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## **Sharing the burden of adapting to increasing flood risk**

Original Research Article

### **Sharing the burden of adapting to increasing flood risk: who pays for flood insurance and flood risk management investment in the United Kingdom**

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**Abstract** Many countries are exploring alternative strategies to counter rising flood risk as there is concern at the extra burden that such increasing risk will bring. The aim of this paper is to explore the nature of these burdens, and outline responses in the United Kingdom where both the government and the private flood insurers have new policies and proposals. Our method is to collate the extensive existing authoritative data and information - from government and the insurance industry - about the risks that are being experienced and the related policy responses. The results show that these seek to concentrate somewhat more the financial burden of, respectively, flood risk management costs and insurance provisions on to those who are at risk and away from the general taxpayer and those who pay insurance premiums. Other countries may well learn from these developments. The pre-existing cross-subsidies are being reduced and, in this way, it is hoped that extra resources for risk management investment will be forthcoming (from local contributions from at-risk communities) and flood insurance will remain affordable, available and commercially viable. A

key conclusion here is that it appears that any increase in flood frequency and severity in the UK appears likely to affect the financially deprived communities to a greater extent than others, not least because they are less likely to insure. Government arrangements to prioritise their contribution to risk reducing towards these financially deprived communities is a sign that this regressive effect of floods is real and serious, and those arrangements are to be welcomed.

**Keywords** Flooding; adaptation; insurance; investment; policy; United Kingdom.

# **Sharing the burden of adapting to increasing flood risk: who pays for flood insurance and flood risk management investment in the United Kingdom**

## **1. Introduction**

The burden of flooding appears to be increasing for many communities around the world (Intergovernmental Panel on Climate Change 2013) owing to socio-economic change, demographic movements, and climate change leading to sea level rise and possible increased fluvial and pluvial flooding. Not only is the probability of flooding likely to be increasing, but so also are its consequences for those affected (Samuels and Gouldby 2009), although important uncertainties surround both determinants of risk.

The aim of this paper is, first, to address the question of who carries the burden of this increasing risk and, secondly, how this fits alongside the burden already felt by communities affected by current flood frequencies and severities. Rather than collect new data ourselves the method of analysis whereby we address this question is to collate the extensive existing authoritative data and information - from government and the insurance industry - about the risks that are being experienced and the related policy responses. The policies that we are principally concerned with here are, first, the provision in the United Kingdom (UK) of flood risk management (FRM) investment and the reduction of risk that this provides through structural and non-structural interventions, and, secondly, the recompense of those suffering damage or incurring other losses from flooding, either through flood insurance (as in the UK) or through compensation schemes, the latter largely provided by governments elsewhere. Our investigation's objective here is to identify possible changes in the burden of flooding going forward, and their likely consequences.

In this respect we examine insurance and related measures because they can be an effective mechanism assisting adaptation to increasing levels of risk, if policy and practice are sufficiently geared in that direction, but the burdens are not evenly distributed (Priest et al. 2005; O’Neil and O’Neil 2012). The same applies to flood risk management investment: this should reduce risk or hold it at current levels, but it is generally expensive and because it is usually funded from general taxation it has substantial distributional consequences: the burden again falls unevenly (Penning-Rowse and Pardoe 2012a, 2014).

The analysis reported here is concerned mainly with United Kingdom, but this is to be seen within an international context whereby many countries are seeking to adapt to increased flood risk by implementing new or adapted insurance regimes (Lamond and Penning-Rowse 2014). Moreover we believe that some of the lessons learnt here have more general applicability, not least in other European countries seeking under the EU Floods Directive 2007 (EU Directive 2007/60/EC) to develop their flood risk management plans or contemplating flood insurance as a risk managing measure. Set within that context of international experience in this field, we build on previous research that quantifies the costs and benefits of flood risk management for different communities (Penning-Rowse and Pardoe 2012b), analyses of related justice issues (Johnson et al. 2007; Walker and Burningham 2011), and research on the consequences of moving towards risk-reflective pricing of insurance products (Pardoe et al. 2013; Penning-Rowse and Pardoe 2014). We also draw here on the latest flood risk assessments for the UK and two new policy initiatives which could crucially affect the burden that the risk of flooding imposes upon different groups within our society.

## **2. Ideas and international experience**

### **2.1 The nature of flood-related burdens**

Table 1 outlines the four key burdens that we see as being associated with flooding: (A) flood risk; (B) financing flood risk management; (C) the recovery from flooding and (D) the responsibility for flood risk management decision-making. The Table also gives examples of how these different burdens may be spread across society along burden-sharing spectra; examples from different countries will sit somewhere along these ranges. In this respect we see that such burdens may be financial as well as non-financial (e.g. the burden of the responsibility for decision-making) and are distributed amongst different groups in society, almost invariably unequally. The financial burdens include how flood risk management measures are funded and how communities and individuals recover the losses they incur in floods.

*Table 1 should be inserted about here.*

Elaborating on Table 1 (A), at the most basic level the flood risk itself is a key burden associated with flooding, the effects of which are not evenly distributed across society: some communities and properties are more at risk than others or are more vulnerable (Walker and Burningham 2011; O'Neil and O'Neil 2012). Individuals who experience flooding have the heaviest emotional and often financial burden to carry, including the strains of losing their possessions and the cost of the restoration of their properties following a flood (Tapsell et al. 2009). However, the emotional and financial burden of individuals can be positively or negatively impacted by how floods are managed and whether recovery is assisted and assisted quickly. Equally, those living in areas of flood risk may continue to live with the uncertainty about whether a flood will occur in the future and, for some, the associated anxiety may continue to be a burden long after a flood has been experienced (Tapsell et al. 2002).

Other groups also shoulder some of the loads associated with flood risk. These groups may include general taxpayers who contribute financially to flood risk management (Table 1, B) and recovery activities (Table 1, C) via paying their taxes, whether or not they benefit from the expenditure that results. There are also insurers and their shareholders who risk financial losses if claims exceed income, but who also assist those who experience flooding in supporting flood-event recovery with compensatory payouts (Table 1, C). Taxpayers also have this burden if recovery is funded by the state through some form of solidarity scheme whereby all assist the few.

Although flood risk is fundamentally associated by the physical environment (e.g. the proximity of a property to a river or coast) the burden of that risk may be redistributed by flood risk management decisions and measures, and communities with similar flood risks may be treated differently and protected to different standards. The extremes here might be a concentration on defending against flooding, with low residual risk, whereas another approach might focus on assisting communities to be resilient and live with rather than reduce their flood risk. Both situations are illustrated with one example. In The Netherlands the traditional stance within the dike rings is a universally high protection standard (of 1:10,000 years), and although there is movement towards multi-layered safety and hence other more adaptable forms of flood risk management this overarching standard of protection remains. However, for those at risk from flooding outside of these areas there is not the same norm: here there is more of an emphasis on living with the flood risk.

Therefore another burden relates to managing flood risk and making decisions about how this risk might be mitigated: taking ownership of the flooding issue and incurring the burden of making flood risk management decisions that inherently advantage some groups over others (Table 1, D). This can also be seen as a spectrum, ranging between centralised decision-making whereby flood risk management decisions are taken by nationally based trained flood professionals (as in the UK in the

past (Penning-Rowse et al. 1986)), to decisions being the sole responsibility of the at-risk property owner (now being encouraged by the UK government (Department for Environment, Food and Rural Affairs (Defra) 2004)). Politicians are also responsible for decisions about funding and the powers given to the institutions involved in flood risk management. Local flood managers have the burden of delivering flood mitigation measures on the ground. In reality, responsibility for decision-making will lie somewhere along the ranges shown in Table 1 (D), and where this involves some degree of stakeholder engagement this spreads somewhat the decision-making burden.

The spreading of the different flood burdens listed in Table 1 across society varies internationally. Some countries mainly place the decision making burden on the individual at-risk property owners or communities, whereas others have high levels of government intervention. Differences here generally depend on how flood risk management is conceived, organised and funded: the overall philosophy, or approach. In this respect the different flood mitigation measures can be divided into those approaches which prioritise preventative strategies and those which are more reactive. These two approaches bring both different burdens and involve different people and communities carrying those burdens, as discussed below.

## 2.2 Preventative action: the burden of financing flood risk management investment

There are various ways to fund flood risk management and spread its cost burden. On one end of the spectrum is a national-solidarity philosophy, in which flood burdens are carried on a relatively equal basis by the majority, irrespective of risk exposure (Table 1, B). A clear example of this is the use of public money (gathered via some degree of general taxation) to manage flood risk. At the opposite end is the situation whereby flood risk management is funded by those who directly benefit from its measures and the consequent reduction in the flood risk they enjoy as individuals or communities. The arguments here are related to notions of fairness and equity, as where funding is



driven by a philosophy of solidarity decisions will inevitably need to be about where limited resources are deployed and some communities will benefit and others will not (see HR Wallingford 2008; Johnson et al. 2007; Penning-Rowsell and Pardoe 2012a, b).

In addition to who is paying for flood risk management activities, there is also the issue of the instruments by which these funds are raised. For instance, it is possible to have two quite different systems based on the principle of beneficiary pays. One approach would be to expect individual households to purchase their own property-level flood risk management solutions, whereas another may collect a levy or tax from only those at risk from flooding and use these resources to fund only the reduction of their flood risk.

Different approaches and decisions may be purely a question of financing and because they are considered to be the most efficient way of undertaking flood risk management, or there may be a more ideological element in placing the burden of funding on those directly benefiting from flood risk management and away from the predominantly risk-free general taxpayer.

The majority of systems in Europe have some government intervention in flood risk management financing; it is the degree to which this is spread towards those at risk of flooding that differs. For instance, Garrelts and Lange (2011) describe the funding for coastal protection schemes in Germany which are primarily 50% funded by the Federal government and 50% by the Länder or at a regional government level. In The Netherlands, there appears to be a great deal of national solidarity in relation to flood risk management and much importance is placed upon maintaining high protection standards of defence for all, which in turn requires relatively large amounts of expenditure. Van Rijswick and Havekes (2012) report that approximately €6.5 billion annually are spend on water management; however only a small part of this is generated at a national level via general taxation.

The majority of funding for Netherland flood risk management in is gathered by the local Water Boards and specific water management taxes (specifically through Inhabitant, Property and Pollution taxes) payable by those residing within the control and area of each board. Yet standards are nationally determined.

In Austria, the burden of flood risk management is spread more widely. Austrian flood risk management authorities have reported annual average spending of €220 million on flood protection (Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft 2006). The sum comes 60% from Federal (national) funds, 23% from contributions by the federal provinces and the final 17% from stakeholder contributions, although the actual contributions made by the Federal and regional government and by private companies and communities may vary for different schemes. So although taxpayers are making a large contribution, the stakeholders who benefit directly from flood risk management measures are also responsible for shouldering a large proportion of flood risk management costs.

There may also be a difference in philosophy between the funding of collective measures (whether this is national, regional or local level funding) and individual flood defence measures. This may be partly a technical decision based upon the potential solutions available or a more preference-led decision based upon the preferred type of flood risk management (protection-based or more resilience oriented). In many European countries there is a movement away from large-scale structural defences towards flood risk management measures which are considered to be more resilient and sustainable (e.g. Defra 2004; Bavarian State Ministry of the Environment 2006; Ministeri van Loudbouw et al. 2006). This move away from major engineering schemes potentially shifts a greater burden for financing flood risk management on to those at risk rather than the general taxpayer.

However, this is not always the case. In England and Wales there have been a number of pilot projects which financially assisted at-risk individuals in implementing property level protection through either a part-contribution or covering the full cost of measures (Harries 2009; Merritt 2012). But this was a small scale initiative, with less than 2,000 properties assisted, such that the overall impact on at-risk properties generally was very limited (Wicks et al. 2012). Property-level measures continue primarily to be funded by private companies or households with the property-owner alone shouldering the burden of financing their own risk mitigation owing to a lack of action or finance from regional or national governments.

### 2.3 Reactive measures: the burdens of compensation or flood insurance

We see reactive approaches to burden sharing as including the financing of post-event recovery. The spectrum in this case (Table 1, C) again varies from a national-solidarity approach where all recovery comes from the State and one in which individuals have to finance their own recovery. Priest (2003) broadly divides recovery from losses into the following types: loss bearing; loss sharing; compensation; and charitable and international aid. These options vary according to the directness of financial input by the individual affected, with loss bearing being the closest and international aid being the furthest from the individual. In some countries there is little formal assistance following flood events and the majority of the loss falls upon individuals and communities (risk-bearing). Table 2 gives international examples of the type of flood insurance and compensation approaches as analysed from a range of different sources (Gaschen et al. 1998; Michel-Kerjan 2001; Fiselier and Oosterberg 2004; Comité Européen des Assurances 2005; Consorcio de Compensacion de Seguros 2008; Porrini and Schwarze 2014). In these examples, the role of the state varies from very little intervention (e.g. UK) to a fully state-implemented insurance scheme (e.g. United States of America) and to recovery mainly implemented by compensation (e.g. Netherlands). In the case of

compensation and government assistance following flooding, society as a whole contributes through taxes. If a commercial market provides insurance then participants provide these payments through their premiums.

*Table 2 should be inserted about here.*

What is of primary concern here is the balance between different levels of individual loss bearing and more structured mechanisms designed to provide financial recompense. Internationally, there is also a difference between those countries which have developed compensation approaches to recovery and those who have employed insurance approaches and the benefits and limitations can vary. The private insurance market is often seen as the most effective and most efficient way in which to provide insurance and recovery from flooding and other natural perils (Botzen and van den Bergh 2008). Insurance provided in this way reduces the burden on governments and the need to provide recompense via taxation because the premiums charged should be sufficient to cover the losses generated. Ideally, this approach also has the advantage that it places the onus for financial recovery on the individual at risk and has the potential to incentivise self-help flood mitigation and less risky behaviour.

However, there are also many international examples of compensation funds to assist in the financial recover of individuals from flooding. It is important to stress the difference between the more formal state compensation schemes (e.g. Austria) which have defined those natural perils which are included, have clear procedures in place and have a formalised mechanism for claiming assistance, and those where emergency legislation *ex-post* is introduced on a case-by-case basis following a disaster (e.g. Germany; Italy). Although in many cases individuals may be compensated in similar ways, expectations of the State may differ considerably and there will be less certainty

about whether victims will receive any financial assistance when the case-by-case approach is adopted.

There is also a difference between those recovery systems which are financed in advance of flooding (or other natural events) (e.g. Austria) and those where funds are collected *ex-post*. The arguments between structural versus ad hoc compensation are complex. Faure (2004) contends that on the one side there is the argument that a structured approach whereby victims are confident that they will get some compensation following flooding sends the wrong signal and is potentially detrimental to the uptake of household financial solutions (i.e. insurance, self-insurance) or preventive measures. However, on the other hand there is an argument that while ad hoc compensation creates “legal uncertainty” (Faure 2004, p. 21) it also has the potential for flexible responses via different terms and conditions and amounts of compensation to be provided after different events which have had different impacts. Establishing an appropriate balance between different burden-sharing arrangements is critical to the effectiveness and fairness of the approach to compensation payments.

### **3. Modern assessments of UK flood risk**

The nature and extent of flood risk will affect the distribution and severity of all the burdens incurred or imposed, and here we turn to the example of flood risk in the United Kingdom, and this issue of fairness and effectiveness that it helps to illustrate. The level of risk may be rising globally, and this is certainly judged to be the case in the UK and that conclusion should be seen as the context to the policy shifts we describe below. Much effort has been devoted to risk assessments here, largely based on the National Flood Risk Assessment (NaFRA; Environment Agency, undated) as updated by the Adaptation Sub-Committee of the Climate Change Committee (established under

the Climate Change Act 2008; HM Government, 2008) and by its Climate Change Risk Assessment (CCRA).

The Adaptation Sub-Committee (2012) has suggested that one in seven properties in the UK (3.6 million homes and businesses) are currently at some risk of flooding although many of these properties are protected to a high standard. The number of properties at "significant risk"<sup>1</sup> (with the flooding return period of less than 75 years) is some 300,000, after accounting for the effect of flood defences, and those at non-significant risk total perhaps 3.2 million. The number of properties at risk from floods with a return period of less than, say, one in 25 years is relatively unknown (at least to the public), which is unfortunate given importance of that regularity of flooding to that particular group of communities.

The Adaptation Sub-Committee has also suggested that risk is rising, owing to two factors. Firstly, there is evidence that floodplain development is continuing, although little of this is against the advice of the Environment Agency. In the future, secondly, with climate change, risk is liable to rise in some quite complex ways. Some properties and households now at non-significant risk could face significant risk and some now off the floodplain could become at risk.

But quantifying future flood risk is not straightforward. Nevertheless the UK's Climate Change Risk Assessment (CCRA) has assessed possible flood frequencies and impacts to the 2080s (Ramsbottom et al. 2012; CCRA 2012), allowing for population growth, and the results forecast very substantial increases in risk: the number of residential properties at a significant likelihood of flooding would rise by the 2050s from 560,000 to c. 1,035,000 (i.e. c. 1.8-fold), and to c. 1.24m by the 2080s. The number of properties within this flood probability band in the most economically deprived areas of the country could rise to between 170,000 and 560,000 (2080s) (currently 70,000; i.e. a c. 5.2-fold

rise). In terms of the CCRA's assessment of future flood losses, these also show large increases, driven by changing GDP levels rather than just climate change. Annual property flood damage would rise circa 2.6-fold by the 2050s and circa 3.5-fold by the 2080s, and annual insurance claims would rise circa 3-fold by the 2080s.

The CCRA assessment also suggested, in line with the *Foresight Future Flooding* findings (Evans et al. 2004), that current levels of investment in flood defences, whilst helping to reduce risks to many thousands of properties, are unlikely to maintain current levels of risk, given the strengths of the two risk-enhancing factors indicated above. They suggest that by 2035, the combined effect of increased investment and faster uptake of property level measures could reduce the numbers of properties at significant risk by half, but that this was unlikely given the relatively poor uptake of these measures until now. Indeed the uptake of property-level protection measures is substantially lower than that needed to reach all 300,000 properties that would benefit from such measures within meaningful timeframe of some 25 years.

In summary, the most up-to-date assessment of risk of flooding in the UK suggests that both a large number of properties is now liable to risk, although many are protected, and that the problem is getting worse. The assessment also suggests that deprived communities are likely to suffer disproportionately from increases in flood risk. The extent of flood damage currently experienced remains controversial (Penning-Rowsell 2013, 2014a, b), but what appears uncontested is the potential for increased flooding in the future, not least owing to the fact that climate change has already resulted in sea level rise. In contrast our larger rivers continue to show no trend yet in rising flood frequencies (Marsh and Hannaford 2008). However, "significant positive trends were observed in all high-flows indicators over the 30–40 years prior to 2003, primarily in maritime-influenced, upland catchments in the north and west of the UK" (Environment Agency 2011 p. 27) but regional

generalisations from those small catchments (Environment Agency 2011) appears somewhat unsupported.

#### 4. Sharing the burden in the UK

##### 4.1 A new approach to burden sharing: the *Partnership Funding* scheme

For flood risk management in England and Wales, a very substantial change to the funding system took place in 2011, against the background of the forecasts of higher risk levels outlined above. The change was one to an arrangement promoting local/national cost-sharing from one dominated by central government providing virtually all investment costs in the form of a block grant to the Environment Agency (EA). The significance of this change is that it introduced a far greater and critical element of Localism into what previously was a highly centralised arrangement, and to a change where the likelihood increases of the burden of this investment falling partly on those who would benefit from the associated risk reduction. In the context of the financial burden spreading approaches Table 1 (B) this highlights a shift from a national solidarity approach to one closer that of beneficiary pays.

The block grant system remains (Figure 1), but risk reducing schemes in many cases can only proceed if the national contribution is complemented by locally derived resources. The new *Partnership Funding* arrangement (Defra 2011a, b) operates on a formula basis to determine the Flood Defence Grant in Aid (FDGiA) – how the EA block grant (provided by Defra) is to be allocated, scheme-by-scheme (Johns, 2011):

$$\text{£ FDGiA} = H + B + E \dots\dots\dots (1)$$

Where (see Table 3):

H - is the value of qualifying Household benefits for that scheme, times the payment rate



B - is the value of Other Whole-life Benefits for that scheme, times their payment rate

E - is the number of Environmental Outcomes for that scheme, times their payment rates.

*Table 3 should be inserted about here.*

*Figure 1 should be inserted about here.*

From this can be derived an Outcome Measure (OM) Score (as a %) - being the £FDGiA sum from the above formula divided by the scheme costs - and this metric can be used to prioritise decision-making. Many schemes will have an OM value greater than 100%, and then the full cost is available from the grant. In other cases there is a shortfall: the grant fails to cover the costs and the shortfall needs to be met from local contributions if the scheme is to proceed. These contributions can come from a number of sources, with the three prime headings being a small c. £30m p.a. local levy collected by the Environment Agency from local authorities, the public (e.g. local authorities directly) and the private sector (e.g. developers or industry).

One of the characteristics of this Partnership Funding is that any scheme delivering worthwhile benefits (as defined in the Defra policy) can receive some level of central government funding, unlike the situation previously where, if the scheme did not warrant proceeding by the rules then extant (MAFF 1999), the central government contribution was zero. To be eligible for a grant the Partnership Funding (PF) score must show that there are sufficient funds available: the PF score must be above 100% (the score broadly is the maximum permitted grant for the scheme plus the local contribution divided by cost of scheme). To receive a grant in a particular year a scheme must be successful in a process that prioritises funding against the PF scores and accommodates local choices. Regarding the latter criterion, a stated objective of Defra's policy here is to enable more local choice in the solutions adopted to reduce flood risk, and Regional Flood and Coastal

Committees now play a central part in ensuring that local choices are reflected in the programmes that they are now required to agree.

We can now begin to see how this new funding arrangement might operate. In the expenditure programme for schemes active in the financial year 2012/13 there were 140 schemes (at an average cost of £4.078m) for which a local contribution has been potentially forthcoming, out of a total of 398 schemes (i.e. 35%), with that contribution varying from 0.3% to 95% of total costs (Figure 2). Of the schemes with some proposed local contribution, the total contributions are set to be £141m out of total scheme costs of £585m (i.e. an average of 24.5%), representing a sizeable additional resource over and above that provided nationally by the general taxpayer and a major burden for local contributors. One might expect that these schemes with the high local contributions are the smaller schemes, which they are, but the schemes without a contribution average £5.403m, or only 32% larger by total cost than those with the local resources. Hence it is not simply the case that local is small and national is very much larger.

*Figure 2 should be inserted about here.*

Figure 3 again shows a wide range of contribution levels: a highly differentiated picture of different burden distributions. But those schemes with the highest number of deprived households do have, in general, the lowest contribution levels: deprived areas get the higher levels of taxpayer funded grant aid. Reinforcing this picture, Figure 4 shows that the communities with the higher numbers of deprived households covered by proposed schemes are also concentrated in the relatively impoverished north of the country: few are south of Birmingham and almost none is south of London. Thus whilst it might have been the case that partnership funding would disproportionately advantage the more prosperous areas more able to make those local contributions, such as in the

South of England, the formula given above in fact delivers quite a different pattern. This is mainly because that formula purposefully prioritises those schemes to be implemented in areas of financial deprivation by giving them higher rates of payment (Table 3).

*Figure 3 should be inserted about here.*

*Figure 4 should be inserted about here.*

What we see here, therefore, is a concerted attempt to shift the burden of FRM in the form of contributions to investment away from the general taxpayer and towards those at risk and who will be the beneficiaries of that investment. But an important safety net appears to exist whereby it is not just the affluent areas that may benefit from these arrangements, as the funding formula acts in the opposite direction. These results, although preliminary in that the data record potential contributions rather than final agreements, suggest that the burden of flood risk management expenditure, financed by general taxation, is indeed being complemented by the newly encouraged local contributions<sup>2</sup>. Schemes in the more affluent areas or where local authorities were willing to commit large sums are inevitably seen to be jumping the queue, owing to the contributions that are forthcoming there<sup>3</sup>; which areas as a result might therefore suffer by not getting the central government grant that their schemes deserve is unclear.

#### 4.2 The introduction of Flood Re: towards redistributing the burden of flood recovery?

Internationally, there are many approaches to assisting victims in recovering their flood losses (Table 2). What this tells us is that there is no one solution presented here but a range of possibilities, which itself is a function of many factors such as history (Penning-Rowsell et al. 2014), governance

arrangements (i.e. the role of the state vis-à-vis insurance markets), and a proactive vs. reactive philosophy. Within the UK there has been a long tradition of individual household responsibility for recovery from flood events and an emphasis on insurance rather than a recovery system based on the principles of compensation. Flood insurance is provided by the private market and currently reflects the notion that the beneficiary pays in so far as individual households pay the premiums and are primarily responsible for their own recovery.

But flood insurance cannot be commercially viable if just those at risk are the sources of premium income (Arnell 2000). Therefore, inherent in the approach until now are a number of cross-subsidies through which the burden of recovery is spread more widely than the individual household at risk and those making a claim. First, flood cover is sold within a bundle of different perils designed to spread losses more widely between risks (Table 2). Additionally, market competition appears to prevent insurers from charging full actuarial-based premiums, resulting in a cross-subsidy between low and high risk properties with little difference between the premiums charged (Lamond et al., 2009). The ABI (2010) also suggest that 78% of properties at significant flood risk are under-priced by an average of £420 (c. €500): a very large sum when average household flood insurance premiums are c. £30 (c. €36).

But the situation is changing. Insurers' concerns about climate change, the prospect of new entrants to the market, and a realisation that higher flood defences are not sufficient to reduce future potential losses have led them to edge towards adopting more risk-reflective pricing as a more viable long-term solution than the current pattern of cross-subsidies. Various new models of flood insurance provision have therefore been considered (Defra 2013a) many of which would have fundamental impacts upon the future distribution of flood recovery burdens, principally charging much more to those at greatest risk. The state could intervene here to limit such increases, on a

solidarity basis, but both insurers and the UK Government appear eager to maintain a private system of flood insurance, but for different reasons. A private market system has the advantage that it places the burden of recovery on the individual, rather on the UK taxpayer (via the government); the disadvantages include the low penetration rates of households in the much lower income deciles (Figure 5). The government has been concerned not to have a larger role in recovery provision, such as through a state compensation schemes or state-funded or administered insurance, if the private market were to disappear. Equally, the insurers have been keen to maintain a private market system because many of the risks (i.e. low and moderate flood risks) remain apparently profitable and they feared the state encroaching into other areas of their business.

*Figure 5 should be inserted about here.*

But the insurer's concerns, listed above, meant that status quo was itself unacceptable and the new scheme – *Flood Re* - is the result of protracted negotiations between UK Government and the insurance industry. This scheme proposes the introduction of a pooled approach to deal with the higher risk properties (Defra 2013a, b). The pool will act as a reinsurance or claims pool from which insurers will be allowed to draw to settle claims (or a proportion of the claims) from properties at high flood risk from which they do not achieve an adequate premium to cover the claims they face (apparently c. 50% of the total number at risk<sup>4</sup>). Those premiums (and therefore any subsequent claims) are to be subsidised by a *levy* payable by all household insurers at an annual total of c. £180 million for each of the first five years (Defra 2013a), taken from all customers' existing premiums. To maintain the affordability of flood insurance for high risk properties the new Flood-Re system will effectively cap the premiums paid for high risk properties and insurers will be able to obtain compensation for any net losses from insuring them from the pool.

What is important about the new approach is that it formalises the existing cross-subsidy and is applied equally (i.e. the same amount) to all household insurance policies, irrespective of risk or the premium being charged. The losses from the higher flood risks are spread both between all policies, and therefore between all flood risks, and across the insurance industry as a whole, rather than within one possibly vulnerable insurer. It is this more even distribution of the high risks which is allowing flood insurance to remain commercially viable and therefore available to these properties, maintaining the previous approach whereby the lower risks subsidise the higher ones.

For the most part, therefore, Flood-Re is therefore not substantially redistributing the burdens of recovery from flood damages: the burden of those most at risk is still being subsidised by those at lesser or no risk, although premiums for high risk properties will be 20% to 25% higher than today (Defra 2013a). Moreover the exclusion of the most expensive 1% of properties from the pool (the top Council Tax<sup>5</sup> band in England) is an attempt to remove the largest injustices in cross-subsidy and a movement towards redistributing recovery burdens towards those who are perceived to be more able to afford them. But the pool will still be large, although limited annually to £2.5bn or a 1 in 200 year loss (ABI 2013): above this the UK Government assumes primary responsibility rather than the insurers. However, there is uncertainty about how Flood-Re will work in practice and there are many governance and administrative issues to determine, not least whether Flood Re is compatible with EU competition rules concerning State Aid<sup>6</sup>.

Nevertheless, there are already some issues in terms of the distribution of flood recovery burdens. Newly built property (i.e. since 2009) is excluded from the pool to further discourage floodplain development, thereby favouring pre-existing high flood risks rather than new ones. Additionally, self-help risk mitigation is not encouraged, nor is there exclusion from the pool for those who make repeated claims: those at high-risk repeatedly benefiting from the pool at the expense of all those at

lower risks. Moreover, the new system, despite the subsidy for of high risk premiums, posits premiums that will still be beyond the reach of some households, who may chose not to insure. The burden of recovery stays with the flood victim, who may well not be able to afford the costs involved.

Such affordability issues are likely to worsen in the future because Flood-Re is seen as a transitional arrangement (for approximately 20 to 25 years) and established to allow the adjustment of premiums towards full actuarial pricing. In this respect Pardoe et al. (2013) have indicated that if flood insurance moves towards a full beneficiary-pays approach and the cross-subsidy were completely removed (as is intended in the future) there would be a substantial increase in the costs for floodplain dwellers and in particular for those financially deprived and those in private (rather than Local Authority) housing. The trends appear therefore to be regressive and, ultimately, without care, movement towards a full beneficiary-pays approach to flood insurance may perversely necessitate the introduction of other state-based instruments to assist high-risk deprived households (and potentially also those on more moderate incomes) whilst insurers cater only (and very profitably) for those at low risk!

## **5. Conclusions**

In conclusion, we can see that many countries - faced with the possibility of substantially higher levels of flood risk in the future - are exploring alternative intervention and hence adaptation strategies, not least in Europe in following the requirements of the EU Floods Directive 2007 (EU Directive 2007/60/EC). This forms a response to widespread concern at the rising burden that such increasing risk will bring; both for the communities at risk and for the general taxpayer faced with the increasing sums needs to counter risk and recover from flood events. Those countries with market-based insurance schemes for compensating flood victims for the losses that they incur are

also concerned about the commercial viability of such schemes, not least owing to the many uncertainties that inherently accompany all forecasts of rising risk. At the global level reinsurance provides a safety net for such schemes, but even here there is concern that this reinsurance may not adequately cover those most at risk (for example in developing countries), or that hard-pressed governments are not free of the burden of being the insurer of last resort.

Whilst globally there is little consensus about the best way forward in terms of responding and thereby adapting to increased flood risk, our analysis shows that in the UK both the government and the private flood insurers have responded with new policies and proposals to concentrate somewhat more the financial burden of, respectively, flood risk management investment costs and insurance provisions on to those who are at risk and away from the general taxpayer and those who pay insurance premiums. The pre-existing cross-subsidies are being reduced, both for risk reducing flood risk management schemes and – over a long time period – for those who insure against flood losses through private insurance companies. In this way, from our analysis of the relevant policy documents, it is hoped that extra resources for risk management investment will be forthcoming (from local contributions from at-risk communities) and flood insurance will remain affordable, available and commercially viable as a major plank in managing the flood risk that the country experiences.

But no definitive conclusions can yet be drawn on the key distributional impact of these changes, although they appear to be regressive in that affluent communities may jump the queue for risk reducing investment and Flood-Re favours the affluent at risk rather than the uninsured poor. As it is, any increase in flood frequency and severity in the UK appears likely to affect the financially deprived communities to a greater extent than others, not least, again, because they are less likely to insure. Government arrangements to prioritise their contribution to risk reducing towards these



financially deprived communities is a sign that this regressive effect of floods is real and serious, and they are to be welcomed.

Our assessment, finally, is focused on a global message, in that other countries may well learn from these developments in the UK and thereby inform global adaptation strategies and practices.

However, the nature and scale of future flooding may be important here. If climate change results in many more minor floods, then compensation schemes, flood insurance and risk-reducing investment may easily adjust, not least as the pace of change is not likely to be rapid. If, in contrast, climate change results in more (but still rare) catastrophic events, then the arrangements now in place both in the UK and elsewhere may be taken by surprise and be more vulnerable.

### **Acknowledgements**

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<sup>1</sup> As defined by the National Flood Risk Assessment (NaFRA) as areas where the change of flooding in any one year is greater than 1 in 75 years (1.3%) (Environment Agency, undated). After this point the term significant relates to risks of this nature.

<sup>2</sup> By 2014 the agreed and formally 'signed off' Partnership Funding local contributions amounted to some £60m but the total agreed was nearer £150m.

<sup>3</sup> Alan Bell (Morpeth Flood Action Group; personal communication April 9<sup>th</sup> 2014)

<sup>4</sup> Source: Daniel Johns, Secretariat, Climate Change Committee, 10.6.2014.

<sup>5</sup> A local form of taxation in England, Wales and Scotland collected from all residential properties. The tax is broadly related to the capital value of a property which are arranged into eight bands A-H (nine in Wales).

<sup>6</sup> In 2014 this remains yet to be resolved.

## References

Adaptation Sub-Committee (2012) Climate Change – Is the UK preparing for flooding and water scarcity? Committee on Climate Change, London

Arnell, N (2000) Flood Insurance. In: Parker D J (ed) Floods, Routledge, London

Association of British Insurers (ABI) (2010) Under-pricing of the flood element of home insurance for domestic customers at significant risk, ABI Research Brief, September 2010, Association of British Insurers, London

Association of British Insurers (ABI) (2013) Flood Re Proposal: Memorandum of understanding, 26th June 2013.

[https://consult.defra.gov.uk/flooding/floodinsurance/supporting\\_documents/20130626%20Flood%20Insurance%20MOU%20June%202013%20unprotected.pdf](https://consult.defra.gov.uk/flooding/floodinsurance/supporting_documents/20130626%20Flood%20Insurance%20MOU%20June%202013%20unprotected.pdf). Cited 30 June 2013

Bavarian State Ministry of the Environment (2006) River Basin Agenda for Alpine Space. Model and Examples for Sustainable Development of the Alpine River Basins, Short Report, Munich, Germany

Botzen WJW, van den Bergh JCJM (2008) Insurance against climate change and flooding in the Netherlands: Present, future, and comparison with other countries. Risk Anal 28(2):413-426

Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (2006): Hochwasserschutz in Österreich – Flood protection in Austria. 2nd Edition. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Vienna

Climate Change Risk Assessment (2012) Floods and coastal erosion: sector perspective (summary).

Defra, London

Consortio de Compensacion de Seguros (2008) Natural catastrophes insurance cover A diversity of systems. Consortio de Compensacion de Seguros, Madrid, Spain

Comité Européen des Assurances (2005) The insurance of natural events on European markets, Property Insurance Committee, AB 5050 (06/05), Comité Européen des Assurances, Paris, France

Department for Environment, Food and Rural Affairs (Defra) (2004) Making Space for Water: Developing a New Government Strategy for Flood and Coastal Erosion Risk Management in England. A Consultation Exercise. Department for the Environment, Food and Rural Affairs, London

Department for Environment, Food and Rural Affairs (Defra) (2011a) Flood and coastal resilience partnership funding: Defra policy statement on an outcome-focused, partnership approach to funding flood and coastal erosion risk management. May 2011. Defra, London

Department for Environment, Food and Rural Affairs (Defra) (2011b) More flood and coastal defence schemes to go ahead under new funding system, Environment Minister, Partnership funding announcement, 23 May 2011, <http://www.defra.gov.uk/news/2011/05/23/more-flood-defence-schemes/>. Cited. 9 April 2013

Department for Environment, Food and Rural Affairs (Defra) (2013a) Securing the future availability and affordability of home insurance in areas of flood risk June 2013, Full consultation document, Defra, London.

[https://consult.defra.gov.uk/flooding/floodinsurance/supporting\\_documents/20130626%20FINAL%20Future%20of%20Flood%20Insurance%20%20consultation%20document.pdf](https://consult.defra.gov.uk/flooding/floodinsurance/supporting_documents/20130626%20FINAL%20Future%20of%20Flood%20Insurance%20%20consultation%20document.pdf). Cited 30 June 2013

Department for Environment, Food and Rural Affairs (Defra) (2013b) Securing the future of flood insurance: An introductory guide. Defra, London

[https://consult.defra.gov.uk/flooding/floodinsurance/supporting\\_documents/20130626%20FINAL%20Flood%20Insurance%20%20Introductory%20Note.pdf](https://consult.defra.gov.uk/flooding/floodinsurance/supporting_documents/20130626%20FINAL%20Flood%20Insurance%20%20Introductory%20Note.pdf). Cited 30 June 2013

Environment Agency (undated) Understanding Flood Risk. Our National Flood Risk Assessment (NaFRA). Environment Agency, Bristol

Environment Agency (2011) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities. Bristol, Environment Agency

European Parliament and the Council (eds.) (2007). Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, 'EU Floods Directive.' L288 of the Official Journal of the European Union

Evans E, Ashley R, Hall J, Penning-Rowse EC, Sayers P, Thorne C, Watkinson A (2004) Foresight Future Flooding, Scientific Summaries: Volume 1 Future risks and their drivers and Volume 2 Managing future risk. Office of Science and Technology, London

Faure M (2004) Financial compensation in case of catastrophes: A European law and economics perspective. Documents de Recherche du Centre d'Analyse Economique, DR 10-03/04. METRO Institute, Maastricht University, The Netherlands

Fiselier J, Oosterber W (2004) A quick scan of spatial measures and instruments for flood risk reduction in selected EU countries. Ministry of Transport, Public Works and Water Management, Directorate-General of Public Works and Water Management, RIZA Institute for Inland Water Management and Waste Water Treatment

Garrelts H, Lange, H (2011) Path Dependencies and Path Change in Complex Fields of Action: Climate Adaptation Policies in Germany in the Realm of Flood Risk Management. *Ambio* 40: 200–209

Gaschen S, Hausmann P, Menzinger I, Schaad W (1998) Floods - an insurable risk? A market survey. Swiss Re, Zurich, Switzerland

Hannaford J, Marsh TJ (2008) High-flow and flood trends in a network of undisturbed catchments in the UK. *Int J Climatol* 28(10): 1325–1338

Harries T (2009) Review of the Pilot Flood Protection Grant Scheme in a Recently Flooded Area, R&D Technical Report FD2651/TR. Department for Environment, Food and Rural Affairs (Defra), London

HM Government (2008) Climate Change Act 2008. The Stationery Office, London.

<http://www.legislation.gov.uk/ukpga/2004/36/introduction>. Cited 3 April 2013

HR Wallingford (2008) Who benefits from flood management policies?, R&D final report FD2606. Department for Environment, Food and Rural Affairs (Defra), London

Intergovernmental Panel on Climate Change (2013) Summary for Policymakers. In: Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V, Midgley PM (ed) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK

JBA Consulting Ltd (2012) Evaluation of the Defra Property-level Flood Protection Scheme: 25918, Summary Report, Report prepared by JBA Consulting for the Environment Agency, March 2012.

[http://a0768b4a8a31e106d8b0-](http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0312bwdv-e-e.pdf)

[50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0312bwdv-e-e.pdf](http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0312bwdv-e-e.pdf). Cited 11

November 2013

Johns D (2011) Understanding the risks, building resilience, empowering communities: A benefit-led, partnership approach to funding. PowerPoint presentation, Defra, London

Johnson C, Penning-Rowsell EC, Parker DJ (2007) Natural and imposed injustices: the challenges in implementing 'fair' flood risk management policy in England. *Geogr J* 173: 374–390

Lamond J, Penning-Rowsell EC (2014) The robustness of flood insurance regimes given changing risk resulting from climate change. *Clim Risk Manage* 2(2014): 1–10

Lamond J, Proverbs D, Hammond F (2009) Accessibility of flood risk insurance in the UK - confusion, competition and complacency. *J Risk Res* 12(5): 825-840

Michel-Kerjan E (2001) Insurance against natural disasters: do the French have the answer? Strengths and limitations. Working paper 2001. Laboratoire d'économétrie, Ecole Polytechnique, Paris

Ministeri van Loubouw, Natur en Voedselkwaliteit (2006) Spatial Planning Key Decision: Room for the River. Investing in the Safety and Vitalist of the Dutch River Basin Region. Arnhem, The Netherlands

Ministry of Agriculture, Fisheries and Food (MAFF) (1999) Flood and Coastal Defence Project Appraisal Guidance (FCDPAG3) Economic Appraisal. MAFF, London

Office of National Statistics (ONS) (2011) Living Costs and Food Survey2011. UK Data Service, Identifier 10.5255/UKDA-SN-7272-2, <http://discover.ukdataservice.ac.uk/catalogue/?sn=7272&type=Data%20catalogue>. Cited 11 April 2014

O'Neill J, O'Neill M (2012) Social justice and the future of flood insurance. Joseph Rowntree Foundation, York

Pardoe JL, Penning-Rowell EC, Cope M (2013) Alternative investment streams for flood risk management and flood insurance: An analysis of "who gains and who loses? In: Klijn F, Schweckendiek T (eds) Comprehensive Flood Risk Management: Research for Policy and Practice. Taylor and Francis, London

Penning-Rowse EC (2013) A 'realist' approach to the extent of flood risk in England and Wales. In: Klijn F, Schreckendiek T (eds) *Comprehensive Flood Risk Management: Research for Policy and Practice*. Taylor and Francis, London

Penning-Rowse EC (2014a) A realistic assessment of fluvial and coastal flood risk in England and Wales. *T I Brit Geogr* (in press) DOI 10.1111/tran.12053

Penning-Rowse EC (2014b) The 2013/14 floods: what do they tell us about overall flood risk in England and Wales? *Circulation* 121: 1-3

Penning-Rowse EC, Pardoe JL (2012a) Who loses if flood risk is reduced: should we be concerned? *Area* 44(2): 152-159

Penning-Rowse EC, Pardoe JL (2012b) Who benefits and who loses from flood risk reduction? *Environ Plann C* 30: 448-466

Penning-Rowse EC, Pardoe JL (2014). The distributional impacts of climate and policy change: flood risk management in England and Wales. *Environ Plann C* (in press) DOI 10.1068/c13241

Penning-Rowse EC, Parker DJ, Harding DM (1986) *Floods and drainage: British policies for hazard reduction, agricultural improvement and wetland conservation*. Allen and Unwin, London

Penning-Rowse EC, Priest SJ, Johnson CJ (2014) The evolution of UK flood insurance: incremental change over six decades. *Int J Water Resour D* (in press) DOI 10.1080/07900627.2014.903166



Porrini D, Schwarze R (2014) Insurance models and European climate change policies: an assessment. *Eur J Intl L* 38: 7-28

Priest SJ (2003) Responding to flood risk in the UK: A strategic Reappraisal. Unpublished PhD Thesis. Department of Geography, University of Southampton

Priest SJ, Clark MJ, Treby EJ (2005) UK Flood insurance: the challenge of the uninsured. *Area* 37(3): 295-302

Priest SJ (2014) Review of international flood insurance and recovery mechanisms: Implications for New Zealand and the resilience of older people, Research report for the Community Resilience and Good Ageing: Doing Better in Bad Times Project. <http://resilience.goodhomes.co.nz/publications/>. Cited 20 October 2014

Ramsbottom D, Sayers P, Panzeri M (2012) Climate Change Risk Assessment for the Floods and Coastal Erosion Sector. Defra, London

Samuels P, Gouldby B (2009) Language of Risk: Project definitions (2nd Edition). HR Wallingford, Wallingford.  
[http://www.floodsite.net/html/partner\\_area/project\\_docs/floodsite\\_language\\_of\\_risk\\_v4\\_0\\_p1.pdf](http://www.floodsite.net/html/partner_area/project_docs/floodsite_language_of_risk_v4_0_p1.pdf)  
Cited 20 October 2014

Tapsell SM, Penning-Rowsell EC, Tunstall SM, Wilson TL (2002) Vulnerability to flooding: health and social dimensions, Flood risk in a changing climate. *Philos Trans R Soc London Ser A* 360(1796): 1511-1525

Tapsell SM, Tunstall SM, Priest SJ (2009) Developing a conceptual model of flood impact upon human health, Report T10-09-02 for the Integrated Project FLOODsite. Flood Hazard Research Centre. London. [http://www.floodsite.net/html/partner\\_area/project\\_docs/T10-09-02\\_Health\\_Impacts\\_Model\\_v1\\_1\\_Pn10.pdf](http://www.floodsite.net/html/partner_area/project_docs/T10-09-02_Health_Impacts_Model_v1_1_Pn10.pdf). Cited 20 October 2014

Van Rijswick HFMW, Havekes HJM (2012) European and Dutch Water Law. Europa Law Publishing, Groningen

Walker G, Burningham K (2011) Flood risk, vulnerability and environmental justice: Evidence and evaluation of inequality in a UK context. Crit Soc Pol 31: 216-241

Wicks J, Clarke J, Lovell L, Priest SJ, Parker D. (2012) Benefits of FIM and LUM: Accompanying report to 'Benefits of non-structural responses: Baseline and scenario analysis for England and Wales' Unpublished research report prepared by Halcrow for the Environment Agency, Bristol

Figure captions

Figure 1. Taxpayer funded flood risk management investment in England 2005-15

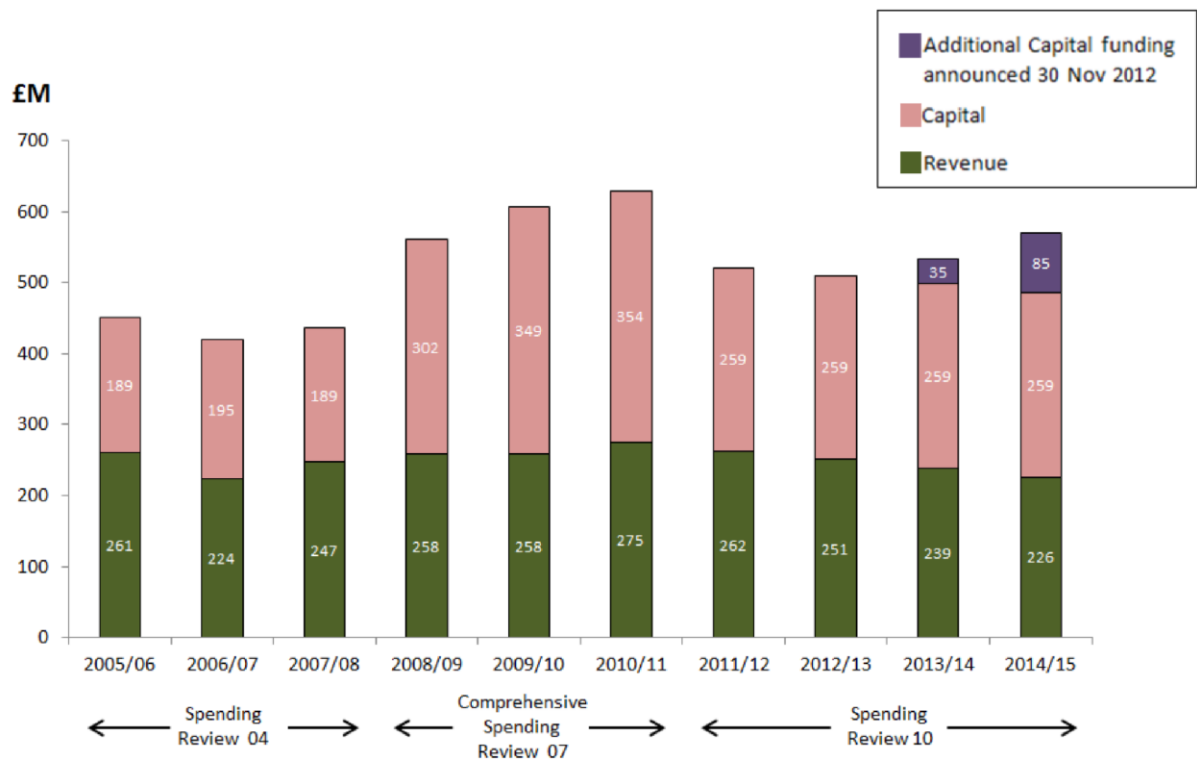


Figure 2. The percentage local contribution to flood risk management costs for those schemes being actively promoted by the Environment Agency in 2012/13

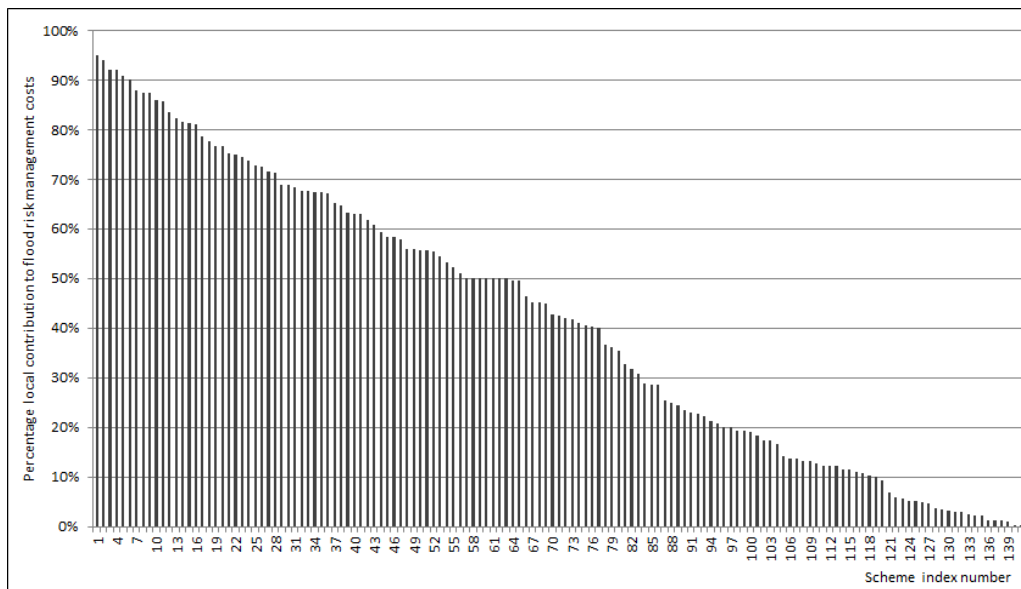


Figure 3. The pattern of local contributions and financial deprivation (flood risk management schemes being actively promoted by the Environment Agency in 2012/13)

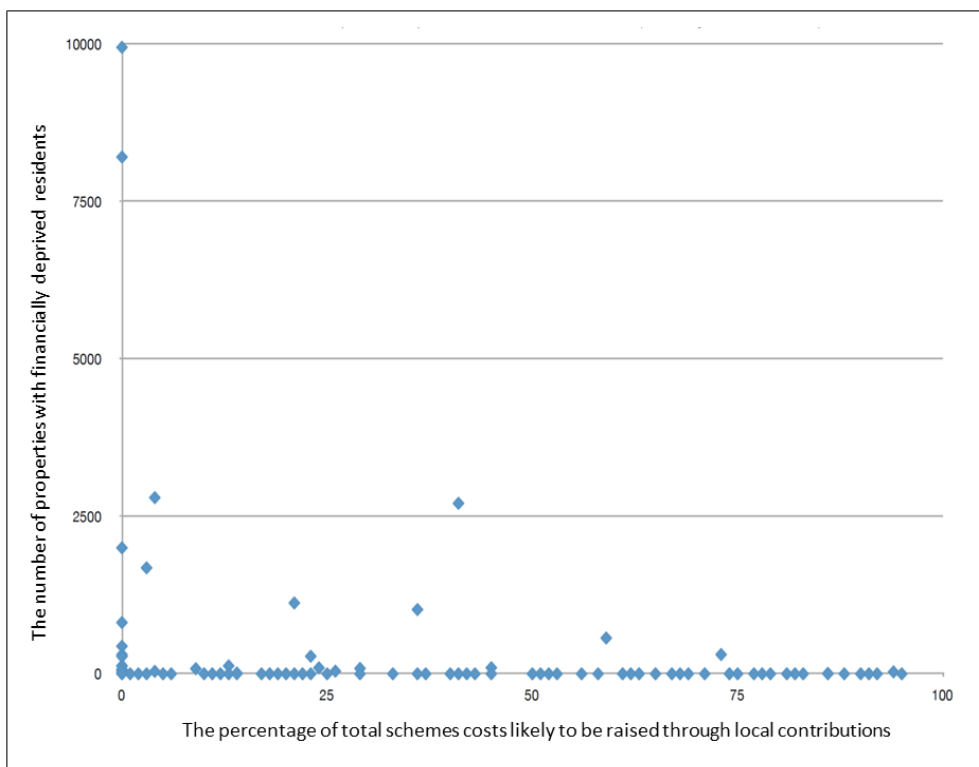


Figure 4. The location of English flood risk management schemes with the most deprived residents  
(open circles indicate zero deprived residents)

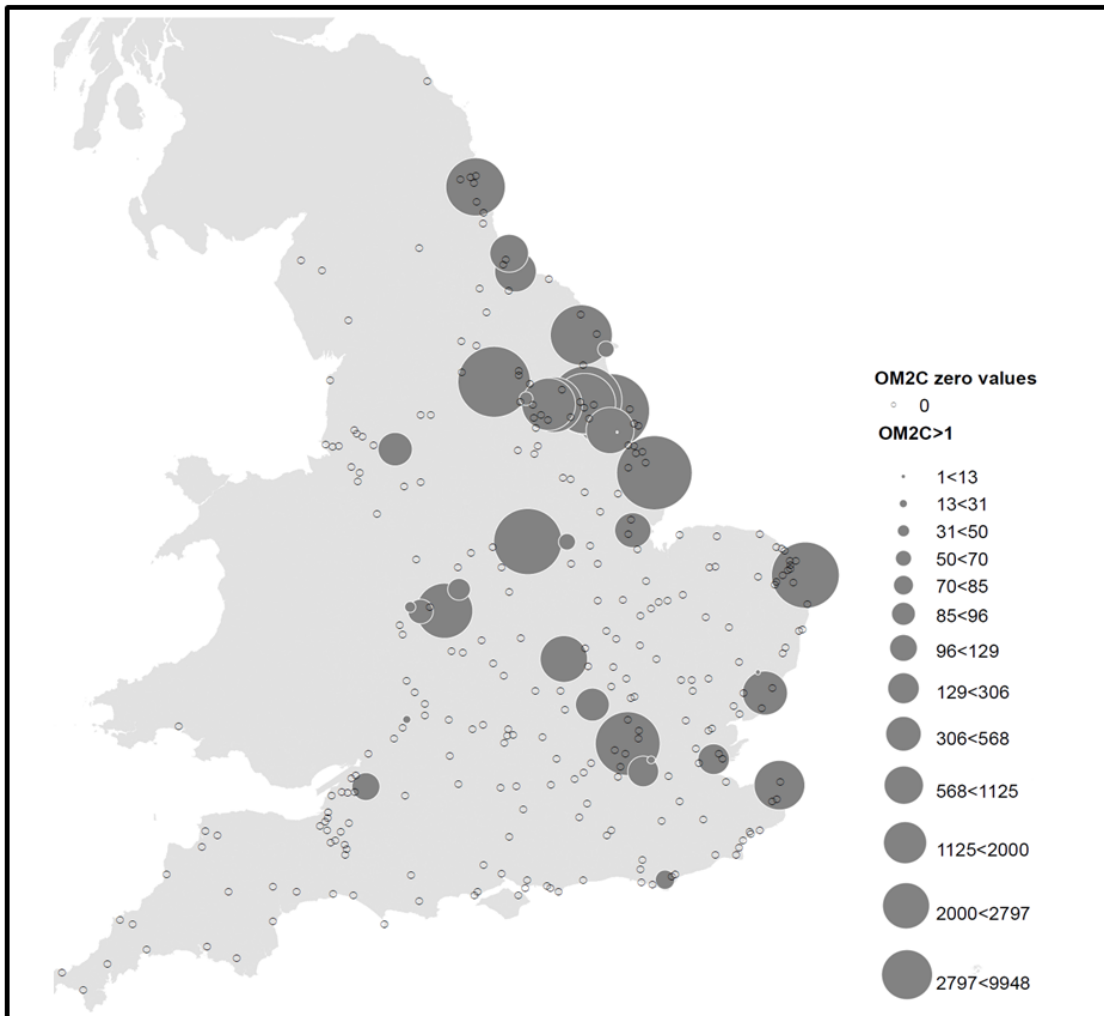


Figure 5. The penetration of structural and contents insurance by weekly household income deciles in the United Kingdom in 2011 (Source: data from Office of National Statistics 2011)

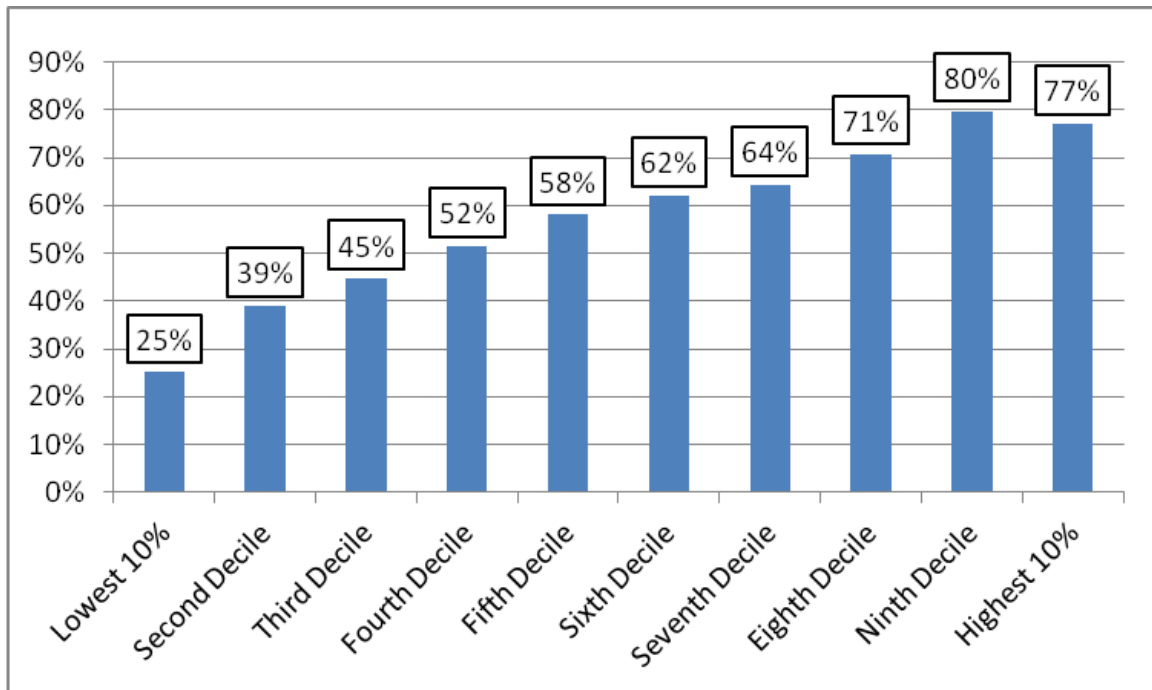


Table 1. Approaches to spreading the burdens from flooding

Flood-related burdens	Spectra of burden sharing	
A. Flood risk	<b>Highly defended</b> (e.g. flood risk largely reduced)	<b>Living with floods</b> (e.g. the aim is not to prevent flooding but to live with the impacts)
B. Financing flood risk management	<b>National solidarity</b> (e.g. Flood risk management funded centrally via general taxation)	<b>Beneficiary pays</b> (e.g. measures fully funded by those at risk)
C. Recovery from flooding	<b>National solidarity</b> (e.g. Compensation scheme funded by taxation)	<b>Beneficiary pays</b> (e.g. Actuarial based private insurance market)
D. Responsibility for flood risk management decision-making	<b>Centralised</b> (e.g. Decisions are taken flood risk professionals centrally with little public input)	<b>Individual at risk household</b> (e.g. It is up to the household to decide how to manage their own risk)

Table 2. The approaches to compensation and insurance within different national flood recovery systems

		APPROACHES TO COMPENSATION				
		No state compensation provided <sup>1</sup>	Ad hoc compensation (i.e. only implemented in legislation or provided at the time of event)	Ex-post compensation (i.e. schemes are enshrined in legislation/policy but no fund established prior to event)	Ex-ante compensation (i.e. schemes enshrined in legislation and fund established prior to event permitting a reserve)	
APPROACHES TO INSURANCE	No (little) flood insurance available			Netherlands (sea and river) <sup>2</sup> Canada (most flooding)		
	Insurance provided via the private market	Optional <sup>3</sup> individual flood cover (risk-reflective)	Taiwan	Germany Italy Australia		
		Optional composite cover (bundled with other perils)	Portugal* Brazil	Germany Australia	Austria	
		Compulsory inclusion of cover in a package	Netherlands (rainfall and SWF) United Kingdom (pre-2015)			
	Pooled flood <sup>4</sup> insurance (with no state guarantee)	Norway United Kingdom (post 2015)				
	Pooled flood insurance <sup>d</sup> (has a state guarantee)	France Denmark (sea flooding)			Belgium <sup>5</sup>	
	State-run <sup>d</sup> (and subsidised) flood insurance scheme	Spain <sup>6</sup>	United States			

Sources: After Priest (2014).

<sup>1</sup> Where it is unknown whether a country has state compensation - these have been placed in this category but signified by \*

<sup>2</sup> There is one policy available for flooding but premiums are high and uptake is limited.

<sup>3</sup> Whether optional or compulsory relates to whether there is a choice whether cover for flooding can be taken out, if flood is taken out,

<sup>4</sup> These strategies may also have some private market involvement, however insurance is not solely provided on this basis.

<sup>5</sup> Although there are ex ante schemes established in Belgium, in practice financing is provided both *ex ante* and *ex post* (i.e. the fund is topped up if funds prove to be inadequate).

<sup>6</sup> Although there is some insurance written by the private market so that it could be considered to be a pooled-type system with a state guarantee.



Table 3. The new payment rates for the Partnership Funding arrangement used in England (Source: Adapted from Defra 2011a)

Outcome Measure (OM)	Qualifying outcomes/benefits	Payment rate
OM1	Present value of the whole life benefits of the current proposed investment, less benefits or payments associated with the outcome measures below.	£0.556 per £1.00 of qualifying benefit (i.e. 5.56%)
OM2	The Number of households protected against flood risk:	
	In the 20% most deprived areas	£0.45 per £1.00 of benefit
	In the 21% to 40% most deprived areas	£0.30 per £1.00 of benefit
	In the 60% least deprived areas	£0.20 per £1.00 of benefit
OM3	The number of households better protected against coastal erosion	
	In the 20% most deprived areas	£0.45 per £1.00 of benefit
	In the 21% to 40% most deprived areas	£0.30 per £1.00 of benefit
	In the 60% least deprived areas	£0.20 per £1.00 of benefit
OM4	Statutory environmental obligations	
	Hectares of water-dependent habitat created or protected	£15,000 per hectare
	Hectares of inter-tidal habitat created	£50,000 per hectare
	Kilometres of protected river improved	£80,000 per km of river bed