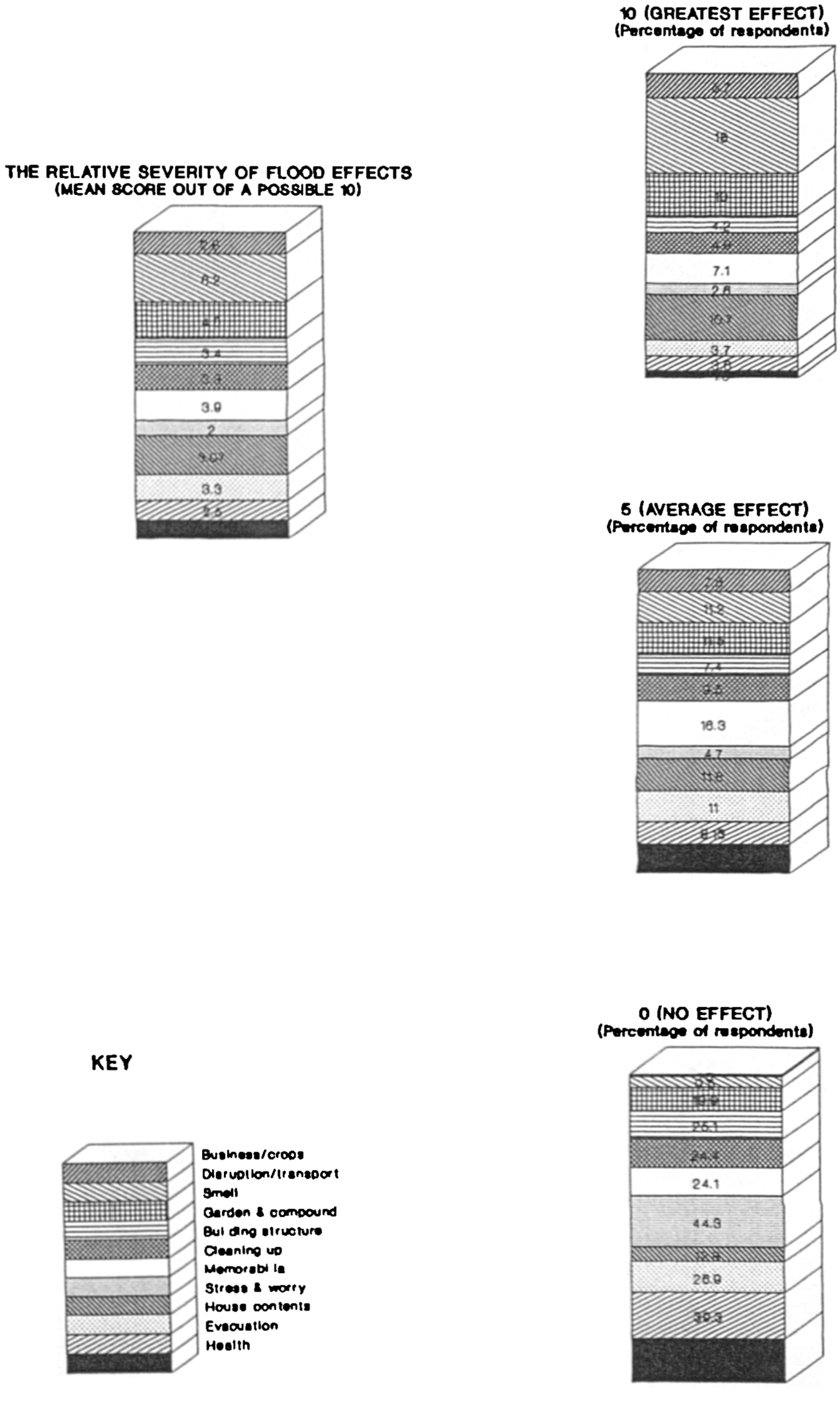

Figure K.3: The relative severity of various flood effects on households in Peninsular Malaysia

that Malay households have lived with floods for a much longer time and are therefore more experienced. They are therefore more adapted to floods and tend to have a more philosophical attitude towards floods. Combined with their 'resigned' attitude towards life in general (see Chapter 6), it is not surprising to find that Malays generally rate flood effects lower than the other ethnic groups. The chi-square test value of .04 provided evidence of the existence of significant differences amongst the ethnic groups in their rating of the health effects of floods.

When households with flood frequencies of 1 in 2 or more are considered, a lower percentage of Malays (6.1 per cent) rated health effects as severe as compared to 11.0 per cent and 29.4 per cent of Chinese and Indian respondents respectively. This again indicates the low importance paid to health effects by Malays. However, the high percentage of Indians with a high rating of health effects is difficult to explain. It could be due to the tendency for Indians to exaggerate the importance of the health effects but this is at best an intelligent guess. Much more research into the sociological aspects of Indian culture and its influence on Indian thinking and way of life needs to be done to ascertain the actual reasons. Nevertheless, the chi-square test yielded a test value of .00 which indicates the presence of significant differences in rating health effects amongst the ethnic groups living in highly flood-prone areas.

Education, age and income level do not appear to have any associations with the rating of the relative severity of health. The chi-square test revealed that there are no significant differences amongst highly flood-prone households (with frequencies of at least 1 in 2) and those which are less flood-prone (with frequencies of 1 in 10 or less).

(g) Reported loss of memorabilia or of other irreplaceable and non-monetary goods

Although the total tangible loss of memorabilia reported by respondents is not high, there are many instances where the value of certain memorabilia can not be quantified. For example, a rare family photograph taken a century ago which included many members who have since passed away may be invaluable to the family concerned. It is extremely stressful for a family to lose such memorabilia in a flood even though the actual photograph may cost next to nothing in the market. Enduring gifts such as jewellery from loved ones may also be lost in a flood. For example, Makcik Mabee (see Appendix H) has revealed to the author the time she lost a pair of gold earrings given to her by her late mother. She was so stressed by it that she wept for many days and continued to search for them after the flood. It was part of her family heritage which she would pass on to one of her daughters but the earrings are lost forever and can never be replaced. More significantly, they were also quite valuable with an estimated value at about $400 (1993 prices). She confided that she had pawned them several times (and recovered them later) after severe floods to help the family recover.

There are also countless incidents where flood victims have lost memorabilia which include treasured cooking utensils, clothes, jewellery, paintings, antique furniture and others. In one example, a Malay woman claimed that she could not replace one of her cooking pots which had been passed down by her great grandmother. Apparently, this cooking pot made from brass and silver is specially made for preparing a type of special Malay cake. It keeps the heat even and almost always yielded good results for this woman. The author enquired why she was so stressed when she could just go out and replace one, even with a microwave oven! But, according to the woman, this type of cake can only be made with 'that' kind of cooking pot. There are similar ones in the market but they do not make it like they used to, apparently due to inferior cheap alloys used nowadays. It is hard to argue with the expert on Malay cake in this matter.

From such experiences, it can be concluded that despite the apparent low cost of damage to memorabilia, some memorabilia are unquantifiable and irreplaceable. Damage to these memorabilia or losing them can cause considerable stress to those who are attached to them. There are also those who lose or damage antique furniture, paintings and other family treasures as a result of floods. Such items are difficult to price.

(h) Evacuation

The majority of floodplain occupants in Peninsular Malaysia would have experienced evacuation during their lifetime. Evacuation can be divided into temporary and permanent. The former is very common in the peninsula, especially in the East Coast where evacuation is a routine response to the seasonal monsoon floods. In the current study, respondents did not rate the relative severity of evacuation highly. A mean score of 2.5 was given by all respondents who gave evacuation a rating. This is due to the fact that many respondents consider evacuation as a necessary safety routine during the flood season. As such, it is not considered a severe effect of floods. In the East Coast, 73.8 per cent of respondents rated evacuation as a minor effect of flooding as compared to 63.2 per cent of West Coast respondents. The chi-square test value of .00 indicates the existence of significant differences in rating the severity of evacuation between respondents from the two coasts. In terms of sample areas, Kelantan had the highest percentage of respondents (77.6 per cent) giving evacuation a minor rating and Kuala Lumpur had the lowest percentage (48.2 per cent). This indicates that the majority of respondents from the former area do not consider evacuation a severe flood effect. On the other hand, the majority of respondents in the latter area regard evacuation as a severe effect. This is because respondents from Kelantan are used to being evacuated whereas their counterparts from Kuala Lumpur are not.

Respondents from rural areas also rate the effect of evacuation low when compared to urban respondents. For example, 73.7 per cent of rural respondents rated evacuation as a minor effect as compared to 65.0 per cent of urban respondents. The chi-square test value of .00 confirms that there are significant differences in the ratings of urban and rural respondents. Squatters also tend to rate evacuation low as they are also used to being evacuated. However, there is no significant difference in rating the effect of evacuation amongst respondents from different habitation types although farming households tend to rate evacuation lower than the others.

K.4 Commercial flood damage

In Peninsular Malaysia, little is known about the extent of flood damage to private commercial properties. There is a dearth of information and hitherto, to the best knowledge of the author, actual flood damage from commercial properties has not been surveyed although flood damage estimates have been made from time to time by the Drainage and Irrigation Department, various other government departments and the newspapers. Even so, such damages are concentrated on structural damage to infrastructure, public properties, and crops. In a study of 80 commercial properties in Kuala Lumpur, Smith (1985) has estimated the average potential flood damage to stock and equipment at $114,290 (1985 prices). This is the expected amount at a flood depth of 2 metres but is expected to decrease with lower depths of flooding.

Although the extent of actual flood damage on private commercial properties is largely unknown, it is hypothesized to be substantial. This is because floods can damage the physical structure of commercial properties and their contents (goods, machinery, raw materials etc.), affect property value, reduce the volume of business, cause disruption to transportation, cut off electrical supplies (thereby stopping production), stop workers from commuting to factories, and give rise to indirect losses. Also, flood damage includes transporting cost of goods and raw materials to alternative location, loss of trade due to temporary closure of business outlets, loss of business orders, increase in costs of transportation caused by disruption to usual traffic, the devaluation of the property value in the market, etc. Unfortunately, such losses are difficult to estimate unless a former detailed survey is carried out for such properties. In the current research, these losses are not surveyed due to inherent difficulty in estimation but is expected to be important, especially for businesses relying on day to day transactions. A flood of 2 weeks duration may theoretically reduce the monthly business volume by half, if not more (since customers may seek alternative outlets rather than stick to a flood-prone business).

K.5 Industrial flood damage

In terms of industrial damages, only a few companies were identified as having recent flood experience and only four gave information on flood damages during the 1991 flood in Pulau Pinang. Table K.11 indicates that industrial properties can be severely affected by floods as some of them suffered production losses ranging from 10 per cent to 95 per cent during the 1991 flood, ranging from $10,000 to $500,000 (1991 prices). A garment factory reported that its production shifts were only running at 70.0 per cent capacity and this amounted to a loss of $300,000. Furthermore, another it suffered another $200,000 due to damage to goods.

During a 1983 flood, an electronic factory suffered losses estimated at $300,000 (1983 prices) (The Star 26.10.83). Raw materials and finished products such as electronic clocks, radios and cassette players were damaged by the flood waters. Work at the factory was disrupted as workers could not reach it due to the flood waters and the resultant traffic jams. Hundreds of workers from other factories were also stranded and work at these factories was also disrupted, resulting in loss of production (New Straits Times 25.10.83). Flood loss suffered by factories is, therefore, a common risk endured by factories and industries in the Pulau Pinang industrial zones. With rapid future expansion of the Free Trade Zone and industrial Park in Pulau Pinang, many are targeted on floodplains, and flood hazards expected to exacerbate, flood loss to factories and other industrial concerns is expected to rise in the future.

Table K.11: Reported losses from some industrial properties during the 1991 flood in Pulau Pinang (1991 prices)

Name of company	% Reduction in full capacity (Estimated loss in $)	Damage to contents (Estimated loss in $)	Total Loss (in $)
Eastern Garment MFG. Co. Sdn. Bhd.	70 (300,000)	(200,000)	(500,000)
Robert Bosch(M) Sdn. Bhd.	95 (10,000)	(Nil)	(10,000)
Hewlett Packard(M) Sdn. Bhd.	10 (NA)	(NA)	(NA)
Sanyo Electric(Penang) Sdn. Bhd.	50 (NA)	(Nil)	(NA)

APPENDIX L ASSOCIATIONS BETWEEN DEPENDENT AND INDEPENDENT VARIABLES SIGNIFICANT AT, OR ABOVE, THE 95 PER CENT CONFIDENCE LEVEL

[NS = Not significant 0.n = Significance level - = Insufficient observations]

(a)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE COAST C0101	SITE C0103
Q2(a)	NEW	0.03	0.00
Q4(a)	C0145	0.00	0.00
Q4(a)	DISAD2	0.00	0.00
Q4(b)	C0147	0.00	0.00
Q4(c)	C0149	0.01	0.02
Q5	C0151	0.00	0.01
Q6	C0152	NS	NS
Q7	C0154	NS	NS
Q10	C0161	0.02	0.00
Q10	C0163	0.00	0.00
Q10	C0165	0.01	0.00
Q10	C0167	0.01	0 00
Q10	C0169	0.01	0 00
Q11	C0171	0.01	0 01
Q13	C0176	0.00	0.00
Q15	C0203	0.00	0.00
Q15	C0205	0.00	0.00
Q15	C0207	NS	NS
Q15	C0209	0.02	0.00
Q15	C0211	0.04	0 00
Q16	C0213	NS	0.00
Q17(a)	C0216	0.00	0 00
Q17(b)	C0218	0.00	0.00
Q18(a)	C0220	0.03	NS
Q18(b)	C0222	0 00	0.00
Q19(a)	C0228	0.00	0 00
Q19(b)	C0230	0.00	0 00
Q20(a)	C0232	0.00	0.00
Q20(b)	C0233	NS	NS
Q20(c)	C0234	NS	0 01
Q20(d)	C0235	0.00	0.00
Q20(e)	C0236	0.00	0 00
Q20(f)	C0237	NS	0.00
Q20(g)	C0238	NS	0 00
Q20(h)	C0239	0.00	0 00
Q20(i)	C0240	0.00	0 00
Q20(j)	C0241	0.00	0 00
Q20(k)	C0242	0 01	0 00
Q20(l)	C0243	NS	0 00
Q20(m)	C0244	0.00	0.00
Q20(n)	C0245	0.04	0.00
Q20(o)	C0246	NS	0 00
Q21(a)	C0301	0.00	0.00
Q21(b)	C0303	0.00	0.00
Q22(a)i	C0305	0.00	0.00
Q22(a)ii	C0306	0 00	0.00
Q22(c)i	C0309	0.01	NS
Q22(c)ii	C0310	NS	NS
Q22(d)i	C0311	0.00	0.00
Q22(d)ii	C0312	0.02	0.00
Q22(e)i	C0313	0.00	0.00
Q22(e)ii	C0314	0.02	NS
Q22(f)i	C0315	0.01	0.02
Q22(f)ii	C0316	NS	NS
Q22(g)i	C0317	0.00	0.00
Q22(g)ii	C0318	0.05	NS
Q22(h)i	C0319	NS	NS
Q22(h)ii	C0320	0.05	NS
Q22(j)ii	C0324	NS	NS
Q22(k)ii	C0326	NS	NS
Q22(l)ii	C0328	0.05	NS
Q22(o)ii	C0334	NS	NS
Q22(q)i	C0337	NS	NS
Q22(q)ii	C0338	NS	NS
Q22(r)i	C0339	NS	NS
Q22(r)ii	C0340	NS	NS
Q22(s)ii	C0342	0.00	0.00
Q22(t)ii	C0344	0.01	0.03
Q22(v)	C0347	0.00	0.00
Q22(w)	C0349	NS	NS

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE COAST C0101	SITE C0103
Q24(B)(i)b	C0428	0.00	0.00
Q24(B)(i)d	C0432	0.00	0.00
Q24(B)(i)e	C0434	0.01	0.00
Q24(B)(i)f	C0436	0.00	0.00
Q24(B)(i)g	C0438	0.00	0.00
Q24(B)(i)h	C0440	0.01	0.01
Q24(B)j	C0444	0.02	0.00
Q24(B)(i)k	C0446	0.00	0.00
Q24(B)(i)l	C0448	0.00	0.01
Q24(B)(i)m	C0450	0.01	0.05
Q24(B)(i)n	C0452	0.00	0.00
Q24(B)(i)o	C0454	0.00	0.00
Q24(B)(i)p	C0456	0.00	0.00
Q24(B)(i)q	C0458	NS	0.00
Q24(B)(i)r	C0460	0.00	0.00
Q24(B)(i)s	C0462	0.00	0.00
Q24(B)(i)t	C0464	0.00	0.00
Q24(B)(i)u	C0466	0.00	0.00
Q24(B)(i)v	C0468	0.00	0.00
Q24(B)(i)w	C0470	0.00	0.00
Q24(B)(i)x	C0472	0.00	0.00
Q24(B)(ii)b	C0503	0.00	0.00
Q24(B)(ii)c	C0505	0.00	-
Q24(B)(ii)d	C0507	0.00	NS
Q24(B)(ii)e	C0509	0.00	0.00
Q24(B)(ii)f	C0511	0.00	0.00
Q24(B)(ii)g	C0513	0.00	0.00
Q24(B)(ii)h	C0515	0.00	0.00
Q24(B)(ii)i	C0517	0.00	0.02
Q24(B)(ii)j	C0519	0.00	0.00
Q24(B)(ii)k	C0521	0.00	0.00
Q24(B)(ii)l	C0523	0.00	0.01
Q24(B)(ii)m	C0525	0.00	0.00
Q24(B)(ii)n	C0527	0.00	0.00
Q24(B)(ii)o	C0529	0.00	0.00
Q24(B)(ii)p	C0531	0.00	0.00
Q24(B)(ii)q	C0533	0.00	0.00
Q24(B)(ii)r	C0535	0.00	0.00
Q24(B)(ii)s	C0537	0.00	0.00
Q24(B)(ii)t	C0539	0.00	0.00
Q24(B)(ii)u	C0541	0.00	0.00
Q24(B)(ii)v	C0543	0.00	0.00
Q24(B)(ii)w	C0545	0.00	NS
Q24(B)(ii)x	C0547	0.00	-

(a1)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE COAST C0101	SITE C0103	URBAN/RURAL C0104
Q23	C0351	NS	0.00	NS
Q24(a)	C0402	0.00	0.00	0.01
Q24(a)	C0404	0.00	0.00	0.00
Q24(a)	C0405	NS	0.00	NS
Q24(a)	C0406	0.00	0.00	NS
Q24(a)	C0407	0.00	0.00	0.00
Q24(a)	C0408	NS	0.00	NS
Q24(a)	C0409	0.00	0.00	NS
Q24(a)	C0410	NS	0.00	0.02
Q24(a)	C0411			NS
Q24(a)	C0412	0.00	0.00	NS
Q24(a)	C0413			
Q24(a)	C0414	NS	NS	NS
Q24(a)	C0415	NS	0.00	NS
Q24(a)	C0416	0.00	0.00	0.00
Q24(a)	C0417	NS	0.03	NS
Q24(a)	C0418	0.00	0.00	0.01
Q24(a)	C0419	NS	NS	NS
Q24(a)	C0420	NS	0.00	0.00
Q24(a)	C0421			
Q24(a)	C0422	0.00	0.00	0.00
Q24(a)	C0423	NS	NS	0.02
Q24(a)	C0424	NS	NS	0.01
Q24(b)	C0551	0.00	0.00	0.00
Q25(a)	C0553	0.00	0.00	0.00
Q25(b)	C0558	NS	NS	NS
Q25(b)	C0559	NS	NS	NS
Q25(b)	C0560	NS	NS	0.03
Q25(b)	C0561	0.01	0.02	0.02
Q25(b)	C0562	0.04	0.03	NS
Q25(b)	C0563	NS	NS	NS
Q25(b)	C0564	NS	NS	NS
Q25(b)	C0566	NS	NS	NS
Q25(b)	C0568	NS	NS	NS
Q25(b)	C0570	0.00	0.00	0.02
Q25(b)	C0571	NS	NS	0.02
Q25(b)	C0574	0.03	NS	NS
Q25(b)	C0576	0.00	0.00	0.01
Q25(b)	C0577	NS	NS	NS
Q25(c)	C0579	NS	NS	NS

(b)

QUESTION	DEPENDENT VARIABLE	FLOOD FREQ. C0159	FLOOD RECENCY RECFLD	FLOOD TYPE C0105	FLOOD SEVERITY C1275
		INDEPENDENT VARIABLE			
Q2(a)	NEW	0.00	NS	NS	NS
Q4(a)	C0145	0.00	0.00	0.00	NS
Q4(a)	DISAD2	NS	NS	0.00	NS
Q4(b)	C0147	0.00	0.00	0.00	NS
Q4(c)	C0149	0.00	NS	0.00	NS
Q5	C0151	0.01	0.01	NS	NS
Q6	C0152	0.00	0.00	0.00	–
Q7	C0154	NS	NS	NS	NS
Q10	C0161	0.00	0.00	0.00	NS
Q10	C0163	0.00	0.00	0.00	NS
Q10	C0165	0.00	0.00	NS	NS
Q10	C0167	0.00	0.00	NS	NS
Q10	C0169	0.00	0.00	NS	–
Q11	C0171	0.00	0.00	0.00	NS
Q13	C0176	0.00	0.00	0.01	NS
Q15	C0203	0.00	0.01	0.00	NS
Q15	C0205	0.00	0.00	0.00	NS
Q15	C0207	0.00	0.00	0.00	NS
Q15	C0209	0.00	0.00	0.00	NS
Q15	C0211	0.00	0.03	0.00	–
Q16	C0213	0.00	0.00	0.00	NS
Q17(a)	C0216	0.00	0.06	0.00	NS
Q17(b)	C0218	0.00	0.00	0.00	NS
Q18(a)	C0220	NS	NS	0.00	NS
Q18(b)	C0222	0.00	0.02	NS	NS
Q19(a)	C0228	0.00	NS	NS	NS
Q19(b)	C0230	0.00	0.00	NS	NS
Q20(a)	C0232	0.02	NS	0.00	0.01
Q20(b)	C0233	NS	NS	NS	NS
Q20(c)	C0234	NS	NS	0.03	NS
Q20(d)	C0236	0.03	NS	NS	NS
Q20(e)	C0236	0.00	0.04	0.03	0.01
Q20(f)	C0237	0.00	NS	NS	NS
Q20(g)	C0238	0.00	0.00	0.00	NS
Q20(h)	C0239	0.00	0.00	0.00	0.02
Q20(i)	C0240	0.00	0.00	NS	0.00
Q20(j)	C0241	0.00	0.00	0.00	NS
Q20(k)	C0242	0.00	NS	NS	NS
Q20(l)	C0243	0.00	NS	0.00	NS
Q20(m)	C0244	0.00	0.00	0.00	0.04
Q20(n)	C0245	0.00	0.00	0.02	NS
Q20(o)	C0246	NS	0.02	0.01	0.03
Q21(a)	C0301	0.00	NS	0.00	0.00
Q21(b)	C0303	0.03	NS	0.04	0.02
Q22(a)i	C0305	NS	NS	0.00	–
Q22(a)ii	C0306	NS	NS	0.03	–
Q22(c)i	C0309	NS	NS	NS	NS
Q22 c)ii	C0310	0.01	NS	NS	0.03
Q22(d)i	C0311	0.06	0.00	0.00	NS
Q22(d)ii	C0312	0.03	NS	0.00	NS
Q22(e)i	C0313	NS	NS	0.00	NS
Q22(e)ii	C0314	0.03	NS	0.04	NS
Q22(f)i	C0315	NS	NS	0.01	NS
Q22(f)ii	C0316	0.02	NS	0.00	NS
Q22(g)i	C0317	NS	NS	0.02	–
Q22 g)ii	C0318	NS	NS	NS	–
Q22(h)i	C0319	NS	NS	0.01	0.01
Q22(h)ii	C0320	02	0.06	NS	NS
Q22(j)ii	C0324	NS	0.04	NS	0.03
Q22(k)ii	C0326	NS	NS	0.02	NS
Q22(l)ii	C0328	NS	NS	NS	NS
Q22(o)ii	C0334	NS	NS	NS	NS
Q22(q)i	C0337	0.00	NS	NS	NS
Q22(q)ii	C0338	0.00	NS	NS	0.01
Q22(r)i	C0339	NS	0.02	0.00	NS
Q22(r)ii	C0340	NS	NS	NS	NS
Q22(s)ii	C0342	NS	0.01	0.00	NS
Q22(t)ii	C0344	NS	NS	NS	NS
Q22(v)	C0347	NS	NS	0.00	NS
Q22(w)	C0349	NS	NS	NS	NS

QUESTION	DEPENDENT VARIABLE	FLOOD FREQ. C0159	FLOOD RECENCY RECFLD	FLOOD TYPE C0105	FLOOD SEVERITY C1275
		INDEPENDENT VARIABLE			
Q24(B)(i)b	C0428	0.01	0.00	0.00	0.00
Q24(B)(i)d	C0432	NS	NS	NS	0.05
Q24(B)(i)e	C0434	NS	0.04	NS	0.03
Q24(B)(i)f	C0436	NS	NS	0.00	NS
Q24(B)(i)g	C0438	0.00	0.00	0.00	NS
Q24(B)(i)h	C0440	NS	NS	NS	–
Q24(B)j	C0444	NS	NS	NS	NS
Q24(B)(i)k	C0446	NS	NS	NS	NS
Q24(B)(i)l	C0448	NS	NS	NS	NS
Q24(B)(i)m	C0450	0.01	NS	NS	NS
Q24(B)(i)n	C0452	0.00	NS	0.01	NS
Q24(B)(i)o	C0454	0.00	NS	0.03	NS
Q24(B)(i)p	C0456	NS	NS	NS	NS
Q24(B)(i)q	C0458	0.01	NS	NS	NS
Q24(B)(i)r	C0460	0.00	NS	0.00	NS
Q24(B)(i)s	C0462	0.00	NS	NS	NS
Q24(B)(i)t	C0464	0.00	NS	NS	NS
Q24(B)(i)u	C0466	0.00	0.03	NS	0.02
Q24(B)(i)v	C0468	NS	NS	0.01	NS
Q24(B)(i)w	C0470	NS	0.03	0.00	NS
Q24(B)(i)x	C0472	0.03	NS	NS	NS
Q24(B)(ii)b	C0503	NS	NS	0.00	0.01
Q24(B)(ii)c	C0505	NS	NS	0.01	NS
Q24(B)(ii)d	C0507	NS	NS	NS	–
Q24(B)(ii)e	C0509	NS	0.01	NS	NS
Q24(B)(ii)f	C0511	0.01	0.00	0.00	NS
Q24(B)(ii)g	C0513	NS	0.03	0.01	NS
Q24(B)(ii)h	C0515	NS	0.03	NS	NS
Q24(B)(ii)i	C0517	NS	NS	NS	NS
Q24(B)(ii)j	C0519	0.00	0.00	0.00	–
Q24(B)(ii)k	C0521	NS	NS	NS	–
Q24(B)(ii)l	C0523	NS	NS	NS	–
Q24(B)(ii)m	C0526	NS	NS	0.00	NS
Q24(B)(ii)n	C0527	0.01	0.00	0.00	NS
Q24(B)(ii)o	C0529	0.00	0.00	0.00	–
Q24(B)(ii)p	C0531	0.01	0.00	0.01	–
Q'S(B)(ii)q	C0533	0.05	0.00	0.02	0.01
Q24(B)(ii)r	C0535	0.00	NS	0.00	NS
Q24(B)(ii)s	C0537	0.00	0.04	0.01	NS
Q24(B)(ii)t	C0539	NS	0.00	NS	–
Q24(B)(ii)u	C0541	0.01	NS	0.00	–
Q24(B)(ii)v	C0543	NS	0.00	0.00	–
Q24(B)(ii)w	C0545	NS	NS	0.00	–
Q24(B)(ii)x	C0547	NS	NS	NS	–

(b1)

DEPENDENT VARIABLE	INDEPENDENT VARIABLE FLOOD FREQ. C0159	FLOOD RECENCY RECFLD	FLOOD TYPE C0105	FLOOD SEVERITY C1275
C0351	0.00	0.01	0.03	NS
C0402	NS	0.02	0.00	NS
C0404	0.00	NS	0.00	NS
C0405	NS	NS	0.00	NS
C0406	NS	NS	NS	0.02
C0407	NS	NS	NS	NS
C0408	NS	NS	NS	NS
C0409	0.00	NS	0.00	NS
C0410	NS	0.02	0.01	NS
C0411	-	-	-	-
C0412	NS	0.05	0.02	NS
C0413	-	-	-	-
C0414	NS	NS	NS	NS
C0415	NS	NS	NS	NS
C0416	0.00	NS	0.00	NS
C0417	NS	NS	NS	NS
C0418	0.00	0.00	0.00	NS
C0419	NS	NS	NS	NS
C0420	NS	NS	0.00	0.02
C0421	-	-	-	-
C0422	NS	NS	0.00	NS
C0423	NS	NS	NS	NS
C0424	NS	-	NS	NS
C0551	NS	NS	0.00	NS
C0553	NS	NS	0.01	NS
C0558	NS	NS	NS	NS
C0559	NS	NS	NS	NS
C0560	0.02	NS	0.01	NS
C0561	NS	-	NS	NS
C0562	NS	NS	NS	NS
C0563	0.01	NS	0.03	NS
C0564	NS	NS	NS	NS
C0566	NS	NS	-	-
C0568	NS	NS	NS	NS
C0570	NS	NS	NS	NS
C0571	NS	NS	NS	NS
C0574	0.00	NS	NS	NS
C0576	NS	NS	NS	NS
C0577	0.04	NS	NS	NS
C0579	NS	NS	NS	NS

(c)

QUESTION	DEPENDENT VARIABLE	BUILDING TYPE C0121	WALL TYPE C0122	BUILDING AGE C0123	FLOOR TYPE C0124	WITH/OUT STILTS C0125	STILT HEIGHT C0126	STILT TYPE C0127
		INDEPENDENT VARIABLE						
Q2(a)	NEW	NS	0.00	NS	0.00	0.00	0.00	0.00
Q4(a)	C0145	0.00	0.00	0.00	0.00	0.00	0.04	0.05
Q4(a)	DISAD2	0.03	NS	0.00	0.00	0.00	NS	NS
Q4(b)	C0147	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Q4(c)	C0149	0.00	0.00	0.00	0.00	0.00	0.00	NS
Q5	C0151	NS	0.01	0.03	NS	NS	0.01	NS
Q6	C0152	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Q7	C0154	0.00	0.03	0.01	NS	NS	0.01	–
Q10	C0161	0.01	0.00	0.00	0.01	0.00	0.00	0.01
Q10	C0163	0.01	0.00	0.00	NS	0.00	0.00	NS
Q10	C0165	0.01	0.00	0.00	0.01*	0.00	0.00	0.00
Q10	C0167	0.01	0.00	0.01	NS	0.02	0.00	0.01
Q10	C0169	0.00	0.03	NS	NS	0.05	0.01	NS
Q11	C0171	0.00	0.00	0.05	0.00	0.00	0.00	NS
Q13	C0176	0.01	0.00	0.00	0.01	0.00	0.03	0.00
Q15	C0203	NS	0.00	0.00	0.01	0.01	0.00	0.01
Q15	C0205	0.06	0.00	0.00	NS	0.04	0.00	0.01
Q15	C0207	NS	0.00	0.00	0.00	0.00	0.00	0.01
Q15	C0209	0.00	NS	NS	NS	NS	0.00	–
Q15	C0211	0.00	NS	NS	NS	NS	NS	–
Q16	C0213	0.00	0.00	0.01	0.00	0.00	0.00	0.05
Q17(a)	C0216	0.00	NS	NS	0.00	0.00	NS	NS
Q17(b)	C0218	0.06	0.00	0.02	0.00	NS	NS	NS
Q18(a)	C0220	NS	NS	0.02	NS	NS	0.00	0.03
Q18(b)	C0222	0.00	0.00	NS	0.03	0.00	NS	NS
Q19(a)	C0226	NS	NS	NS	NS	0.06	NS	0.00
Q19(b)	C0230	0.00	NS	NS	0.02	NS	NS	0.03
Q20(a)	C0232	0.00	0.00	0.00	0.00	0.00	NS	NS
Q20(b)	C0233	NS	NS	NS	0.00	0.03	NS	0.00
Q20(c)	C0234	0.00	0.00	0.04	0.01	NS	NS	NS
Q20(d)	C0235	0.01	0.00	0.00	0.00	0.00	NS	0.04
Q20(e)	C0236	0.00	0.00	0.00	0.00	0.00	NS	NS
Q20(f)	C0237	0.00	0.00	0.00	0.03	0.03	NS	NS
Q20(g)	C0238	0.04	0.00	0.00	0.00	0.00	0.00	0.02
Q20(h)	C0239	0.00	0.00	NS	0.00	0.00	NS	0.01
Q20(i)	C0240	0.00	0.00	0.02	0.00	0.00	NS	0.00
Q20(j)	C0241	0.00	0.00	0.00	0.00	0.00	0.00	NS
Q20(k)	C0242	0.05	0.00	NS	0.00	NS	0.01	NS
Q20(l)	C0243	0.01	0.00	0.01	0.00	NS	NS	NS
Q20(m)	C0244	0.00	0.00	NS	0.00	0.00	0.00	0.00
Q20(n)	C0245	0.00	0.00	0.00	0.00	NS	NS	NS
Q20(o)	C0246	0.00	0.00	0.00	0.00	0.00	NS	0.00
Q21(a)	C0301	0.00	0.00	NS	0.00	0.00	NS	NS
Q21(b)	C0303	NS	NS	0.02	0.00	0.00	NS	NS
Q22 a)i	C0305	0.01	0.00	NS	0.00	0.00	NS	0.01
Q22(a)ii	C0306	NS	0.00	NS	0.05	0.01	NS	NS
Q22(c)i	C0309	NS	NS	NS	NS	NS	NS	NS
Q22 c)ii	C0310	NS	NS	NS	NS	NS	0.01	NS
Q22 d)i	C0311	NS	0.00	NS	NS	NS	NS	NS
Q22 d)ii	C0312	0.00	NS	NS	NS	NS	NS	NS
Q22 e)i	C0313	NS	NS	NS	NS	NS	0.03	NS
Q22 e)ii	C0314	NS	NS	NS	NS	0.01	NS	NS
Q22(f)i	C0315	NS	NS	0.01	NS	NS	0.03	NS
Q22(f)ii	C0316	NS	NS	0.04	NS	NS	NS	NS
Q22(g)i	C0317	NS	NS	NS	NS	NS	–	NS
Q22 g)ii	C0318	NS	NS	NS	NS	NS	–	–
Q22(h)i	C0319	0.00	0.00	NS	0.00	0.04	NS	NS
Q22(h)ii	C0320	0.00	0.00	NS	0.00	0.00	NS	NS
Q22(j)ii	C0324	NS	NS	NS	NS	NS	NS	NS
Q22(k)ii	C0326	NS	NS	NS	NS	NS	NS	NS
Q22(l)ii	C0328	NS	NS	NS	0.00	0.00	–	–
Q22(o)ii	C0334	0.02	NS	NS	NS	NS	NS	NS
Q22 q)i	C0337	NS	0.00	NS	NS	NS	–	–
Q22 q)ii	C0338	0.05	0.00	0.00	0.02	0.05	–	–
Q22(r)i	C0339	0.02	0.01	NS	0.00	0.00	–	–
Q22(r)ii	C0340	0.02	0.00	NS	0.02	0.00	NS	NS
Q22(s)ii	C0342	NS	NS	NS	0.03	NS	0.03	NS
Q22(t)ii	C0344	0.01	NS	NS	0.03	NS	NS	NS
Q22(v)	C0347	NS	0.02	NS	0.06	NS	NS	NS
Q22(w)	C0349	NS	0.00	NS	0.00	0.01	NS	NS
Q24(B (i)b	C0428	0.00	0.00	0.05	0.00	0.00	NS	NS
Q24(B)(i)d	C0432	0.00	0.00	NS	0.03	0.00	NS	NS
Q24(B (i)e	C0434	0.02	NS	NS	0.01	0.01	NS	NS
Q24(B (i)f	C0436	0.00	0.00	NS	0.00	0.00	NS	NS
Q24(B (i)g	C0438	0.00	0.00	0.01	0.00	0.00	0.03	NS
Q24(B)(i)h	C0440	–	–	–	NS	0.02	–	NS
Q24(B)j	C0444	NS	NS	NS	NS	NS	NS	NS
Q24(B (i)k	C0446	NS	NS	NS	NS	0.03	NS	NS
Q24(B (i)l	C0448	NS	NS	NS	0.02	0.01	0.03	NS
Q24(B (i)m	C0450	NS	NS	NS	NS	0.00	0.00	NS
Q24(B)(i)n	C0452	NS	NS	NS	0.00	0.00	0.00	NS
Q24(B)(i)o	C0454	NS	NS	0.04	0.00	0.00	0.06	0.01
Q24(B (i)p	C0456	0.00	0.00	NS	0.00	0.00	NS	0.01
Q24(B)(i)q	C0458	0.01	NS	NS	NS	0.01	NS	NS
Q24(B (i)r	C0460	0.00	0.00	NS	0.00	0.00	0.05	NS
Q24(B)(i)s	C0462	0.00	0.00	0.00	0.00	0.00	0.00	NS
Q24(B)(i)t	C0464	0.00	0.00	NS	0.00	0.00	0.00	0.04
Q24(B)(i)u	C0466	0.00	0.00	NS	0.00	0.00	NS	NS
Q24(B)(i)v	C0468	0.00	0.00	NS	0.00	0.00	NS	NS
Q24(B)(i)w	C0470	0.00	NS	0.02	0.00	0.00	NS	NS
Q24(B)(i)x	C0472	0.00	NS	0.04	0.00	0.00	0.04	NS
Q24(B)(ii)b	C0503					0.00	NS	
Q24(B)(ii)c	C0506					0.00	NS	
Q24(B)(ii)d	C0507					0.00	NS	
Q24(B)(ii)e	C0509					0.00	NS	
Q24(B)(ii)f	C0511					0.00	NS	
Q24(B (ii)g	C0513					0.00	NS	
Q24(B)(ii)h	C0515					0.00	NS	
Q24(B)(ii)i	C0517					0.04	NS	
Q24(B)(ii)j	C0519					0.00	NS	
Q24(B)(ii)k	C0521					0.00	NS	
Q24(B)(ii)l	C0523					0.00	0.02	
Q24(B)(ii)m	C0525					0.00	0.04	
Q24(B)(ii)n	C0527					0.00	NS	
Q24(B)(ii)o	C0529					0.00	NS	
Q24(B)(ii)p	C0531					0.00	NS	
Q"8(B)(ii)q	C0533					0.00	NS	
Q24(B)(ii)r	C0535					0.00	NS	
Q24(B)(ii)s	C0537					0.00	NS	
Q24(B)(ii)t	C0539					0.00	NS	
Q24(B)(ii)u	C0541					0.00	NS	
Q24(B)(ii)v	C0543					0.00	NS	
Q24(B)(ii)w	C0545					0.00	NS	
Q24(B)(ii)x	C0547					NS	0.03	

(c1)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE	ALL• RESPONDENTS	RESPONDENTS LIVING IN AREAS FLOODED ONCE A YEAR OR MORE	RESPONDENTS LIVING IN AREAS FLOODED ONCE IN 3 YEARS OR LESS
		BUILDING AGE C0123	WITH OR WITHOUT STILTS C0125	WITH OR WITHOUT STILTS C0125	WITH OR WITHOUT STILTS C0125
Q23	C0351	NS	NS	NS	NS
Q24(a)	C0402	NS	0.02	0.02	NS
Q24(a)	C0404	0.05	0.00	0.00	NS
Q24(a)	C0405	0.00	0.03	0.01	NS
Q24(a)	C0406	NS	0.00	0.00	NS
Q24(a)	C0407	NS	0.00	0.00	NS
Q24(a)	C0408	NS	0.04	NS	0.04
Q24(a)	C0409	NS	0.00	0.00	NS
Q24(a)	C0410	0.01	NS	NS	NS
Q24(a)	C0411	–	–	–	–
Q24(a)	C0412	NS	0.00	0.03	NS
Q24(a)	C0413	–	–	–	–
Q24(a)	C0414	NS	NS	NS	NS
Q24(a)	C0415	NS	NS	NS	NS
Q24(a)	C0416	NS	0.00	0.00	NS
Q24(a)	C0417	NS	NS	NS	NS
Q24(a)	C0418	NS	0.01	0.00	NS
Q24(a)	C0419	NS	NS	NS	NS
Q24(a)	C0420	NS	NS	NS	NS
Q24(a)	C0421	–	–	–	–
Q24(a)	C0422	0 02	0.00	0.00	NS
Q24(a)	C0423	NS	NS	NS	NS
Q24(a)	C0424	NS	NS	NS	NS
Q24(b)	C0551	NS	0 01	0.02	NS
Q25(a)	C0553	NS	0.00	0.02	NS
Q25(b)	C0558	NS	NS	NS	NS
Q25(b)	C0559	NS	NS	NS	NS
Q25(b)	C0560	0.03	0.02	0.05	–
Q25(b)	C0561	NS	0.05	NS	–
Q25(b)	C0562	NS	NS	NS	0.02
Q25(b)	C0563	NS	NS	NS	0.03
Q25(b)	C0564	NS	NS	NS	NS
Q25(b)	C0566	NS	NS	–	–
Q25(b)	C0568	NS	NS	NS	NS
Q25(b)	C0570	NS	NS	NS	NS
Q25(b)	C0571	NS	0 02	NS	NS
Q25(b)	C0574	NS	0 01	0.03	NS
Q25(b)	C0576	NS	NS	NS	NS
Q25(b)	C0577	NS	NS	NS	NS
Q25(c)	C0579	NS	NS	NS	NS

(d)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE										
		LENGTH OF RESIDENCE	RESPONDENT'S AGE	EDUCATION	FAMILY SIZE	ETHNIC GROUP	RELIGION	OCCUPATION	INCOME	GENDER	TENURE	GROUP MEMBERSHIP
		C0131	C1353	C1358	C1361	C1354	C1355	C1356	C1359	C1352	C0130	C0156
Q2(a)	NEW	0.02	NS	NS	NS	0.00	0.00	NS	NS	NS	NS	NS
Q4(a)	C0145	NS	0.02	NS	0.01	0.00	0.00	NS	0.00	NS	NS	NS
Q4(a)	DISAD2	NS	NS	NS	NS	0.02	0.01	NS	0.03	NS	NS	NS
Q4(b)	C0147	NS	0.02	NS	0.03	0.00	0.00	NS	0.00	NS	0.04	NS
Q4(c)	C0149	0.06	0.02	0.06	NS	0.00	0.00	0.05	0.00	NS	NS	NS
Q5	C0151	NS	NS	NS	NS	NS	NS	0.00	NS	NS	NS	NS
Q6	C0152	NS	0.06	0.01	NS	0.00	0.00	NS	0.00	NS	NS	NS
Q7	C0154	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	0.00	NS
Q10	C0161	NS	NS	NS	0.00	0.00	0.00	NS	0.00	NS	0.01	0.02
Q10	C0163	NS	NS	NS	0.00	0.00	0.00	NS	0.02	NS	0.02	NS
Q10	C0165	NS	0.00	NS	0.03	0.00	0.00	NS	NS	0.04	0.01	0.03
Q10	C0167	NS	NS	NS	0.05	0.00	0.00	NS	NS	NS	NS	0.00
Q10	C0169	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	0.01	–
Q11	C0171	NS	NS	NS	0.00	0.00	0.00	0.00	0.00	NS	NS	NS
Q13	C0176	0.00	0.00	0.00	NS	0.00	0.00	0.00	0.00	0.00	0.01	NS
Q15	C0203	NS	NS	0.01	0.02	0.00	0.00	NS	0.00	NS	NS	NS
Q15	C0205	0.02	0.02	0.00	0.00	0.00	0.00	NS	NS	0.00	NS	NS
Q15	C0207	NS	NS	0.02	0.05	0.00	0.00	NS	NS	0.01	NS	NS
Q15	C0209	NS	0.04	NS	NS	0.00	0.00	NS	NS	NS	NS	NS
Q15	C0211	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	NS	–
Q16	C0213	NS	0.06	0.02	0.00	0.00	0.00	0.00	0.01	NS	NS	NS
Q17(a)	C0216	NS	0.02	0.02	NS	NS	NS	0.01	0.02	0.00	NS	NS
Q17(b)	C0218	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q18(a)	C0220	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q18(b)	C0222	0.02	0.00	0.02	0.01	0.00	0.00	0.00	0.00	NS	0.00	0.04
Q19(a)	C0228	NS	0.06	0.00	NS	NS	NS	0.00	0.05	NS	NS	NS
Q19(b)	C0230	NS	NS	0.04	NS	NS	0.03	0.00	0.00	NS	NS	0.03
Q20(a)	C0232	0.04	0.06	0.01	0.03	0.00	0.00	0.00	0.00	NS	0.01	NS
Q20(b)	C0233	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q20(c)	C0234	NS	NS	NS	NS	0.02	0.01	NS	NS	0.02	NS	NS
Q20(d)	C0235	NS	NS	0.00	NS	NS	NS	0.00	0.00	NS	NS	NS
Q20(e)	C0236	NS	NS	0.00	NS	0.00	0.00	0.01	0.00	NS	NS	NS
Q20(f)	C0237	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	NS	0.03
Q20(g)	C0238	NS	NS	NS	NS	0.00	0.00	NS	0.00	NS	0.04	NS
Q20(h)	C0239	0.04	NS	NS	0.02	0.02	0.00	NS	0.00	NS	NS	NS
Q20(i)	C0240	NS	NS	NS	NS	NS	NS	0.00	0.02	NS	NS	NS
Q20(j)	C0241	0.00	NS	NS	NS	NS	NS	0.00	0.00	NS	NS	0.02
Q20(k)	C0242	NS	NS	NS	NS	0.00	0.00	NS	0.05	NS	NS	NS
Q20(l)	C0243	NS	NS	NS	NS	NS	0.00	NS	NS	NS	NS	NS
Q20(m)	C0244	0.02	NS	NS	NS	0.00	0.00	NS	0.00	NS	NS	NS
Q20(n)	C0245	0.00	NS	NS	NS	0.00	0.00	NS	0.00	0.05	NS	NS
Q20(o)	C0246	0.01	NS	NS	NS	0.00	0.00	0.01	0.00	NS	NS	NS
Q21(a)	C0301	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NS	NS	NS
Q21(b)	C0303	0.00	0.03	0.00	NS	0.02	NS	0.00	0.00	NS	NS	NS
Q22(a)i	C0305	NS	NS	NS	NS	0.01	0.00	–	0.00	NS	NS	NS
Q22(a)ii	C0306	NS	NS	NS	NS	0.01	0.00	–	0.00	NS	NS	NS
Q22(c)i	C0309	NS	NS	0.01	NS	NS	NS	NS	0.04	NS	NS	NS
Q22 c)ii	C0310	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q22 d)i	C0311	NS	NS	0.00	NS	NS	0.05	NS	NS	NS	NS	NS
Q22(d)ii	C0312	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q22 e)i	C0313	NS	NS	NS	0.01	NS	NS	NS	NS	NS	0.00	NS
Q22 e)ii	C0314	0.05	NS	NS	0.01	0.03	NS	NS	NS	NS	NS	NS
Q22(f)i	C0315	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q22(f)ii	C0316	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q22 g)i	C0317	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q22 g)ii	C0318	NS	NS	0.05	NS	NS	NS	–	NS	NS	NS	NS
Q22(h)i	C0319	NS	NS	0.00	NS	NS	0.01	NS	0.00	0.04	NS	NS
Q22(h)ii	C0320	NS	NS	0.01	NS	0.03	0.03	NS	0.01	NS	0.03	NS
Q22(j)ii	C0324	NS	NS	0.01	NS	NS	NS	NS	0.06	NS	NS	NS
Q22(k)ii	C0326	NS	NS	NS	NS	0.03	NS	NS	NS	NS	NS	NS
Q22(l)ii	C0328	NS	NS	NS	NS	0.03	0.05	NS	0.00	NS	NS	NS
Q22 o)ii	C0334	NS	NS	NS	0.04	0.01	0.04	NS	NS	0.03	NS	NS
Q22 q)i	C0337	NS	NS	NS	NS	0.01	0.01	NS	0.02	NS	NS	NS
Q22 q)ii	C0338	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	NS	NS
Q22(r)i	C0339	NS	0.03	0.00	NS	NS	0.01	NS	NS	NS	NS	NS
Q22(r)ii	C0340	NS	NS	0.01	0.03	0.00	0.00	0.01	0.00	NS	NS	0.06
Q22(s)ii	C0342	0.01	NS	NS	NS	0.00	NS	NS	0.03	NS	NS	NS
Q22(t)ii	C0344	NS	NS	NS	NS	0.02	NS	NS	NS	0.03	NS	NS
Q22(v)	C0347	NS	NS	0.00	NS	NS	NS	NS	NS	NS	NS	NS
Q22 w)	C0349	NS	NS	0.03	NS	0.02	NS	0.01	0.05	NS	NS	NS
Q24(B)(i)b	C0428	NS	0.00	NS	NS	0.00	0.00	0.00	0.00	NS	0.00	NS
Q24(B)(i)d	C0432	NS	NS	NS	NS	0.00	0.00	NS	0.01	NS	NS	NS
Q24(B)(i)e	C0434	NS	NS	NS	NS	0.00	0.00	NS	0.02	NS	NS	NS
Q24(B)(i)f	C0436	NS	NS	0.05	NS	0.00	0.00	NS	0.02	NS	NS	NS
Q24(B)(i)g	C0438	0.02	NS	NS	NS	0.00	0.00	0.05	0.00	NS	NS	NS
Q24(B)(i)h	C0440	–	NS	NS	NS	–	–	NS	NS	–	NS	NS
Q24(B (i)j	C0444	NS	NS	NS	NS	0.01	0.04	NS	NS	NS	NS	NS
Q24(B)(i)k	C0446	NS	NS	NS	NS	0.00	0.02	NS	NS	NS	NS	NS
Q24(B)(i)l	C0448	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q24(B)(i)m	C0450	NS	NS	NS	NS	NS	NS	NS	0.00	NS	NS	0.00
Q24(B)(i)n	C0452	NS	0.04	NS	NS	0.00	0.00	NS	NS	NS	NS	NS
Q24(B)(i)o	C0454	NS	NS	NS	NS	0.00	0.00	NS	NS	NS	NS	NS
Q24(B)(i)p	C0456	NS	NS	NS	NS	NS	NS	NS	0.02	NS	NS	NS
Q24(B)(i)q	C0458	0.03	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.03
Q24(B (i)r	C0460	NS	0.00	NS	NS	0.00	0.00	0.02	0.00	NS	NS	NS
Q24(B)(i)s	C0462	NS	0.03	NS	NS	0.00	0.00	NS	0.05	0.01	NS	0.02
Q24(B)(i)t	C0464	NS	NS	NS	NS	0.00	0.00	NS	0.01	NS	NS	NS
Q24(B)(i)u	C0466	NS	NS	NS	NS	0.01	0.00	NS	0.00	0.00	NS	NS
Q24(B)(i)v	C0468	NS	NS	NS	NS	0.00	0.00	0.00	0.00	0.03	0.00	NS
Q24(B)(i)w	C0470	NS	NS	NS	NS	0.00	0.00	NS	0.00	NS	0.00	NS
Q24(B)(i)x	C0472	NS	NS	NS	NS	0.00	0.00	0.05	0.00	NS	NS	NS
Q24(B)(ii)b	C0503	NS	0.01	NS	NS	0.00	0.00	0.05	0.00	NS	0.01	NS
Q24(B)(ii)c	C0505	NS	NS	NS	–	–	NS	–	–	–	–	NS
Q24(B)(ii)d	C0507	NS	NS	NS	NS	0.04	0.02	0.01	0.00	NS	NS	–
Q24(B)(ii)e	C0509	NS	NS	NS	NS	NS	NS	0.00	0.00	NS	NS	0.03
Q24(B)(ii)f	C0511	NS	0.01	NS	NS	0.00	0.00	0.01	0.00	NS	NS	NS
Q24(B)(ii)g	C0513	0.01	NS	NS	NS	0.00	0.00	0.00	0.00	NS	NS	0.04
Q24(B)(ii)h	C0515	NS	NS	NS	NS	0.04	0.00	NS	0.01	NS	–	NS
Q24(B)(ii)i	C0517	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.01
Q24(B)(ii)j	C0519	NS	NS	NS	NS	0.00	NS	–	0.01	NS	NS	NS
Q24(B)(ii)k	C0521	NS	NS	NS	NS	0.00	0.01	NS	NS	NS	NS	NS
Q24(B)(ii)l	C0523	NS	NS	NS	NS	0.04	0.03	–	NS	NS	NS	–
Q24(B)(ii)m	C0525	0.02	NS	NS	NS	0.01	0.03	NS	0.02	NS	NS	–
Q24(B)(ii)n	C0527	NS	NS	NS	NS	0.00	0.00	0.01	0.00	NS	NS	–
Q24(B)(ii)o	C0529	NS	NS	NS	NS	0.00	0.00	0.01	0.00	NS	0.01	–
Q24(B)(ii)p	C0531	NS	NS	NS	NS	NS	NS	0.00	0.01	NS	NS	–
Q'$(B)(ii)q	C0533	NS	NS	NS	NS	NS	NS	0.03	0.00	NS	NS	–
Q24(B)(ii)r	C0535	NS	NS	NS	NS	0.00	0.00	0.00	0.00	NS	NS	0.03
Q24(B)(ii)s	C0537	NS	NS	0.03	0.01	0.00	0.00	NS	0.00	NS	NS	NS
Q24(B)(ii)t	C0539	NS	NS	NS	NS	NS	NS	0.00	0.03	NS	NS	NS
Q24(B)(ii)u	C0541	NS	NS	0.05	NS	0.00	0.00	NS	0.00	0.00	NS	NS
Q24(B)(ii)v	C0543	NS	0.02	NS	NS	0.00	0.00	0.01	0.00	0.03	NS	–
Q24(B)(ii)w	C0545	0.03	NS	NS	NS	0.01	NS	NS	NS	NS	NS	NS
Q24(B)(ii)x	C0547	NS	0.05	NS	–	0.00	NS	–	–	NS	NS	NS

(d1)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE LENGTH OF RESIDENCE C0131	RESPONDENT'S AGE C1353	EDUCATION C1358	ETHNIC GROUP C1354	RELIGION C1355	OCCUPATION C1356	INCOME C1359	GENDER C1352	TENURE C0130
Q23	C0351	NS	NS	0.03	0.02	0.01	0.01	0.02	NS	NS
Q24(a)	C0402	NS	0.05	NS	0.01	0.02	0.00	0.04	NS	0.01
Q24(a)	C0404	NS	0.01	NS	0.00	0.00	0.02	0.00	NS	0.04
Q24(a)	C0405	0.00	NS	0.00	0.01	0.01	NS	0.02	NS	NS
Q24(a)	C0406	NS	NS	NS	NS	NS	NS	0.01	NS	NS
Q24(a)	C0407	0.00	NS	NS	0.01	0.02	0.00	0.00	NS	NS
Q24(a)	C0408	0.04	NS	0.00	0.00	0.00	0.04	0.01	0.04	NS
Q24(a)	C0409	NS	NS	NS	0.00	0.00	0.00	0.00	NS	NS
Q24(a)	C0410	0.00	NS	NS	NS	NS	NS	0.00	NS	NS
Q24(a)	C0411									
Q24(a)	C0412	0.04	NS	NS	0.00	0.00	NS	0.00	NS	NS
Q24(a)	C0413									
Q24(a)	C0414	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q24(a)	C0415	0.03	NS	NS	NS	NS	NS	NS	NS	NS
Q24(a)	C0416	NS	NS	NS	0.01	0.05	NS	0.05	NS	NS
Q24(a)	C0417	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q24(a)	C0418	NS	NS	NS	NS	NS	0.02	NS	NS	NS
Q24(a)	C0419	NS	NS	NS	0.04	NS	NS	NS	NS	0.01
Q24(a)	C0420	NS	NS	NS	NS	NS	0.01	NS	0.01	NS
Q24(a)	C0421									
Q24(a)	C0422	NS	NS	0 01	NS	0.05	0.00	0.00	NS	0.02
Q24(a)	C0423	NS	NS	0.03	0.01	0.01	0.02	0.00	NS	NS
Q24(a)	C0424	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q24(b)	C0551	NS	NS	NS	NS	0.00	0.02	NS	0.04	NS
Q25(a)	C0553	NS	0 02	0.00	0.00	0 02	0.00	0.00	NS	NS
Q25(b)	C0558	NS	NS	NS	NS	NS	NS	NS	0.01	NS
Q25(b)	C0559	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0560	NS	NS	NS	NS	NS	0.04	NS	NS	NS
Q25(b)	C0561	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0562	NS	NS	NS	NS	NS	NS	NS	NS	0.00
Q25(b)	C0563	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0564	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0566	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0568	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0570	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0571	NS	NS	NS	NS	NS	NS	NS	NS	NS
Q25(b)	C0574	NS	NS	NS	NS	NS	0.04	0.01	NS	NS
Q25(b)	C0576	NS	NS	NS	NS	NS	NS	0.01	NS	NS
Q25(b)	C0577	NS	NS	0 00	0 03	NS	0.02	NS	NS	NS
Q25(c)	C0579	NS	0 03	0.04	NS	NS	NS	NS	0.04	NS

(e)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE: BELIEF IN GOD C0232	BLAME ON HUMANS C0235	FLOODS COMMON C0236	FLOODS UNCOMMON C0243	ATTITUDE TO GOVT C0245
Q2(a)	NEW	0.00	NS	0.00	0.02	NS
Q4(a)	C0145	NS	NS	0.00	0.00	0.00
Q4(a)	DISAD2	0.00	NS	NS	NS	NS
Q4(b)	C0147	0.00	0.01	0.00	0.00	NS
Q4(c)	C0149	0.00	NS	0.00	0.00	0.00
Q5	C0151	0.02	NS	0.02	0.05	NS
Q6	C0152	NS	–	–	–	NS
Q7	C0154	NS	NS	–	–	NS
Q10	C0161	0.01	NS	0.00	0.00	0.00
Q10	C0163	0.00	0.00	0.00	0.00	0.00
Q10	C0165	0.01	0.00	0.00	0.00	0.00
Q10	C0167	0.05	NS	–	–	0.00
Q10	C0169	0.00	–	–	–	0.00
Q11	C0171	0.00	0.00	0.00	0.00	0.00
Q13	C0176	0.00	0.00	0.00	0.00	0.00
Q15	C0203	NS	0.01	0.00	0.00	0.00
Q15	C0205	0.05	0.00	0.00	0.00	0.00
Q15	C0207	0.00	0.02	0.00	0.00	0.00
Q15	C0209	0.00	–	–	–	–
Q15	C0211	0.00	–	–	–	–
Q16	C0213	0.00	0.00	0.00	0.00	0.00
Q17(a)	C0216	NS	0.00	0.00	0.00	0.00
Q17(b)	C0218	NS	NS	0.01	0.00	0.00
Q18(a)	C0220	NS	NS	NS	NS	NS
Q18(b)	C0222	0.00	NS	–	0.00	0.00
Q19(a)	C0226	0.01	0.01	0.00	0.03	NS
Q19(b)	C0230	0.00	–	–	–	NS
Q20(a)	C0232	–	0.00	0.00	0.02	NS
Q20(b)	C0233	NS	NS	–	–	NS
Q20(c)	C0234	NS	0.00	0.00	0.01	0.01
Q20(d)	C0235	0.00	–	0.00	0.00	NS
Q20(e)	C0236	0.00	0.00	0.00	0.00	NS
Q20(f)	C0237	NS	0.00	0.00	0.00	NS
Q20(g)	C0238	0.00	0.00	–	0.00	NS
Q20(h)	C0239	0.00	0.00	0.00	0.00	0.00
Q20(i)	C0240	0.02	0.00	0.00	0.00	NS
Q20(j)	C0241	0.00	0.00	0.00	0.00	0.00
Q20(k)	C0242	NS	0.00	0.00	0.00	NS
Q20(l)	C0243	NS	0.00	0.00	–	NS
Q20(m)	C0244	0.00	0.00	0.00	0.00	NS
Q20(n)	C0245	NS	0.05	0.00	0.00	–
Q20(o)	C0246	NS	0.00	0.00	0.00	0.00
Q21(a)	C0301	0.00	0.00	0.04	NS	0.00
Q21(b)	C0303	0.00	0.00	0.01	NS	0.02
Q22(a)i	C0305	0.00	0.00	NS	NS	NS
Q22(a)ii	C0306	0.01	0.00	–	NS	NS
Q22(c)i	C0309	NS	0.01	0.02	NS	NS
Q22(c)ii	C0310	NS	NS	NS	NS	NS
Q22(d)i	C0311	NS	0.00	0.00	NS	NS
Q22(d)ii	C0312	NS	NS	NS	NS	NS
Q22(e)i	C0313	NS	NS	NS	NS	NS
Q22(e)ii	C0314	NS	0.01	0.00	NS	0.01
Q22(f)i	C0315	NS	NS	NS	NS	NS
Q22(f)ii	C0316	NS	NS	0.02	NS	NS
Q22(g)i	C0317	NS	NS	–	NS	0.03
Q22(g)ii	C0318	NS	NS	–	NS	NS
Q22(h)i	C0319	NS	0.03	NS	0.00	0.02
Q22(h)ii	C0320	0.03	0.00	0.02	0.01	NS
Q22(j)ii	C0324	NS	NS	0.04	NS	0.03
Q22(k)ii	C0326	NS				0.00
Q22(l)ii	C0328	NS				NS
Q22(o)ii	C0334	NS				0.01
Q22(q)i	C0337	NS				0.04
Q22(q)ii	C0338	0.00				0.04
Q22(r)i	C0339	NS				0.02
Q22(r)ii	C0340	0.01				NS
Q22(s)ii	C0342	NS				0.00
Q22(t)ii	C0344	0.01				0.03
Q22(v)	C0347	NS				0.01
Q22(w)	C0349	0.04				0.00

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE: BELIEF IN GOD C0232	BLAME ON HUMANS C0236	FLOODS COMMON C0236	FLOODS UNCOMMON C0243	ATTITUDE TO GOVT C0245
Q24(B)(i)b	C0428	0.00				NS
Q24(B)(i)d	C0432	0.00				NS
Q24(B)(i)e	C0434	0.00				0.02
Q24(B)(i)f	C0436	0.00				NS
Q24(B)(i)g	C0438	0.00				NS
Q24(B)(i)h	C0440	0.00				NS
Q24(B)(i)j	C0444	NS				NS
Q24(B)(i)k	C0446	NS				NS
Q24(B)(i)l	C0448	NS				NS
Q24(B)(i)m	C0450	NS				NS
Q24(B)(i)n	C0452	0.04				NS
Q24(B)(i)o	C0454	NS				NS
Q24(B)(i)p	C0456	0.00				NS
Q24(B)(i)q	C0458	NS				NS
Q24(B)(i)r	C0460	0.00				NS
Q24(B)(i)s	C0462	0.00				0.05
Q24(B)(i)t	C0464	0.00				0.02
Q24(B)(i)u	C0466	0.00				NS
Q24(B)(i)v	C0468	0.00				NS
Q24(B)(i)w	C0470	0.00				NS
Q24(B)(i)x	C0472	0.00				NS
Q24(B)(ii)b	C0503	0.00	0.02	0.04	NS	NS
Q24(B)(ii)c	C0505	NS	0.00	NS	NS	0.01
Q24(B)(ii)d	C0507	0.01	NS	0.03	0.05	NS
Q24(B)(ii)e	C0509	0.00	NS	0.00	NS	NS
Q24(B)(ii)f	C0511	0.00	0.05	0.01	NS	NS
Q24(B)(ii)g	C0513	0.00	0.00	0.05	NS	NS
Q24(B)(ii)h	C0515	0.00	0.02	NS	NS	0.00
Q24(B)(ii)i	C0517	NS	NS	NS	NS	NS
Q24(B)(ii)j	C0519	0.01	0.01	NS	0.03	0.05
Q24(B)(ii)k	C0521	0.09	NS	0.01	NS	0.03
Q24(B)(ii)l	C0523	0.01	NS	0.02	NS	NS
Q24(B)(ii)m	C0525	0.00	0.00	0.03	NS	NS
Q24(B)(ii)n	C0527	0.00	0.03	0.00	NS	NS
Q24(B)(ii)o	C0529	0.00	NS	0.00	0.00	NS
Q24(B)(ii)p	C0531	0.00	0.01	0.00	NS	NS
Q'S(B)(ii)q	C0533	NS	NS	NS	NS	NS
Q24(B)(ii)r	C0535	0.00	NS	0.01	NS	0.00
Q24(B)(ii)s	C0537	0.00	NS	0.00	NS	0.03
Q24(B)(ii)t	C0539	0.00	NS	0.00	NS	0.00
Q24(B)(ii)u	C0541	0.00	NS	0.00	NS	0.00
Q24(B)(ii)v	C0543	–	–	–	–	–
Q24(B)(ii)w	C0545	0.00	NS	NS	NS	0.01
Q24(B)(ii)x	C0547	0.00	0.02	0.01	NS	NS

(e1)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE BELIEF IN GOD C0232	BLAME ON HUMANS C0235	FLOODS COMMON C0238	FLOODS UNCOMMON C0243	ATTITUDE TO GOVERNMENT C0245
Q23	C0351	NS	0.00	0.00	0.00	NS
Q24(a)	C0402	0.00	NS	NS	NS	NS
Q24(a)	C0404	0.00	0.02	0.02	NS	NS
Q24(a)	C0405	NS	0.00	0.01	0.00	NS
Q24(a)	C0406	0.02	0.00	0.00	0.00	0.00
Q24(a)	C0407	NS	0.00	NS	NS	NS
Q24(a)	C0408	NS	0.00	0.03	0.00	0.01
Q24(a)	C0409	0.00	NS	NS	NS	0.00
Q24(a)	C0410	0.00	0.04	NS	NS	NS
Q24(a)	C0411					
Q24(a)	C0412	0.00	0.04	0.02	NS	NS
Q24(a)	C0413					
Q24(a)	C0414	NS	NS	NS	NS	NS
Q24(a)	C0415	0.01	0.02	NS	NS	NS
Q24(a)	C0416	0.00	NS	0.00	NS	0.01
Q24(a)	C0417	NS	NS	NS	NS	NS
Q24(a)	C0418	0.01	NS	NS	NS	NS
Q24(a)	C0419	NS	NS	NS	NS	NS
Q24(a)	C0420	NS	NS	NS	NS	NS
Q24(a)	C0421					
Q24(a)	C0422	NS	0.00	NS	NS	0.00
Q24(a)	C0423	NS	0.00	NS	NS	NS
Q24(a)	C0424	NS	NS	NS	NS	NS
Q24(b)	C0551	NS	NS	NS	NS	NS
Q25(a)	C0553	0.00	0.02	NS	NS	NS
Q25(b)	C0558	NS	0.04	NS	NS	0.03
Q25(b)	C0559	NS	0.03	NS	NS	NS
Q25(b)	C0560	NS	0.02	NS	NS	0.03
Q25(b)	C0561	NS	NS	NS	NS	NS
Q25(b)	C0562	NS	NS	0.02	NS	NS
Q25(b)	C0563	NS	0.00	NS	0.02	NS
Q25(b)	C0564	0.04	NS	NS	NS	NS
Q25(b)	C0566	NS	NS	NS	NS	NS
Q25(b)	C0568	NS	NS	NS	NS	NS
Q25(b)	C0570	NS	NS	NS	NS	0.05
Q25(b)	C0571	NS	NS	NS	NS	NS
Q25(b)	C0574	NS	0.02	0.00	NS	NS
Q25(b)	C0576	0.00	NS	NS	NS	NS
Q25(b)	C0577	NS	NS	0.03	0.03	NS
Q25(c)	C0579	NS	NS	0.00	0.02	NS

(f)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE: FLOOD AWARENESS	INDEPENDENT VARIABLE: OPTIMISM OR PESSIMISM NEW	INDEPENDENT VARIABLE: FLOOD PERCEPTION C0171
Q2(a)	NEW			0.00
Q4(a)	C0145	0.00	0.00	0.00
Q4(a)	DISAD2		NS	NS
Q4(b)	C0147	0.00	0.00	0.00
Q4(c)	C0149	0.00	0.00	0.00
Q5	C0151	NS	NS	0.01
Q6	C0152	0.00	NS	0.01
Q7	C0154	0.00	NS	0.00
Q10	C0161	0.00	0.00	0.00
Q10	C0163	0.00	0.00	0.00
Q10	C0165	0.00	0.00	0.00
Q10	C0167	0.00	0.04	0.00
Q10	C0169	0.00	0.03	0.00
Q11	C0171	0.00	0.00	
Q13	C0176	NS	0.04	0.00
Q15	C0203	0.00	0.00	0.00
Q15	C0205	0.00	0.00	0.00
Q15	C0207	0.00	0.00	0.00
Q15	C0209	0.00	0.01	0.00
Q15	C0211	NS	0.03	0.00
Q16	C0213	0.00	0.00	0.00
Q17(a)	C0216	0.00	0.00	0.00
Q17(b)	C0218	0.04	NS	NS
Q18(a)	C0220	NS	NS	NS
Q18(b)	C0222	0.06	0.01	0.00
Q19(a)	C0228	0.00	0.03	0.00
Q19(b)	C0230	0.02	0.01	0.00
Q20(a)	C0232	0.00	0.01	0.00
Q20(b)	C0233	NS	NS	NS
Q20(c)	C0234	NS	NS	NS
Q20(d)	C0235	NS	NS	NS
Q20(e)	C0236	NS	NS	NS
Q20(f)	C0237	0.00	0.00	0.00
Q20(g)	C0238	0.00	0.00	0.00
Q20(h)	C0239	NS	NS	0.00
Q20(i)	C0240	NS	NS	0.00
Q20(j)	C0241	0.00	0.00	0.00
Q20(k)	C0242	0.00	0.00	0.00
Q20(l)	C0243	0.00	0.01	0.00
Q20(m)	C0244	0.00	0.00	0.00
Q20(n)	C0245	0.04	NS	NS
Q20(o)	C0246	NS	NS	NS
Q21(a)	C0301	NS	NS	NS
Q21(b)	C0303	NS	NS	0.02
Q22(a)i	C0305	NS	NS	0.01
Q22(a)ii	C0306	NS	NS	NS
Q22(c)i	C0309	0.01	0.02	0.04
Q22(c)ii	C0310	0.00	NS	0.01
Q22(d)i	C0311	0.02	NS	0.01
Q22(d)ii	C0312	NS	0.04	NS
Q22(e)i	C0313	NS	NS	NS
Q22(e)ii	C0314	NS	NS	NS
Q22(f)i	C0315	NS	0.00	NS
Q22(f)ii	C0316	NS	0.00	NS
Q22(g)i	C0317	NS	0.01	NS
Q22(g)ii	C0318	NS	0.00	0.08
Q22(h)i	C0319	0.03	NS	NS
Q22(h)ii	C0320	0.00	0.03	0.00
Q22(j)ii	C0324	0.00	NS	NS
Q22(k)ii	C0326	NS	0.04	0.01
Q22(l)ii	C0328	NS	NS	NS
Q22(o)ii	C0334	NS	NS	NS
Q22(q)i	C0337	0.00	0.00	0.00
Q22(q)ii	C0338	0.01	0.00	0.00
Q22(r)i	C0339	NS	NS	NS
Q22(r)ii	C0340	NS	0.01	NS
Q22(s)ii	C0342	NS	NS	0.04
Q22(t)ii	C0344	0.02	NS	NS
Q22(v)	C0347	0.01	0.00	0.04
Q22(w)	C0349	0.00	0.00	0.02
Q24(B)(i)b	C0428	0.00	0.00	0.02
Q24(B)(i)d	C0432	NS	NS	NS
Q24(B)(i)e	C0434	NS	NS	NS
Q24(B)(i)f	C0436	0.00	NS	NS
Q24(B)(i)g	C0438	0.00	NS	NS
Q24(B)(i)h	C0440	NS	NS	NS
Q24(B)(i)j	C0444	NS	NS	NS
Q24(B)(i)k	C0446	NS	0.00	NS
Q24(B)(i)l	C0448	NS	NS	NS
Q24(B)(i)m	C0450	0.00	0.01	0.01
Q24(B)(i)n	C0452	0.00	0.01	0.00
Q24(B)(i)o	C0454	0.00	0.01	0.00
Q24(B)(i)p	C0456	0.00	NS	NS
Q24(B)(i)q	C0458	0.00	0.05	0.01
Q24(B)(i)r	C0460	0.00	0.00	0.01
Q24(B)(i)s	C0462	0.00	NS	0.00
Q24(B)(i)t	C0464	0.00	0.00	0.00
Q24(B)(i)u	C0466	0.02	0.01	0.01
Q24(B)(i)v	C0468	NS	NS	NS
Q24(B)(i)w	C0470	0.02	0.00	NS
Q24(B)(i)x	C0472	0.05	NS	NS
Q24(B)(ii)b	C0503	0.01	0.00	NS
Q24(B)(ii)c	C0505	NS	NS	NS
Q24(B)(ii)d	C0507	NS	NS	NS
Q24(B)(ii)e	C0509	0.01	NS	NS
Q24(B)(ii)f	C0511	0.00	NS	0.04
Q24(B)(ii)g	C0513	0.00	NS	NS
Q24(B)(ii)h	C0515	NS	NS	NS
Q24(B)(ii)i	C0517	NS	NS	NS
Q24(B)(ii)j	C0519	NS	NS	0.00
Q24(B)(ii)k	C0521	NS	NS	NS
Q24(B)(ii)l	C0523	NS	NS	NS
Q24(B)(ii)m	C0525	0.00	–	0.00
Q24(B)(ii)n	C0527	NS	NS	0.00
Q24(B)(ii)o	C0529	0.00	–	0.00
Q24(B)(ii)p	C0531	NS	–	0.00
Q24(B)(ii)q	C0533	NS	–	0.03
Q24(B)(ii)r	C0535	0.00	NS	0.00
Q24(B)(ii)s	C0537	0.04	NS	0.00
Q24(B)(ii)t	C0539	0.00	–	0.00
Q24(B)(ii)u	C0541	0.03	NS	0.00
Q24(B)(ii)v	C0543	NS	–	NS
Q24(B)(ii)w	C0545	NS	NS	NS
Q24(B)(ii)x	C0547	NS	NS	NS

(f1)

QUESTION	DEPENDENT VARIABLE	INDEPENDENT VARIABLE FLOOD AWARENESS C0145	OPTIMISM/ PESSIMISM NEW	FLOOD PERCEPTION C0171
Q23	C0351	0.00	NS	0.00
Q24(a)	C0402	NS	NS	NS
Q24(a)	C0404	NS	NS	0.02
Q24(a)	C0405	NS	NS	NS
Q24(a)	C0406	NS	0.03	NS
Q24(a)	C0407	0.01	NS	NS
Q24(a)	C0408	0.02	0.00	0.04
Q24(a)	C0409	0.00	NS	0.01
Q24(a)	C0410	NS	NS	NS
Q24(a)	C0411			
Q24(a)	C0412	0.00	0.02	NS
Q24(a)	C0413			
Q24(a)	C0414	NS	NS	NS
Q24(a)	C0415	NS	NS	NS
Q24(a)	C0416	0.00	NS	0.03
Q24(a)	C0417	NS	NS	NS
Q24(a)	C0418	NS	NS	NS
Q24(a)	C0419	NS	NS	NS
Q24(a)	C0420	NS	NS	NS
Q24(a)	C0421			
Q24(a)	C0422	0.01	0.03	NS
Q24(a)	C0423	NS	NS	NS
Q24(a)	C0424	NS	NS	NS
Q24(b)	C0551	NS	NS	NS
Q25(a)	C0553	0.02	NS	NS
Q25(b)	C0558	NS	NS	NS
Q25(b)	C0559	NS	NS	NS
Q25(b)	C0560	NS	NS	0.02
Q25(b)	C0561	NS	NS	NS
Q25(b)	C0562	NS	NS	NS
Q25(b)	C0563	NS	NS	0.00
Q25(b)	C0564	NS	NS	NS
Q25(b)	C0566	NS	NS	NS
Q25(b)	C0568	NS	NS	NS
Q25(b)	C0570	NS	NS	NS
Q25(b)	C0571	NS	NS	NS
Q25(b)	C0574	NS	0.01	0.00
Q25(b)	C0576	NS	NS	NS
Q25(b)	C0577	NS	NS	NS
Q25(c)	C0579	NS	NS	NS

APPENDIX M: EXPERTS' OPINION ON FLOOD HAZARD MANAGEMENT IN PENINSULAR MALAYSIA, WITH SPECIAL REFERENCE TO FLOOD FORECASTING AND WARNING SYSTEMS

M.1 Introduction

This section discusses the results of a questionnaire survey on how flood management experts, viz. government officers, academics, consultants and workers of voluntary organisations whose work is related to the flood hazard, view existing flood hazard management strategies and policies in Peninsular Malaysia (see Appendix F, Section F.3.4). Together with the section on flood warnings in the main household survey (see Appendix A), this opinion survey is carried out as a means of evaluating the effectiveness of flood hazard institutions, with special reference to flood forecasting and warning systems in Peninsular Malaysia.

There were 49 respondents in this survey. While the main part of the survey is based on a structured quantitative questionnaire, detailed notes were taken (in a qualitative manner) when respondents revealed some relevant aspects of flood hazard management not covered in the questionnaire. Of the respondents, 25 were government officers (51.0 per cent), 7 academics (14.3 per cent), 7 consultants (14.3 per cent), 5 workers from environmental groups (10.2 per cent) and 5 others (10.2 per cent).

M.2 Rating the seriousness of flooding in states

Based on a scale of 1 (least serious) to 10 (most serious), respondents were required to rate the seriousness of the flood hazard in each state in the peninsula. With an average rating of 8.3, the state of Kelantan appears to have the highest average rating (Table M.1). This was followed by Terengganu and Pahang. All three are East Coast states. In all three states, not one respondent rated the seriousness of flooding to be less than 5. On the other hand, the seriousness of flooding in West Coast states appear to be rated lower. Only Kuala Lumpur, Perak and Selangor were rated above 6.0. In the case of Johor, the eastern half is considered located in the East Coast while the western half is on the West Coast.

M.3 Rating government spending in flood management

The results revealed that the experts did not rate the Malaysian government's spending on flood management highly. On a scale of 1 to 10, the overall average rating of was 4.9 (Table M.2). And although government officers gave the highest ratings, their average rating was 5.6. Consultants and other professionals appear to give government spending the lowest ratings. This is an indication of the inadequacy of spending in this area.

The experts' opinion of inadequacy of government spending does not end there. The majority of the experts (63.4 per cent) also believed that government spending was uneven, some states receiving more allocations than others (Table M.3). According to the experts, there are many reasons for this. The most common reason is politics as 61.3 per cent of those rating spending as unevenly distributed mentioned so. In Malaysia, it is not uncommon for political parties to try to win over the public through the implementation of flood mitigation schemes. In fact, many such schemes are carried out as a kind of 'pre-election promise'. This suggests that political considerations often outweigh others in determining the deployment of

Table M.1: Average ratings of the seriousness of flooding by experts of flood hazard management in Peninsular Malaysia

State	Average rating	% rating 1-5	% rating 6-10
Kelantan	8.3	0.0	100.0
Terengganu	8.2	0.0	100.0
Pahang	7.7	0.0	100.0
Kuala Lumpur	7.1	16.3	83.7
Johor	6.5	14.3	85.7
Perak	6.3	16.3	83.7
Selangor	6.2	22.4	77.6
Pulau Pinang	5.8	36.7	63.3
Kedah	4.9	71.4	28.6
Perlis	4.5	69.4	30.6
Negri Sembilan	4.2	77.6	22.4
Melaka	3.8	79.6	20.4

Table M.2: Experts' rating of Malaysian government's spending on flood management

Profession	Frequency	Percentage	Average rating
Government officers	24	49.0	5.6
Academics	7	14.3	5.1
Environmental groups	5	10.2	4.0
Consultants	7	14.3	3.9
Others	5	10.2	3.6
Overall average rating			4.9

Table M.3: Experts' rating of distribution of government spending on flood management

Rating	Frequency	Percentage
Very evenly distributed	2	4.1
Fairly evenly distributed	12	24.5
Fairly unevenly distributed	15	30.6
Very unevenly distributed	16	32.8
No idea	4	8.2

resources to manage floods. Variation in flood risk and exposure was only second in importance. This was indicated by 35.5 per cent of the experts. Other reasons given include population and development densities, climatic difference, whether a state was comparatively rich or poor, and others.

On the other hand, while many reasons are given by the experts who think government spending is evenly distributed, none is dominant. Amongst the popular ones are difference in population size, politics, flood risk difference and physical and physiographic difference (Table M.4).

When the experts were asked to rate the overall flood management strategy of the Malaysian government, they gave an overall average rating of 5.1. This implies that the Malaysian flood management strategy is only averagely effective, and certainly there is room for improvement. In fact, 73.5 per cent of the experts rated it between a value of 3 and 5, implying a below average strategy. Only 10.2 per cent rated it with a value of 7 and above, indicating a strategy with a high level of effectiveness.

M.4 Opinion and views on various aspects of floods and government flood management

The majority of the experts (59.2 per cent) agree that the flood management policies and strategies of the Malaysian government are over-dependent on the engineering approach, as compared to only 14.3 per cent who did not think so. However, almost all the experts (98.0 per cent) are of the opinion that there is a need to incorporate a multi-disciplinary approach to flood hazard management in the peninsula.

The majority of the experts (81.6 per cent) disagree with the statement that the likelihood of flooding is decreasing in many parts of the peninsula as a result of flood control by the DID and other government agencies. Clearly, this is a *strong indication of the lack of confidence* of the experts in government flood management strategies and policies but also, more significantly, that they think that the occurrence of floods is not decreasing. The experts also do not think that floods are decreasing as a result of climatic changes as 85.7 per cent of them disagree with the statement. In fact, 85.7 per cent of them think that floods are increasing and becoming worse because of uncontrolled and haphazard development.

Furthermore, 81.6 per cent of the experts believe that the DID is inadequate to tackle the flood problem in the peninsula. This implies that there is a need to incorporate other government agencies and departments into a more concerted effort in managing the flood problem. And 63.3 per cent of the experts believe that pressure groups, such as voluntary environmental groups, should not refrain from leaving government agencies alone to do their work. Rather, this implies that such groups should keep the agencies on the right track by creating more public awareness and public accountability on the part of the government agencies with a view to improve flood protection.

M.5 Opinions on flood forecasting and warning systems

A series of questions were put to government officers about their agency's/department's annual budgetary allocation for flood forecasting and warning systems for the years 1991, 1992 and 1993. In Table M.5, it is obvious that their ratings of agency/departmental budgetary allocations is only average for 1991 and 1992. If 7 is taken as the arbitrary cut-off

Table M.4: Main reasons why experts think government spending is not evenly distributed

Reasons	Frequency	Percentage
Politics	19	61.3
Difference in flood risk	11	35.5
Population difference	7	22.6
Disparity in development	5	16.1
Some states richer than others	5	16.1

Table M.5: Government officers' rating of budgetary allocations of their respective agency/department on flood forecasting and warning systems

Rating	1991		1992		1993	
	Frequency	%	Frequency	%	Frequency	%
1	0	0.0	0	0.0	0	0.0
2	1	4.0	1	4.0	1	4.0
3	0	0.0	1	4.0	1	4.0
4	1	4.0	0	0.0	0	0.0
5	3	12.0	2	8.0	2	8.0
6	7	28.0	8	32.0	5	20.0
7	3	12.0	4	16.0	4	16.0
8	2	8.0	2	8.0	4	16.0
9	0	0.0	0	0.0	1	4.0
10	0	0.0	0	0.0	0	0.0
Don't know	8	32.0	7	28.0	7	28.0

1 = least adequate
10 = most adequate

point for adequacy, then only 20.0 per cent and 24.0 per cent rated the allocations in those two years as adequate. However, the 1993 ratings were better as 36.0 per cent rated the allocations 7 and above. This is due to the increase in such allocations in 1993 and is a good sign that the government is paying more attention to the flood problem.

When government officers were asked to assess the areal coverage of flood forecasting and warning systems in the region under their agency's/department's control, 60.0 per cent of them indicated that it was below 30.0 per cent coverage. Only 12.0 per cent said their region's coverage was more than 30.0 per cent. Furthermore, 68.0 per cent of the experts thought that the current extent of coverage in their respective regions was insufficient. Only one officer thought that it was sufficient. He is the flood forecasting officer in Kuala Lumpur, the area of which is small. The flood warning service covers almost the entire region under the federal capital. This small percentage of flood forecasting and warning areal coverage reflects the inadequacy of the service and implies much scope for improvement. It also means that non-structural flood management programmes need to be up-graded and further developed to increase overall flood management effectiveness. Of the officers who gave a positive reply, 76.5 per cent believed that a minimum coverage of 70.0 per cent would suffice for their region. Surprisingly, a significant percentage of 28.0 per cent were not sure and could not give an answer.

When all the experts were asked as to whether the current flood forecasting and warning system was the best available, only 6.1 per cent thought so. The majority of 87.8 per cent did not think so and suggested various other systems which they thought were better. 49.0 per cent suggested that radar and telemetry system was the best currently available. The rest suggested computer analysis, flood routing, better weather forecasting as alternative systems. This suggests that the current systems employed by each state are not the most current and effective systems. Thus, there is much room for improvement in this respect. Almost all the experts, except two, thought that the flood forecasting and warning systems in their region should be improved, and the main reasons given were the inadequacy of current systems, increasing flood risk, systems not computerised and the need to constantly keep abreast with current technology. Many suggestions were put forward as to how the existing systems could be improved (Table M.6).

Of those who are involved with forecasting and warning, 68.8 per cent believed that less than 30.0 per cent of current forecasting and warning systems are automated. This means actual forecasting and warning dissemination is operated automatically via telemetry, computer modelling, faxing, sirens etc. In contrast, this implies that a greater proportion of such work is still being carried out manually. If a 70.0 per cent automation rate is considered as the target, then there is a 40.0 per cent difference which needs to be made up. However, 75.5 per cent of the experts thought that automation is not likely to take up more than 50.0 per cent of a forecasting and warning functions. This implies that the responsibility of flood duty officers is very important in this line of work. In fact, the experts rated the importance of the flood duty officer's experience in forecasting with an average of 7.5 out of a maximum of 10. This line of work is so highly specialised that 75.5 per cent of experts were of the opinion that even with maximum automation available, no untrained personnel would be able to take over the functions of a flood duty officer.

When assessing the competence of flood duty officers, only 62.5 per cent of the experts were satisfied with those working in their region. Of all the qualities of a flood duty officer, the most important considered by the experts were qualifications and experience. In both cases 30.6 per cent each of the experts said so. Other important qualities include commitment and dedication, knowledge of rivers and being responsible and hard-working.

Table M.6: Experts' suggestions as to how current flood forecasting and warning systems could be improved

Suggestion	Number	%
Install more radar stations	15	30.6
Install more telemetric stations	30	61.2
Employ automatic computer analysis	18	36.7
Install more automatic sirens	14	28.6
Install more auto-loggers (rainfall and river level)	11	22.4
Employ radar estimate of rainfall	9	18.4
Purchase new flood forecasting models	8	16.3
Set up a flood control centre	6	12.2
Allocate more spending on flood forecasting	5	10.2
Employ more qualified staff	5	10.2
Provide better information to the public	4	8.2
Employ a multi-disciplinary approach	4	8.2
Educate the public on how to response	4	8.2
Employ a combination of methods	3	6.1
Update current systems	3	6.1
Employ flood routing programmes	2	4.1
Employ flood watching	2	4.1
Employ flood wardens	2	4.1
Use satellite data in forecasting	2	4.1
Install more flood warning boards	1	2.0

The importance of an adequate warning lead time can not be over-emphasised. In Peninsular Malaysia, the experts gave their opinions on the average target warning lead time for various types of catchments. The results are shown in Table M.7. In all catchments, the current average lead times are still short of the target lead times. For instance, in urban and rural catchments, the current average lead time is 1.1 and 2.3 hours short of the target lead time respectively. This shows that there is much scope for improvement. Furthermore, target lead times are those expected at the current moment based on current technology. Future advancement in forecasting and warning technologies may extend lead times significantly. In order to improve target lead times, the main suggestions given by the experts were that of setting up more radar stations (30.6 per cent) and using radar estimates of rainfall (26.5 per cent). Other suggestions include setting up a coordinated central body responsible for forecasting and warning (16.3 per cent), using computer analysis (22.4 per cent), better communication system (16.3 per cent), using new computer models (12.2 per cent) and using satellite data in rainfall estimation (10.2 per cent).

In Peninsular Malaysia, it is noted that the majority of the forecasting work is still very much based on conventional forecasts using point rainfall (from rain gauges) and river levels (from river level gauges). Although such conventional methods are reasonably accurate (if used together with other methods such as flood routing), they do not produce sufficiently long lead times for warnings to be effective, especially in the case of urban catchments. In the current research, 60.0 per cent of government officers mentioned that more than 70.0 per cent of their work on forecasting was based on point rainfall. The reliability of point rainfall is reasonably high as 59.2 per cent of all experts with a reliability of 60.0 per cent or more when used as an input in forecasting floods. The average rating given for point rainfall was 5.7 out of a maximum of 10. Many regions in the peninsula also use gauged river levels as inputs in forecasting. In this research, 56.0 per cent of government officers said their region used such data and river levels are given an average rating of 6.8. A majority of 67.3 per cent of the experts interviewed were of the opinion that river level data is 70.0 per cent or more reliable when used as inputs in forecasting floods. Because conventional flood forecasting using rainfall and river level data is relatively cheap and fairly reliable, it is used widely in most states and regions Peninsular Malaysia. This method has proven quite effective in the larger river systems such as the Pahang, Perak and Kelantan Rivers where warnings given to downstream areas are usually in advance of at least a few hours or more. Also, conventional methods are suitable for forested or rural catchment where flood routing models are more predictable and the lag time between rainfall and flood flow is longer.

On the other hand, despite the fact that radar estimates of rainfall provides the best possible lead time and is the current state of the art method of forecasting heavy rains and floods[1], it has not hitherto been sufficiently developed in Peninsular Malaysia. Although government flood duty officers and those associated with rainfall and flood forecasting are aware of such remote sensing methods, 64.0 per cent of them say that radar is not used at all in their forecasting work. This may be partly due to the fact that radar estimates are not as reliable as rainfall and river level data which are 'actuals' rather than estimates. The experts have only given radar estimates an average reliability of 3.6 out of a maximum of 10. In fact, 81.6 per cent of the experts were of the opinion that radar estimates do not perform well and were

[1] Radar estimates of rainfall coupled with satellite estimates, with further confirmation from rain gauges and river level gauges is effectively employed by the NRA in Britain in their forecasting models. The use of radar estimates has effectively increased warning lead times, especially in urban catchments (see Haggett 1986; Haggett et al 1991; Chan 1994).

Table M.7: Experts' opinion on the average target warning lead times for issuing warnings in Peninsular Malaysia (in hours)

Type of catchment	Average target lead time	Current average lead time	Maximum lead time achievable
Urban	3.0	1.9	3.2
Rural	8.6	6.3	8.6
Mixed	5.3	4.1	6.1
Region/country	5.6	4.4	6.1

less than 50.0 per cent reliable when used as inputs in forecasting floods. The same is also true in the case of satellite estimates of rainfall. Although government officers are aware of such data, 68.0 per cent said their regions did not have access to such data. Their forecasting systems did not use such data. In fact, only the Malaysian Meteorological Service use satellite images to predict rainfall and the rainfall predicted is more qualitative rather than quantitative. The experts only rated satellite data at 2.7 out of 10, indicating that they are highly unreliable when used as inputs in forecasting floods. In fact, 75.5 per cent of the experts said that such data would only produce a performance with a reliability of less than 30.0 per cent.

Table M.8 gives an indication of the evaluation of the experts' assessment of accuracy, reliability, timeliness and coverage of each type of data input for forecasting flood. In terms of accuracy, remotely sensed rainfall such as satellite and radar estimates are the least accurate and least reliable when used as inputs for forecasting floods, but they provide the fastest time (therefore increasing warning lead time) and their coverage is the most extensive. In the case of conventional point rainfall and gauged river levels, their accuracy and reliability are high but is the slowest (therefore limiting the warning lead time) and covers the least area. Clearly, there is a need to combine both remotely sensed data and conventional data to fully exploit both accuracy and reliability as well as timeliness and coverage.

Finally, experts were asked to rate the current state of flood forecasting and warning in Peninsular Malaysia. The results in Table M.9 and Table M.10 show that both forecasting and warning technologies are not rated highly. In fact, 71.4 per cent rated forecasting technology 5 and below. The corresponding percentage for warning was 65.3 per cent. Only 14.3 per cent and 16.3 per cent of the experts rated forecasting and warning at 7 or higher. According to the experts, Malaysian forecasting and warning technologies also do not compare favourably with their immediate neighbours or the other countries in the world. For instance, 81.6 per cent were of the opinion that both the Malaysian flood forecasting and warning technologies were average (4) to below average (6) when compared to its neighbours. When compared with the rest of the world, 89.9 per cent indicated that the Malaysian forecasting was below average as compared to 93.9 per cent for warning technology. The results once again confirmed that forecasting and warning technologies in the peninsula are behind time and that there is plenty of room for improvement. As non-structural flood management methods are poorly developed in the peninsula, this is one area where much work needs to be done. Advancement in these two areas would certainly reduce potential flood losses.

Table M.8: Experts' opinion on the accuracy, reliability, timeliness and coverage of satellite forecasted rainfall, radar estimated rainfall, point rainfall and gauged river levels as inputs for forecasting flood.

Type of data	Accuracy	Reliability	Timeliness	Coverage
Satellite rainfall	4.1	4.4	1.6	1.2
Radar rainfall	3.3	3.5	2.3	2.2
Point rainfall	2.3	2.4	3.4	4.1
Gauge river levels	1.9	1.7	4.0	4.2
Key:				
	1 = most accurate	1 = most reliable	1 = fastest	1 = largest
	5 = least accurate	5 = least reliable	5 = slowest	5 = smallest

Table M.9: Experts' opinion on the current state of flood forecasting and warning technology in Peninsular Malaysia.

Rating	Forecasting technology		Warning technology	
	Frequency	%	Frequency	%
1 (very backward)	0	0.0	0	0.0
2	0	0.0	1	2.0
3	14	28.6	13	26.5
4	11	22.4	9	18.4
5	10	20.4	9	18.4
6	7	14.3	9	18.4
7	5	10.2	5	10.2
8	2	4.1	3	6.1
9	0	0.0	0	0.0
10 (most advanced)	0	0.0	0	0.0

Table M.10: Experts' opinion on the current international standing of Malaysian flood forecasting and warning technology.

Rating	In the ASEAN region				In the world			
	Forecasting		Warning		Forecasting		Warning	
	Freq	%	Freq	%	Freq	%	Freq	%
1 - the best	0	0.0	0	0.0	0	0.0	0	0.0
2	1	2.0	1	0.0	1	2.0	0	0.0
3	7	14.3	7	14.3	3	6.1	2	4.1
4	18	36.7	18	36.7	12	24.5	12	24.5
5	18	36.7	17	34.7	12	24.5	15	30.6
6	4	8.2	5	10.2	17	34.7	15	30.6
7 - the worst	0	0.0	0	0.0	3	6.1	4	8.2
8 - don't know	1	2.0	1	2.0	1	2.0	1	2.0
Total	49	100.0	49	100.0	49	100.0	49	100.0

APPENDIX N HOUSEHOLD CHARACTERISTICS OF SELECTED SAMPLE AREAS IN PENINSULAR MALAYSIA

N.1 Introduction

This appendix summarises the main socio-economic characteristics of households surveyed in this research. It forms the background material from which socio-economic characteristics of individuals are tested against their perception and response to the flood hazard.

N.2 Characteristics of sample areas

In this research, a total of 618 heads of households, 332 (53.7 per cent) from the East Coast and 286 (46.3 per cent) from the West Coast are interviewed. The breakdown into the four sample areas is shown in Table N.1.

A total of 336 households (54.4 per cent) are urban while 282 households (45.6 per cent) are rural (Table N.2). All households in Kuala Lumpur are urban. The majority of households in Pulau Pinang are also urban. On the other hand, the majority of households in both the Kelantan and Pekan areas are rural.

Within the four sample areas, different locations are subjected to different types of flooding which are classified as river floods, a combination of tidal and river floods, and tidal floods. The total number of households subjected to each type of floods is shown in Table N.3.

Households are also classified into residential, farming, commercial and fishing because perception and response to the flood hazard are envisaged to be different between them (Table N.4).

Building types are classified into detached, semi-detached, terraced and flat (Table N.5). Detached houses are mainly traditional houses (usually built on stilts) found in the rural areas as can be seen in the high proportion of such houses in the Kelantan and Pekan areas. In the Pulau Pinang and Kuala Lumpur areas, detached houses are usually modern houses but those located near river banks are squatter-type houses. A minority of the semi-detached houses are traditional type houses which have stilts but all terraced houses and flats are modern buildings.

N.3 Building characteristics

Building material is envisaged to have some influence on damage reduction and indirectly on perception and the employment of adjustment strategies. Different types of building materials are shown in Table N.6. Likewise, age of buildings may have similar influences and is shown in Table N.7. Floor types of houses are also envisaged to have an effect on perception and adjustment of respondents. For instance, those with carpeted floors would suffer a higher damage potential than those with cement floors. Thus, the perception and willingness to take action and adopt certain strategies may be different between the above two groups. On the whole, the majority of houses have wooden and cement floors, 51.5 per cent and 39.2 per cent respectively (Table N.8).

One of the unique features of traditional Malay houses is that they are built on stilts. The origin of the stilt house appears to be human's attempts to inhabit the low-lying fringes of coastal, riverine and swampy areas as this evidence is in abundance in rural Malay houses throughout the peninsula. As a means to keep above the water level, the stilt house would be a natural answer to the swampy or damp environment (Voon et al 1978 p63). With inland migration of settlements, however, the stilt house is gradually being diffused as they cost more to build than conventional houses built on the ground (based on qualitative interviews with respondents living in stilt houses). Furthermore, the empty space below a stilt house is not utilised and is considered by modern builders as a waste of space. Naturally, the lesser threat of floods on higher grounds meant that stilts were expendable and with the encroachment of modernizing influences on human values, there is now a strong likelihood that the traditional stilt house will feature decreasingly in the landscape of rural Malaysia, except perhaps in the flood-prone areas. Despite that, traditional stilt houses have evolved over time and have become as much a necessary part of Malay culture in architecture as it is an essential need for protection against nature. The stilts of such houses vary in height and materials. In the former, the house may be raised from one to three metres or more above the ground, and different parts of the house may again show differences in height above ground level (Voon et al 1978 p63). In terms of the latter, the majority are built of wood although wooden stilts can be reinforced with a surrounding layer of cement or concrete. Wooden stilts are susceptible to wear and tear caused by frequent inundations of river and/or sea water, in many instances causing houses to collapse. In many modern Malay houses, wooden stilts have given way to completely concrete or cemented ones. Because floods are generally more frequent and of a greater magnitude in the East Coast than those in the West Coast of the peninsula, more houses in the former are built on stilts and they tend to be higher.

In the current research, 58.9 per cent of houses surveyed are built on stilts (Table N.9). In the East Coast, the two sample areas of Pekan and Kelantan have the highest percentages of houses built on stilts, i.e. 86.4 per cent and 79.7 per cent respectively. On the other hand, the corresponding figures for the two West Coast areas of Pulau Pinang and Kuala Lumpur were much lower, i.e. 33.7 per cent and 28.1 per cent respectively. The East Coast locations also have a higher average stilt height of 1.5 m compared to the West Coast locations of 1 m.

The distribution of stilt heights by sample area is given in Table N.10. In terms of the building material of the stilts, it was found that the majority of houses (41.1 per cent) had stilts built of wood (Table N.11). This is especially so in Pekan where 56.2 per cent of houses had wooden stilts. In Pulau Pinang, however, 55.2 per cent of houses were built on wooden stilts reinforced with an external layer of concrete. On the whole, the number of houses with different stilt type is fairly evenly distributed between wood, wood with reinforced concrete and pure concrete.

N.4 Socio-economic characteristics of households

In Peninsular Malaysia, other than their attractiveness as fertile agricultural land, floodplain regions are generally considered low priority in terms of property land value, although in highly developed urban areas, population pressures and shortages of land might result in such areas being deliberately developed. Many of the flood-prone riverine areas in cities are occupied by squatters. In general, the majority of occupants in floodplains are farmers and those who cannot afford to live elsewhere. This has given rise to a characteristically low socio-economic profile amongst households in floodplain regions.

N.4.1 Tenure

In the current research, ownership of floodplain properties is quite high at 79.6 per cent, with Pekan and Kelantan registering the highest rates at 85.7 per cent and 81.8 per cent respectively (Table N.12). Although slightly lower rates are registered for Pulau Pinang and Kuala Lumpur, the overall percentage of ownership of properties is considered high.

N.4.2 Length of residence

The average number of years respondents have lived in their current property is about 22 years and 11 months (Table N.13). Respondents in Kelantan appear to have lived in their current properties the longest while those in Kuala Lumpur have the shortest occupancy.

N.4.3 Gender

On the whole, as Malaysian society, especially in the rural agricultural areas are dominated by a patrilinear society, more males were interviewed than there were females. This was deliberate because females tend not to be as open as males when responding to questions. Furthermore, as males are usually the breadwinner of the household, it is usually their perceptions and decisions that determine the course of action taken by each household when responding to the flood hazard. In the current survey, although 73.9 per cent of respondents were males (Table N.14), this does not reflect the actual sex ratio in Malaysian society which is about 100:102 males to females in 1991 (Department of Statistics Malaysia 1992 p28). However, the sample for females is large enough for most statistical analysis to be performed.

N.4.4 Age

The average age of respondents in the current survey is about 41 years and 4 months. On the average, respondents in the two East Coast areas are slightly older than their counterparts in the West Coast. This could be due to the fact that many of the respondents from the East Coast are padi farmers who are over 50 years of age. However, the difference is small, about two years. The age distribution of respondents in all the sample areas is given in Table N.15.

N.4.5 Ethnicity

In 1990, the Malays made up 58.1 per cent of the total population of the peninsula compared to 31.4 per cent and 9.9 per cent by the Chinese and Indians respectively (International Law Book services 1991 p23). In the current survey, the ratio of the various groups closely resembles the 1990 figures (Table N.16). It should be noted that the Malays dominate the East Coast areas but their numbers in the West Coast are only slightly higher than that of the Chinese. This is not surprising as Malays form 77.9 per cent of farming households which are mostly located in the East Coast. On the other hand, the Chinese form 58.3 per cent of commercial households which are mostly located in the West Coast. Furthermore, 67.4 per cent of rural households are Malays as compared to only 22.7 per cent Chinese.

N.4.6 Religion

Theoretically, all Malays are muslims in Malaysia. Unlike the Chinese and Indians who do not have a common religion, Islam provides the main foundation on which Malay unity is bound. Thus, religion (Islam) and the institutions linked to it - the mosque, the 'surau' (prayer house in which the men congregate at least once a day), the 'pondok' school (where all Malay children receive religious instruction after their normal school hours) all form an important part of Malay culture, expressed in the kampung way of life. Thus, most important functions, official, ceremonial or communal such as the 'kenduri' (feast), election of the ketua kampung or penghulu (headman), opening of a new mosque and other important functions are held in the mosque or surau. In fact, in some cases even political gatherings are held in the mosque. The mosque, surau and pondok (considered sacred places other than their functional importance) are usually built on high ground to prevent them from being flooded. Some of these places also act as relief centres for flood evacuees during times of floods.

In the current research, 61.5 per cent of respondents are muslims followed by 16.7 per cent buddhists (Table N.17). Muslims (mainly Malays) are mostly concentrated in the two East Coast areas but buddhists and taoists (mainly Chinese) and hindus (mainly Indians) are concentrated more on the West Coast. All Malays in the current research are muslim. Chinese and Indians are a mixture of buddhists, christians, hindus, taoists and others. Amongst the Chinese, 58.0 per cent are buddhist and 23.9 per cent are taoists. The majority of Indians (65.7 per cent) are hindus. However, a significant percentage of Indians are christians (17.1 per cent) and muslims (11.4 per cent). While the distribution of urban and rural muslims is quite even (44.7 per cent and 55.3 per cent respectively), the majority of hindus (85.1 per cent), buddhists (68.9 per cent), and taoists (61.9 per cent) are urban dwellers.

N.4.7 Occupation

The majority of respondents were either entrepreneurs (traders and business operators) (24.1 per cent) or farmers (15.4 per cent). The distribution of occupations amongst the respondents is varied (Table N.18). Unemployment amongst the respondents is very low, only 1.1 per cent, the highest of which is in Pekan (3.6 per cent). One distinct characteristic is that only few professionals (3.1 per cent) choose to live in floodplains.

N.4.8 Education

Educational achievements of floodplain occupants are low, despite the fact that primary and secondary education is provided free by government schools. In the current survey, only a small minority of 5.0 per cent of respondents have reached tertiary education (degree and diploma levels) (Table N.19). The percentage with at least secondary education is about 43.5 per cent. On the other hand, the figure for illiteracy is significantly high at 12.9 per cent. The rate of illiteracy is highest in the East Coast areas, with Kelantan and Pekan registering 20.8 per cent and 17.9 per cent respectively. This is not surprising as most of the respondents in the East Coast are poor aged peasant farmers living in the rural areas. Those with higher educational achievements such as the children of farmers have migrated to the urban areas where better job opportunities and the attraction of city life are on offer. Kuala Lumpur appears to be the area where floodplain occupants have the highest educational achievements. 51.8 per cent of its respondents have at least secondary education.

N.4.9 Household Income

The average household monthly income of all respondents approximates $917[1] (Table N.20) but this figure is misleading as significant income disparities exist between regions, states, ethnic groups, urban and rural areas, and other parameters are not uncommon. The difference between the average monthly incomes of an East Coast floodplain occupant ($550) and the West Coast counterpart ($1,353) is about $803. The latter earns more than twice the monthly income of the former. In terms of the four sample areas, respondents from Kuala Lumpur

[1] All figures are at 1993 prices (during time of survey) unless otherwise specified.

have the highest monthly income while respondents from Pekan have the lowest. It should be noted that Pekan has the highest percentage (19.3 per cent) of respondents with monthly household incomes of less than $175. Households earning less than this income are classified by Sulaiman Alias (1989) as living below the 'Hard-core' poverty line. According to the Deputy Prime Minister Mr. Ghaffar Baba, households with incomes less than $350 are considered poor (Utusan Malaysia 20.6.89). It has also been identified elsewhere that the East Coast states have high rates of poverty between 15.0 to 40.0 per cent, Kelantan being the poorest (International Law Book Services 1991 p235). In the current survey, 25.2 per cent of households were identified as poor. Those living on marginal incomes (between $350 and $499) are also substantial, totalling 15.2 per cent. As a comparison, the average household income for Peninsular Malaysia is about $1,254 per month in 1990 (Government of Malaysia 1991a p38), or approximately $1,378 at 1993 prices.

During and immediately after the colonial period, wide income disparities existed among the various ethnic groups. The British encouraged the more industrious Chinese to work the mines and get involved with commercial activities but preferred the Malays to go into government service. Indians were mostly encouraged to work in rubber estates and the public services such as the building of roads and railways. As a result, the Chinese were economically most advanced, followed by the Indians. The Malays were the least advanced as the majority still remained in the rural areas as farmers and fishermen. Income disparities became wider as the Chinese moved further and further ahead of the other two ethnic groups. When this trend continued and even worsened after the colonial period, it culminated in jealousies and discontent resulting in the racial riots of 13 May 1969. Since then, the New Economic Policy (NEP) incorporated a policy of 'positive discrimination' whereby Malays were given special preferences (in the economic and education spheres) to enable them to catch up with the Chinese and the Indians. Successive governments have since then adhered to the NEP and even today, although the NEP has lapsed in 1990, post-1990 policies regarding income distribution remained similar to that of the NEP. Although the Malays have improved their economic status, they are still behind the Chinese.

In the current survey, the average incomes of the Chinese, Indians and Malays were $1,418, $1,320 and $625 respectively. The average monthly income of the Chinese is more than double that of the Malays. About 35.2 per cent of Malays had monthly incomes below $350 and were therefore poor. Corresponding figures for the Chinese and Indians were 16.8 per cent and 6.7 per cent respectively. On the other hand, only 16.1 per cent of Malays had monthly incomes above $1,000 as compared to 45.5 per cent of Chinese and 45.0 per cent of Indians. The chi-square test gives an observed significance level of 0.0000 which suggests that ethnic group and income are not independent. It indicates that there are significant differences between the incomes of the various ethnic groups. Urban respondents also tend to have higher average monthly income ($1,247) than their rural counterparts ($529). For instance, 41.7 per cent of urban respondents had incomes above $1,000 as compared to 9.8 per cent of rural respondents. On the other hand, poverty was high among the latter (49.2 per cent) but much lower in the former (15.7 per cent). The chi-square value of 0.0000 indicates that there are *significant differences between the incomes of urban and rural folks.* Different household types also show considerable differences in incomes. Naturally, commercial households have the highest average monthly income of $2,193. This was followed by residential households with a figure of $850. Farming and fishing households had much lower average monthly incomes with figures of $346 and $325 respectively. This is not surprising as farmers and fishermen generally belong to the lowest income strata of Malaysian society. The chi-square value of .0000[2] also indicates significant differences between the incomes of the various household types.

N.4.10 Family size

Family or household size has a significant effect on many aspects of flooding on the household. For instance, a large family involves a greater risk, especially if the bulk of the family members are children. Furthermore, large families need more transport during evacuation. However, if the majority are adults, then it would facilitate the moving of damageable items from the house.In the current research, the average family size ranged from 6 to 8 persons. Floodplain occupants in Pulau Pinang appear to have the largest family size of 8. This is possibly due to the shortage of land and expensive housing on the island, forcing the poor to live together as extended families. West Coast respondents have an average family size of 7 as compared to a figure of 6 for East Coast respondents. In general, 57.4 per cent of respondents have family sizes of 6 or less. With the exception of commercial households which sometimes include workers who are relatives, thereby increasing the size of the household, there is no apparent difference between the average family size of the different household types.

N.5 Frequency and magnitude of flooding

Naturally, the frequency and magnitude of flooding varies over space and time. While flooding in the East Coast is generally of greater magnitude (more severe) and of longer duration (caused by monsoon storms during the Northeast Monsoon Season), flooding in the West Coast is currently of shorter duration but more frequent (caused by year round convectional storms). The chi-square test result of .0000 indicates that there are significant differences in flood frequency between properties on the East and West Coasts. Similarly, the a test result of .0000 also indicated that there are significant differences in flood frequency between the four sample areas. There are more properties in Pulau Pinang which flood more than once a year than elsewhere. When respondents were asked about the number of times their property had been flooded in the last ten years, a significant number (49.0 per cent) reported a frequency of ten in ten years (Table N.21). In fact, many of the more severely flooded areas such as Rawang Road in Pulau Pinang, Old Klang Road and Kampung Pantai Dalam in Kuala Lumpur, Kota Bharu town in Kelantan and parts of Pekan town are flooded many times a year. For instance, Makcik Mabee's house in Rawang Road is flooded at least 7 times a year (see Appendix H Case 1). Of the four sample areas, there appears to be a large number of properties in Pulau Pinang which are flooded at least once a year. In the Kelantan and Pekan areas, flood frequencies are also high.

The frequency of flooding is higher in the urban areas. The chi-square test gives a value of 0.0259 which indicates that there are significant differences in flood frequency between urban and rural households. For instance, 33.9 per cent of urban properties are flooded more than once a year as compared to 24.5 per cent for rural properties. On the other end of the scale, the percentage of properties experiencing a flood frequency of once in three years or less is almost the same for rural and urban areas, being 36.5 per cent and 36.0 per cent respectively. The higher frequency of flooding for urban areas may be attributed to *intense development* which altered the hydrological regime of such areas, giving rise to higher rates of run-off,

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[2] This result is obtained by excluding those who refused to report their incomes and collapsing some income categories in order to satisfy the chi-square requirement of not having more than 20.0 percent of cells with frequencies less than 5.

lower moisture retention of soils and shorter lag time. All these, among other factors, will bring about higher flood peaks and more frequent flooding.

In the case of flood types, the chi-square test yielded a result of .0000, indicating that there are significant differences in flood frequency between properties affected by river, tidal and combined river-tidal flooding. Properties affected by tidal flooding appear to experience the most frequent flooding. In the current survey, although 67.6 per cent of such properties were reported to be flooded more than once a year, the truth is that these properties experience flooding at the regular interval of twice a month when every 14 days at new and full moon, lunar and solar tidal maxima coincide to produce spring tides. In the case of properties only affected by river flooding, especially those located on upstream stretches of rivers, 29.9 per cent reported experiencing a flooding frequency of more than once a year. On the other hand, 42.3 per cent of properties affected solely by river floods experience a flood frequency of less than once in three years. However, properties which are affected by both river and tidal flooding do not appear to have a high flood frequency. Only 22.2 per cent are flooded more than once a year. This could be due to the respondents' denial of 'normal' flooding during spring tides which they probably consider as 'high waters' rather than as 'floods'.

In terms of type of establishment, a greater number of commercial (39.6 per cent) and residential households (33.0 per cent) were flooded more than once a year than other establishments. Only 19.5 per cent of fishing and 17.9 per cent of farming households experienced this level of flood frequency. This could be due to the fact that farming and fishing households, mostly located in the rural areas experience fewer flash floods caused by localised thunderstorms as compared to commercial and residential households which are mostly located in the urban areas. The chi-square test gave a value of 0.0016, indicating that significant differences in flood frequency exist between different types of households.

As to be expected, there are more houses with stilts (52.7 per cent) which are flooded at least once a year than those without (43.7 per cent). Houses with higher stilts (2 metres or more) also tend to be flooded more frequently. This is not surprising as the owners have probably specifically built them to as a form of adaptation to the severe flooding in the area. A chi-square value of 0.0000 indicates that significant differences in flood frequency exist between houses with stilts and those without stilts. The test also showed that there are significant differences in flood frequency between houses with high stilts (2 m or more) and those with low stilts (0.5 m or less).

Flood magnitude may be indicated by a number of parameters, of which a principal one is flood depth. Respondents were asked about the flood depth during the worst flood experienced while living in their current properties. Flood depth reported varies between 0.3 m to more than 3 m. The majority of properties (70.1 per cent) generally experience flood depths of less than 1.8 m but there are a significant number of properties (13.2 per cent) with flood depths of more than 3 m (Table N.22). This indicates a substantial risk to life for those living in them. In terms of sample areas, the two East Coast areas appear to suffer the greatest flood depths. For instance, the greatest average flood depth of 2 m was reported by respondents from Pekan. This was followed by a figure of 1.9 m at the Kelantan area. By contrast, the two West Coast areas of Kuala Lumpur and Pulau Pinang had average flood depths of 1.7 m and 1.1 m respectively. It should also be noted that the East Coast areas have a larger number of properties experiencing greater flood depths. For instance, the proportion of properties experiencing flood depths of 2.4 m or more in Pekan and Kelantan are 39.4 per cent and 27.3 per cent respectively. The corresponding figures for Kuala Lumpur and Pulau Pinang are 16.0 per cent and 2.3 per cent respectively. chi-square test values of .0000 and .0000 indicate the existence of significant differences in flood depths between coasts as well as between sample areas respectively.

Flood duration may also be an indicator of flood magnitude. In Peninsular Malaysia, the existence of different types of floods and their combinations have given rise to a great variation in flood duration. Generally, floods can last between less than an hour (in the case of flash floods) to more than a month (in the case of monsoon floods). In the two West Coast areas where most of the floods are flashy in nature, flood duration tends to be short. For instance, 92.9 per cent of respondents in Pulau Pinang reported that the worst flood lasted less than 24 hours (Table N.23). In Kuala Lumpur, the corresponding figure was 40.5 per cent. On the other hand, only 10.3 per cent and 4.6 per cent of households in the Kelantan and Pekan areas were flooded for that duration. A great majority of respondents from the East Coast areas reported durations between a week to 30 days. This is not surprising as East Coast areas are usually inundated by monsoon floods during the Northeast Monsoon Season from November to March. Thus, in some of the low-lying areas, the flood water subsides at a very slow rate. In many instances, the water may actually rise again due to another spell of flooding caused by heavy monsoon rains. The chi-square test yielded a value of .0000, indicating that significant differences in flood duration exist between coasts as well as between sample areas.

Flood duration is also significantly different between urban and rural areas. In the former, the high frequency of flash floods invariably gives rise to short flood durations. On the other hand, areas are seldom subject to flash floods because of the nature of the land surface. The chi-square test result of .0000 indicated that there are significant differences in flood duration between urban and rural areas. In areas subject to tidal flooding, the duration is usually short. In fact, 80.6 per cent of households subject to tidal floods indicated that the duration of flooding was less than 24 hours. This is obvious as the effect of high tides come and go within a day. The duration of river floods, on the other hand, varies from a few hours to a few weeks. A combination of tidal and river floods appears to increase flood duration. This is because flood waters are prevented from flowing sea-wards by incoming tides which also increase the depth of flooding. The chi-square test generated a value of 0.0000 indicating the existence of significant differences in flood duration between different flood types.

The magnitude of a flood event can also be evaluated in terms of total actual damage caused by the flood (Table N.24). In the current survey the total reported flood damage of the worst flood and the most recent flood was surveyed. During the worst flood, the average total damage suffered for all areas was $1,837. The greatest loss was in the highly built up area of Kuala Lumpur where the average total damage was $2,753. The lowest damage was found in the Kelantan area (For a more detailed discussion on flood damage see Appendix K). The chi-square test value of .0000 indicated that significant differences in actual flood damage exist between coasts and sample areas, damages being higher in the West Coast than in the East Coast. For the most recent flood, however, similar average damages were reported by all sample areas except Pulau Pinang which had the highest figure (Table N.25). This is due largely to the June 1991 flood which inundated most of Georgetown and other parts of Pulau Pinang. On the other hand, the most recent floods experienced by respondents in the other sample areas were of lesser magnitude. On the whole, actual damages were much lower compared to that suffered in the worst flood. An average damage of $1,393 was reported by 234 respondents who suffered damages during the most recent flood.

Although the average flood damage is not excessively high for both the most recent and worst flood, the amount of damage must be seen in the perspective of the household's income. It is when the amount of household flood damage is compared to the household's monthly income that the damage severity becomes clear. In the most recent flood, 49.2 per cent of poor households with reported monthly incomes less than $350 suffered flood damages more than their monthly incomes. For the low income households earning monthly incomes less than $500, 39.0 per cent suffered flood damages greater than their monthly incomes (Table N.26). However, a comparatively lower percentage of the higher income households appear to suffer flood losses in excess of their monthly incomes. For example, 35.7 per cent of households with monthly incomes between $500 and $999 suffered damages greater than their monthly incomes. The corresponding percentages for households within the income groups $1,000-1,999 and $2,000-2,999 are 27.3 per cent and 30.0 per cent respectively. Only 10.5 per cent of households with monthly incomes of $3,000 or more suffered damages more than their monthly incomes.

The amount of flood damage is more severe when the figures for the worst flood experienced is cross-tabulated against the monthly incomes of households (Table N.27). For example, a total of 100 (77.5 per cent) out of 129 poor households with reported monthly incomes less than $350 suffered flood damages greater than their monthly incomes. A total of 136 households (68.7 per cent) out of 198 with monthly incomes less than $500 reported flood damages more than their monthly incomes. In comparison, only 16.1 per cent of wealthier households with monthly incomes in excess of $3,000 suffered flood losses greater than their monthly incomes. Thus, while flood losses are insignificant for the higher income households, they are very significant for lower income households. This is especially so for those living close to or below the poverty level. Flood losses can, therefore, increase flood hazard vulnerability amongst the poor and reinforce poverty.

Table N.1: Distribution of households in sample areas within the East and West Coasts

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
East Coast	-	192	-	140	332 (53.7)
West Coast	172	-	114	-	286 (46.3)
Total	172 (27.8)	192 (31.1)	114 (18.4)	140 (22.7)	618 (100.0)

(Figures in parentheses are percentages)

Table N.2: Distribution of rural and urban households by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Urban	113 (65.7)	55 (28.6)	114 (100.0)	54 (38.6)	336 (54.4)
Rural	59 (34.3)	137 (71.4)	0 (0.0)	86 (61.4)	282 (45.6)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.3: Households affected by various flood types by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
River flood	110 (64.0)	131 (68.2)	114 (100.0)	23 (16.4)	378 (61.2)
Tidal & River flood	36 (20.9)	50 (26.0)	0 (0.0)	117 (83.6)	203 (32.8)
Tidal flood	26 (15.1)	11 (5.7)	0 (0.0)	0 (0.0)	37 (6.0)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.4: Type of establishment of households by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Residential	121 (70.4)	72 (37.5)	90 (79.0)	53 (37.8)	336 (54.4)
Farming	18 (10.5)	79 (41.1)	0 (0.0)	48 (34.3)	145 (23.5)
Commercial	32 (18.6)	30 (15.6)	24 (21.1)	10 (7.1)	96 (15.5)
Fishing	1 (0.6)	11 (5.7)	0 (0.0)	29 (20.7)	41 (6.6)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.5: Distribution of building type by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Detached	92 (53.5)	134 (69.8)	59 (51.8)	114 (81.4)	399 (64.5)
Semi-detached	33 (19.2)	45 (23.4)	13 (11.4)	21 (15.0)	112 (18.1)
Terraced	41 (23.8)	12 (6.3)	36 (31.6)	5 (3.6)	94 (15.2)
Flat	5 (3.5)	1 (0.5)	6 (5.3)	0 (0.0)	13 (2.1)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.6: Building material of outer wall of buildings by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Brick & concrete	69 (40.1)	12 (6.3)	23 (20.2)	21 (15.0)	125 (20.2)
Brick & wood	59 (34.3)	61 (31.8)	34 (29.8)	22 (15.7)	176 (28.5)
Wood	43 (25.0)	119 (62.0)	57 (50.0)	97 (69.3)	316 (51.1)
Others	1 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.7: Age of buildings (Years) by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
> 100	0 (0.0)	2 (1.0)	0 (0.0)	0 (0.0)	2 (0.3)
81 - 100	0 (0.0)	5 (2.6)	0 (0.0)	0 (0.0)	5 (0.8)
61 - 80	9 (5.2)	11 (5.7)	3 (2.6)	7 (5.0)	30 (4.9)
41 - 60	44 (25.6)	30 (15.6)	14 (12.3)	20 (14.3)	108 (17.5)
21 - 40	60 (34.9)	56 (29.2)	60 (52.6)	48 (34.3)	224 (36.2)
11 - 20	37 (21.5)	53 (27.6)	31 (27.2)	39 (27.9)	160 (25.9)
< 11	7 (12.8)	35 (18.2)	6 (5.3)	26 (18.6)	89 (14.4)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)
Average	30.4	29.0	28.1	26.0	28.7

(Figures in parentheses are percentages)

Table N.8: Floor type of buildings by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Marble	18 (10.5)	4 (2.1)	1 (0.9)	12 (8.6)	35 (5.7)
Carpet	8 (4.7)	1 (0.5)	0 (0.0)	1 (0.7)	10 (1.6)
Cement	106 (61.6)	52 (27.1)	74 (64.9)	10 (7.1)	242 (39.4)
Wood	31 (18.0)	134 (69.8)	36 (31.6)	117 (83.6)	318 (51.5)
Vinyl	8 (4.7)	1 (0.5)	0 (0.0)	0 (0.0)	9 (1.5)
Others	1 (0.6)	0 (0.0)	3 (2.6)	0 (0.0)	4 (0.7
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.9: Number of buildings with and without stilts by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
With stilts	58 (33.7)	153 (79.7)	32 (28.1)	121 (86.4)	364 (58.9)
Without stilts	114 (66.3)	39 (20.3)	82 (71.9)	19 (13.6)	254 (41.1)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.10: Distribution of stilt heights of surveyed buildings by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
< 1 metre	28 (48.2)	50 (32.7)	21 (65.7)	36 (29.7)	135 (37.1)
1 - 2 metres	19 (32.8)	51 (33.3)	10 (31.2)	59 (48.8)	139 (38.2)
> 2 metres	11 (19.0)	52 (34.0)	1 (3.1)	26 (21.5)	90 (24.7)
Total	58 (100.0)	153 (100.0)	32 (100.0)	121 (100.0)	364 (100.0)
Average	1.2 metres	1.5 metres	0.9 metres	1.4 metres	1.3 metres

(Figures in parentheses are percentages)

Table N.11: Stilt type of houses surveyed by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Concrete	6 (10.3)	75 (49.0)	4 (12.5)	26 (21.5)	111 (30.5)
Wood & concrete	32 (55.2)	30 (19.6)	10 (31.2)	26 (21.5)	98 (26.9)
Wood	20 (34.5)	47 (30.7)	15 (46.9)	68 (56.3)	150 (41.2)
Bamboo	0 (0.0)	1 (0.7)	3 (9.4)	1 (0.7)	5 (1.4)
Total	58 (100.0)	153 (100.0)	32 (100.0)	121 (100.0)	364 (100.0)

(Figures in parentheses are percentages)

Table N.12: Property ownership amongst respondents by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Owner	130 (75.6)	157 (81.8)	85 (74.6)	120 (85.7)	492 (79.6)
Tenant	42 (24.4)	35 (18.2)	29 (25.4)	20 (14.3)	126 (20.4)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.13: Number of years respondents have occupied the current property by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
> 61 years	1 (0.6)	7 (3.7)	0 (0.0)	5 (3.5)	13 (2.0)
51-60 years	6 (3.5)	12 (6.3)	0 (0.0)	5 (3.5)	23 (3.7)
41-50 years	17 (9.9)	12 (6.3)	2 (1.8)	7 (5.0)	38 (6.1)
31-40 years	22 (12.8)	23 (12.0)	14 (12.3)	17 (12.1)	76 (12.3)
21-30 years	31 (18.0)	40 (20.8)	35 (30.7)	23 (16.4)	129 (20.9)
11-20 years	50 (29.1)	55 (28.6)	37 (32.5)	40 (28.6)	182 (29.4)
1-10 years	45 (26.2)	43 (22.4)	26 (22.8)	43 (30.7)	157 (25.4)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)
Average	23 years & 4 months	24 years & 10 months	19 years & 11 months	22 years & 6 months	22 years & 11 months

(Figures in parentheses are percentages)

Table N.14: Gender of respondents by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Male	125 (72.7)	142 (74.0)	85 (74.6)	105 (75.0)	457 (73.9)
Female	47 (27.3)	50 (26.0)	29 (25.4)	35 (25.0)	161 (26.1)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.15: Age of respondents by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
> 60 years	17 (9.9)	27 (14.1)	10 (8.8)	14 (10.0)	68 (11.0)
51-60 years	24 (14.0)	31 (16.1)	16 (14.0)	30 (21.4)	101 (16.3)
41-50 years	46 (26.7)	46 (24.0)	32 (28.1)	30 (21.4)	154 (24.9)
31-40 years	46 (26.7)	44 (22.9)	30 (26.3)	40 (28.6)	160 (25.9)
21-30 years	24 (14.0)	33 (17.2)	22 (19.3)	18 (12.9)	97 (15.7)
< 21 years	15 (8.7)	11 (5.7)	4 (3.5)	8 (5.7)	38 (6.1)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.00	618 (100.00
Average age	40 years & 4 months	42 years	40 years & 7 months	42 years	41 years & 4 months

(Figures in parentheses are percentages)

Table N.16: Ethnicity of respondents by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Malay	76 (44.2)	123 (64.1)	52 (45.6)	98 (70.0)	349 (56.5)
Chinese	55 (32.0)	65 (33.9)	34 (29.8)	22 (15.7)	176 (28.5)
Indian	41 (23.8)	2 (1.0)	27 (23.7)	0 (0.0)	70 (11.3)
Others	0 (0.0)	2 (1.0)	1 (0.9)	20 (14.3)	23 (3.7)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.17: Respondents' religion by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Muslim	82 (47.7)	128 (66.7)	54 (47.4)	116 (86.1)	380 (61.5)
Christian	10 (5.8)	10 (5.2)	10 (8.8)	10 (9.1)	40 (6.5)
Buddhist	35 (20.3)	36 (18.8)	21 (18.4)	11 (23.3)	103 (16.7)
Hindu	26 (15.1)	2 (1.0)	19 (16.7)	0 (0.0)	47 (7.6)
Taoist	14 (8.1)	16 (8.3)	9 (7.9)	3 (2.1)	42 (6.8)
Others	5 (2.9)	0 (0.0)	1 (0.9)	0 (0.0)	6 (1.0)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.18: Respondents' occupation by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Professional	9 (5.2)	1 (0.5)	5 (4.4)	4 (2.9)	19 (3.1)
Farmer	15 (8.7)	50 (26.0)	0 (0.0)	30 (21.4)	95 (15.4)
Artisan	24 (14.0)	15 (7.8)	19 (16.7)	14 (10.0)	72 (11.2)
Trade & Business	39 (22.7)	50 (26.0)	40 (35.1)	20 (14.3)	149 (24.1)
Labourer	11 (6.4)	20 (10.4)	9 (7.9)	6 (4.3)	46 (7.4)
Education	10 (5.8)	8 (4.2)	7 (6.1)	4 (2.9)	29 (4.7)
Manufacture	25 (14.5)	2 (1.0)	12 (10.5)	2 (1.4)	41 (6.6)
Fisherman	2 (1.2)	11 (5.7)	0 (0.0)	29 (20.7)	42 (6.8)
Unemployed	2 (1.2)	1 (0.5)	0 (0.0)	5 (3.6)	8 (1.3)
Retired	11 (6.4)	12 (6.3)	5 (4.4)	6 (4.3)	34 (5.5)
Housewife	16 (9.3)	13 (6.8)	13 (11.4)	18 (12.9)	60 (9.7)
Student	8 (4.7)	9 (4.7)	4 (3.5)	2 (1.4)	23 (3.7)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.19: Respondents' educational achievement by sample area

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Degree	6 (3.5)	2 (1.0)	2 (1.8)	1 (0.7)	11 (1.8)
Diploma	5 (2.9)	8 (4.2)	7 (6.1)	0 (0.0)	20 (3.2)
Upper Secondary	36 (20.9)	22 (11.5)	22 (19.3)	16 (11.4)	96 (15.5)
Lower Secondary	35 (20.3)	51 (26.6)	28 (24.6)	28 (20.0)	142 (23.0)
Completed Primary	40 (23.3)	35 (18.2)	37 (32.5)	28 (20.0)	140 (22.7)
Few years Primary	36 (20.9)	34 (17.7)	17 (14.9)	42 (30.0)	129 (20.9)
Illiterate	14 (8.1)	40 (20.8)	1 (0.9)	25 (17.9)	80 (12.9)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.20: Reported monthly household incomes by sample area (in Malaysian Ringgits)

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
10,000 & above	2 (1.2)	0 (0.0)	1 (0.9)	0 (0.0)	3 (0.5)
5,000-9,999	1 (0.6)	1 (0.5)	4 (3.5)	0 (0.0)	6 (1.0)
4,000-4,999	1 (0.6)	0 (0.0)	2 (1.8)	0 (0.0)	3 (0.5)
3,000-3,999	3 (1.7)	1 (0.5)	4 (3.5)	0 (0.0)	8 (1.3)
2,500-2,999	3 (1.7)	1 (0.5)	3 (2.6)	0 (0.0)	7 (1.1)
2,000-2,499	7 (4.1)	3 (1.6)	6 (5.3)	1 (0.7)	17 (2.8)
1,500-1,999	12 (7.0)	9 (4.7)	13 (11.4)	1 (0.7)	35 (5.7)
1,000-1,499	28 (16.3)	14 (7.3)	28 (24.6)	7 (5.0)	77 (12.5)
750-999	27 (15.7)	10 (5.2)	26 (22.8)	12 (8.6)	75 (12.1)
500-749	35 (20.3)	31 (16.1)	12 (10.5)	19 (13.6)	97 (15.7)
350-499	27 (15.7)	35 (18.2)	5 (4.4)	27 (19.3)	94 (15.2)
175-349	7 (4.1)	52 (27.1)	2 (1.8)	41 (29.3)	102 (16.5)
< 175	5 (2.9)	22 (11.5)	0 (0.0)	27 (19.3)	54 (8.7)
Refused	14 (8.1)	13 (6.8)	8 (7.0)	5 (3.6)	40 (6.5)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)
Average monthly income	1,151	629	1,655	445	917

(Figures in parentheses are percentages)

Table N.21: Reported flood frequency of properties in four sample areas in Peninsular Malaysia

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Don't know	4 (2.3)	1 (0.5)	1 (0.9)	1 (0.7)	7 (1.1)
0 in 10	0 (0.0)	6 (3.1)	21 (18.4)	3 (2.1)	30 (4.9)
1 in 10	38 (22.1)	33 (17.2)	8 (7.0)	18 (12.9)	97 (15.7)
2 in 10	14 (8.1)	16 (8.3)	13 (11.4)	16 (11.4)	59 (9.5)
3 in 10	6 (3.5)	16 (8.3)	10 (8.8)	6 (4.3)	38 (6.1)
4 in 10	4 (2.3)	6 (3.1)	3 (2.6)	1 (0.7)	14 (2.3)
5 in 10	2 (1.2)	6 (3.1)	3 (2.6)	4 (2.9)	15 (2.4)
6 in 10	0 (0.0)	6 (3.1)	0 (0.0)	6 (4.3)	12 (1.9)
7 in 10	3 (1.7)	9 (4.7)	5 (4.4)	7 (5.0)	24 (3.9)
8 in 10	2 (1.2)	7 (3.6)	2 (1.8)	5 (3.6)	16 (2.6)
9 in 10	0 (0.0)	1 (0.5)	0 (0.0)	2 (1.4)	3 (0.5)
10 in 10	9 (5.2)	47 (24.5)	14 (12.3)	50 (35.7)	120 (19.4)
11 + in 10	90 (52.3)	38 (19.8)	34 (29.8)	21 (15.0)	183 (29.6)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.22: Reported flood depth of properties in four sample areas during the worst flood

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Don't know	2 (1.3)	3 (1.6)	0 (0.0)	1 (0.8)	6 (1.0)
0.3 m	27 (15.7)	4 (2.2)	2 (1.9)	4 (3.0)	37 (6.2)
0.6 m	20 (11.6)	13 (7.1)	5 (4.7)	8 (6.1)	46 (7.8)
0.9 m	34 (19.8)	15 (8.2)	11 (10.4)	25 (18.9)	85 (14.3)
1.2 m	23 (13.4)	27 (14.8)	15 (14.2)	13 (9.8)	78 (13.2)
1.5 m	41 (23.8)	24 (13.1)	21 (19.8)	10 (7.6)	96 (16.2)
1.8 m	15 (8.7)	28 (15.3)	11 (10.4)	14 (10.6)	68 (11.5)
2.1 m	6 (3.5)	19 (10.4)	24 (22.6)	5 (3.8)	54 (9.1)
2.4 m	3 (1.7)	6 (3.3)	9 (8.5)	9 (6.8)	27 (4.6)
2.7 m	0 (0.0)	7 (3.8)	3 (2.8)	8 (6.1)	18 (3.0)
3.0 m	0 (0.0)	9 (4.9)	1 (0.9)	13 (9.8)	23 (3.9)
> 3.0 m	1 (0.6)	28 (15.3)	4 (3.8)	22 (16.7)	55 (9.3)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.23: Reported flood duration in four sample areas during the worst flood

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
Don't know	4 (2.3)	8 (4.4)	1 (0.9)	5 (3.8)	18 (3.0)
1-2 hours	7 (4.1)	0 (0.0)	3 (2.8)	1 (0.8)	11 (1.9)
3-5 hours	17 (9.9)	3 (1.6)	20 (18.9)	0 (0.0)	40 (6.7)
6-12 hours	99 (57.6)	3 (1.6)	11 (10.4)	0 (0.0)	60 (10.1)
13-24 hours	15 (8.7)	5 (2.7)	8 (7.5)	0 (0.0)	113 (19.1)
1-2 days	24 (14.0)	23 (12.6)	11 (10.4)	2 (1.5)	60 (10.1)
3-4 days	5 (2.9)	64 (35.0)	7 (6.6)	10 (7.6)	86 (14.5)
5-7 days	1 (0.6)	54 (29.5)	16 (15.1)	30 (22.7)	101 (17.0)
8-10 days	0 (0.0)	14 (7.7)	27 (25.5)	16 (12.1)	57 (9.6)
11-30 days	0 (0.0)	9 (4.9)	2 (1.9)	63 (47.7)	74 (12.5)
> 30 days	0 (0.0)	0 (0.0)	0 (0.0)	5 (3.8)	5 (0.8)
Total	172 (100.0)	192 (100.0)	114 (100.0)	140 (100.0)	618 (100.0)

(Figures in parentheses are percentages)

Table N.24: Total reported actual flood damage suffered by households in four sample areas during the worst flood (In Malaysian Ringgits)

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
1-100	12 (8.0)	12 (7.9)	1 (1.2)	2 (2.0)	27 (5.6)
101-200	9 (6.0)	21 (13.9)	2 (2.4)	2 (2.0)	34 (7.0)
201-300	13 (8.7)	11 (7.3)	1 (1.2)	4 (4.0)	29 (6.0)
301-400	9 (6.0)	9 (6.0)	3 (3.6)	3 (3.0)	24 (4.9)
401-500	6 (4.0)	16 (10.6)	8 (9.5)	6 (6.0)	36 (7.4)
501-1,000	30 (20.0)	32 (21.2)	15 (17.9)	21 (21.0)	98 (20.2)
1,001-2,000	24 (16.0)	26 (17.2)	17 (20.2)	25 (25.0)	92 (19.0)
2,001-3,000	16 (10.7)	9 (6.0)	10 (11.9)	22 (22.0)	57 (11.8)
3,001-4,000	13 (8.7)	6 (4.0)	9 (10.7)	8 (8.0)	36 (7.4)
4,001-5,000	10 (6.7)	2 (1.3)	7 (8.3)	1 (1.0)	20 (4.1)
5,001-7,500	2 (1.3)	5 (3.3)	7 (8.3)	5 (5.0)	19 (3.9)
7,501-10,000	2 (1.3)	1 (0.7)	2 (2.4)	0 (0.0)	5 (1.0)
10,001-15,000	4 (2.7)	0 (0.0)	0 (0.0)	1 (1.0)	5 (1.0)
15,001-20,000	0 (0.0)	1 (0.7)	0 (0.0)	0 (0.0)	1 (0.2)
> 20,000	0 (0.0)	0 (0.0)	2 (2.4)	0 (0.0)	2 (0.4)
Total	150 (100.0)	151 (100.0)	84 (100.0)	100 (100.0)	485 (100.0)
Average	$1,867	$1,257	$2,753	$1,897	$1,837

(Figures in parentheses are percentages)

Table N.25: Total actual flood damage reported by households in four sample areas during the most recent flood (In Malaysian Ringgits)

	Pulau Pinang	Kelantan	Kuala Lumpur	Pekan	Total
1-100	8 (7.2)	18 (24.7)	1 (5.0)	2 (6.7)	29 (12.4)
101-200	9 (8.1)	16 (21.9)	2 (10.0)	7 (23.3)	34 (14.5)
201-300	16 (14.4)	6 (8.2)	4 (20.0)	0 (0.0)	26 (11.1)
301-400	9 (8.1)	5 (6.8)	1 (5.0)	3 (10.0)	18 (7.7)
401-500	4 (3.6)	3 (4.1)	3 (15.0)	3 (10.0)	13 (5.6)
501-1,000	14 (12.6)	12 (16.4)	2 (10.0)	4 (13.3)	18 (7.7)
1,001-2,000	15 (13.5)	6 (8.2)	5 (25.0)	6 (20.0)	32 (13.7)
2,001-3,000	13 (11.7)	1 (1.4)	0 (0.0)	4 (13.3)	18 (7.7)
3,001-4,000	11 (9.9)	2 (2.7)	1 (5.0)	0 (0.0)	14 (6.0)
4,001-5,000	6 (5.4)	2 (2.7)	0 (0.0)	0 (0.0)	8 (3.4)
5,001-7,500	2 (1.8)	0 (0.0)	1 (5.0)	1 (3.3)	4 (1.7)
7,501-10,000	3 (2.7)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.3)
10,001-15,000	1 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.4)
15,001-20,000	0 (0.0)	2 (2.7)	0 (0.0)	0 (0.00)	2 (0.9)
Total	111 (100.0)	73 (100.0)	20 (100.0)	30 (100.0)	234 (100.0)
Average	$1,738	$1,088	$1,090	$1,060	$1,393

(Figures in parentheses are percentages)

Table N.26: Cross tabulation of estimated total flood damage suffered during the most recent flood (C1275) by reported average monthly income of respondent (C1359)

	C1275 <$500	$500-999	$1,000-1,999	$2,000-2,999	$3,000+	TOTAL
C1359 <$500	61 (54.5)	18 (56.2)	14 (46.7)	4 (23.5)	3 (10.4)	100 (45.5)
$500-999	29 (25.9)	7 (21.9)	6 (20.0)	5 (29.4)	9 (31.0)	56 (25.5)
$1,000-1,999	18 (16.0)	6 (18.8)	8 (26.7)	5 (29.4)	7 (24.1)	44 (20.0)
$2,000-2,999	3 (2.7)	1 (3.1)	2 (6.6)	1 (5.9)	3 (10.4)	10 (4.5)
$3,000+	1 (0.9)	0 (0.0)	0 (0.0)	2 (11.8)	7 (24.1)	10 (4.5)
TOTAL	112	32	30	17	29	220
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

(Figures in parentheses are percentages)

Table N.27: Cross tabulation of estimated total flood damage suffered during the worst flood (C1032) by reported average monthly income of respondent (C1359)

	C1032 <$500	$500-999	$1,000-1,999	$2,000-2,999	$3,000+	TOTAL
C1359 <$500	62 (45.3)	52 (55.3)	43 (48.3)	20 (35.7)	21 (25.0)	198 (43.0)
$500-999	44 (32.1)	21 (22.3)	21 (23.6)	16 (28.6)	23 (27.4)	125 (27.2)
$1,000-1,999	27 (19.7)	17 (18.1)	21 (23.6)	13 (23.2)	18 (21.4)	96 (20.9)
$2,000-2,999	4 (2.9)	4 (4.3)	1 (1.1)	3 (5.4)	9 (10.7)	21 (4.6)
$3,000+	0 (0.0)	0 (0.0)	3 (3.4)	4 (7.1)	13 (15.5)	20 (4.3)
TOTAL	137	94	89	56	84	460
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

(Figures in parentheses are percentages)

APPENDIX O: PUBLISHED PAPER

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16. Flood hazard mitigation in peninsular Malaysia

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INTRODUCTION

Peninsular Malaysia lies approximately between latitudes 1°N to 7°N and longitudes 100°E to 105°E. It covers an area of 131,795 km². The climate is equatorial with uniformly high temperatures all year round (mean monthly temperature is about 26.7°C). The mean annual rainfall is high and varies from about 150 cm to more than 350 cm. In general, rainfall decreases as one moves from the east coast to the west coast. In the east coast, the mean annual rainfall can be as high as 400 cm. The bulk of this rainfall is deposited during the Northeast Monsoon Season from November to March (Ref.1). In the west coast, most of the rains fall during the two short inter-monsoon seasons in April and October where convectional rain storms occur frequently.

The topography of the peninsula is characterised by various fold mountain ranges in a predominantly northwest to southeast direction. A central mountain range, the Titiwangsa Range, forms the backbone of the peninsula. It is flanked by seven other mountain ranges. Average height ranges from about 1500 meters to 2000 meters. Near the coasts and rivers are flat alluvial plains with heights no more than one or two meters above sea level. It is in these lowland plains that most of the population is concentrated.

The heavy all year round rainfall in the Malaysian peninsula has given rise to a more than 100 river systems, though there is no single large river dominating the drainage pattern. The Titiwangsa Range is the main divide which determines whether a river flows eastward into the South China Sea or westwards into the Straits of Malacca. Due to the nature of its topography, the river courses are relatively short. The gradients of the rivers in the upper courses are steep, some drop about 1200 meters in less than 24 km before they emerge on to the coastal flood plains. In the lower stretches and the flood plains, the river gradients are gentle and flat, giving rise to widespread meandering patterns. Although the year-round precipitation ensures perennial stream flow and no river course is ever completely dry at any one time of the year, the torrential and localised nature of the rainfall causes rapid fluctuations in the river discharge. Consequently, the occurrence of floods is not uncommon (Ref.2).

THE FLOOD HAZARD

Historical floods

Although its neighbours Indonesia and the Philippines experience earthquakes, volcano eruptions and typhoons, Malaysians are fortunate in that there are no such natural hazards in the peninsula. The flood hazard is the only significant natural hazard that affects Peninsular Malaysia. While localised flooding occurs almost every year in one place or another, widespread and extensive floods in the peninsula have occurred regularly with a frequency of once in a few years. In the distance past, major floods in 1886, 1926, 1931, 1947, 1954, 1957, 1965, 1967 and 1971 have caused extensive damage to public utilities, crops and properties, disruption of social and economic activities, breakdown of essential services, outbreak of diseases and even the loss of lives. More recently, extensive floods have also occurred in 1973, 1979, 1983, 1986, 1988 and 1991. In the highly developed urban areas, flash floods are also a common hazard during torrential convection storms which occur all year round (Ref.3). The major flood-prone areas in the peninsula are mostly located in the coastal plains and riverine areas (Fig.1).

Flood damage

The costs incurred by the Malaysian Government in rescue and flood relief operations, as well as rehabilitation of public works and utilities is substantial. It is estimated that the damages for an annual flood, a 10-year flood and a 40-year flood are M$3.0 million, M$18.0 million and M$44.0 million respectively. Very little is remembered of the 1886 flood except that it was called the "Storm Forest Flood". This was because the flood, accompanied by gale force winds, destroyed several hundred sq.km of lowlying forests in the Kelantan River and Besut River flood plains. The 1926 flood was perhaps the biggest flood in living memory. During this flood most parts of the peninsula were affected. The 1971 flood was so serious that it was declared a national disaster by the Prime Minister. During this flood, most parts of the peninsula suffered damages on an unprecedented scale. The federal capital of Kuala Lumpur (M$34 million flood damage) and the Pahang River Basin (M$30 million flood damage) were the two worst hit areas. The 1967 flood was also a big one causing the most damage in the Kelantan, Terengganu and Perak river basins. The damage estimated for the Kelantan River Basin alone was M$78 million. More recently, the 1986 flood in Kelantan and Terengganu caused an unprecedented postponement of the public school examinations (Ref.4). A summary of flood damage for selected floods is shown in Table 1.

Types of flooding

In general, flood types in Peninsular Malaysia may be classified into the following categories:

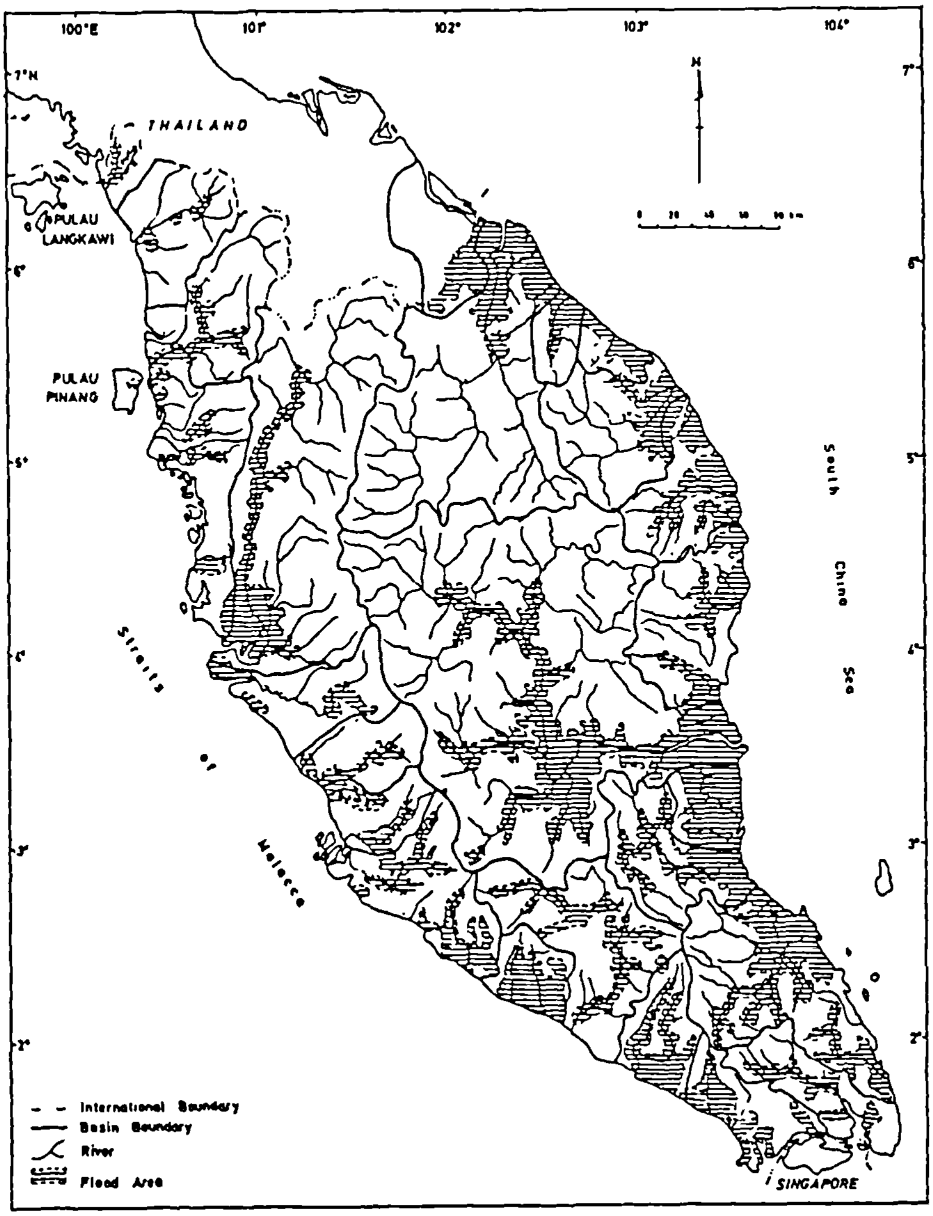

Fig. 1. Flood-prone areas in peninsular Malaysia (after Japan International Cooperation Agency, 1982)

Table 1 : Flood Damage for Selected Floods in Peninsular Malaysia

Flood Event (Year)	(Place)	Damage (M$million)	Death	Persons Evacuated
1967	Kelantan R. Basin	78.4	38	320,000
1967	Perak R. Basin	60.8	0	280,000
1967	Terengganu R. Basin	15.8	17	78,000
1971	Pahang R. Basin	37.7	24	153,000
1971	Kuala Lumpur	34.3	24	NA
1984	Batu Pahat R. Basin	18.0	0	8,400
1988	Kelantan R. Basin	29.8	19	36,800
1991	Peninsular Malaysia	NA	11	NA
1992	Peninsular Malaysia	NA	12	NA

(Source: Drainage and Irrigation Department Malaysia and Malaysian National Security Council)

(1) Overbank flooding due to overbank flow as a result of insufficient channel capacity;

(2) Tidal flooding which is the combined result of high tides and back water effect; and

(3) Inland flooding due to poor drainage.

FLOOD MITIGATION

Pre-1971

In Peninsular Malaysia, the Government is the main body responsible for flood mitigation. However, prior to the 1971 flood, flood mitigation was not even mentioned as a function of any agency/department. Although the Drainage and Irrigation Department (DID) was entrusted with the responsibility of providing drainage and irrigation, the responsibility of flood mitigation was not part of its function (even though flood mitigation is closely related to drainage). Because of its role in drainage and river conservancy, the DID employed mostly structural measures of flood control. This was inevitable because the DID was an agency entirely dominated by engineers.

The Malaysian Meteorological Service (MMS) was responsible for forecasting the weather, but it was never entrusted with the responsibility of forecasting floods. Because of this, all it did was to forecast heavy rain spells. In the case of the Public Works Department (PWD), flood mitigation measures would mean building stronger and higher bridges, building roads higher than the normal flood mark, or even building alternative roads which avoided the flood plains. Only the Police Department, the Welfare Department and the Ministry of

Health could be said to employ some form of non-structural flood mitigation measures. The Police Department was involved with the dissemination of flood warnings and rescue operations. The Welfare Department only moved in during and after a flood, mostly to provide relief. And the Health Department's concern was really the control of diseases rather than flood mitigation of any sort. As a result, flood mitigation measures prior to 1971 were almost entirely structural.

Whenever flooding occurred, each and every Government agency was responsible for the protection, rehabilitation, relief and carrying out of all other works related to the flood hazard within its jurisdiction. There was no central controlling body to monitor and coordinate the work. As a result, there was little team work between the Government agencies and often there was overlapping of responsibilities between two or more agencies, frequently resulting in confusion.

Post-1971

Despite its disastrous nature, the 1971 flood was really a blessing in disguise. It exposed the inadequacies of flood protection measures and the non-existence of a central body to plan, manage and monitor all aspects of flood mitigation in the peninsula. Furthermore, it showed that rapid development of flood plain regions since independence had substantially increased flood damage potential, particularly in urban areas. As a result, the Government embarked on a new approach towards comprehensive flood mitigation in the peninsula. A Water Resources Committee, headed by the Prime Minister's Department was set up to tackle the flood problems and other water related issues. Based on the recommendations of this committee, the flood mitigation strategies introduced were:

(1) The establishment of flood hazard institutions:

(a) The Permanent Commission on Flood Control:

This commission was established by a decision of the Malaysian Cabinet on 21st December 1971. Its immediate task was to study short-term measures to prevent the occurrence of floods and long-term measures for flood mitigation. As such, its main objective is to prevent floods from occurring. However, in the event of unavoidable flooding, its objective is to minimize flood damage in terms of loss of life and property. It is headed by the Minister of Agriculture with the DID serving as the secretariat.

(b) The National Disaster Relief and Preparedness Committee (NDRPC):

The NDRPC is headed by the Minister of Information and has its secretariat at the National Security Council in the Prime Minister's Department. The committee is responsible for coordinating all relief operations before, during and after a flood. The NDRPC is theoretically responsible for all the operations at the national, state, district, mukim and village levels (Fig.2). In reality, however, it coordinates operations at the national level and overlooks operations at the state

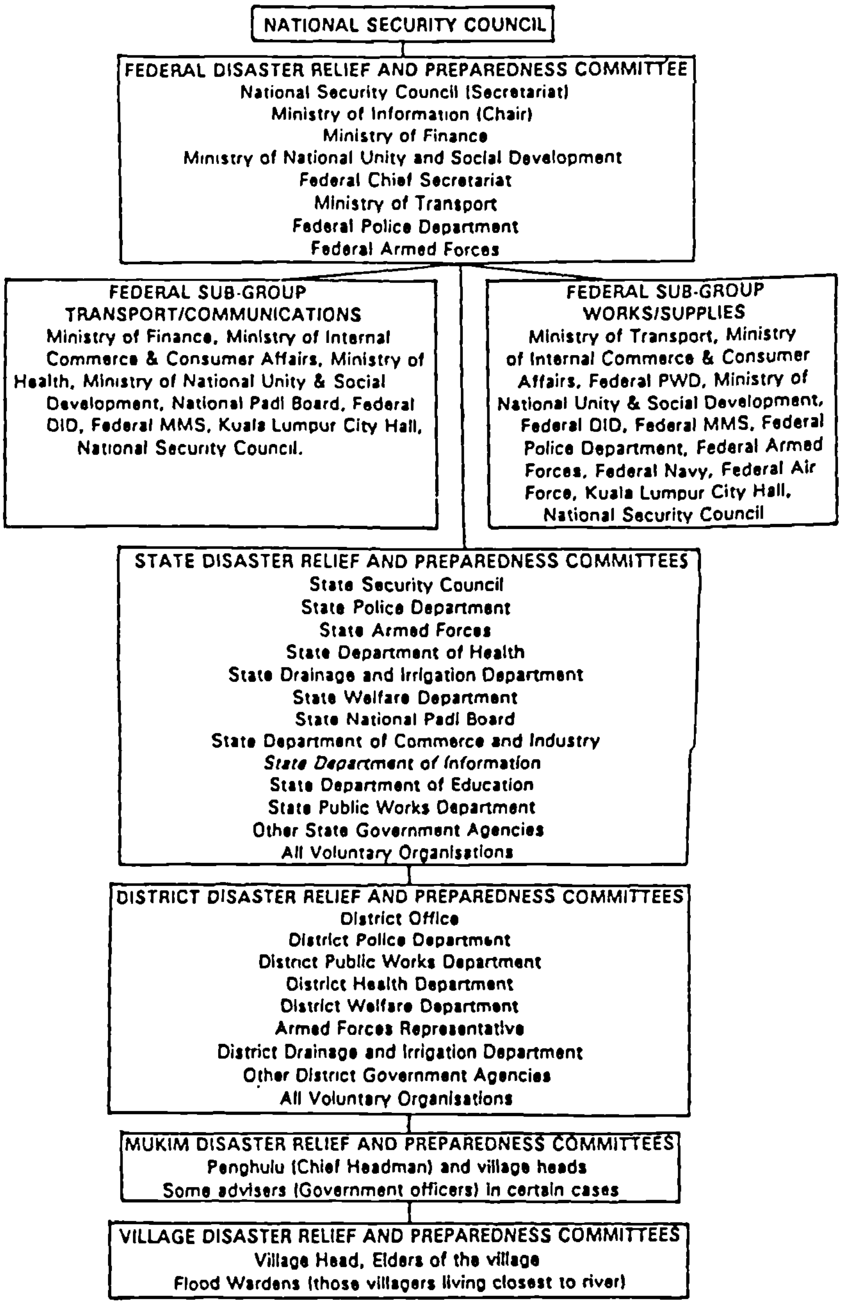

Fig. 2. Structure of the Federal Disaster Relief and Preparedness Committee in peninsular Malaysia (source: National Security Council of Malaysia)

level. Much of the operations in each state is left to be run by the respective state authorities. The main task of the NDRPC is to ensure that assistance and aid are provided to flood victims in an orderly and effective manner from the national level downwards.

(c) The Drainage and Irrigation Department:

Although river conservancy has always been a traditional function of the DID, flood mitigation was only officially designated as an additional function in 1972 (Ref.5). With these two functions going hand in hand, the DID is now responsible for the maintenance of river channels free from foreign obstructions, preventing silt from reaching the river, de-silting of river beds, diversion of river channels for mining and other purposes, river improvement works, river training and the construction and maintenance of other engineering structures for flood protection.

(2) The establishment of a flood disaster relief machinery:

This machinery was set up to ensure that all assistance and aid can be brought to the flood victims as quickly and as efficiently as possible. It is coordinated by the National Security Council (NSC) and the NDRPC is a part of this machinery (Fig.3). When the MMS and DID has forecasted an impending flood, the machinery will be activated. However, the full machinery will only be activated when floods occur in several states or when a state experiences a massive flood which cannot be adequately handled by the state authorities. In the event of massive and widespread flooding seriously crippling several states, then the NSC will advise the Honourable Prime Minister who may then decide whether or not to declare the flooding as a national disaster.

At the federal level, the NSC is the secretariat for the Flood Disaster Relief and Preparedness Committee (FDRPC) which comprises members from the Ministries of Information, Finance, National Unity and Social development, Transport, the Federal Chief Secretary, the Federal Police Department and the Federal Armed Forces. The FDRPC coordinates all relief operations from the Malaysian Control Centre in Kuala Lumpur. At the state level, there are 11 State Flood Relief and Preparedness Committees (SFRPC) for Peninsular Malaysia. Each state is given funds by the Federal Government every year to enable it to run its own flood relief operations. At the district level, there are several district committees under each state, depending on the number of districts in a particular state. Each district will have its own District Flood Relief and Preparedness Committees (DFRPC) which receives funds and directives from the SFRPC. Below the district level, there are several Mukim[1] Flood Relief and Preparedness Committees (MFRPC), again depending on the number of mukims in each

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[1] A "mukim" is an administrative unit just below that of a district. A district is made up of several mukims. Likewise, a mukim is made of several villages, the latter being the smallest administrative unit.

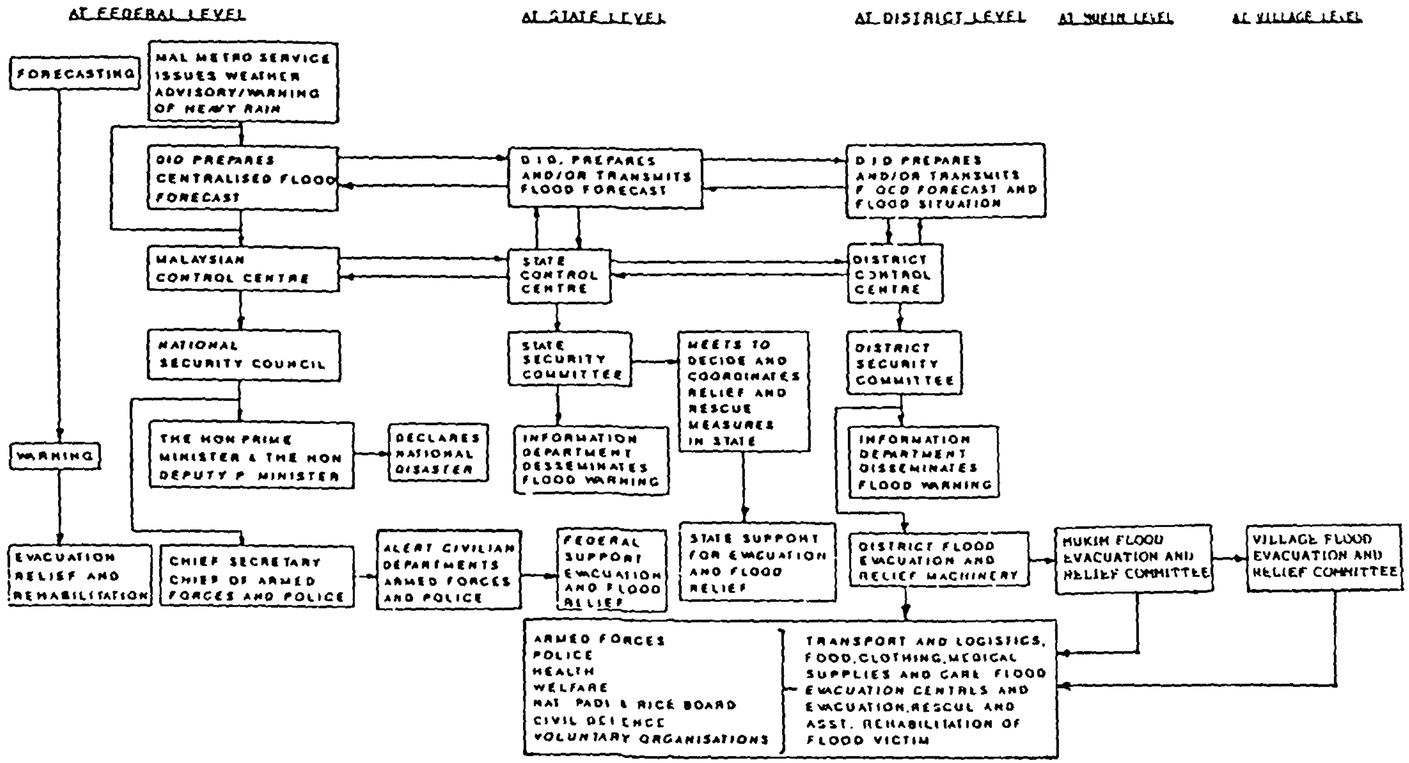

Fig. 3. The Flood Disaster Relief Control Machinery in peninsular Malaysia (source: National Security Council of Malaysia)

district. Each MFRPC is headed by a penghulu.[2] Finally, there are many Village Flood Relief and Preparedness Committees (VFRPC) under each mukim. Each VFRPC is headed by a ketua kampung[3].

(3) The collection of hydrological and flood data:

The importance of accurate hydrological data in the planning, design and implementation of flood mitigation methods cannot be underestimated, especially with reference to flood forecasting. Accurate hydrological data forms the basis of all aspects of water resource planning and management. Recognising this importance, the Malaysian Government has invested substantially in a programme to expand, update and improve the hydrological network in the peninsula. New procedures on data collection and processing are also constantly being introduced. The hydrological data bank is now fully computerised. This affords easy access and manipulation of the data which is now used for a variety of purposes. In terms of flood mitigation, it includes flood forecasting, flood analysis, design flood estimation and flood mapping. Other areas using hydrological data are water resource planning and management, drainage and irrigation, domestic water supply, generation of hydro-electricity, agriculture, land use planning, recreation and related researches.

(4) The carrying out of river basin studies, water resource studies and specific flood mitigation studies:

Since the 1971 flood, the Government has commissioned a number of river basin studies where major floods have occurred. These studies were aimed at understanding the hydrological characteristics of these basins, particularly with reference to its flood characteristics. By doing so, master plans for general water resource management (including flood mitigation) could then be prepared for each basin. To date, river basin studies which have been completed in the peninsula include the Kelang River Basin Study for Kuala Lumpur (1974), the Pahang River Basin Study (1974), the Kelantan River Basin Study (1978), the Terengganu River Basin Study (1978), the Batu Pahat River Basin Study (1984), the Johor River Basin Study (1985), the Golok River Basin Study (1985), the Besut River Basin Study (1990), the Krian River Basin Study (1990), and the Pinang River Basin Study (1991).

With the help of the Japan International Cooperation Agency, the Government also carried out a National Water Resources Study which was completed in 1982. Under this study, flood studies in other river basins not previously studied were carried out. The results of this study is now being used to develop a comprehensive and coordinated water resources development programme for the peninsula. One of the salient

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[2] A "penghulu" is the Malay term for headman to a group of villages. However, in some areas the term is used synonymously with "ketua kampung" or village head.

[3] "Ketua kampung" is literally translated as village head, "ketua" being head and "kampung" being village.

features of this study is the formulation of a 20-year plan for flood mitigation works in 31 river basins and many other flood prone areas in the peninsula. Under this plan, a total of 573 km of river channel will be improved, 10 multi-purpose dams will be constructed, 74 km of flood bypass will be constructed, 11 ring bunds around urban centres will be built, and 10,000 people in flood-prone areas will be resettled. The cost of the entire plan is about M$2 billion. When fully completed it will provide protection to some 1.6 million people in the peninsula.

Specific flood mitigation studies have also been conducted to alleviate flooding in strategically important flood-prone areas in the peninsula. To date, the studies completed include the Cukai Flood Mitigation Study (1978), the Lower Perak Flood Mitigation Study (1980), and the Kangar Flood Mitigation Study (1983). Other studies aimed at flood alleviation include the Sewerage and Drainage Master Plan Studies for urban centres in the peninsula. These include studies for Kuala Lumpur, Kelang and Port Kelang, Butterworth and Bukit Mertajam, Alor Setar, Johor Bahru, Seremban, Melaka, Kuantan, Kota Bharu, Kuala Terengganu, Port Dickson and Muar. The completed master plans are of immense value to Government authorities and the private sector in terms of future land use planning in the areas concerned.

(5) The implementation of flood mitigation projects:

From past flood experiences, the Government is aware that providing costly structural (engineering) protection to the masses is not the only means of reducing the flood hazard. To date, flood mitigation strategies adopted represent a multi-disciplinary approach. All strategies can be grouped under two types of flood mitigation measures: structural measures and non-structural measures. The former represents all those measures involving the construction of engineering structures while the latter includes those measures which are non-engineering in nature. Non-structural measures are usually used in areas where structural measures are either too costly or are not economically justified. In most cases, non-structural measures are used to supplement structural measures.

(a) Structural measures:

(i) Improvement of river channels:

This is one of the oldest methods and is still the most widely used in the peninsula. Perennial silting of river channels have raised the river bed in relation to the flood plain. In many instances, the flood plain level may be below that of the river level, flooding being avoided by a raised natural levee (in some cases by an artificial embankment) on both sides of the river. As a result, the river bed has to be constantly dredged to deepen it. The rate of dredging should at least keep up with the rate of silting. River channels can also be improved by canalization. This latter method reduces the volume of discharge in the main river channel. As a result, flood flows can be contained.

(ii) Construction of levees or embankments:

Usually, this method is applied hand in hand with dredging and canalization. The sand and silt from the river bed is dumped on both sides of the river bank resulting in the formation of two raised river banks or levees. In urban areas, however, dumping of sand and silt is not feasible because of the constricted nature of river banks in such areas. Consequently, concrete embankments may have to be built.

(iii) Construction of flood diversion channels:

This method involves the construction of artificial channels along the main river channel to divert part of the discharge during flood flows. Diversion channels are built just before the main river enters a flood-prone area. This method is only feasible if the intended diversion channel is not too long. Otherwise, the cost of construction may be too high.

(iv) Construction of flood retention ponds:

A flood retention pond can be easily built in an area where there is a depression. Otherwise, it may prove too costly. In many cases, old mining depressions are ideal locations for the building of such ponds. Artificial retention ponds are like huge reservoirs. A small channel with a gate joins the retention pond to the main river. The gate can be opened during flood flows.

(v) Use of natural and man-made ponds for flood attenuation:

Man-made ponds such as disused mining pools and park lakes are ideal for flood storage. If flood flows can be diverted into such ponds and lakes, then flood peaks can be attenuated. The outflow from such ponds can also be regulated. This method has great potential for large urban areas such as Kuala Lumpur and Georgetown.

(vi) Construction of polders/ring bunds/tidal bunds:

This method requires the construction of a raised ring bund surrounding the area that is being protected. It is only applied in localised areas with a high damage potential and where it is not economically feasible to carry out an overall basin protection. A good example of poldering is the flood mitigation scheme of Pekan on the estuary of the Pahang River. Tidal bunds are built in coastal and estuarine areas to control tidal flooding. They are effective on the west coast of the peninsula which is sheltered from both the monsoons.

(vii) Construction of multi-purpose dams:

The building of dams solely for the purpose of flood mitigation in Peninsular Malaysia is seldom if not never economically justified. As a result, multi-purpose dams have been built. These dams serve a variety of functions. They generate hydro-electricity, provide water supply, regulate flood peak flows and can be used for recreational purposes. Some examples are Kenyir Dam in Terengganu, Chenderoh and Temengor Dams in Perak, Pedu and Muda Dams in Kedah, Klang

Gates and Langat Dams in Selangor, and Machap and Sembrong Dams in Johor.

(b) Non-structural measures:

(i) Legislation:

In Peninsular Malaysia legislation with respect to flood mitigation is rather vague. There are a few laws touching on flood mitigation but only in an indirect manner. For instance, the Waters Enactment 1920 provides that "the entire property in and control of all rivers in any State is and shall be vested solely in the Ruler of such State". With respect to flood mitigation, the Waters Enactment contains provisions for:

(1) prohibiting the construction of buildings and structures in the vicinity of a river or a declared flood channel "except in a case which may be expressly authorised by any other law" or "except in accordance with the terms of a written permission by the State Authority";

(2) allowing the Ruler of a State, if he is satisfied that the bed of any river is insufficient to contain flood waters, to declare by notification in the Gazette that the abutting land of such river shall be a flood channel and be subjected to the State's control;

(3) empowering the State ruler to put a stop to all illegal acts and interference with the bank of a river; and

(4) the issuance of a written authorization from the Ruler-in-Council for the construction of any revetment or erection of any building or structure within 15.2 meters of a river bank or within any flood channel.

The National Land Code also contains some provisions for dealing with flood control. In Malaysia, land is the property of the State. As such, the State authority has the right to reserve land for any public purpose by notification in the Gazette. Since flood mitigation is considered a public purpose, certain flood-prone areas may be set aside as "reserved land" and thereby not to be developed.

The Mining Enactment 1929, the Drainage Works Ordinance 1954 and the Land Conservation Act 1960 also touches on flood mitigation indirectly. All have provisions for the regulation of land and river use. However, the term flood mitigation is not spelled out clearly and the approval of land and river use is clearly left to the discretion of the authorities concerned.

(ii) Restriction of development:

This measure is a case of "prevention is better than cure". In areas where the building of flood mitigation structures cannot be economically justified, the planning authority may use this as a measure to avoid rather than control floods. Recently, the information gathered through flood risk analysis and flood mapping in the peninsula (Ref.6) has made it easier for planners to restrict development in crucial flood-prone areas.

(iii) Flood risk analysis:

Expanding urban areas due to increased economic development have resulted in increased runoff, subsequently giving rise to increased flooding. Flood risk analysis is a technique of flood mitigation aimed at monitoring such changes in economic development in relation to flood peaks. Flood risk maps are prepared to help the authorities, particularly planners in the approval of development projects. They also help the public, particularly developers and property buyers, appraise certain properties in flood hazard areas.

(iv) Land use change:

Changing the type of crop can have a drastic effect on the runoff pattern. For instance, by converting padi land into oil palm can substantially increase surface cover and thereby reduce runoff. Another method is to cultivate cover crops such as peanuts or sweet potatoes between rows of rubber or oil palm trees. Other common cover crops planted in between rows of coconut trees are coffee and cocoa. The planting of such cover crops is not only beneficial as a measure of flood control but it also nourishes the soil and provides the farmer with a source of additional income.

(v) Resettlement of population:

As far as the Government is concerned, this measure is only used as a last resort when all flood mitigation measures do not seem to work. This measure is very costly for the Government because alternative land (and houses in many cases) will have to be allocated to each household that is being resettled.

(vi) Flood proofing:

Malaysians are very proud of their cultural heritage. There is a campaign to preserve old Malay palaces and mosques, Chinese shop-houses, Indian temples and old Portuguese, Dutch and British colonial buildings. Where such buildings happen to be located in flood-prone areas, all efforts are channelled to flood proof them. Flood proofing includes the construction of protection works to prevent flood waters from entering the individual buildings. This usually entails the building of a flood wall or a raised bund around the building. However, there are other methods such as raising the floor of the building, building a higher threshold across the doors, and replacing wooden stilts with concrete ones. Many individual property owners in flood-prone areas have also flood proofed their properties.

(vii) Flood insurance:

While insurance has been widely used as a means of flood protection in many countries in the west, particularly the United States and the United Kingdom, it is not well developed in Malaysia. In Malaysia, factory owners can insure the building structure as well as its contents (usually production goods) against flood damage but there is no specific insurance for individual house owners against such damage. Usually, the flood damage clause is incorporated as a sub-clause in the fire policy of the house. In this sub-clause, only the structure of the building is covered. House owners in flood-prone areas can take up special insurance against flood damage to house contents but the premium charged by insurers may be too high for its justification. Because of this limitation, there is great scope for the further development of flood insurance.

(viii) A sound watershed development and management policy:

While it is arguably difficult to control seasonal floods caused by the Monsoons, their severity can nevertheless be reduced. So too are flash floods caused by over-development and deforestation. In order to reduce if not control flooding, the solution lies in a sound watershed development and management policy. To date, less than 60 % of the total area in Peninsula Malaysia is still covered by natural forest. The Government (through the Forestry Department) has a long term plan for reafforestation in the National Forest Policy adopted in 1977. In this policy, development programmes in forested watershed are closely monitored. The country's forestry programme is also based on one of sustainable utilization rather than all-out exploitation.

(ix) The implementation of flood forecasting and warning systems:

Before the 1971 flood, flood forecasting methods were only used in a few of the major river systems. These were rather crude forms of forecasting based on simple stage-correlation whereby the river level at an upstream station is used to predict the level at a downstream station, usually located in a populated flood-prone area. Warning is then issued when a certain preset critical level at the upstream is exceeded. For instance, the river level at Kuala Krai is used to predict the river level at Kota Bharu. All these are done manually.

Since the 1971 flood, flood forecasting and warning systems have gradually been improved. The Government has pumped in a lot of funds to upgrade the hydrological infra-structure which supports flood forecasting and warning systems. There are now 42 telemetric rainfall stations, 47 telemetric river level stations, 119 manual rain gauges, 56 flood notice boards, 23 automatic sirens, 83 fixed VHF radio stations, and 63 mobile VHF radio stations throughout the peninsula. As a result of these new infra-structure, real-time flood forecasting has been made available for the Kelantan, Pahang, Perak, Klang, Batu Pahat, Muar and Johor rivers.

(x) Educating the masses:

Through its many agencies, the Government has set up various information programmes to educate the masses on how to response when a flood occurs. For instance, the Police tell the people when to move. The Welfare Department instructs the people where to go for shelter, food, clothing and other needs. There are also leaflets and posters distributed to people in flood-prone areas telling them what to do during a flood. The ketua kampung and his village committee are briefed by Government officers well in advance of any flood. The committee in turn briefs the village folks.

CONCLUSION

As a developing country, Malaysia's flood mitigation policy can be described as commendable, particularly since 1971. Since the First Malaysia Plan (1971-1975), the country's expenditure on flood mitigation has increased substantially. From a mere M$14 million in this plan, it has shot up to a massive M$700 million for the Sixth Malaysia Plan (1991-1995), a 50 fold increase over a 20 year period. Even after discounting inflation, the real increase is still substantial. With the many structural and non-structural measures being implemented for flood control and for flood relief, the country is moving in the right direction towards a comprehensive programme of flood mitigation. Yet, there are many areas which can still be improved.

While the total number of telemetric stations for rainfall and river flow in the peninsula seems large enough, a closer scrutiny would expose the inadequacies of uneven distribution. Most telemetric stations are located in populated areas while the sparsely populated areas, especially highland watershed areas, do not have enough telemetric stations. The MMS and DID have also not utilised remotely sensed rainfall (radar[4] and satellite sensed rainfall) as an input in its forecasting models. This could have been deliberately overlooked because of the high cost involved but real-time flood forecasting cannot be detached from the usage of such techniques.

Although the DID is officially recognised as the authority on all aspects of river use and management, it has no legislative authority or enforcement powers when it comes to rivers. All such powers are still vested with the respective State Authorities or the District Offices. Given the present status quo, the States will never relinquish their stranglehold on their rivers. At the moment, all the DID can do is to give advice to the State authorities when a certain project concerning a river is proposed. There is even no provision that a State authority needs to seek advice from DID's expertise. Even if it does, it may not adhere to DID's recommendations. So the only way to be certain that flood mitigation is given due consideration in any project is to make the DID one of the authorities that approve or reject the proposals. This would be difficult as legislation would have to be passed by the Federal Parliament.

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[4] The MMS has used radar to predict rainfall in a qualitative way. The current radar can tell the meteorologist whether a certain region has rain or not. What it cannot do, however, is to tell the meteorologist how much rain the region is getting. Given the importance of time in the issuance of flood warning, this quantitative sensing of rain is vital to flood forecasting as it increases the lead time (time between the issuance of a warning and time when a flood occurs).

While there are some laws governing the regulation of river use and have some bearing on flood mitigation, they are not sufficiently clear or forceful enough as measures of flood mitigation. These laws were formulated mainly for the purpose of regulating and managing single sectoral water use. New laws must be passed to enable the authorities to have direct control in all aspects of water use which may affect flooding. This include laws that specify clearly water rights administration, water resource development, flood plain management and all aspects of flood mitigation. Alternatively, the existing laws should be updated with a stronger emphasis on flood mitigation.

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