



Homeowner responsibility in flood risk management – The fairness of financial support for property-level flood resilience

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ABSTRACT

Governments worldwide are diversifying their flood risk management (FRM) strategies to deal with flood risks. This requires the involvement of multiple policy domains as well as non-state actors – including homeowners. Homeowners can get involved in FRM through property-level flood resilience (PFR) measures. Various initiatives have been launched to financially support homeowners in the implementation of these measures, such as government grants and insurance mechanisms. However, even with financial support, transferring responsibility to homeowners has justice implications: many may lack the economic, social, or cultural capacity to implement PFR, and strict eligibility criteria can exclude certain groups from benefiting. This paper examines the justice implications of financial support for PFR by analysing how different mechanisms align with four conceptualisations of distributive justice: libertarian, utilitarian, Rawlsian, and egalitarian. England and Flanders serve as illustrative cases. England has developed multiple types of financial support and has a longer history of working with PFR, while in Flanders support remains limited and highly localised. By focusing on the justice dimensions of financial support for PFR – rather than a strict comparison of the two contexts – the analysis reveals how the presence of absence of support mechanisms can reinforce or mitigate inequality. These insights are important if PFR is to become mainstreamed and integrated into FRM.

1. Introduction

Climate change and urbanisation are increasing the frequency, intensity, and damage of floods (Attems et al., 2019; Christensen and Christensen, 2003; Kabisch et al., 2016; Kaufmann et al., 2018). This requires changes in government approaches to flood risk management (FRM). In many countries, governments were the main actor responsible for managing flood risks, often through collective, infrastructural flood protection (e.g., embankments) (Gralepois et al., 2016; Johnson and Priest, 2008). However, these measures were insufficient to prevent loss and damage from floods (Owusu et al., 2015; Santoro et al., 2019). It is increasingly recognised that public authorities cannot offer complete protection (Beck, 2006), due to the unpredictability of floods and

financial and organisational constraints (Jongman et al., 2014; Michel-Kerjan et al., 2012; Tullos, 2018). Governments are therefore diversifying their FRM strategies (for an overview, see Hegger et al., 2016), requiring the involvement of various policy domains, insurers, and homeowners (Forrest et al., 2020; Karrasch et al., 2021; Kaufmann et al., 2016; Keskitalo, 2013; Snel et al., 2022; Thaler and Levin-Keitel, 2016; Vitale, 2023). Homeowners can contribute to the implementation of FRM through property-level flood resilience (PFR) (other terms include property flood resilience and property-level protection¹). PFR includes measures to protect properties from flooding, reduce damage, and build resilience, such as coping mechanisms (e.g., moving belongings upstairs), immediate adaptations (e.g., sandbags), and future adaptations (e.g., flood gates, non-return valves) (Mees et al., 2017;

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¹ In this paper, we use the term PFR in line with common usage in academic and policy literature (e.g., Adedjei et al., 2018; Hudson and Berghäuser, 2023; Adebimpe et al., 2021). While resilience is technically a system property, referring to their capacity to absorb, adapt to, and recover from disturbances (e.g., Hegger et al., 2016), PFR here refers to a range of protective and adaptive measures implemented at the property level to reduce flood damage and enhance recovery. We acknowledge that that “property-level flood resilience” is not resilience in the systemic or ecological sense, but we retain the term to remain consistent with professional and policy language (e.g., Defra, Environment Agency), and to signal its intended contribution to flood resilience at the property scale.

Penning-Rowsell et al., 2016).

Previous research examined the willingness of homeowners to assume responsibility in FRM (Lawrence et al., 2014; Raška et al., 2020; Snel et al., 2020; Terpstra and Gutteling, 2008) and the role of experts in supporting households in implementing PFR (Davids et al., 2023). However, transferring FRM responsibility to homeowners has justice implications. People are impacted by floods in different ways, due to their location and exposure, and their social, physical, financial, and psychological characteristics. This can create inequalities in the capacity of people to prepare for, respond to, and recover after floods (Forrest et al., 2020; O'Hare and White, 2018; Thaler et al., 2018). In the context of PFR, this means that some groups may lack the economic, social, or cultural capacity to take up FRM responsibility (Snel et al., 2022).

There are various ways in which homeowners can be supported in the implementation of PFR e.g., government grants. It has also been recognised that insurers could play a role in compensating homeowners beyond the damage floods have caused to their property, to encourage adaptive and resilient rebuilding (Suykens et al., 2019). Such support mechanisms for PFR raise questions around who has access to support and who benefits. There are few studies considering how financial support for PFR may break down or reinforce existing inequality. This paper offers novel insight into the fairness of financial support mechanisms by examining their distributional impacts through a justice lens. England and Flanders are chosen as case studies; however, rather than conducting a strict comparison between the countries, the paper explores how different financial mechanisms reflect underlying justice principles. England has a long history of homeowners being responsible for protecting their properties, offers a wide array of financial mechanisms for PFR, and serves as a frontrunner in the mainstreaming of such approaches. It is also among the first countries to introduce an insurance scheme that compensates homeowners beyond damage costs. In Flanders, PFR is still in its infancy and there is limited financial support for homeowners – despite increased interest in PFR. The inclusion of Flanders enables reflection on how emerging financial support for PFR may shape justice outcomes, and it provides an opportunity to shed light on early-stage policy choices and their distributional implications. The contrast between two policy landscapes helps to unpack what the absence or limited availability of support means in terms of exclusion, strengthening the analysis and offering insights relevant for countries where PFR is both well-established and still developing.

By using a distributive justice lens, the paper contributes to understanding how financial support for PFR may mitigate or reinforce inequality in FRM. This is highly relevant for countries where PFR is still relatively new, such as Flanders, as it may prevent disproportionate burdens on those with insufficient capacity to take on responsibility in FRM.

2. Theoretical background

The literature presents different rationales for increased homeowner involvement in FRM, summarised by Snel et al. (2020). It is, for example, often argued that PFR is needed because collective flood protection does not sufficiently reduce risks or build resilience to future flooding. Furthermore, government capacities to continue to provide collective protection are limited, and measures are most needed on private land. Although valid reasons, there are important factors that determine the willingness and capacity of homeowners to implement PFR.

2.1. Willingness and capacity to implement PFR

Previous research examined the willingness of homeowners to implement PFR. For example, Lawrence et al. (2014) investigated the relationships between flood experience, risk perception, and PFR implementation in New Zealand. They found that flood experience is an important determinant of risk perception, and accordingly is likely to

contribute to the preparedness of homeowners. Similarly, in England, risk perception and expected damage from flooding are important for the uptake of PFR. However, homeowners often do not feel responsible for protecting their properties against flooding (Joseph et al., 2015). Raška et al. (2020) found, based on flood perception surveys in the Czech Republic, that homeowners perceive FRM as a government responsibility. The same applies to the Netherlands. Terpstra and Gutteling (2008) found that flood risk perception is low, and the government is seen as primarily responsible for flood protection, reducing people's willingness to implement PFR.

This suggests that PFR is unlikely to be effective unless homeowners perceive flooding as a real risk and feel responsible to undertake protective action (Henstra et al., 2019; Wamsler, 2016). It has therefore been suggested that efforts are required to raise awareness among at-risk populations of the limits of collective flood protection (Joseph et al., 2015). However, the capacity of people to implement PFR is often overlooked in the literature (Hudson and Thaler, 2023). Hudson (2020) aimed to fill this gap by looking at affordability. It was found that in many European countries, homeowners cannot afford PFR. When citizens do not have sufficient financial capacity, they will logically refrain from taking action (Snel et al., 2022). This underlines the importance of considering the burden PFR creates when expecting people to contribute to FRM (Attems et al., 2019; Hudson and Thaler, 2023). Transferring responsibility for flood protection to homeowners may be problematic without attention to their capacity to deal with flooding and implement PFR (Doorn, 2016; Paauw et al., 2024).

This capacity is not solely determined by financial means. It is often a combination of someone's exposure to flood risks, as well as their socioeconomic and demographic background (Davids, 2021; Koks et al., 2015). Here, we mainly focus on the latter, which includes "the characteristics of a person or a group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard" (Liverman, 2015, p. 308). Characteristics that determine the ability of homeowners to assume responsibility in FRM include socioeconomic status, age, gender, education, social capital, ethnicity, property type, and ownership (Coninx and Bachus, 2007; Fielding and Burningham, 2005; Foster et al., 2019; Norris et al., 2008; Walker and Burningham, 2011). The idea of a mismatch between the need for PFR and people's capacity to implement measures aligns with the capabilities approach. This theory focuses on functionings and capabilities. Functionings are activities and states of beings that constitute people's wellbeing. Capabilities are the opportunities that people have to pursue the functionings they see as important, such as physical capacity, talents, knowledge, lack of environmental constraints, social support, money, etc. (Sen, 2001). The impacts of climate change, such as flooding, can reduce someone's capabilities to achieve their desired functionings (Schlosberg, 2012). In this way, the capabilities approach draws attention to a potential gap between an ideal (e.g., protecting properties through PFR) and the ability of people to achieve that ideal (Alexander et al., 2016; Cañizares-Gaztelu et al., 2024), which is where financial support may come in.

2.2. Financial support for PFR and distributive justice

Governments can assist homeowners in implementing PFR through policy instruments such as financial support (e.g., subsidies, grants). Such instruments are inherently associated with power, and issues of legitimacy and (de)politicisation (Lascoumes and Le Galès, 2007). They are not neutral, as some will benefit whereas others are excluded. Questions arise regarding who has access to support and who does not, and for whom the support might be insufficient to implement PFR. These are questions of distributive justice. Distributive justice in FRM focuses on the distribution of resources (benefits) and risks (burdens) associated with floods, and to what extent this can be considered as fair (Thaler and Hartmann, 2016). In the literature, fairness and justice are often used interchangeably which we do here as well (e.g., Hay, 1995). Distributive

justice can be strengthened through compensation for groups experiencing disproportionate flood risks, to achieve a more equitable FRM (Thaler et al., 2018; van Doorn-Hoekveld et al., 2016). However, there are various conceptualisations of justice, illustrating different perspectives on what is considered a fair policy outcome and who should receive compensation for flood risks. The conceptualisations are summarised by Kaufmann et al. (2018) and shown in Table 1.

The first conceptualisation is libertarian, which prescribes that government intervention should be limited (i.e., maximum liberty) as people are entitled to what they have achieved individually (Davy, 1997; Nozick, 1974). In the context of flooding, this means that individuals carry the burden of flood risks without government support (Kaufmann et al., 2018). PFR implementation will depend on individual capacities leading to elitist outcomes. Utilitarianism is the second conceptualisation and aims to redistribute collective resources to maximise societal benefits (i.e., maximising utility) (Davy, 1997; Mill, 2010). This means that major flood risks impacting a large part of the population will be managed and funded by the state. If a minority is exposed to flooding, they have to individually finance FRM measures (Kaufmann et al., 2018).

In the Rawlsian definition, it is believed resources should be redistributed to support and favour the most vulnerable in society (Davy, 1997; Kaufmann et al., 2018; Rawls, 1973). In the context of FRM, this means that those with high flood exposure as well as those who lack capacity to deal with flooding should receive support (i.e., solidarity). The last conceptualisation is the egalitarian principle, drawing attention to the importance of equal opportunities for everyone (Davy, 1997; Sen, 2010). The state provides a minimum level of flood safety and those at risk of flooding are compensated for this 'inequality' to receive the same opportunities as those not at risk (Kaufmann et al., 2018). This differs from the Rawlsian approach as it is not limited to the most vulnerable.

3. Methods

This paper explores the fairness of financial support mechanisms for PFR by analysing their distributional consequences in two distinct policy contexts: England (UK) and Flanders (Belgium). In both countries, responsibilities for FRM are devolved – within the UK to its constituent nations, and in Belgium to the regional governments. England and Flanders were selected because they represent different stages in the development of PFR support: England has a more mature system with multiple mechanisms in place, while in Flanders, support for PFR is still emerging. Here, support remains limited and localised, often restricted to a few policy initiatives. Although we do not conduct a direct comparison of the two, examining these contrasting contexts enables reflection on how varying degrees and types of financial support align with different conceptualisations of distributive justice. The objective of this paper is therefore to bring together information on the distributional consequences of financial PFR support in each context and reflect on the fairness of the mechanisms. We also aim to gain insight into best practices for strengthening justice in PFR, which may be relevant for other European countries where PFR is still new. This is important, as FRM has significant distributional effects (van Doorn-Hoekveld et al., 2016) and the shift from collective protection to PFR might negatively impact those who lack capacity to implement their own measures –

drawing attention to potentially unintended consequences of FRM policy (Lascoumes and Le Galès, 2007).

We adopted a qualitative, mixed-method approach. We first identified the financial support for PFR currently available in England and Flanders. This was done through an analysis of policy documents. In England, we analysed eight core policy documents by key FRM institutions such as Defra, the Environment Agency (EA), and Flood Re. These included national strategies and policy statements specifying goals and regulations around PFR, evaluations of grant schemes, and insurance-related policy documents. For Flanders, we consulted three relevant documents at regional and local government levels, including subsidy guidelines and project materials from the Flemish Environment Agency. The documents were selected based on their relevance to PFR support mechanisms and prominence in policy discussions. They were identified through expert knowledge within the research team or references in prior literature. The policy documents were consulted to identify and describe existing financial support mechanisms, their eligibility criteria, and underlying objectives associated with PFR. The purpose of these documents is to provide factual grounding and context to the interviews.

Semi-structured interviews were conducted to understand the practical implementation of PFR support, including their distributional consequences. A total of 12 interviews were carried out between mid-2022 and December 2024: eight in England and four in Flanders. The lower number of interviewees in Flanders reflects the early stage of PFR policy development, with fewer actors involved in the design and implementation of support mechanisms. Interviewees were selected using purposive and snowball sampling, based on their involvement in the design, administration, or evaluation of PFR-related mechanisms across public and private sectors, and included policy makers, public authorities advising on the implementation of PFR, the insurance sector, PFR manufacturers, and civil society actors. In England, interviewees represented key institutions and sectors, including the central government (Defra), regulatory agencies (EA), the insurance sector (Flood Re), civil society organisations (National Flood Forum), and PFR manufacturers or industry consultants. In Flanders, interviews were conducted primarily with representatives from regional (Flemish Environment Agency) and local government institutions where PFR support is available (e.g., municipalities, provinces). Questions were tailored to country-specific circumstances and encouraged discussion about PFR and potential distributive justice implications. The data were systematically analysed guided by three themes as per Kaufmann et al. (2018) (see Table 1): (1) Who is responsible for administering the financial support mechanism? (2) Who benefits from the support, who is eligible? And (3) who pays for PFR measures through the support mechanism? These themes structured the interview analysis, helping to identify how support mechanisms operate in practice and who may be excluded. Once these patterns were established, they were interpreted using the four conceptualisations of distributive justice proposed by Kaufmann et al. (2018), to assess how different mechanisms align with libertarian, utilitarian, Rawlsian, or egalitarian principles.

In Flanders, we also organised a workshop for PFR experts on May 31st, 2024. The goal was to reflect on insights from the English case and assess their relevance for Flemish PFR policy. Participants included representatives from the Flemish Environment Agency, municipal and

Table 1
Overview of the conceptualisations of distributive justice. Table adjusted from Kaufmann et al. (2018).

	Libertarian	Utilitarian	Rawlsian	Egalitarian
Who is responsible for FRM?	Individuals	Major flood risk impacting the majority of the population: state; minor flood risk: individuals	State for the most vulnerable	State
Who is benefitting?	Those who can afford it themselves	Protection for the ones that result in the highest benefits for society	The most flood-prone and households with limited capacity to protect themselves	Everyone has the same right to protection
Who pays for FRM?	Beneficiary pays	Collective as long as benefits exceed costs	Solidarity-based for the most vulnerable; potentially individual for those who are not considered vulnerable	Solidarity-based

provincial authorities, and private-sector consultants. Two English experts, from Flood Re and the National Flood Forum, presented their experiences with the Build Back Better initiative, prompting discussion on insurance-led PFR schemes, inequalities in access and eligibility, and barriers to more inclusive support. The workshop provided contextual perspectives that complemented the interview findings.

4. Policy context: PFR in England and Flanders

PFR is well developed in English flood risk policy (Mees et al., 2016). This may be explained by the importance of private responsibility and a restriction of government interference (van Doorn-Hoekveld et al., 2016). Flood risk managers realised early on that relying on collective flood protection was not sufficient. “In 1953, we had huge flooding in Britain [...]. At that point, the state intervened and said, ‘we are going to protect you’. [...] And then around the mid-1990s, people realised they cannot do this. It is not feasible. And since then, there has been this gradual development of shifting responsibility to homeowners” (interview, 13–10–2023). Sharing responsibility in FRM was institutionalised in the Making Space for Water policy vision in 2004 and in the National Flood and Coastal Erosion Risk Management Strategy (FCERM) in 2011. The Department for Environment, Food & Rural Affairs (Defra) published the Flood and Water Management Policy in 2020, setting out ambitions and actions around PFR. Furthermore, the Environment Agency (EA) wrote the FCERM Strategy for England, including strategies

to make the nation more resilient to flooding and coastal change by 2100, with objectives around PFR. Government funds for PFR have also increased over time. Between 2016 and 2021, the EA had £ 2.6 billion available to reduce the risk to 300,000 properties. Between 2021 and 2027, this increased to £ 5.2 billion pounds, under “the condition that we reduce the risk to 330,000 properties [...] and there are a number of PFR schemes in the programme” (interview, 01–11–2023). The shift towards individual responsibility was coupled with insurers recognising that their risk from flooding was increasing and so the status quo in the market was no longer possible (Penning-Rowsell et al., 2014), ultimately leading to the creation of Flood Re.

In Flanders, FRM is characterised by collective flood protection. Although FRM is not legally a state responsibility, the establishment of governmental FRM agencies created expectations among the public that preventing damage from floods is a government task (Mees et al., 2016). As a result, PFR is in its infancy. The Flemish government published a brochure on PFR in 2011 and has carried out pilot projects since, which focused on raising awareness (Davids et al., 2019). This was further supported by a new discourse on multi-layer water safety (MLWS) in 2012 (Kaufmann et al., 2016; Mees, 2017). Around that time, the Flemish Environment Agency conducted analyses showing the importance of PFR. “For decades, we thought, ‘we will solve it. We build dikes, flood retention areas, straighten rivers where necessary. That clearly did not work and shifted problems, meaning we really had to focus on MLWS. And that includes the protection of houses. It was partly

Table 2
Overview of the current financial support mechanisms for PFR in England and Flanders.

PFR incentive	Country	Description	Amount of funding	How it works
GiA funding for PFR	England	PFR measures are included as part of the national approach to implementing flood risk management alongside defences and other actions. Funding comes from Defra, but the scheme is administered by the EA. In 2021, the EA received a 6-year settlement of £ 5.2 billion to reduce flood risks to 330,000 properties, with multiple PFR schemes in the programme (interview, 01–11–2023).	Depends on a number of indicators, typically between £ 4,500–£ 11,500 per property (interview, 01–11–2023). No funds are paid to the individual homeowner, the authorities design and implement the scheme. Although the homeowner must agree to participate.	GiA funding is continuously available for properties in the ‘very significant’ flood risk band (interview, 01–11–2023). Recent flood experience is not required, although the implementation will need to demonstrate a certain risk reduction. There is the need to demonstrate the flood risks to a property. A survey will determine which PFR measures are implemented; however only those which prevent water from entering the property are permitted.
Defra’s PFR repair grants	England	A post-flood initiative to instigate more resilient repair after floods. The Ministry of Housing, Communities & Local Government (MHCLG) can instigate the Flood Recovery Framework after major flooding, which gives LAs the ability to seek funding from the government for expenses they are incurring to recover from flooding (Defra, 2023a). This also triggers Defra’s PFR repair grants (interview, 01–11–2023).	Up to £ 5,000 per property and is payable on receipt of evidence of the changes made to the property (CCI, 2021). No funds are paid to the individual, it is implemented via the local authority.	After nation-wide flooding, funding can be devolved from Defra to LAs if > 25 properties have been severely affected by flooding in that area (Defra, 2023a). The type of PFR measures implemented are identified based on a property survey but measures may include both resistance and recoverability.
Flood Re’s BBB	England	Aiming to encourage more resilient repair post flooding. Flood Re is a re-insurance scheme. Insurers can cede properties with the highest flood risks to Flood Re to ensure affordability of the flood part of household insurance (Flood Re, n.d.a). BBB aims to reduce costs from flood damage by providing financial support for PFR.	Property owners can receive up to £ 10,000 on top of their damage claim to repair and resiliently rebuild their homes (Flood Re, n.d.a). No funds are paid to the individual, the scheme is administered via the insurance claim.	Funding is available to property owners who experienced recent damage from flooding and whose case has been ceded to Flood Re. The type of PFR measures implemented will be identified based on a survey of the property, but may include both resistance and recoverability measures.
Flemish subsidies	Flanders	No funding is provided from the regional government, but municipalities and provincial governments can provide subsidies to (partly) cover PFR implementation. This is the case in the Municipality of Geraardsbergen and the Province of Flemish-Brabant.	In Geraardsbergen, the subsidy covers up to 50 %, with a max. of €250 per property (Gemeente Geraardsbergen, n.d.). Individuals pay up front costs and reclaim funds. In Flemish Brabant, the subsidy covers 50 % of the costs, up to €7,500 per property (Provincie Vlaams-Brabant, n.d.). Some funds can be received prior to conducting works with the remain claimed post-implementation. All costs are paid by the individual	Applications are run through the municipal government, even for the provincial subsidies (Provincie Vlaams-Brabant, 2023b). They are available to homeowners without recent flood experience, but eligibility criteria apply. All PFR measures to prevent flooding are eligible for both mechanisms.
Individual initiatives	Both	Homeowners can implement PFR measures without financial support. In this case, they are responsible for covering the full cost of the measures. This does not happen often, as people are reluctant to pay for PFR.		N/A

stimulated by contacts we had with the UK" (interview, 29-07-2022). Since then, the discourse on PFR was strengthened, but clear statements from the government on the responsibility of citizens in FRM are rare (Mees et al., 2016). The Flemish government aims to further develop its policy on PFR through, amongst other things, financial support.

5. Results

5.1. Financial support for PFR

Financial support for PFR can include grants, subsidies, instalment payments to spread costs, and insurance mechanisms to retrofit PFR into a recently flooded property (Beddoes and Booth, 2011; Hudson, 2020; Hudson and Thaler, 2023; Priest et al., 2016). Various examples of these types of financial support mechanisms are available in England and Flanders (see Table 2). The mechanisms differ in the way they work and the amount of funding that is provided – and thus to what extent the costs of PFR measures are (fully) covered. An English PFR expert estimated it costs £ 10,000–£ 12,000 to fit a property with the right PFR measures (interview, 31-10-2023; 11-01-2023).

In England, following the Easter 1998 and Autumn 2000 floods, individuals who repeatedly flooded started to implement PFR to reduce future disruption. From 2008 onwards, there have also been various pilots implemented in Local Authorities (LAs) (e.g., Appleby, Chew Magna, Uckfield, Nottingham, Morecombe) to explore and evaluate the potential of different types of interventions (e.g., Defra, 2008a, 2008b; Harries, 2009; May, 2012; May et al., 2014; Thurston et al., 2008) and their cost effectiveness (e.g., Keating et al., 2015; May and Chatterton, 2012; Stevens and Chatterton, 2012). Pilots were often small scale and focused on areas which had flooded recently; however, they were undertaken post-reconstruction. Following flooding in 2013–2014, Repair and Renew Grants (precursor to Defra's Property Flood Resilience (PFR) repair grants, see below) were initiated aiming to lead to more resilient reinstatement and the implementation of PFR during reconstruction (similar approach to current schemes).

At present, there are two main types of funding from the UK government: the Grant-in-Aid (GiA) funding for PFR and Defra's Property Flood Resilience (PFR) repair grants. In the context of the FCERM Strategy, the EA receives funding from Defra as GiA (Defra, 2023b). The EA can spend this money directly on managing flood risks or pass some funding on to LAs. PFR is now one of the measures that can be funded by GiA and, as such, property adaptation can be included (alongside other more traditional approaches to FRM such as defences). Although the funding comes from Defra, the EA administers this scheme and the measures implemented will be determined based on technical assessments of the risk. Where an approach to managing risk recognises the potential for PFR measures to be included, a survey will be conducted to identify a set of bespoke measures (e.g. flood doors, barriers, non-return valves, etc.) which will be utilised on each property and the homeowner will need to agree to participate. The specific PFR products need to meet minimum quality standards and will be implemented and tested by EA recognised suppliers and, currently, for this scheme, only measures which prevent water from entering the home (i.e., resistance measures) are permitted. The homeowner is somewhat of a passive recipient in the process. They will not receive any funds, nor be required to organise actions, although they need to approve and agree with the plans.

Defra retains a portion of its government funding for FCERM, which is used – amongst other things – for their PFR repair grants (Defra, 2023b). These are funds which can be applied post-flooding to add to insurance funding, to ensure that when a property is repaired it is more resilient to future flooding. Similar to the GiA funding for PFR, this approach requires the agreement of the homeowner but will largely be implemented by LAs working alongside insurers. A survey of the property will be undertaken as part of the process and the best way to spend the grant provided will be determined, discussed with the homeowner, and implemented. Measures might include those which would prevent

water from entering a property but also those adaptations through the use of more flood resilient materials which would reduce future damages and disruption (i.e., recoverability).

In addition to government funding, there is currently also a financial mechanism instigated by the English insurance sector to retrofit PFR measures into flooded properties. Flood Re, a joint initiative between the UK government and insurers, aims to ensure the affordability of flood insurance, so that those who otherwise would not be able to afford insurance can continue to obtain it (Flood Re, n.d.a). To achieve this, they have launched Build Back Better (BBB) which stimulates individuals and businesses to implement PFR after flooding (Hampton and Curtis, 2022). The BBB approach is somewhat similar to the Defra PFR repair grants in that it aims to bridge the gap between the cost of putting a property back to its previous state after flooding and delivering a resilient reinstatement. However, the approach is more integrated with the flood insurance system with the funding coming from Flood Re, who work directly with insurers. This approach will consider a mix of resistance measures to prevent water from entering a property, alongside recoverability measures to reduce the future susceptibility of the property to damage.

In Flanders, the regional government previously funded pilot projects aimed at raising awareness and advising on the PFR measures most suitable for a property (Davids et al., 2019). At present, subsidies for PFR installation are only available in two areas: in the municipality of Geraardsbergen and in the Province of Flemish Brabant. The amount of funding varies per location and no regional-level financial support for PFR is currently available. In Geraardsbergen, residents across the municipality are eligible for funding covering 50 % of the costs of approved 'water-protective' measures, with a maximum of €250 per address. Permitted measures include flood barriers, water-resistant doors and windows (i.e., resistance) but also non-return valves and in exceptional cases, water pumps (i.e., recoverability) (Gemeente Geraardsbergen, n.d.). Homeowners carry the full responsibility for initiating, organising, and documenting the implementation process, and need to provide proof such as purchase receipt and photographs of the implemented measures in the subsidy application. In Flemish Brabant, the process is similar although homeowners can receive a higher subsidy: up to €7,500 (maximum of 50 % of the estimated costs). To be eligible for funding, the property must be located in a municipality that has adopted local subsidy regulations for PFR. A water safety assessment (in Dutch: *waterveiligheidsstudie*) also needs to be conducted for the property (Provincie Vlaams-Brabant, 2023a). Upon approval of the subsidy application, 50 % of the awarded amount is paid in advance; the remaining 50 % is paid after verification of the completed works. Both resistance and recoverability measures are permitted under the subsidy arrangement.

5.2. PFR and justice: distributional outcomes of financial support

The financial support mechanisms for PFR in England and Flanders have distributional effects and therefore raise justice concerns. Following Table 1, we further characterise the mechanisms based on three questions: (1) Who is responsible for administering the financial support mechanism? (2) Who benefits from the support, who is eligible? And (3) who pays for PFR measures through the support mechanism? A comprehensive overview of the answers to these questions is given Table 3. The subsequent text highlights critical justice elements associated with the PFR support mechanisms, building on the information in Table 3.

5.2.1. Pre- vs. post-flood support and accessibility

The mechanisms can be divided into pre-flood and post-flood support. Pre-flood support refers to schemes available to homeowners without flood experience. It is often still necessary to provide evidence of the flood risk to a property – for which previous flood experience can be an important measure. However, flooding does not need to have happened recently (interview, 01-11-2023). We consider the GiA funding for PFR and the Flemish subsidies as pre-flood support. Both

Table 3

Distributional impacts of financial support mechanisms for PFR, with specific attention to who is responsible for the scheme, who benefits and who does not, and who pays for the PFR measures. Table adjusted from Kaufmann et al. (2018).

Individual initiatives	
Who is responsible?	Individual property owners.
Who benefits from the support? Who is eligible?	Those who benefit will be homeowners with sufficient capacity to implement PFR measures. This does not solely depend on the availability financial means. Other determinants will be related to, for example, age, knowledge and information on the topic, sociocultural background, networks with neighbours, type of property or floods experienced, etc.
Who pays for PFR measures?	Individual property owners.
Pre-flood support	
GiA funding for PFR	
Who is responsible?	EA, but LAs also have a role to play in demonstrating the risk to a particular property for it to be eligible for the funding.
Who benefits from the support? Who is eligible?	Those who benefit will be homeowners at 'very significant risk' of flooding, meaning the property is at risk of flooding in the 5 % probability event or greater, or 1 in 20 return period (interview, 01–11–2023). The risk to the property must be demonstrated, for example, through showing evidence from previous flooding – but the flooding does not have to be recent. Other measures can also be used to demonstrate the risk.
Who pays for PFR measures?	The EA receives funding from Defra in the context of the FCERM Strategy (Defra, 2023b), which can be used for PFR schemes. The amount of funding available for a PFR scheme is based on Partnership Funding. This means that the EA provides part of the funding, but other sources need to be brought in from, for example, local communities, businesses, developers, or local councils (EA, 2023). There are three main elements that determine the amount of funding for PFR: (1) type of property, (2) type of risk and (3) social deprivation – this means that areas that are more deprived can qualify for more funding. There are no upfront costs for homeowners.
Flemish subsidies	
Who is responsible?	Municipal/provincial governments administer the subsidies, homeowners are responsible for applying for the subsidies.
Who benefits from the support? Who is eligible?	Those who benefit will be homeowners in an area where the subsidies are provided. Subsidies are only available in a limited number of municipalities throughout Flanders leading to spatial inequalities. Subsidy availability often depends on the severity of the risks experienced (interview, 28–07–2023). Additionally, there is often an extensive list of criteria to be eligible for a subsidy. In Flemish Brabant, for example, the homeowner should receive official approval by their municipal authority for the project and subsidy application; the area where the measures are implemented should be identified in the municipal rainwater and drought plan as an area in need of PFR; the subsidy applies to residential properties only; the property must comply with environmental or urban development permits; flood risk assessments need to be available for the properties before PFR measures are installed; the properties must be disconnected from the sewerage system; the required permits are obtained before construction works are started; and properties applying for the subsidies have not received PFR subsidies before (Provincie Vlaams-Brabant, 2023a). In Geraardsbergen, associations with non-commercial purposes (e.g., schools) are also eligible for the subsidy; the measures have to contribute to reducing flood risk to the property and costs have to be at least €150; however, the subsidy can only be awarded based on proof consisting of pictures of the installed measures and original purchase/installation receipts must be provided (which have to be from after 13/11/2010) (Gemeente Geraardsbergen, n.d.).
Who pays for PFR measures?	Subsidies are paid by the municipal/provincial government, but the money ultimately comes from taxpayers. Important to note here is that the Flemish subsidies are quite low and so it is to be expected homeowners need to contribute a significant sum of money themselves. In Flemish-Brabant, 50 % of the awarded subsidy amount can be covered upfront by the provincial government – the other half must be paid upfront by the homeowner (Provincie Vlaams-Brabant, 2023a). In Geraardsbergen, all costs must be paid upfront by the homeowner.
Post-flood support	
Defra's PFR repair grants	
Who is responsible?	MHCLG instigates the Flood Recovery Framework which also triggers Defra's PFR repair grants. LAs play an important role in administering the scheme. Homeowners are responsible for applying for the grant, of which the process differs per LA (interview, 30–11–2023).
Who benefits from the support? Who is eligible?	Those who benefit will be homeowners who have been impacted by significant, nation-wide flooding and live in an area where at least 25 properties have been affected (interview, 01–11–2023). Other factors determining eligibility include: the water must have entered the habitable part of the property (the property must be inhabited); there is only one grant available for homes that are shared; caravans and uninsured homes are eligible, as long as it is private accommodation; garages, outhouses, basements, cellars, and storage areas are not eligible; and properties flooded from sewerage systems are not eligible. Important to note is also that properties that have had resistance measures installed through a previous grant and have since flooded are still eligible (CCI, 2021).
Who pays for PFR measures?	Defra provides the funding for PFR measures, up to £ 5,000. However, the money is ultimately coming from taxpayers. Important to note here is also that the grant is not paid upfront. The £ 5,000 is payable on receipt of evidence of the changes made to the property (CCI, 2021). It is possible for LAs to pay the money upfront to help people who can't afford PFR, but in practice LAs often do not do that. The property owner invests the money and claims it back from the LA who claims it from Defra (interview, 31–10–2023).
Flood Re's BBB	
Who is responsible?	Flood Re, with homeowners being responsible for filing their claim.
Who benefits from the support? Who is eligible?	Those who benefit will be homeowners who have flood insurance and who's case has been ceded to Flood Re. For renters, it is much more complicated – if not impossible, to receive funding. Other eligibility criteria include: the holder of the insurance policy (or immediate family) must live in the property for some or all of the time; homeowners have a Council Tax bands A to H (or equivalent); the property is used for residential purposes; properties are a single residential unit or a building comprising two or three residential units; the property is insured on an individual basis; the property was built before 1 January 2009; the property is located in the UK – excluding the Isle of Man and the Channel Islands (Flood Re, n.d.c). The website also includes properties expected to not fulfil the eligibility criteria.
Who pays for PFR measures?	Funding for Flood Re comes from three sources: (1) the government imposes a statutory levy on all insurers offering home insurance in the UK (Hampton and Curtis, 2022); (2) when a property is ceded to Flood Re, the insurer is also charged a fixed premium, based on the property's Council Tax band keeping the price of the policy down; (3) there's a limited excess of £ 250 per policy (Flood Re, n.d.b). All three sources are paid by insurers, although some of it may be passed through to policyholders (personal communication, 11–07–2024).

types of funding are continuously available, whether a flood event has occurred or not. Post-flood support includes schemes that are only administered after flooding has occurred, and the money is intended to retrofit PFR into a property that has recently been damaged by flooding. Defra's PFR repair grants and Flood Re's BBB scheme are key examples.

The distinction between pre- and post-flood support is important as it influences who can access the schemes and, therefore, benefits. For example, Defra's PFR repair grants are only available to those who have been impacted by significant, nationwide flooding and live in an area where at least 25 properties are affected – excluding those who have not recently experienced flooding or are, for example, the only household in a particular area whose property flooded. Similarly, BBB funds are only available to those who have suffered damage after flooding, and subsequently have filed a damage claim with an insurer who ceded their policy to Flood Re. Those without insurance do not benefit, and as the name of the scheme suggests, its aim is to build back better after flooding; meaning those without flood damage are not eligible. In terms of distributive justice, a benefit of pre-flood support is that it is continuously available to all homeowners. However, eligibility criteria can still vary. The GiA funding, for example, is only available to properties at 'very significant risk' of flooding (5 % probability event) for which sufficient evidence needs to be available (interview 01–11–2023); meaning those at lower risk of flooding cannot benefit. Similarly, strict eligibility criteria apply for the Flemish subsidies. For example, properties in flood risk areas must be identified as 'in need of PFR' in plans and policies and the subsidies are only available to residential properties. An overview of all eligibility criteria of the financial support mechanisms can be found in [Table 3](#).

5.2.2. Spatial differences in availability of financial support

The support mechanisms do not only differ in terms of their pre- and post-flood accessibility and eligibility criteria. There are also differences in the way the schemes are administered, resulting in negative distributional outcomes. For example, the process through which Defra's PFR repair grants are made available is complicated, and its availability depends on the capacity of LAs to administer the schemes:

"It relies on (1) the government announcing that it is going to happen [...] and on (2) LAs having informed Defra of the number of properties that have flooded within their area. [...] So once Defra have that list, they will then (3) invite those LAs to say whether they want to be a part of this scheme or not. [...] Now, the LA has to then (4) have the resources, so the people, to be able to actually administer the scheme. [...]. The LA has to bear all those costs themselves. If the LA decides it's going to do it [...] then (5) they have to advertise it to the properties that are flooded. The homeowners (6) [...] have to opt into the scheme, and then it's this kind of protracted to and fro between the LA and the homeowner about what measure is appropriate and what will be funded. (7) The LA has to fund those measures initially, and then they send a bill to Defra once a quarter to get their money back" (interview, 01–11–2023).

Naturally, this may lead to situations where the scheme is only available in some places. Furthermore, "with LAs, the level of knowledge and capacity is not always great, so some authorities do a good job, whereas others do not" (interview, 31–10–2023). This contributes to spatial differences in the availability and quality of Defra's PFR repair grants, raising fairness questions. LAs play a comparatively smaller role in administering the GiA funding, where their main task is to demonstrate the flood risk to a property.

Similarly, in Flanders, the PFR subsidies are not universally available across the region. PFR in Flanders is still in its infancy. There have been pilot projects to stimulate PFR uptake initiated by the Flemish Environment Agency: "we first started in three pilot areas. [...] We noticed people were quite enthusiastic about the initiative, so we selected three additional municipalities [...]. Why did we choose these? Because they are towns very prone to flooding" (interview, 29–07–2023). The Province of Flemish Brabant provides subsidies to support homeowners in PFR implementation, however, the subsidy "only applies to five

municipalities in the whole province. And that is of course a form of inequality. The five municipalities were selected based on the heavy flooding that occurred at certain times. But there are other municipalities where there has also been serious flooding [...]. It was impossible to change the regulations and make the subsidy available in all municipalities in the province, despite advice from our legal department that the principle of equality is actually violated" (interview, 29–09–2021).

5.2.3. Consideration of the capacity to implement PFR

Active consideration of differences in the capacity of people to implement PFR is rare in England and Flanders; however, some examples were found. The first relates to the way in which GiA funding for PFR is calculated. The level of funding is determined by Partnership Funding which requires other sources to contribute in addition to central funds (EA, 2023). The amount of government funding is based on three main elements: flood risk, type of property, and social deprivation. As explained by an EA interviewee: "we took the Partnership Funding calculator, and we looked at a typical PFR scheme, and started changing different dimensions of the calculator [...]. We found that some made a big difference in the amount of funding provided. So, social deprivation made a big difference. [...] But actually, a lot of other things didn't make too much of a difference to the amount of government funding that you could get. So, what we essentially did was, we said: 'OK, we'll just put default values in for all those things, and the only variables will be these three things'" (interview, 01–11–2023). This means that areas considered as socially deprived can receive more funding for PFR. Deprivation is determined by examining income, employment, education, health, crime, barriers to housing and services, and living environment (UK Government, 2019).

Flood Re also contains elements that aim to consider differing capacities to afford insurance. The scheme was established to ensure affordability and availability of insurance to those who could not obtain it if pricing were purely risk reflective. Furthermore, premiums for policies ceded to Flood Re are calculated based on the Council Tax band (A through H). The Council Tax bands reflect the value of the property: "we have a crude structure for home insurance and floods where we price it by Council Tax band. And that's because it is meant to be reflective of differences in affordability" (interview, 30–11–2023). This means that those with higher Council Tax bands are charged a higher premium than those in lower bands. However, property value is not a direct indication of people's capacity to afford insurance, as some might own a property with a high value but have little direct income to spend (i.e., asset rich and cash poor). Retired individuals on fixed pensions fall into this category and with increasing living costs across Europe, many others may be in this situation. "If you think about variation in people's 'take-home' income, and the variation in claim costs by region across the UK, affordability can mean different things in different places [...]. I think we charge the same price for a Council Tax band A property in central London as a band A property in a small village in Wales. But if those two properties filed a claim after flooding, the costs for us would be much higher in central London. So, is that fair?" (interview, 30–11–2023).

In Flanders, in the Province of Flemish Brabant, flood risk managers considered making the subsidies income-dependent, "so people with a limited income could receive more funding, in percentages. [...] But that proposal was not accepted, based on the argument that with the number of yearly subsidy applications – we are aiming for 50–60 per year – it would be too much of an administrative burden [...] even though we see that the cases where the maximum of €7,500 is paid out, they are often large, spacious houses – the villas" (interview, 29–09–2021). Although 50 % of the awarded subsidy amount can be given to homeowners upfront, reducing the amount that people need to pay out of pocket, it is not inconceivable that some may still lack the financial capacity to cover the costs of PFR. There is also the question of property ownership and quality, which are important determinants of the capacity of people to deal with flooding. "If you are a tenant, you are reliant on your landlord.

If you are poor, or maybe not poor, but aren't rich, you can't afford this stuff. And you can't afford to maintain it either [...] If you live for example in a row of terraced houses, unless all your neighbours do it, PFR is a waste of time. [...] And if the quality of your house is poor [...] then PFR does not do much good" (interview, 13–10–2023).

5.3. Summary of justice-relevant patterns

The above results reveal a range of justice-relevant patterns in the financial support mechanisms for PFR. Across both contexts, there are clear differences in who benefits from the support, how eligibility is determined, and who ultimately bears the costs of resilience measures. For example, schemes such as Defra's PFR repair grants and Flood Re's BBB initiative are only available to those who have already experienced flooding, thereby excluding those at high risk who have not yet been affected. In Flanders, the limited spatial coverage of subsidies – financial support is only available in select municipalities – raises concerns about unequal access based on location. Meanwhile, the design of the support mechanisms rarely accounts for differences in people's financial capacity, potentially disadvantaging lower-income households. These patterns point to structural inequalities in the distribution and accessibility of financial support. While some mechanisms enable risk reduction for certain groups, others risk reinforcing existing inequalities and shifting responsibility to those least able to carry it. In the discussion, we interpret these findings using the four perspectives on distributive justice to better understand the fairness of financial support mechanisms for PFR and their implications for future policy design.

6. Discussion

The results show that the examples of financial support mechanisms for PFR across England and Flanders are established in different ways, leading to differences in who is responsible for the scheme, who benefits from support, and who pays for measures (see Table 3). We specifically highlighted how the timing (pre- or post-flood) and geographic distribution of availability, and the extent to which people's capacity to implement PFR is considered, shape the accessibility of support. By comparing their institutional design and accessibility, we assessed how these mechanisms distribute responsibility and resources. In the next sections, we reflect on these findings in light of the research objective – to assess the fairness of financial support mechanisms for PFR – and link them to broader perspectives on distributive justice.

6.1. Linking PFR support to conceptualisations of distributive justice

To interpret the fairness of the financial support mechanisms, we draw on the four conceptualisations of distributive justice in FRM presented in Table 1. These perspectives serve as analytical tools to understand who is expected to act, who benefits, and whose needs are recognised within current support schemes. Homeowners can decide to implement PFR on their property without financial support (i.e., individual initiatives). In this case, homeowners are fully responsible for covering PFR costs, leading to situations where only those with sufficient financial, social, or cultural capacity can implement the measures, i.e., 'elitist' outcomes. This finding aligns with the libertarian principle of distributive justice and illustrates how, in the absence of financial support, homeowners carry the burden of implementing PFR on their own (Kaufmann et al., 2018). This can disproportionately benefit those with greater capacity to implement the measures, while those without sufficient financial means, but also those without knowledge of PFR or connections to PFR manufacturers, for example, are left behind and are less well-protected to future flooding (Forrest et al., 2020). Without financial support, PFR can reinforce existing inequalities in society – raising serious justice concerns.

While the financial support mechanisms in England and Flanders have varying distributional outcomes, they mainly align with one

conceptualisation of justice. The existing support is largely available in areas with recent flood experience and high risks, or where flood risks outweigh the cost of financially supporting homeowners in PFR implementation. The mechanisms therefore align with a utilitarian perspective on distributive justice. While the GiA funding in England has an in-built Rawlsian justice element – the Partnership Funding calculator favours areas of social deprivation, meaning that these areas can receive more funding (EA, 2023; Kaufmann et al., 2018) – this is only a small part of the scheme. Funding is also determined based on property type and type of risk, and there are eligibility criteria that exclude groups from benefiting. The GiA funding is continuously available to properties 'at significant risk of flooding', which are prioritised for funding as the costs of flood damage will outweigh the costs of PFR. This raises questions around support for socially deprived households who experience lower flood risks or a type of flood risk that is not prioritised, but who nevertheless have insufficient capacity to deal with those risks. The GiA scheme reflects an objective to maximise flood risk reductions to prioritise societal benefits which aligns with the utilitarian principle (Kaufmann et al., 2018).

The Flemish subsidies and Defra's PFR repair grants are unevenly available across regions, leading to geographic inequalities in access. In Flanders, subsidies are only available in a handful of municipalities where flood risks are most significant, often in areas where PFR pilot projects have previously been conducted. This leads to spatial differences in the ability of homeowners to access funding, excluding some whilst benefiting others. Strict eligibility criteria also often apply. In the rest of Flanders, where flood risks are lower, homeowners are responsible for funding their own PFR measures. As government funding for PFR is directed towards those areas where risks are highest and therefore seen as a collective problem, this also aligns with the utilitarian conceptualisation (Kaufmann et al., 2016). Similarly, Defra's PFR repair grants are available after significant, nationwide flooding where more than 25 properties in a LA are affected. LAs are also involved in scheme administration, leading to differences in availability and quality of implementation. This means that, like the Flemish subsidies, Defra's grants are only available in a small number of areas – often where risks are high and where potential reductions in damage costs are significant. If a majority of people are impacted by a flood, they are eligible for the grants, but if a minority is impacted, they are not. This is another example of resources being distributed in such a way as to achieve maximum societal benefits (Kaufmann et al., 2016). The Flemish subsidies and Defra's PFR repair grants exclude groups from benefiting which may reinforce inequality.

The last support mechanism is Flood Re's BBB, available post-flooding. The literature describes that in general, insurance mechanisms fit with the utilitarian perspective as funds are pooled to ensure the greatest return to policy holders (Thaler and Hartmann, 2016). BBB aims to consider differences in the capacity of people to afford insurance by determining premiums based on Council Tax bands (i.e., a Rawlsian element, Kaufmann et al., 2018). However, only those with insurance benefit from BBB, and the insurer needs to have ceded that particular property to Flood Re for the homeowners to be eligible. Deprived households (who cannot afford insurance) or tenants cannot benefit from insurance-based support for PFR (Penning-Rowsell and Priest, 2015), which again excludes those who may need the financial support most. The findings suggest that while current support mechanisms in England and Flanders aim to build resilience at the property level, their design reflects utilitarian principles that prioritise areas with highest risks or largest affected populations – thereby overlooking those with limited capacity to assume responsibility for PFR. This illustrates how the schemes fall short, especially when assessed through a Rawlsian distributive justice lens.

6.2. Fairness of PFR in FRM

The above shows that financial support for PFR in England and

Flanders mainly aligns with a utilitarian justice perspective. We have illustrated that, as a result, support is not universally available, and many people cannot access the funding. For example, tenants do not own the property they live in, making it more difficult for them to implement PFR measures. This aligns with previous research (Isunju et al., 2016). Another example, relevant in the context of Flood Re's BBB, is that those without insurance will not be able to benefit from the scheme, and the emotional strain and distress associated with facing flooding without insurance is significantly higher (Hampton and Curtis, 2022). Flood experience is also an important criterion to be eligible for funding, such as in Defra's PFR repair grants, excluding those who may face significant future flood risks but have yet to be flooded. And even with the availability of financial support, there may still be upfront costs for homeowners – such as in Defra's PFR repair grant and the Flemish subsidies. This impacts the ability of homeowners to implement PFR and benefit from the schemes. Lastly, the scale at which PFR is implemented raises fairness questions. Collective flood protection, such as embankments, generally protect a community, neighbourhood, or city from flooding. It provides societal benefits as collective flood risks are reduced. PFR is implemented at the property level with direct benefits for the owner, such as a potential increase in property values, continued mortgageability, and reduced insurance premiums and excesses – on top of flood risk reductions (The Flood Hub.. n.d.). One can question whether this is fair, as those who do not have the capacity to implement PFR do not only continue to face flood risks, but they also do not accrue these additional benefits.

In short, our analysis shows that current financial support mechanisms for PFR tend to privilege those with sufficient financial, social, or cultural capacity to deal with flooding, while offering limited assistance to those who are most vulnerable and lacking in capacity. This reinforces rather than mitigates underlying social inequalities – which is a key concern in light of just and inclusive climate change adaptation. Not everyone benefits from financial support for PFR and some are disproportionately burdened by the shift from collective to individual responsibility in FRM (Doorn, 2016). This can reinforce inequalities, leading to a situation where deprived communities are less well protected against future flooding (Paauw et al., 2024). As an interviewee explained, “there is a circular link between poverty and flooding. Someone who has a poor-quality house, who is maybe a tenant, and has not got the resources, or may not be insured... If they flood, the costs to get back on their feet – emotionally, timewise, resource-wise – are much greater than if you have someone who is better off and perhaps has insurance. And this also means that they are in a poorer state when they flood, so it just goes round and round and round” (interview, 13–10–2023). Currently, there are few options to assist residents in these situations. This raises questions around the fairness of PFR in FRM more generally.

Considering the differing capacities of people to implement PFR, it is relevant here to link the discussion to the capabilities approach. The approach draws attention to potential mismatches between people's desired functionings and their ability to achieve them (Sen, 2001). Importantly, the capabilities approach can also be used as a normative framework (Robeyns, 2005). It states that something cannot be considered as ‘just’ if it limits the capabilities necessary to achieve a functioning (Schlosberg, 2012). Furthermore, the approach underlines the importance of real outcomes for people as a basis for judging the fairness of, for example, a policy or scheme (Day, 2017). Climate impacts, such as flooding, have been recognised as significantly impacting people's capabilities to achieve their desired functionings (Schlosberg, 2012). Following this reasoning, a mismatch between the ‘ideal’ of widespread PFR implementation and the reality of people's differing capacities to do so could be considered as unfair. This, in turn, provides a basis for redesigning support mechanisms to specifically facilitate and empower those who cannot implement PFR themselves, to ensure that they can also achieve their desired functionings and are protected against future flooding (Alexander et al., 2016; Gross and Wilson, 2020);

whilst also still facilitating and encouraging those who are able to self-implement.

This reflects broader tensions within climate change adaptation and especially the trend toward responsabilisation and individualised resilience. It has been argued that adaptation and vulnerability research insufficiently engage with socio-political dimensions and processes can reinforce vulnerability over time (Eriksen et al., 2015). Others have suggested that the interest in strengthening resilience in both policy literature and practice aligns with governance rationalities that shift risk management away from the state – while overlooking the structural inequalities and unequal capacities of individuals to adapt (Joseph, 2013). While PFR is often framed as a pragmatic solution to the limits of collective flood protection, the current approach to implementation risks reinforcing inequality by overlooking the capacity of homeowners to actually implement the measures. This underlines key insights from both the capabilities approach and the environmental justice literature: strategies to strengthen resilience should not only be based on efficiency or effectiveness in terms of risk reduction, but also on their social consequences and ability to empower those who need the most support. It also resonates with broader theoretical critiques (from, for example, political ecology) that efforts to strengthen resilience, such as PFR, can be technocratic and depoliticised – which can unintentionally reproduce inequality when implemented without sufficient attention to differing capacities of vulnerable groups (Watts, 2015).

6.3. Policy implications

We are therefore inclined to suggest that differing capacities to implement PFR need to be recognised for the shift from collective flood protection to individual responsibility in FRM to be fair, underlining the importance of recognition justice (Martin et al., 2013; Schlosberg, 2004). Support mechanisms could distinguish between those who can individually afford PFR and protect themselves, and those who do not have the capacity to do this. Specifically targeting groups who lack the capacity to deal with flooding aligns with previous research underlining the importance of recognition for fair FRM (Paauw et al., 2024). It can also be linked to the Rawlsian conceptualisation of justice, where specific attention should be attributed to those who are considered ‘most vulnerable’, determined by the level of risk experienced and by someone's socioeconomic and demographic background (Kaufmann et al., 2018). This underscores that fairness in FRM requires systemic attention to diverse needs and capacities – not just financial but also social and structural, such as age, knowledge of PFR, social networks, property type and ownership (Coninx and Bachus, 2007; Fielding and Burningham, 2005; Foster et al., 2019; Norris et al., 2008; Walker and Burningham, 2011) to avoid reinforcing existing inequality.

Building on this need to recognise differing capacities to implement PFR measures, our findings suggest several actionable policy recommendations to ensure PFR support mechanisms are not only effective, but also fair and inclusive. Firstly, eligibility criteria for financial support should not only rely on past flood events but also consider future risk exposure and changing capacities of people to implement the measures. Secondly, the support mechanisms could be designed with accessibility in mind, ensuring that administrative complexity, or for example upfront costs, do not prevent those most in need from accessing support. Thirdly, attention should be attributed to renters and others who do not own the property they reside in, as they are often excluded from current schemes despite facing flood risks. By explicitly recognising and addressing such structural barriers and varied capacities, policymakers can design financial support mechanisms that ensure no one gets left behind in the shift to more PFR in FRM.

7. Conclusion

This paper investigated the distributional fairness of financial support mechanisms for PFR in England and Flanders. We found that the

distinction between pre- and post-flood support is important, as it has implications for who can access the funding. Furthermore, the schemes often have strict eligibility criteria and differ in the way they are administered, leading to spatial inequalities in their availability. Our results show that the support mechanisms mainly target areas where flood risks are significant, or where potential damages outweigh the costs of funding PFR. This aligns with a utilitarian justice perspective. However, this also means that not everyone can benefit from the support. Some groups are systematically excluded, including tenants, those with insufficient financial capacity, and those without insurance. This is problematic as approaches to providing PFR can reinforce existing inequality. Financial support for PFR should be applauded, as without this implementation is likely to result in elitist outcomes. Greater attention to PFR and drivers to mainstream it are also likely to introduce greater economies of scale, a more competitive market, innovation, and cost reductions for all. However, more attention should be attributed to who benefits from the funding and who is excluded. We found that the support mechanisms favour those who experience the highest flood risks – even though the need for support is also determined by socioeconomic and demographic characteristics. Therefore, we suggest that differing capacities to implement PFR need to be actively recognised and that funds should be directed to those who need it most. This is required to empower those who cannot implement PFR on their own, to prevent disproportionate burdens on socially deprived communities, and to strengthen the distributive fairness of PFR.

While the geographical focus of this paper is limited, England and Flanders were deliberately selected to reflect differing stages of PFR policy development. This contrast enables a broader reflection on how financial support mechanisms shape justice outcomes in both established and emerging PFR contexts. The lessons learned from the analysis are also applicable to other countries where PFR is in the beginning stages. However, future research should explore the distributional effects of support for PFR in other countries too. Furthermore, we have specifically looked at financial support, but someone's capacity to implement PFR is not just determined by financial means. It is therefore also important to investigate other support for PFR (e.g., strengthening knowledge and awareness, building social networks, etc.) and whether these campaigns reach the most vulnerable. We recommend future research to also examine these dimensions.

CRedit authorship contribution statement

Mandy Paauw: Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Sally Priest:** Writing – review & editing, Writing – original draft, Funding acquisition, Data curation, Conceptualization. **Ann Crabbé:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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Data availability

The authors confirm that the data supporting the findings of this study are available within the article. Raw interview data are not publicly available due to privacy or ethical restrictions. Additional data is available through reports published in the repositories of the involved universities after the SOLARIS project ends.

References

- Adebimpe, O.A., Proverbs, D.G., Oladokun, V.O., 2021. A fuzzy-analytic hierarchy process approach for measuring flood resilience at the individual property level. *Int. J. Build. Pathol. Adapt.* 39 (2), 197–217. <https://doi.org/10.1108/IJBPA-10-2019-0094>.
- Adedeji, T.J., Proverbs, D.G., Xiao, H., Oladokun, V.O., 2018. Towards a conceptual framework for property level flood resilience. *Int. J. Saf. Secur. Eng.* 8 (4), 493–504. <https://doi.org/10.2495/SAFE-V8-N4-493-504>.
- Alexander, M., Priest, S., Mees, H., 2016. A framework for evaluating flood risk governance. *Environ. Sci. Policy* 64, 38–47. <https://doi.org/10.1016/j.envsci.2016.06.004>.
- Attems, M.S., Thaler, T., Genovese, E., Fuchs, S., 2019. Implementation of property-level flood risk adaptation (PLFRA) measures: choices and decisions. *Wiley Interdiscip. Rev. Water* 7 (1), e1404. <https://doi.org/10.1002/wat2.1404>.
- Beck, U., 2006. Living in the world risk society. *Econ. Soc.* 35 (3), 329–345. <https://doi.org/10.1080/03085140600844902>.
- Beddoes, D.W., Booth, C.A., 2011. Property level flood adaptation measures: a novel approach. *Int. J. Saf. Secur. Eng.* 1 (2), 162–181. <https://doi.org/10.2495/SAFE-V1-N2-162-181>.
- Cañizares-Gaztelu, J.C., Copeland, S.M., Doorn, N., 2024. Assessing the capability approach as a justice basis of climate resilience strategies. *J. Glob. Ethics* 1–25. <https://doi.org/10.1080/17449626.2024.2338349>.
- CCI. (2021). *Chartered Insurance Institute. Defra Flood Resilience and Resistance Grant*. Retrieved from (https://www.cii.co.uk/media/10125636/coh_j012904-new-gen-claims-flood-resilience-grants-pl.pdf) Accessed on 29-05-2024.
- Christensen, J.H., Christensen, O.B., 2003. Severe summertime flooding in Europe. *Nature* 421 (6925), 805–806. <https://doi.org/10.1038/421805a>.
- Coninx, I., Bachus, K., 2007. Integrating social vulnerability to floods in a climate change context. Retrieved April 10 (2009).
- Davids, P. (2021). *Rethinking floodlabel: a situational approach to homeowner involvement in flood risk management* Ghent University].
- Davids, P., Boelens, L., Tempels, B., 2019. The effects of tailor-made flood risk advice for homeowners in Flanders, Belgium. *Water Int.* 44 (5), 539–553. <https://doi.org/10.1080/02508060.2019.1614251>.
- Davids, P.R., Priest, S., Hartmann, T., 2023. On the horns of a dilemma: experts as communicators for property-level flood risk adaptation measures (n/a(n/a)). *J. Flood Risk Manag.*, e12881. <https://doi.org/10.1111/jfr3.12881>.
- Davy, B., 1997. *Essential injustice: when legal institutions cannot resolve environmental and land use disputes*. Springer.
- Day, R., 2017. A capabilities approach to environmental justice. In: Holifield, R., Chakraborty, J., Walker, G. (Eds.), *The Routledge handbook of environmental justice*. Routledge, pp. 124–135.
- Defra. (2008a). *Department for Environment, Food & Rural Affairs. Consultation on Policy Options for Promoting Property, level Flood Protection and Resilience*. London Retrieved from (<https://d10ou7l0uhgg4f.cloudfront.net/Uploads/DEFRAFloodProtectionResilienceconsultation.pdf>) Accessed on 27-05-2024.
- Defra. (2008b). *Department for Environment, Food & Rural Affairs. Resilience grants pilot projects*. London.
- Defra. (2023a). *Department for Environment, Food & Rural Affairs. Evaluation of Property Flood Resilience grant scheme - FD2727*. Retrieved from (<https://randd.defra.gov.uk/ProjectDetails?ProjectId=20539>) Accessed 29-05-2024.
- Defra. (2023b). *Department for Environment, Food & Rural Affairs. Funding for Flood and Coastal Erosion Risk Management (FCERM) March 2023 - updated 13102023*. (<https://www.gov.uk/government/statistics/funding-for-flood-and-coastal-erosion-risk-management-in-england/funding-for-flood-and-coastal-erosion-risk-management-fcerm-march-2023-updated-05102023#explanation-of-funding-sources>) Accessed on 07-06-2024.
- Doorn, N. (2016). Distributing responsibilities for safety from flooding. E3S Web of Conferences.
- EA. (2023). *Guidance: Partnership funding for FCERM projects*. (<https://www.gov.uk/guidance/partnership-funding-for-fcerm-projects>) Accessed 10-06-2024.

² <https://jpi-climate.eu/programme/solstice/>

- Eriksen, S.H., Nightingale, A.J., Eakin, H., 2015. Reframing adaptation: the political nature of climate change adaptation. *Glob. Environ. Change* 35, 523–533. <https://doi.org/10.1016/j.gloenvcha.2015.09.014>.
- Fielding, J., Burningham, K., 2005. Environmental inequality and flood hazard. *Local Environ.* 10 (4), 379–395. <https://doi.org/10.1080/13549830500160875>.
- Flood Re. (n.d.a). *About us*. (<https://www.floodre.co.uk/about-us/>).
- Flood Re. (n.d.b). *How is Flood Re funded?* Retrieved 7 June 2024 from (<https://www.floodre.co.uk/faq/how-is-flood-re-funded/>).
- Flood Re. (n.d.c). *Qualifying policies which may be ceded to Flood Re*. (<https://www.floodre.co.uk/%20%20find-an-insurer/eligibility-criteria/>) Accessed 07-06-2024.
- Forrest, S.A., Trell, E.-M., Woltjer, J., 2020. Socio-spatial inequalities in flood resilience: rainfall flooding in the city of Arnhem. *Cities* 105, 102843. <https://doi.org/10.1016/j.cities.2020.102843>.
- Foster, S., Leichenko, R., Nguyen, K.H., Blake, R., Kunreuther, H., Madajewicz, M., Petkova, E.P., Zimmerman, R., Corbin-Mark, C., Yeampierre, E., 2019. New York City panel on climate change 2019 report chapter 6: community-based assessments of adaptation and equity. *Ann. N. Y. Acad. Sci.* 1439 (1), 126–173.
- Gemeente Geraardsbergen. (n.d.). *Lokale premie wateroverlast waterbeschermende maatregelen*. Retrieved 7 June 2024 from (<https://www.geraardsbergen.be/subsidie-wateroverlast-waterbeschermende-maatregelen>).
- Gralepois, M., Larrue, C., Wiering, M., Crabbé, A., Tapsell, S., Mees, H., Ek, K., Szwed, M., 2016. Is flood defense changing in nature? Shifts in the flood defense strategy in six European countries. *Ecol. Soc.* 21 (4). <https://doi.org/10.5751/ES-08907-210437>.
- Gross, J., Wilson, N., 2020. Cultural democracy: an ecological and capabilities approach. *Int. J. Cult. Policy* 26 (3), 328–343. <https://doi.org/10.1080/10286632.2018.1538363>.
- Hampton, S., Curtis, J., 2022. A bridge over troubled water? Flood insurance and the governance of climate change adaptation. *Geoforum* 136, 80–91. <https://doi.org/10.1016/j.geoforum.2022.08.008>.
- Harries, T. (2009). *Review of the Pilot Flood Protection Grant Scheme in a Recently Flooded Area, FCERM R&D Technical Report FD2651/TR*. London Retrieved from (https://assets.publishing.service.gov.uk/media/6032d484e90e0766004259ac/Review_of_Pilot_Flood_Protection_Grant_Scheme.pdf).
- Hay, A.M., 1995. Concepts of equity, fairness and justice in geographical studies. *Trans. Inst. Br. Geogr.* 500–508.
- Hegger, D.L., Driessen, P.P., Wiering, M., Van Rijswijk, H.F., Kundzewicz, Z.W., Matczak, P., Crabbé, A., Raadgever, G.T., Bakker, M.H., Priest, S.J., 2016. Toward more flood resilience: is a diversification of flood risk management strategies the way forward? *Ecol. Soc.* 21 (4). <https://doi.org/10.5751/ES-08854-210452>.
- Henstra, D., Thistlethwaite, J., Brown, C., Scott, D., 2019. Flood risk management and shared responsibility: exploring Canadian public attitudes and expectations. *J. Flood Risk Manag.* 12 (1), e12346.
- Hudson, P., 2020. The affordability of flood risk property-level adaptation measures. *Risk Anal.* 40 (6), 1151–1167. <https://doi.org/10.1111/risa.13465>.
- Hudson, P., Berghäuser, L., 2023. Investigating moral hazard and property-level flood resilience measures through panel data from Germany. *Int. J. Disaster Risk Reduct.* 84, 103480. <https://doi.org/10.1016/j.ijdrr.2022.103480>.
- Hudson, P., Thaler, T., 2023. Defining affordability and adaptation resource prioritisation. *Clim. Risk Manag.* 42, 100569. <https://doi.org/10.1016/j.crm.2023.100569>.
- Isunju, J.B., Orach, C.G., Kemp, J., 2016. Community-level adaptation to minimize vulnerability and exploit opportunities in Kampala's wetlands. *Environ. Urban.* 28 (2), 475–494. <https://doi.org/10.1177/0956247816647342>.
- Johnson, C.L., Priest, S.J., 2008. Flood risk management in England: a changing landscape of risk responsibility? *Int. J. Water Resour. Dev.* 24 (4), 513–525. <https://doi.org/10.1080/07900620801923146>.
- Jongman, B., Hochrainer-Stigler, S., Feyen, L., Aerts, J.C.J.H., Mechler, R., Botzen, W.J.W., Bouwer, L.M., Pflug, G., Rojas, R., Ward, P.J., 2014. Increasing stress on disaster-risk finance due to large floods. *Nat. Clim. Change* 4 (4), 264–268. <https://doi.org/10.1038/nclimate2124>.
- Joseph, J., 2013. Resilience as embedded neoliberalism: a governmentality approach. *Resilience* 1 (1), 38–52. <https://doi.org/10.1080/21693293.2013.765741>.
- Joseph, R., Proverbs, D., Lamond, J., 2015. Homeowners' perceptions of property-level flood risk adaptation (PLFRA) measures: The case of the summer 2007 flood event in England. *Int. J. Saf. Secur. Eng.* 5 (3). <https://doi.org/10.2495/SAFE-V5-N3-251-265>.
- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K., Bonn, A., 2016. Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. *Ecol. Soc.* 21 (2). (<http://www.jstor.org/stable/26270403>).
- Karrasch, L., Restemeyer, B., Klenke, T., 2021. The 'Flood Resilience Rose': a management tool to promote transformation towards flood resilience. *J. Flood Risk Manag.* n/a (n/a), e12726. <https://doi.org/10.1111/jfr3.12726>.
- Kaufmann, M., Mees, H., Liefferink, D., Crabbé, A., 2016. A game of give and take: the introduction of multi-layer (water) safety in the Netherlands and Flanders. *Land Use Policy* 57, 277–286. <https://doi.org/10.1016/j.landusepol.2016.05.033>.
- Kaufmann, M., Priest, S.J., Leroy, P., 2018. The undebated issue of justice: silent discourses in Dutch flood risk management. *Reg. Environ. Change* 18 (2), 325–337. <https://doi.org/10.1007/s10113-016-1086-0>.
- Keating, K., May, P., Pettit, A., & Pickering, R. (2015). *Cost estimation for household flood resistance and resilience measures – summary of evidence, FCERM R&D Programme*. London Retrieved from (https://assets.publishing.service.gov.uk/media/6034ee5e90e076607c1bf3b/Cost_estimation_for_household_flood_resistance_and_resilience_measures.pdf).
- Keskitalo, E.C.H., 2013. *Climate change and flood risk management: Adaptation and Extreme events at the local level*. Edward Elgar Publishing.
- Koks, E.E., Jongman, B., Husby, T.G., Botzen, W.J.W., 2015. Combining hazard, exposure and social vulnerability to provide lessons for flood risk management. *Environ. Sci. Policy* 47, 42–52. <https://doi.org/10.1016/j.envsci.2014.10.013>.
- Lascombes, P., Le Gales, P., 2007. Introduction: understanding public policy through its instruments—From the nature of instruments to the sociology of public policy instrumentation. *Governance* 20 (1), 1–21.
- Lawrence, J., Quade, D., Becker, J., 2014. Integrating the effects of flood experience on risk perception with responses to changing climate risk. *Nat. Hazards* 74 (3), 1773–1794. <https://doi.org/10.1007/s11069-014-1288-z>.
- Liverman, D., 2015. Reading climate change and climate governance as political ecologies. In: Perreault, T., Bridge, G., McCarthy, J. (Eds.), *The Routledge Handbook of Political Ecology*. Routledge, pp. 303–319.
- Martin, A., McGuire, S., Sullivan, S., 2013. Global environmental justice and biodiversity conservation. *Geogr. J.* 179 (2), 122–131. <https://doi.org/10.1111/geoj.12018>.
- May, P., 2012. *Evaluation of the Defra Property-level Flood Protection Scheme, Summary Report prepared by JBA for Defra, prepared by JBA for Environment Agency, London*.
- May, P., & Chatterton, J. (2012). *Establishing the Cost Effectiveness of Property Flood Protection: FD2657, Final report prepared by JBA for Defra*. London.
- May, P., Emonson, P., Jones, B., & Davies, A. (2014). *Post-Installation Effectiveness of Property Level Flood Protection*. London Retrieved from (https://assets.publishing.service.gov.uk/media/6034e365e90e07660e26e9b0/Post-Installation_Effectiveness_of_Property_Level_Flood_Protection_final_report.pdf).
- Mees, H., 2017. Co-Producing Flood Risk Governance Between Authorities and Citizens in Flanders and Abroad. How 'Co' Can We Go. Antwerp: University of Antwerp.
- Mees, H., Crabbé, A., Driessen, P.P., 2017. Conditions for citizen co-production in a resilient, efficient and legitimate flood risk governance arrangement. A tentative framework. *J. Environ. Policy Plan.* 19 (6), 827–842.
- Mees, H., Crabbé, A., Alexander, M., Kaufmann, M., Bruzzone, S., Lévy, L., Lewandowski, J., 2016. Coproducing flood risk management through citizen involvement insights from cross-country comparison in Europe. *Ecol. Soc.* 21 (3). (<http://www.jstor.org/stable/26269953>).
- Mees, H., Tempels, B., Crabbé, A., Boelens, L., 2016. Shifting public-private responsibilities in Flemish flood risk management. Towards a co-evolutionary approach. *Land Use Policy* 57, 23–33. <https://doi.org/10.1016/j.landusepol.2016.05.012>.
- Michel-Kerjan, A., Lemoyne de Forges, S., Kunreuther, H., 2012. Policy tenure under the U.S. national flood insurance program (NFIP). *Risk Anal.* 32 (4), 644–658. <https://doi.org/10.1111/j.1539-6924.2011.01671.x>.
- Mill, J.S., 2010. *Utilitarianism, liberty and representative government*. Wildside Press.
- Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F., Pfefferbaum, R.L., 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *Am. J. Community Psychol.* 41 (1), 127–150. <https://doi.org/10.1007/s10464-007-9156-6>.
- Nozick, R., 1974. *Anarchy, state, utopia*. Basic Books.
- O'Hare, P., White, I., 2018. Beyond 'just' flood risk management: the potential for—and limits to—alleviating flood disadvantage. *Reg. Environ. Change* 18 (2), 385–396. <https://doi.org/10.1007/s10113-017-1216-3>.
- Owusu, S., Wright, G., Arthur, S., 2015. Public attitudes towards flooding and property-level flood protection measures. *Nat. Hazards* 77 (3), 1963–1978. <https://doi.org/10.1007/s11069-015-1686-x>.
- Paauw, M., Smith, G., Crabbé, A., Fournier, M., Munck af Rosenschöld, J., Priest, S., Rekola, A., 2024. Recognition of differences in the capacity to deal with floods—A cross-country comparison of flood risk management. *J. Flood Risk Manag.* n/a (n/a), e12965. <https://doi.org/10.1111/jfr3.12965>.
- Penning-Rowsell, E.C., Priest, S., Johnson, C., 2014. The evolution of UK flood insurance: incremental change over six decades. *Int. J. Water Resour. Dev.* 30 (4), 694–713. <https://doi.org/10.1080/07900627.2014.903166>.
- Penning-Rowsell, E.C., Priest, S.J., & King, D. (2016). Flood risk management and 'fairness': aspirations and reality. <https://doi.org/10.1051/e3sconf/20160724001>.
- Penning-Rowsell, E.C., Priest, S.J., 2015. Sharing the burden of increasing flood risk: who pays for flood insurance and flood risk management in the United Kingdom. *Mitig. Adapt. Strateg. Glob. Change* 20 (6), 991–1009. <https://doi.org/10.1007/s11027-014-9622-z>.
- Priest, S.J., Penning-Rowsell, E.C., Suykens, C., 2016. Promoting adaptive flood risk management: the role and potential of flood recovery mechanisms. *E3S Web Conf.* 7, 17005. <https://doi.org/10.1051/e3sconf/20160717005>.
- Provincie Vlaams-Brabant. (2023a). *Provinciaal subsidiereglement waterpreventie*. Retrieved from (<https://www.vlaamsbrabant.be/sites/default/files/media/files/2023-03/subsidiereglement-waterpreventie-20230330.pdf>) Accessed on 07-06-2024.
- Provincie Vlaams-Brabant. (2023b). *Provincie breidt waterpreventieve maatregelen uit naar alle gemeenten*. Retrieved 7 June 2024 from (<https://pers.vlaamsbrabant.be/provincie-breedt-waterpreventieve-maatregelen-uit-naar-alle-gemeenten-8awc7h>).
- Provincie Vlaams-Brabant. (n.d.). *Subsidie waterpreventie*. Retrieved 7 June 2024 from (<https://www.vlaamsbrabant.be/nl/premies-en-subsidies/subsidie-waterpreventie>).
- Raska, P., Warachowska, W., Slaviková, L., Aubrechtová, T., 2020. Expectations, disappointments, and individual responses: imbalances in multilevel flood risk governance revealed by public survey. *J. Flood Risk Manag.* 13 (3), e12615. <https://doi.org/10.1111/jfr3.12615>.
- Rawls, J., 1973. *A theory of justice*. Harvard University Press.
- Robeyns, I., 2005. The capability approach: a theoretical survey. *J. Hum. Dev.* 6 (1), 93–117. <https://doi.org/10.1080/14649805200034266>.
- Santoro, S., Pluchinotta, I., Pagano, A., Pengal, P., Cokan, B., Giordano, R., 2019. Assessing stakeholders' risk perception to promote Nature Based Solutions as flood

- protection strategies: the case of the Glinščica river (Slovenia). *Sci. Total Environ.* 655, 188–201. <https://doi.org/10.1016/j.scitotenv.2018.11.116>.
- Schlosberg, D., 2004. Reconceiving environmental justice: global movements and political theories. *Environ. Polit.* 13 (3), 517–540. <https://doi.org/10.1080/0964401042000229025>.
- Schlosberg, D., 2012. Climate justice and capabilities: a framework for adaptation policy. *Ethics Int. Aff.* 26 (4), 445–461. <https://doi.org/10.1017/S0892679412000615>.
- Sen, A., 2001. *Development as Freedom*. Oxford University Press.
- Sen, A., 2010. *The idea of justice*. Penguin.
- Snel, K.A.W., Hegger, D., Mees, H., Craig, R.K., Kammerbauer, M., Doorn, N., Bergsma, E., Wamsler, C., 2022. Unpacking notions of residents' responsibility in flood risk governance. *Environ. Policy Gov.* n/a (n/a). <https://doi.org/10.1002/eet.1985>.
- Snel, K.A.W., Witte, P.A., Hartmann, T., Geertman, S.C.M., 2020. The shifting position of homeowners in flood resilience: From recipients to key-stakeholders [10.1002/wat2.1451]. *WIREs Water* 7 (4), e1451. <https://doi.org/10.1002/wat2.1451>.
- Stevens, R., & Chatterton, J. (2012). *Assessing the economic case for property level measures in England, Royal Haskoning DHV Report for the Committee on Climate Change*. London.
- Suykens, C.B.R., Tarlock, D., Priest, S.J., Doorn-Hoekveld, W.J., van Rijswijk, H.F.M.W., 2019. Sticks and carrots for reducing property-level risks from floods: an EU-US comparative perspective. *Water Int.* 44 (5), 622–639. <https://doi.org/10.1080/02508060.2019.1640957>.
- Terpstra, T., Gutteling, J.M., 2008. Households' Perceived Responsibilities in Flood Risk Management in The Netherlands. *Int. J. Water Resour. Dev.* 24 (4), 555–565. <https://doi.org/10.1080/07900620801923385>.
- Thaler, T., Fuchs, S., Priest, S., Doorn, N., 2018. Social justice in the context of adaptation to climate change—reflecting on different policy approaches to distribute and allocate flood risk management. *Reg. Environ. Change* 18 (2), 305–309. <https://doi.org/10.1007/s10113-017-1272-8>.
- Thaler, T., Hartmann, T., 2016. Justice and flood risk management: reflecting on different approaches to distribute and allocate flood risk management in Europe. *Nat. Hazards* 83 (1), 129–147. <https://doi.org/10.1007/s11069-016-2305-1>.
- Thaler, T., Levin-Keitel, M., 2016. Multi-level stakeholder engagement in flood risk management—A question of roles and power: lessons from England. *Environ. Sci. Policy* 55, 292–301. <https://doi.org/10.1016/j.envsci.2015.04.007>.
- The Flood Hub (n.d.). *Property Flood Resilience*. Retrieved 29 July 2024 from (<https://thehub.co.uk/pfr/#property-value>).
- Thurston, N., Finlinson, B., Breakspear, R., Williams, N., Shaw, J., & Chatterton, J. (2008). *Developing the evidence base for flood resistance and resilience, Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme*. London Retrieved from (https://assets.publishing.service.gov.uk/media/602e84bde90e076606603777/Developing_the_evidence_base_for_flood_resistance_and_resilience_report.pdf).
- Tullos, D., 2018. How to achieve better flood-risk governance in the United States. *Proc. Natl. Acad. Sci.* 115 (15), 3731–3734. <https://doi.org/10.1073/pnas.1722412115>.
- UK Government. (2019). *English indices of deprivation 2019*. Retrieved from (<https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019>).
- van Doorn-Hoekveld, W.J., Goytia, S.B., Suykens, C., Homewood, S., Thuillier, T., Manson, C., Chmielewski, P.J., Matczak, P., van Rijswijk, H.F.M.W., 2016. Distributional effects of flood risk management—a cross-country comparison of preflood compensation. *Ecol. Soc.* 21 (4). (<http://www.jstor.org/stable/26270010>).
- Vitale, C., 2023. Understanding the shift toward a risk-based approach in flood risk management, a comparative case study of three Italian rivers. *Environ. Sci. Policy* 146, 13–23. <https://doi.org/10.1016/j.envsci.2023.04.015>.
- Walker, G., Burningham, K., 2011. Flood risk, vulnerability and environmental justice: evidence and evaluation of inequality in a UK context. *Crit. Soc. Policy* 31 (2), 216–240. <https://doi.org/10.1177/0261018310396149>.
- Wamsler, C., 2016. From risk governance to city–citizen collaboration: capitalizing on individual adaptation to climate change. *Environ. Policy Gov.* 26 (3), 184–204. <https://doi.org/10.1002/eet.1707>.
- Watts, M.J., 2015. *Now and then: The origins of political ecology and the rebirth of adaptation as a form of thought*. Routledge.