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The role of different types of knowledge and expertise in explaining recognition justice in flood defence and flood risk prevention

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Abstract

Flood risks worldwide are rising and it is increasingly recognised that the impacts of floods are not neutral. Socioeconomic and demographic characteristics determine people's capacity to deal with flood events. These differences in social vulnerability to floods need to be considered in flood risk management (FRM) to prevent the most vulnerable groups from being disproportionately impacted. However, due to a diversification of FRM strategies and the involvement of various policy domains, the experts working on FRM are no longer a homogeneous group. Where FRM was previously dominated by engineers, now various experts are involved that have different disciplinary backgrounds, knowledge bases and approaches to FRM. As a result, they also differ in their recognition of social vulnerability to floods. In this paper, we explore the different types of knowledge and expertise in FRM in three countries (England, Flanders and France), focussing on the strategies of flood defence and flood risk prevention. We characterise the epistemic communities supporting the domains and study to what extent experts differ in their recognition of social vulnerability to floods. We also dive into the mechanisms employed to stimulate integration between experts and consider the extent to which this integration can strengthen recognition justice.

KEYWORDS

epistemic communities, flood risk management, floods, knowledge, recognition justice, social vulnerability, spatial planning

1 | INTRODUCTION

Floods are posing a serious threat to inhabited areas worldwide and are among the most frequently occurring disasters (Carter et al., 2018). The risk of all types of flooding is increasing due to climate change and urbanisation of floodplains (Christensen & Christensen, 2003; Kabisch et al., 2016; Kaufmann et al., 2018; Keskitalo, 2013). This is complicating the implementation of flood risk management (FRM) strategies. Conventional strategies—often infrastructural, engineered measures—do not sufficiently reduce risks (Plate, 2002). Furthermore, the social and ecological consequences of strategies increasingly need to be considered to prevent

negative outcomes for vulnerable groups and the environment (Feinstein & Mach, 2020).

Different types of knowledge and expertise are therefore introduced in FRM through five commonly acknowledged strategies: (1) flood risk prevention, (2) flood defence, (3) flood risk mitigation, (4) flood preparation and response, and (5) flood recovery (Hegger et al., 2016). A diversification of strategies requires the involvement of various policy domains, such as flood risk engineering, spatial planning, emergency management and disaster relief (Karrasch et al., 2021; Kaufmann et al., 2016; Keskitalo, 2013). As a result, the experts involved in FRM are no longer a homogeneous group. Where FRM was previously mainly the responsibility of engineers in flood defence, at present, experts from other domains are involved, differing in their disciplinary background, knowledge base, expertise and approach to FRM. For example, engineers are often characterised by their technical approach (O'Hare & White, 2018). Spatial planners are involved in FRM through flood risk prevention and have been characterised as multidisciplinary and collaborative (Hartmann & Driessen, 2017).

These differences are highly relevant. Research has underlined the importance of considering differences in the capacity of people to deal with floods in FRM (Forrest et al., 2020), as floods impact people in different ways due to their socioeconomic and demographic characteristics (Forrest et al., 2020; O'Hare & White, 2018; Thaler et al., 2018). A technical, engineering approach may be insufficient to account for these differences in social vulnerability to floods (Johnson et al., 2007), whereas spatial planners' multidisciplinarity (Hartmann & Driessen, 2017) may strengthen their ability to consider the socioeconomic consequences of FRM. The introduction of different types of knowledge and expertise can therefore stimulate a change in FRM policy (Haas, 1992; Meijerink, 2005), and may determine the opportunity space for FRM to become more just in the future (Matczak & Hegger, 2021). This is important, because a lack of recognition of social vulnerability can reinforce inequality, undermining the legitimacy of FRM (Thaler et al., 2018).

Therefore, in this paper, we explore the different types of knowledge and expertise that are present in FRM in three countries: England (UK), Flanders (Belgium) and France. We focus on two of the five FRM strategies, flood defence and flood risk prevention, as the literature shows that actors involved in these strategies significantly differ in their approach to FRM, and because these are among the most dominant strategies in the countries involved. The aim of this paper is to study how experts in the two flood risk domains differ in their recognition of social vulnerability to floods, and whether this can be explained by their disciplinary background and knowledge base—following the logic of the epistemic communities framework (ECF). We also reflect on the mechanisms employed to stimulate coordination among experts in the two strategies, and how this may strengthen recognition justice.

2 | CONCEPTUAL FRAMEWORK

2.1 | Vulnerability, (in)equality and recognition justice in FRM

To explore how different experts in FRM understand vulnerability, (in)equality and justice in floods, we first summarise how these concepts have been framed in the FRM literature. FRM inherently involves decisions about the distribution of flood risks or burdens (Begg, 2018). Often, someone's location or exposure to flood risks are considered in FRM (i.e., flood vulnerability), but social, physical, financial and psychological characteristics of people are overlooked—even though these are also important determinants of vulnerability (O'Hare & White, 2018; Paauw et al., 2024; Taylor, 2014; Thaler et al., 2018; Walker & Burningham, 2011; Watts, 2015). These characteristics are referred to as social vulnerability to floods (Liverman, 2015) and have been related to socioeconomic status, age, gender, education, social capital, ethnicity, property type, health and property ownership (Coninx & Bachus, 2007; Fielding & Burningham, 2005; Foster et al., 2019; Norris et al., 2008; Walker & Burningham, 2011). All these factors can create inequalities in how people can prepare for, endure or recover after floods, and in their ability to participate in FRM (Harries & Penning-Rowsell, 2011; Liverman, 2015; Quandt, 2016). For FRM to be considered as just, differences in social vulnerability need to be recognised and accounted for. This aligns with the concept of recognition justice. Recognition justice prescribes that the diversity of perspectives, conflicting interests and socio-cultural positions that are at the root of injustice need to be recognised (Martin et al., 2013). A lack of recognition can reinforce inequality and create unjust FRM policies that disproportionately burden the most vulnerable (Thaler et al., 2018). The diversification of FRM strategies (Hegger et al., 2014; Kaufmann et al., 2016; Keskitalo, 2013) means that there are now multiple settings or domains in FRM where social vulnerability to floods could be considered. Here, we zoom in on flood defence and flood risk prevention and explore recognition justice in the two strategies.

2.2 | Different approaches of flood defence and flood risk prevention

The experts involved in flood defence and flood risk prevention differ in their approach to FRM. Flood defence is characterised by a technical approach. For decades, the domain was closed-off due to its highly specialised nature. Experts in this strategy were often flood risk engineers, relying on instrumental and calculative modelling to find a solution that eliminates risks (Hartmann & Driessen, 2017; Wiering & Immink, 2006; Woltjer & Al, 2007). Their main task is to reduce flood vulnerability (Tate et al., 2021). The literature also underlines that measures are often implemented in a top-down manner by the responsible authority (Hartmann & Driessen, 2017). This approach to FRM remains highly relevant. Dikes and embankments are needed to protect people and built assets from flooding. Engineered flood defences are also visible in the landscape which fosters feelings of safety among the public (Cologna et al., 2017). However, the engineering approach insufficiently considers the socioeconomic and demographic characteristics of the population at risk (O'Hare & White, 2018). Social vulnerability to floods may therefore be overlooked (Cousins, 2021; Eriksen et al., 2015). According to Wiering and Immink (2006), social science perspectives are needed to design strategies that tackle flood and social vulnerability simultaneously.

Where flood defence focuses on infrastructural works to provide flood protection, such as dikes, embankments and weirs, flood risk prevention aims to keep people away from water through spatial planning, for example, discouraging development in floodplains and excluding vulnerable land uses from flood risk areas (Davids et al., 2019; Hegger et al., 2016; Neuvel & van den Brink, 2009). Measures in flood risk prevention are implemented by spatial planners. Planners are, in contrast to engineers, characterised as multidisciplinary and collaborative actors (Hartmann & Driessen, 2017). They work at the intersection of policy domains, as their job involves guiding decision making related to all areas of government policy (e.g., housing, recreation, transport, nature conservation, cultural heritage) (Boussauw & Lauwers, 2020; Busscher et al., 2019). Spatial planners are seen as mediators or coalition builders, integrating information from various sectors and balancing interests (Boelens, 2020; Boussauw & Lauwers, 2020; Hartmann & Driessen, 2017). We expect this contributes to the capacity of planners to consider the different interests and needs of communities at risk of flooding, and it may stimulate a change in policy that strengthens recognition justice.

2.3 | The role of knowledge and expertise in policy change

We acknowledge there are various analytical frameworks that focus on explaining stability and change in public policies based on the emergence of new ideas and perspectives, such as the advocacy coalition framework and multiple streams framework (Crabbé, 2008; Meijerink, 2005; Zahariadis, 1999). However, as the literature suggests that the difference in approach between experts in flood defence and flood risk prevention is linked to their respective knowledge bases, disciplinary and professional backgrounds, and expertise, we are particularly interested in the ECF. The ECF focuses on the importance of knowledge-based expert groups, new ideas and learning processes in policy change (Meijerink, 2005). An expert group is called an epistemic community, which includes 'professionals with recognised expertise and competence in a particular policy domain' (Haas, 1992, p. 3). Epistemic communities are characterised by four elements: a shared set of normative and principled beliefs, shared causal beliefs, shared notions of validity and a common policy enterprise (Bukowski, 2017; Haas, 1992; Mabon et al., 2019). Table 1 provides an overview of these elements, including a description of their relevance for characterising an epistemic community. We also included type of actors and disciplinary background in the table, as we believe these elements are important to identify (the members of) an epistemic community.

According to the ECF, the introduction of different types of knowledge can lead to shifts in decision making (Haas, 1992) as new information stimulates a change in thinking, beliefs, and discourse (Dunlop, 2012). The involvement of spatial planners in FRM means that different types of knowledge and expertise are introduced. Whereas engineers often focus on technical questions, planners' multidisciplinarity and experience with balancing perspectives may strengthen their ability to place social vulnerability on the FRM agenda. However, it is unlikely that the engineering perspective will be replaced. Rather, the social science perspectives brought in by planners would complement the technical expertise. Designing FRM policies that integrate engineering and social concerns requires collaboration and coordination between the two strategies, drawing attention to the importance of policy integration. Policy integration refers to the cooperation of actors from different domains (Tosun & Lang, 2017). The concept departs from the assumption that measures emerging from one area of expertise are more likely to fail, due to the complexity of societal problems (Howlett & Ramesh, 2014). This is

TABLE 1 Overview of the main elements that characterise epistemic communities, including a brief explanation of the relevance of these elements for identifying and describing an epistemic community.

Characteristic	Explanation and relevance for identifying epistemic communities
Type of actors	Characterising epistemic communities first requires identifying its members or the type of experts involved. Members can include policy makers, politicians, other public authorities, natural and social scientists, and private experts (e.g., consultants) from various disciplinary backgrounds (Dunlop, 2012)
Disciplinary background	As epistemic communities are knowledge-based expert groups (Haas, 1992; Meijerink, 2005), characterising them requires looking into the educational and professional background of its members. Disciplinary backgrounds will influence someone's knowledge base and can be seen as lenses through which experts perceive the world around them
Shared normative and principled beliefs	Community members have similar norms and values that guide their actions (Bukowski, 2017; Haas, 1992; Mabon et al., 2019). Understanding epistemic communities' normative and principled beliefs is crucial, as they will ultimately determine what experts consider as 'good' or desirable outcomes of policy—and therefore what experts will strive for
Shared causal beliefs	Members also share beliefs about the causes of the problem at hand, which serves as a basis for identifying the links between potential policy actions and how this will contribute to the desirable outcome (Bukowski, 2017; Haas, 1992; Mabon et al., 2019). Understanding the shared causal beliefs of epistemic communities will inherently draw attention to their understanding of the problem, which actions they believe will contribute to ameliorating the problem, and the preferred policy actions to achieve that goal. This can be understood as the main approach of epistemic community members
Shared notions of validity	Shared notions of validity refer to the criteria used by members to weigh and legitimise knowledge. In other words, it draws attention to the types of knowledge seen as valid in their domain of expertise (Bloodgood, 2008; Haas, 1992) This links back to the disciplinary background of epistemic community members, and highlights the types of knowledge on which decisions are based
Common policy enterprise	Epistemic community members also share a common policy enterprise, referring to a set of practices or standard operating procedures that are often used to deal with the problem at hand, and ultimately inform policy (Bukowski, 2017; Haas, 1992; Mabon et al., 2019). It includes the practices and instruments most commonly employed by epistemic communities, and therefore further describes their approach to a problem

highly relevant here as causes and impacts of floods span multiple policy domains, requiring measures that consider the problems and solutions emerging from those domains (Candel, 2021).

3 | METHODS

This paper examines the different types of knowledge and expertise in flood defence and flood risk prevention. We compare the perspectives of experts from the two strategies and explore to what extent differences in recognition of social vulnerability can be explained by their disciplinary background, knowledge base, and expertise. We also explore how recognition justice may be strengthened in future FRM and which mechanisms are employed to facilitate the process. England (UK), Flanders (Belgium) and France are chosen as the units of analysis. Although England and Flanders are not considered as states (like France), flood risk responsibilities in the UK and Belgium have been transferred to the devolved administrations of individual countries (England) and regional levels (Flanders). The countries differ in the types and levels of flood risk experienced, and in their cultural, political, and socioeconomic characteristics (Alexander et al., 2016; Larrue et al., 2016; Mees, Suykens, et al., 2016). In each country, FRM is mainly state-oriented as it is reliant on public spending. However, the countries have their own specific governance characteristics that will influence how experts from various disciplinary backgrounds collaborate. The countries all experienced a shift away from the traditional, engineering approach to a more diversified FRM; however, they differ in the way in which other experts were introduced—with implications for recognition justice. This allows for an interesting comparison, as well as for identifying opportunity spaces to strengthen recognition of social vulnerability to floods in different contexts.

The analysis is based on a qualitative approach. Key policy documents were identified in each of the countries to explore the evolution of the two domains and to identify main (decision) points where the role of engineering and/or spatial planning in FRM was strengthened. We mainly analysed policy documents guiding FRM in the three countries, such as the River Basin Management Plans in Flanders, the FCERM Strategy in England, or the PAPI documents in France. We then identified the main experts in defence and prevention in the three countries and invited them for interviews. A total of

55 interviews were conducted for this paper, spread over the countries, and mainly included national- or regional-level policy makers, public authorities and practitioners involved in flood defence and flood risk prevention. Some interviews were also conducted with provincial, local or inter-municipal stakeholders, as well as private experts and researchers in both fields. The semi-structured interviews aided in characterising the epistemic communities supporting the two domains. This was done by looking into the elements identified in Table 1: types of actors, disciplinary background, shared normative and principled beliefs, shared causal beliefs, shared notions of validity and their common policy enterprise (as per Haas, 1992). We then further explored their approach to flood risk, vulnerability and justice in FRM, as well as the mechanisms employed to strengthen collaboration between experts from various disciplinary backgrounds. Interview respondents were identified based on the snowball technique. The interviews were guided by a short list of pre-prepared questions tailored to country-specific circumstances. The data were analysed and compared to identify common themes and differences.

4 | RESULTS

Flood defence was for a long time the dominant strategy to deal with flood risks in England, Flanders and France (Alexander et al., 2016; Johnson et al., 2005; Kaufmann et al., 2016; Larrue et al., 2016; Liefferink et al., 2018; Paauw et al., 2024). There are also traditions of flood risk prevention in the countries, but it remained largely underdeveloped due to the dominance of flood defence (Billet, 2007; Tempels, 2016). This has changed in recent decades, and the countries exemplify different pathways when it comes to the inclusion of spatial planners in FRM. We first explain these pathways. Afterwards, we characterise the epistemic communities that currently support policy making in defence and prevention in each country. We then dive into the levels of recognition of social vulnerability to floods.

4.1 | Integration of spatial planning in FRM

4.1.1 | Flanders

In Flanders, it was increasingly recognised that flood defences cannot sufficiently reduce risks: 'Water managers used to be very optimistic people. When there was a problem, they said "we will fix that." [...] Now, insights have shown that it is not that simple, and that if you arm yourself against a storm, there will always be a stronger storm. And you cannot tackle these risks with technical solutions alone' (interview, 03-04-2023). A new discourse emerged in the 1990s that focussed on integrating spatial planning into FRM, which was institutionalised in 2003 in the Decree on Integrated Water Policy (DIWP) (Kaufmann et al., 2018). The need for strengthening flood risk prevention resulted from a lack of instruments that sufficiently reduced floodplain urbanisation (Mees, Crabbé, et al., 2016). The DIWP introduced instruments that ensured planners consider flood risks in their decisions, such as the 'water assessment' which requires planners to seek advice from flood risk engineers on the impact of a building plan on the water system. However, planners' responsibility in FRM was not explicitly recognised until the introduction of multi-layer water safety (MLWS) in 2013 (Kaufmann et al., 2016). MLWS prescribes a set of FRM measures tackling the probability and consequences of floods (Cauwenberghs, 2013). Collaboration and coordination between experts in defence and prevention is facilitated through the Coordination Committee on Integrated Water Policy (CIW) at the Flemish level (Liefferink et al., 2018). The committee brings together stakeholders from different disciplines, stimulating knowledge sharing across domains.

4.1.2 | France

In France, the involvement of spatial planning in FRM was initially strengthened in the 1980s with the Department of Risk Prevention within the Ministry of Environment. In 1995, the Flood Risk Prevention Plans (PPRI) were introduced, further strengthening the role of planning in FRM. The plans were drafted by the state, to be implemented by municipalities (Barbier & Charpentier, 2022). This hierarchical approach was challenged by decentralisation processes, aided by the Action Programmes for Flood Prevention (PAPI) introduced in 2001 (Larrue et al., 2016). The PAPIs increase the involvement of municipalities in FRM and encourage horizontal partnerships between local governmental actors, water boards, municipalities and regions—working together on the scale of (sub-)watersheds (Guillier et al., 2016). The aim is integrating experts from flood defence and flood risk prevention. In this way, the PAPIs created an institutional framework in which experts from the two flood risk domains collaborate, blurring the lines between the strategies (Larrue et al., 2016). Although flood defence remains the main expenditure, there are efforts to change this: 'The aim of PAPI is [...] to force local authorities to think on the right scale and submit a coherent plan. This means [...] you do not just

TABLE 2 Summary of the main characteristics of the epistemic communities supporting the strategies of flood defence and flood risk prevention in England, Flanders and France.

	Flood defence			Flood risk prevention		
	England (UK)	**Flanders (BE)**	**France**	**England (UK)**	**Flanders (BE)**	**France**
Type of actors	Broad actor network with government agencies (Defra, EA), statutory and non-statutory consultees, local authorities (Lead Local Flood Authorities), and private experts	Fragmented network with government agencies (Flemish Waterways, Flemish Environment Agency), provincial governments, universities, and research institutes (Flanders Hydraulics Research)	Various governmental actors involved (Ministry of Environment, decentralised state services DREAL and DDT). Local scale has taken on more responsibility in recent decades (e.g., water boards). Private experts and consultancies also involved	Strategic policy making is led by the Department for Levelling Up, Housing, and Communities (DLUHC). Statutory and non-statutory consultees involved, as well as Local Planning Authorities. Local planners, elected officials, and communities work on planning applications	Mainly regional, provincial, and municipal government actors, led by the Department of Environment of the Flemish government. Other government agencies, experts from universities, research institutes, and consultancies are also involved	At the national level, some overlap with actors involved in flood defence (Ministry of Environment, DREAL, DDT). Municipalities carry responsibilities for planning their territory; inter-municipal actors for projects crossing administrative boundaries
Disciplinary background	Experts in Defra and EA are multidisciplinary (e.g., social sciences, communication, data sciences, technology, natural sciences). Also still experts with 'traditional' engineering expertise and hydrologists	Mainly engineers and hydrologists as a degree in these fields is required to work on flood defence	National-level and private experts are often civil or hydraulic engineers. Experts in local state services are specialised in government procedures and restrictions—often with a technical background	Experts at the national level have diverse backgrounds. At the local level, actors have backgrounds in spatial planning—sometimes with specialisms (e.g., transport) but often planners are generalists	Multidisciplinarity is at the core of planning. Experts have diverse backgrounds ranging from history to political sciences, communication, architecture, sociology, and planning, to (bio) engineers	At the national level, experts have an engineering background (similar to flood defence). Multidisciplinarity more prominent among those responsible for planning from a perspective larger than risk and at the local level
Shared normative and principled beliefs	Experts aim to improve public safety regarding flood events, whilst also being guided by principles such as economic efficiency and value for money	The goal is to equally protect everyone from flooding, and to safeguard the public interest. Experts aim to protect the largest number of people against the lowest possible cost (economic efficiency)	Actions are to serve the public interest and improve safety in the context of flooding. Environmental protection is considered as important, as well as long-term affordability of measures or economic sustainability	Coordination and integration are important values, as planners have to consider flood risks alongside other issues and interests. Ultimately, the goal is to allow for multifunctional land use where people and water coexist	Activities are guided by the need for coherence, coordination, and spatial integrity. In the context of floods, this means designing a good public space with room for water and people. Also ensuring accessibility to that public space for all	Planners focus on integrating needs and developing a coherent, balanced spatial plan for a sustainable future. Developing a shared strategy that balances interests is considered important

TABLE 2 (Continued)

	Flood defence			Flood risk prevention		
	England (UK)	**Flanders (BE)**	**France**	**England (UK)**	**Flanders (BE)**	**France**
Shared causal beliefs	Floods are understood as technical problems to be solved through infrastructural protection, focussing on areas experiencing the highest flood risk and largest potential damage. Efforts are made to take the needs of the socially vulnerable into account	Focus on flood probability reduction through infrastructural, protective measures that contain and restrain water. The approach is risk-based, prioritising areas where the probability and potential losses are highest	Technical measures and hydraulic infrastructures are proposed to reduce the probability of flooding. There is a focus on areas where the exposure to flood risks is highest, and with the largest potential losses (e.g., bad buildings)	Ultimately, the goal is to reduce exposure to floods by keeping people away from water. This is achieved through discouraging development in areas at risk of flooding. Planning is used as a process to develop a vision for the future	Experts prevent damage from flooding by building in harmony with the environment, meaning controlling development in flood risk zones, and stimulating adjustments to existing buildings to make them more flood resilient. By creating a plan that integrates different needs, it is believed people can learn to live with floods	Damage from flooding is prevented through zoning and restricting urbanisation of flood plains. Long-term strategies are proposed that consider the environment in its entirety, meaning giving space to, for example, population and human health, biodiversity, land, soil, water, air, and climate, cultural heritage, etc.
Shared notions of validity	Knowledge is multidisciplinary and importance is given to those holding lay and contextual knowledge. However, decisions are often taken based on technical and engineering knowledge	Strong trust in engineering knowledge, with scientific knowledge being brought in through research institutes	Technical and scientific knowledge are the most important sources for decision making	Importance of lay and situational knowledge as planning occurs at the very local level. However, still reliance on technical and scientific knowledge as flood risk engineers are often involved in flood-related questions	Multidisciplinary knowledge prevails, as planners work on a range of topics and are collaborative. Local knowledge is highly valued. Flood risk engineers are consulted	Multidisciplinary knowledge is dominant in planning; however, engineering knowledge is given more importance in flood risk questions. Lay and contextual knowledge are integrated
Common policy enterprise	Flood risk modelling is a standard operating procedure, with ongoing efforts to include social and economic information. This is followed by mapping to determine areas at significant risk. Participatory processes are also	Hydrological modelling and flood hazard mapping is used to determine areas at risk. CBAs are often done to determine the optimal mix of measures in terms of minimising costs and maximising people/	CBAs are an important tool to decide on the measures to be implemented. Modelling is a standard operating procedure to make flood hazard maps, indicating which areas should be prioritised	Common practices to deal with flood risks include (Strategic) Flood Risk Assessments at different levels, as well as the sequential tests. In strategic policy making, integrating and reconciling conflicting objectives is	Planners make plans that balance interests and needs (sometimes using multi-criteria analyses). Important instruments include the water assessment and signal areas, aiding in preventing development in flood risk areas. Local stakeholders	Important tools include drafting spatial plans, as well as mapping and CBAs. However, a central role is given to stakeholder engagement and including people's perspectives in holistic plans

(Continues)

TABLE 2 (Continued)

Flood defence			Flood risk prevention		
England (UK)	**Flanders (BE)**	**France**	**England (UK)**	**Flanders (BE)**	**France**
embedded into standard practices	properties protected		considered important, as well as stakeholder engagement	are often engaged through projects	

protect. [...] So, it is about forcing them to have an integrated approach' (interview, 02-04-2022).

4.1.3 | England

The technocratic focus of English flood defence first changed in the 1970s due to the integration of cost–benefit analyses (CBAs) in decision making, necessitating the inclusion of economists. From the 2000s onwards, the engineering perspective was further challenged due to an interest in mitigation, emergency planning and recovery (Alexander et al., 2016), as well as in community scale responses, improving engagement with communities at risk and raising risk awareness. Other disciplines were therefore introduced in organisations traditionally responsible for flood defence, such as the Environment Agency (EA) and the Department for Environment, Food, and Rural Affairs (Defra). The first instruments placing responsibility for FRM with spatial planners were introduced in 1992 and policies linking defence and prevention have been strengthened since, with, for example, the Planning Policy Guidance 25 (2001), the Planning Policy Statement 25 (2006), the Planning Policy Framework (2012), and Defra's (2004) Making Space for Water Policy. These policies require developments to undertake a 'sequential test' (akin to the Flemish 'water assessment') and also introduced the Strategic Flood Risk Assessment. It requires Local Planning Authorities to prepare an assessment of flood risks, which can be used by developers, emergency planners and infrastructure providers. However, defence and prevention remain largely separate domains in England, and collaboration between engineers and other disciplines occurs mainly within the EA and Defra.

4.2 | Characterising the epistemic communities

An overview of the main characteristics of the epistemic communities supporting flood defence and flood risk prevention in the three countries can be found in Table 2. Tables A1 and A2 in Appendix A include extended versions of Table 2 with additional information, empirical data, and sources; we included a summarising table here to improve the readability of the paper. Table 2 provides information on the type of actors, their disciplinary background, their shared normative and principled beliefs, causal beliefs, notions of validity and their common policy enterprise.

Government organisations mostly dominate the flood defence expert groups in the three countries, with some responsibility for local authorities, and input from research institutes, consultancies and private experts (Table 2). Traditionally, experts were mainly (hydraulic) engineers and hydrologists, but in England this has been diversified since the 1970s. Interviewed defence experts in the three countries share similar norms and values, often based on improving public flood safety, safeguarding the public interest, and a focus on economic efficiency and value for money. This can be linked to their shared causal belief that flooding is a technical problem that can be solved through infrastructural, protective defences. Efforts are often focused on flood probability reduction and target areas that experience the highest risk, determined by looking at the probability of a flood event and potential (economic) losses. In England, there are ongoing efforts to also consider social vulnerability in determining risk. Flemish and French flood risk engineers share similar notions of validity. There is a dominance of technical expertise, and engineering and scientific knowledge. Although there is also still a high level of trust in these types of knowledge in England, it has been complemented by multidisciplinary knowledge. Furthermore, there are efforts to include lay and contextual knowledge in England. And lastly, common policy enterprises include hydrological modelling, flood risk mapping, and CBAs. In England, stakeholder engagement processes are also embedded into standard practices, although questions remain around the effectiveness of these processes.

The flood risk prevention expert groups in the three countries also mostly consists of government actors, more

specifically national, regional and local-level spatial planners—with research institutes and consultancies occasionally being involved in strategic policy making (Table 2). In general, the experts interviewed have more diverse disciplinary backgrounds compared those in flood defence, ranging from history to political sciences, communication, architecture, archaeology, sociology, spatial planning, as well as engineers. Shared norms and values often relate to wanting to provide a good and accessible public space for all. Spatial planners also coordinate and integrate different issues in the use of space, to safeguard the multifunctionality of land; and sustainable development is considered important. This is based on the causal belief that people and water can coexist, and so preventing damage from flooding is achieved by restricting development in flood risk areas or building adaptively. Often, space is considered in its entirety, and spatial coherence or integrity is therefore an important goal. Compared to flood defence, lay and local knowledge is more prominent in flood risk prevention due to the need to consider many different perspectives and interests in designing space. Multidisciplinary knowledge is also important due to the diversity of disciplinary backgrounds. There is some reliance on engineering knowledge, as flood risk engineers are consulted in making plans or approving planning applications. Lastly, common policy enterprises are similar across the three countries and involve plan making and mapping. Stakeholder engagement processes are especially important in spatial planning for FRM.

4.3 | Recognition justice in FRM

4.3.1 | Technical expertise and interest in social vulnerability

The dominance of technical knowledge in flood defence in Flanders and France, with a focus on infrastructural protection and economic efficiency, results in little attention to social vulnerability to floods. This becomes apparent from some of the main policy documents in the field. For example, the Water Policy Note and River Basin Management Plans (RBMPs) are important documents in Flemish flood defence. The former sets out the general vision for managing floods, which is then translated into RBMPs proposing more concrete measures to tackle risk. However, the proposed measures do not address the issue of differentiated vulnerability (CIW, 2011). Although the RBMP for the Scheldt river acknowledges that flood risk is determined by social and economic factors, the social component is operationalised as the number of buildings in a flood risk area, and the economic impact is determined based on compensations paid by the disaster fund. There is a lack of attention to differences in the capacity of people to deal with floods. Similarly, in France, floods are seen physical phenomena that increase risk. The proposed solution is new models to help develop effective, long-term strategies that reduce the exposure of people and properties to flooding. Questions around social vulnerability of individual households are not addressed (MDEM et al., 2018; MTE, 2023).

In Flanders and France, flood defence is dominated by flood risk engineers. When looking at the problem of flood risk, interviewed engineers explained they often start from the physical situation: 'Rain falls here, it runs off, and it ends up in this valley. These are physical quantities that are more or less static. Of course, rainfall changes due to climate change. But the social dimension changes more quickly [...]. If we start a big project, in 10 years the situation will be different. That is a difficult thing for us' (interview, 03-04-2023). Issues of FRM are largely considered through a technical lense: 'For example, if we are asked to set up a flood warning system. We will build a website around that. From a technical perspective, everything will be in order. Everyone can find the information there; we will have a number of training courses. But to take the extra step, we also have to think about people with different backgrounds who have difficulties capturing and getting to the information. I think that step is not being taken, because the specialisation and expertise are not available' (interview, 30-09-2022). The social dimensions of FRM are generally not at the heart of concern. In France, engineers often focus on measures that will be affordable in the long run and protect large numbers of people, whereas the specific needs of local residents are forgotten: 'It is just: 'we need a budget, so in the PAPI we need to include a right to impose a tax on our constituents' and then [...] they realise later that people need to be explained to, they need to be communicated with, perhaps a website needs to be set up, and they need to be supported' (interview, 01-04-2022).

In addition, the interviews show that flood risk engineers often believe social vulnerability does not play a big role in floods: 'When we talk about floods and social vulnerability, Belgium does not have much to worry about. Preliminary studies have been conducted by the Flemish Environment Agency, pilot projects [...] and I have contributed to a number of them. To encourage people who flood regularly to better prepare themselves, to take technical measures to reduce damage. The people are then visited at home. They receive suggestions for measures and can make their own cost/benefit assessment. [...] But when you enter those homes, they are not socially vulnerable people. They have a garden from here to there, very large' (interview, 14-06-2023). Interviewees state

that 'inequalities have nothing to do with FRM and policy. These are fundamental inequalities of people in society [...]. It would be better for FRM if inequalities are reduced, because you will have a more balanced society. But this applies to all policy domains. We have to do better on many fundamental social themes, not just in FRM' (interview, 26-08-2021). Social vulnerability is not seen as a problem to be solved in flood defence, and measures should therefore be collective, improve public safety, and serve the public interest. A French engineer explained that vulnerability is mostly seen as a question of location, quality of buildings, and risk awareness, not as something that differs between communities based on socio-economic and demographic factors (interview, 01-04-2022). If social vulnerability is considered in flood defence in France, this will be at a local level in a region-specific PAPI, and so recognition justice will vary per location (SMBSGLP & Environnement, 2015, 2019).

4.3.2 | Multidisciplinarity in English flood defence

Flood defence in England differs from the engineering approach taken in Flanders and France. The multidisciplinarity of experts in English flood defence, as well as the importance given to stakeholder engagement, has strengthened recognition of social vulnerability to floods in this strategy. This is for example illustrated by the existence of the report Social Deprivation and the Likelihood of Flooding by the EA. The report focuses on the number of deprived households that moved from 'very significant or significant risk bands to moderate or low risk bands' due to implemented flood defences (Environment Agency, 2022b). This indicates an interest in ensuring deprived households benefit from public flood defences. Another example is the Partnership Funding approach in which funding is split between national Flood Defence Grant-in-Aid (FDGiA) contributions. Although CBAs are used to justify interventions and achieve maximum benefits (Defra, 2022; Environment Agency, 2022a; Johnson et al., 2007; Thaler & Levin-Keitel, 2016), the way in which funding is calculated recognises that socially deprived households are less likely to be able to contribute. As a result, they are eligible for more government funding (Defra, 2011). This is a step in the right direction, as CBAs in the other countries mainly focus on maximising the number of people protected against the lowest cost, without attention to social vulnerability (interview, 05-05-2023).

Overall, there seems to be an enhanced understanding amongst English flood defence experts that 'a flood will affect different places differentially, and that is, in part, dependent on how much money circulates in that local community. What the linkages are in the community, the networks, the stakeholders, [...] how that all operates. And also the linkages to outside' (interview, 30-03-2022). There are various initiatives, such as the place-based approach of the EA (Environment Agency, 2020a), that advocate for increased recognition of local communities and their needs. Recognition of differences in the capacity of people to deal with floods is further strengthened by Lead Local Flood Authorities. Due to their close proximity to residents, they are well placed to understand the needs of communities and can act as middlemen between those at risk and higher-level policy makers (interview, 21-11-2021). Their ability to perform this role is variable based on differing capacity as well as the development of local relationships.

4.3.3 | The mediating role of spatial planners in FRM

The multidisciplinary background of experts in flood risk prevention, as well as their mediating role with a focus on integrating and balancing interests, increases their sensitivity to social vulnerability to floods. According to planners interviewed in Flanders, actions in flood defence have 'the intention to protect citizens and society from flooding [...]. No distinction is made between different groups. But of course, in the implementation of measures, you will see that some benefit more than others. And this needs to be considered' (interview, 24-09-2021). Therefore, 'giving attention and help to those who need it is important' (interview, 09-05-2023). In France, planners acknowledge that in drawing up a PAPI, local authorities 'will have to ask themselves the question of how to integrate risk into urban planning [...] and that requires work on how to reduce vulnerability. They need to strengthen recognition of different needs. In other words, we want a flood risk prevention strategy that is comprehensive' (interview, 12-04-2022)—where comprehensive means linking hazard management with social concerns (interview, 08-11-2022). In the interviews, spatial planners underlined that 'people's lives are involved in these issues [...]. On the one hand, there's the issue of adapting the territory to risk and climate change. And on the other hand, how the population will evolve in the context of these challenges' (interview, 08-11-2022).

An advantage in the context of recognition justice is that planners often work collaboratively. Stakeholder engagement and local, contextual knowledge were mentioned as important in the interviews, and planners work in close proximity to residents. This strengthens their knowledge of the needs of communities at risk: 'The

social issue is rather around the residential path of the families I was talking about or [for example] the old people, the elderly who stay in a big house [...] who can't go upstairs anymore' (interview, 28-07-2022). In France, local-level planners dealing with flood risk explained that they 'came up with the notion of 'local urban management' in the city's social housing neighbourhoods [...]. Which consists of meeting people on an individual basis, and taking an interest in their lives and needs. This requires teams to closely work with residents' (interview, 08-11-2022). In England, experts in flood risk prevention are also local. Planning in England is based on a two-tier system with a strategic policy and localised decisions (Alexander et al., 2016), which allows for discussion of local issues. Furthermore, Local Planning Authorities consider a range of topics such as utility, energy, environment, etc., resulting in a wide consideration of local problems.

However, there is a downside to planners' position between policy domains. Spatial planners work on the periphery of FRM. Flood risks are an important consideration, but it is tied up with a range of other issues that need to be balanced and integrated into a final plan or decision. Planners' understanding of this large range of issues may remain superficial. As a Flemish planner explained: 'I think that multidisciplinarity is certainly important in spatial planning. And the advantage of this is that as a discipline, we have a slightly broader view, but on the other hand things often remain vague. So, I think that is the other side of the coin, that as a spatial planning you do not always have the instruments or decision-making power to do things' (interview, 09-05-2023). Especially in local planning application decisions it may be difficult to consider social vulnerability, because local-level planners do not necessarily have the expertise on how floods manifest and who is impacted in what way. They rely on other organisations, such as the EA in England, to offer advice on how communities will be impacted by a flood. Similarly, in France, local planners explain they 'do not have the skills or knowledge and continue to bring in engineers or geographers' (interview, 22-11-2022).

5 | DISCUSSION

5.1 | Multidisciplinarity as the explanatory variable

Based on the literature, we expected that spatial planners in flood risk prevention are more sensitive to social vulnerability to floods—due to their multidisciplinarity, position between policy domains, and experience with balancing sometimes conflicting perspectives. The results show a more nuanced picture. In Flanders and France, recognition justice is indeed stronger in flood risk prevention. In contrast, flood defence in England has broadened in recent decades, inviting social science perspectives into organisations traditionally dominated by an engineering approach. As a result, recognition of social vulnerability to floods is stronger in English flood defence compared to planning.

The above suggests that multidisciplinarity, rather than FRM strategy, is an important factor in explaining recognition of social vulnerability to floods. Following the ECF, this can be explained by the fact that experts from various disciplinary backgrounds inherently define and understand issues differently, and, as a result, will introduce other ideas and different solutions. According to the ECF, this is an important driver of policy change (Dunlop, 2012; Meijerink, 2005). Where engineers were previously the sole actors responsible for FRM, approaching floods as technical challenges to keep water away from people (Hartmann & Driessen, 2017), experts from other disciplines are bringing different perspectives to the table. History has shown various examples of a change in FRM that shifted the focus from engineering to other concerns, such as the introduction of economists and efficiency concerns into English flood defence in the 1970s. Meijerink (2005), in their analysis of Dutch coastal flooding policy between 1945 and 2003, draws attention to the integration of ecological concerns in FRM, and how these were placed on the agenda due to the establishment of a multidisciplinary committee for the management of the Eastern Scheldt. Wiering and Crabbé (2006) documented a similar 'ecological turn' in Flanders.

Further improving FRM also requires looking at issues of (in)justice, as dikes have been built and forecasting systems have been successfully set up (Hartmann & Driessen, 2017). Even the Floods Directive (2007/60/EC) calls for multidisciplinarity underlining that, even though floods are natural processes, human activities are enhancing the likelihood of floods negatively impacting people's lives and livelihoods. This requires an integration of engineering and social sciences. Spatial planners' role as mediators between policy domains involves discussions, resolving conflict, and reaching consensus between opposing parties (Healey, 1996, 2003), which inherently brings questions of (in)justice to the fore (Hartmann & Driessen, 2017). The results from Flanders and France confirm this, showing an enhanced recognition of social vulnerability to floods in flood risk prevention. However, we are inclined to suggest that this applies to multidisciplinary teams more generally, as recognition justice in England is stronger in flood defence.

5.2 | Multidisciplinarity and the strength of epistemic communities

The results show that multidisciplinarity has positive implications for the strength of recognition of social vulnerability to floods. However, the broadening of epistemic communities through the inclusion of experts from various disciplinary backgrounds also means that the experts may not share as many of the characteristics as identified by Haas (1992) (i.e., shared normative and principles beliefs, shared causal beliefs, shared notions of validity, and common policy enterprises). Epistemic communities with experts ranging from engineers to social scientists, archaeologists, historians, political scientists, etc. as well as from different levels of government may be less tight knit, which potentially impacts the effectiveness of the FRM strategy that the epistemic community is trying to inform.

It is widely acknowledged that multidisciplinarity and diversity require additional deliberation and consensus seeking, due to ambivalence of goals, uncertainty of knowledge and power, as well as having to consider conflicting positions. This is time intensive and slows down decision making (Jackson, 1996; Voss et al., 2013; Wardekker et al., 2020). FRM is an extremely complex field where 'hundreds or even thousands of conflicting criteria' have to be considered, which can be related to technical, engineering questions, as well as environmental, economic or social concerns (Kiker et al., 2005; Levy, 2005, p. 438). In some instances, decisions must be taken on short notice and under high uncertainty, so information has to be delivered quickly. Decisions often also have far-reaching consequences on human lives and livelihoods. This places high demands on policy makers and the supporting expert groups, and multidisciplinarity increases the chance of conflicts of interest among epistemic community members (Jackson, 1996; Zhou et al., 2018). This 'fragmentation' in disciplines can negatively impact the effectiveness of an FRM strategy, as differences in interpretations and understandings of a problem, as well as how that problem should be addressed, create obstacles to its implementation (Davids et al., 2024; Gilissen et al., 2016).

The literature on governance theory and policy integration provides some insights. Overcoming obstacles of fragmentation has often been related to the creation of shared visions. The starting point for integrating experts from various disciplinary backgrounds is working towards specific, common goals (Cumiskey et al., 2019). This requires developing a variety of policy frames and solutions, connecting scales and balancing different objectives (Dieperink et al., 2016). Others have argued that overcoming boundaries between disciplines depends on strong inter-personal relations, needed to frame common goals and design policies to achieve them (Rosenau & Czempiel, 1992; Winkler, 2006). The importance of common goals and a shared policy vision can be linked back to some of the elements identified by Haas (1992) that bind epistemic communities together. Especially the shared set of normative and principled beliefs, as well as causal beliefs, will contribute to the creation of a shared vision amongst multidisciplinary experts. That is because these beliefs relate to how experts perceive the world around them, how they understand the problem at hand, as well as the most desirable solutions. It is therefore conceivable that these two sets of beliefs are especially important in ensuring epistemic communities remain strong and integrated, despite the introduction of different types of knowledge, instruments, and standard operating procedures by new disciplines.

5.3 | Bridging mechanisms to strengthen recognition justice

England, Flanders and France have taken distinctive approaches to facilitate integration between multidisciplinary experts in flood defence and flood risk prevention. The different arrangements can be seen as bridging mechanisms (Driessen et al., 2018; Gilissen et al., 2016; Hegger et al., 2016; Jordan & Lenschow, 2010). The sections below further elaborate on these bridging mechanisms, which may serve as examples to strengthen recognition justice in FRM.

5.3.1 | Institutional integration mechanisms

In Flanders and France, institutional mechanisms have been set up to stimulate integration of experts in flood defence and flood risk prevention. Such institutional arrangements can serve different purposes, including (1) information exchange, (2) coordinating policies and (3) cooperation (Gilissen et al., 2016). In Flanders, the CIW was established in 2003. The committee is an institutional bridging mechanism, functioning as a shared 'governance arena' (Davids et al., 2024), where flood risk engineers and spatial planners meet, stimulating knowledge exchange as well as policy-strategic collaboration at the highest level in Flanders (Hegger et al., 2018; Liefferink et al., 2018). This is meant to facilitate information exchange and cooperation (Gilissen et al., 2016). The committee was also set up specifically to tackle the problem of continued floodplain urbanisation (Mees, Crabbé, et al., 2016). Planning instruments insufficiently prevented building in flood risk areas, negatively impacting

the objective of flood defence to reduce damage and protect people from floods. The CIW is therefore also an example of a coordination mechanism between policy domains (Gilissen et al., 2016). Spatial planners were asked to take up responsibility in FRM, increasing their attention to the impact of building plans on the flooding system. At the same time, our results show that spatial planners in Flanders are more aware of the impacts of floods on socially vulnerable communities. The CIW may therefore also facilitate knowledge exchange on social vulnerability to floods between planners and engineers, providing an opportunity to strengthen recognition justice in FRM.

A different institutional approach can be observed in France. A hierarchical, top-down process was started by the state to stimulate integration of the strategies at the local level. The PAPI instruments strengthened the role of municipal authorities in FRM whilst also encouraging partnerships between local-level stakeholders. These stakeholders work together on implementing measures in the context of both defence and prevention. Hence, in contrast to Flanders, where the domains remain separate, in France the boundaries between the strategies blurred. This enables knowledge and information exchange between experts (as per Gilissen et al., 2016). The PAPI instruments are also an example cooperation, as experts in defence and prevention collaborate at the local level to achieve the common goals as defined in the region-specific PAPI. Local-level planners in France are sensitive to social vulnerability to floods, and the horizontal integration facilitated by the PAPI provides an opportunity for the exchange of information on the social impacts of floods.

5.3.2 | Agency of individual experts

A different type of bridging mechanism can be observed England. English flood defence differs from the other countries as experts with different disciplinary backgrounds have been integrated into flood defence organisations. The engineering perspective has therefore been complemented with social concerns—in addition to economic and ecological ones. This has strengthened recognition of social vulnerability to floods, drawing specific attention to the role of Lead Local Flood Authorities. These local-level defence experts can act as middlemen between communities at risk and higher-level policy makers, and their contextual knowledge and leadership provides an opportunity to link flood risks to social vulnerability concerns. The position of Lead Local Flood Authorities can be compared to policy entrepreneurs (Dieperink et al., 2018; Zahariadis, 1999), who can strengthen horizontal and vertical coordination by drawing attention to problems, promoting initiatives and solutions, bringing together experts, collecting finances and other resources, and secure action (Dieperink et al., 2018). Furthermore, engagement of policy entrepreneurs in networks that span across jurisdictions, domains and governance levels increases the likelihood of policy change (Mintrom & Norman, 2009). Multidisciplinary, local-level experts in English flood defence therefore present another opportunity to strengthen recognition justice in FRM. However, their ability to promote recognition of socially vulnerable communities will depend on the resources and expertise of a specific Lead Local Flood Authority.

6 | CONCLUSION

In this paper, we compared recognition justice in flood defence and flood risk prevention in England, Flanders, and France. Following the literature and ECF, we expected that the two strategies would differ in their sensitivity to social vulnerability to floods based on a difference in knowledge and expertise of the experts involved. However, we found that multidisciplinarity—rather than type of strategy—is the main determinant of the strength of recognition justice, as illustrated by English flood defence. Multidisciplinarity within an epistemic community may slow down decision-making processes, which can be overcome by a strong common vision or goal. Although the ECF aided in identifying the epistemic communities at work in flood defence and flood risk prevention, some shared characteristics (normative, principled and causal beliefs) may be more important for the effectiveness of epistemic communities than others (shared notions of validity, common policy enterprise). This is especially relevant in light of the increasing complexity of societal problems, which can only be tackled by bringing together a variety of experts. The countries implemented different mechanisms to facilitate integration of flood risk engineers and spatial planners in FRM. In Flanders and France, institutional arrangements were set up, whereas in England various disciplines have been invited into flood defence. The English case also highlighted the potential of experts acting as policy entrepreneurs to strengthen recognition justice.

We recognise that countries can differ significantly in terms of their socioeconomic, political and cultural characteristics. However, in the context of this paper, it has enriched the analysis as different pathways were identified in each of the countries while common themes emerged nevertheless. This paper mainly focussed on recognition of social vulnerability in flood defence and flood

risk prevention. Detailed analyses of the other FRM strategies have not been conducted. Furthermore, local-level practitioners may be better placed to recognise differences in the capacity of people to deal with floods, but data for this paper were mainly gathered at the national level with some case-specific examples. Future research could therefore further explore issues of (recognition) justice and social vulnerability in different socioeconomic and cultural contexts, and in other FRM strategies such as flood recovery, as well as how local-level initiatives may strengthen recognition at a higher level.

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DATA AVAILABILITY STATEMENT

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 will be made available through reports published in the repositories of the involved universities after the SOLARIS project ends.

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ENDNOTE

[1] https://jpi-climate.eu/programme/solstice/.

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APPENDIX A

A.1 | EXTENDED VERSIONS OF TABLE 2

TABLE A1 Summary of the main characteristics of the epistemic community supporting the strategy of flood defence in the three countries included in the analysis. The table provides information on the type of actors, their education and professional background, their shared norms and values, causal beliefs, notions of validity and common policy goals.

	England (UK)	Flanders (BE)	France
Type of actors	Government agencies dominate the actor group, led by Defra and the EA providing strategic oversight and leading implementation. The actor network is broad with statutory and non-statutory consultees. Local Authorities are responsible for surface water flooding Private actors are also involved. Many activities are carried out by private consultancy firms (mainly environmental and engineering focused)	Flood defence is fragmented (Crabbé, 2008; Kaufmann et al., 2016). Two main governmental actors at the regional level are the Flemish Waterways and Flemish Environment Agency (VMM) (interview, 30-09-2022; 03-04-2022) Experts come together in the CIW, which includes additional governmental stakeholders such as the Department for Mobility and Public Works as well as the Agency for Maritime Services and the Coast (CIW, n.d.). Advice can be requested from Flanders Hydraulics Research (Kellens et al., 2013), and hydrologists and hydraulic/civil engineers from universities and private consultancies	Flood defence involves many actors from the national and local level (Larrue et al., 2016). Experts include the Ministry of Environment (General Division of Risk Management), decentralised state services such as the Regional Directorate for the Environment, Planning, and Housing (DREAL) and the Managing Department of Territories (DDT) The local scale has taken more responsibilities in recent decades (Brun, 2009; Richard-Ferroudji, 2014). The Public Territorial Basin Establishment (EPTB) are water boards created by local actors (Larrue et al., 2016). Local actors often must rely on advice from private experts and consultancies
Disciplinary background	The engineering perspective has been challenged since the 1970s (Alexander et al., 2016) so experts in flood defence are interdisciplinary with backgrounds ranging from social sciences, communication, data sciences and technology (Alexander et al., 2016). Interdisciplinarity is strongest in governmental organisations (Defra, EA). There are still experts with 'traditional' technical expertise as well. Some Local Authorities have less diversity in disciplines and are more reliant on engineers and hydrologists	Experts mainly have backgrounds in engineering and hydrology and are 'technically trained people who try to minimise the damage caused by a flood event' (interview, 03-04-2023). In fact, a degree in engineering is often required to work on flood defence: 'some might say that is very diverse, because there are bioengineers, structural engineers, etc. But it is all from an engineering perspective' (interview, 05-05-2023)	Flood defence experts at national level, who have a high level of responsibility, often have a civil or hydraulic engineering background (Gueben-Venière, 2014). Local-level experts within the state services are specialised in procedures relating to government principles and restrictions in a specific area, usually with a technical background (Barbier & Charpentier, 2022). Experts from private consultancies also often come from the engineering discipline. As for ETPB and water boards, experts have backgrounds in ecology, hydrology, agriculture—but no social sciences (Pustelnik, 2008; Richard-Ferroudji, 2014)
Shared normative and principled beliefs	Ultimately, experts aim to improve public safety regarding flood events. Statutory responsibilities focus on warning and emergency response measures (Environment Agency, 2020b). However, as in most cases, risk or direct harm from flooding is low, attention turns to reducing other losses Actions are also often guided by economic efficiency, illustrated by the	Experts aim to protect everyone from flooding (Paauw & Crabbé, 2023) as it is believed that 'water makes no distinction between rich and poor. The houses that suffer from flooding in Flanders are usually single-family homes. Whether those are inhabited by two earners, or certain ethnicities... It is not just the impoverished neighbourhoods that experience flooding. We have never seen that. It	Actions are guided by serving the public interest (interview, June 2022) and improving safety: "We have a repressive role to ensure the safety of the people and properties" (interview, 12-04-2022). This is also illustrated by the following: 'The operation is justified by the people who have been relocated [...] and in relation to a weir that could no longer function properly and was dangerous' and 'there was a

(Continues)

TABLE A1 (Continued)

	England (UK)	Flanders (BE)	France
	fact that economists were the first new discipline to be introduced in English flood defence. All public policy related to flood risk has to consider key principles such as value for money and must meet specific standards when using data to estimate risk (CBAs). Policies can be evaluated and so experts have to ensure they meet the evaluation criteria in terms of risk reduction and minimising costs (Defra, 2011, 2020)	is the average Fleming who is victimised by floods' (interview, 27-09-2021). Flood risk engineers aim to safeguard the public interest: 'our objective is always to serve the public interest and I think there's justice in there somewhere' (interview, 27-09-2021) The optimal mix of measures in flood defence is often determined based on CBAs, which underlines the importance of economic efficiency (Mees et al., 2018)	real danger for anyone who stayed behind' (interview, 14-04-2022) Environmental protection is considered important. An engineer from the water boards explained that 'the structures we are going to finance will protect properties and people from flooding at the bottom of the hill. But my entry point will also be an environmental one' (interview, 10-06-2022) Economic sustainability is also strived for: 'in the 2000s, we considered the [flood risk] infrastructures to be outdated, and we realised it was an aberration to have a structure like this to maintain the coastline and that a decision would have to be taken by 2013 [...]. It's going to cost a fortune. It will be expensive to maintain, and we won't have the means to do it. Because there are no normal maintenance subsidy channels' (interview, 09-10-2022)
Shared causal beliefs	Floods are framed as a technical problem, emphasising the water course or catchment. The product, that is, protection infrastructure, is seen as the solution—which is further promoted by the centralised nature of government organisations responsible for flood defence (Green, 2017). The focus is on the highest risk, determined by looking at hazard, exposure and vulnerability. Often, efforts concentrate on floods that pose the most severe hazard and have high economic damages. There are some modifications for social vulnerability. Social elements remain difficult to model, although there are many efforts ongoing in this area and risk to life has been considered for c. 20 years (Defra, 2006) The National Audit Office will determine the key policy goals which will focus on flood risk reduction but in such a way that maximises the value of public money spent to maintain public safety (National Audit Office, 2023, 2024)	Flood defence focuses on flood probability reduction through infrastructural, protective measures such as dikes, levees, weirs, pumps, etc. (Kaufmann et al., 2016; Mees et al., 2018). There is trust in the capacity of technical measures to contain and restrain water (Crabbé & Coppens, 2019). The approach has shifted, due to an interest in creating more space for water, but classical defence measures remain very important (Mees et al., 2018) Engineers are characterised by their risk-based approach. Risk is defined as the probability of a flood event in a certain time period, and potential consequences and losses (social dimensions are not considered) (Kellens et al., 2013). Their approach has been described as a different way of looking at the world due to the strong trust in technical measures: 'we asked them [flood risk engineers] to calculate what it would mean if all undeveloped plots of land in Flanders would be developed. What this would mean in terms of impacts on the flooding system. And they said: "Nothing." That has no impact.	Flood defence was traditionally the dominant strategy in France in terms of public investment, based on the belief that technical measures such as watercourse maintenance, dikes and other hydraulic infrastructures sufficiently reduce the probability of flooding (Larrue et al., 2016). For example, along the coast, there is often 'a tendency to want to fix [...] and dam up the entire coastline of the region [...], but it is not sustainable, not is it relevant in terms of planning' (interview, 01-04-2022) Vulnerability to flooding is seen as a question of location or building characteristics: 'it was more the technical side that prevailed, with the risk of flooding, the number of properties and the fact that we needed a procedure to reduce the vulnerability of the sector and people' (interview, 14-03-2022). Although it is often believed that reducing the exposure of buildings and people is sufficient to tackle the issue of flood risk, there is increasing interest in socioeconomic characteristics of people. However, engineers do not

TABLE A1 (Continued)

		Because if you are building something, according to new legislation, you have to buffer all the rainwater on your property. So, it has no impact for us. It is the same as undeveloped land' (interview, 05-08-2023)	have the knowledge on how to support people (interview, 09-06-2022)
Shared notions of validity	All forms of knowledge are relevant and there is a focus on including those holding lay, contextual or local expert knowledge. Despite these efforts, decisions are often taken based on technical or engineering knowledge (Environment Agency, 2020a, 2020b; interview, 21-11-2021) Due to the inclusion of experts from different disciplines in flood defence, multidisciplinary knowledge plays an important role and there are various mechanisms to bring in scientific knowledge and developments. However, this will require development of tools or knowledge that is usable in practice for those developing flood risk policy. This translation of science into flood defence practice is relatively well-developed in England (Alexander et al., 2016)	In the past, 'there was a lot of trust in engineering knowledge. As a result, people said [to engineers]: "just get started, we provide the money and you solve the problems"' (interview, 03-04-2023). This trust in engineering expertise dates to Napoleonistic times. For example, the Department for Mobility and Public Works consists of a group of engineers who are believed to safeguard economic welfare and public safety through collective, infrastructural works (Crabbé, 2008) Scientific knowledge is also important. 'We start from very scientific information and data. And the more local we go, the more elements you have to consider. [...] But it is very difficult, because local knowledge is usually not available at a higher level' (03-04-2023)	Technical and scientific knowledge are the main sources of information for decision making. 'I think that, at the time, I had a fairly scientific background and was relatively young, so I thought that a scientific demonstration was enough to win people over' (interview, 14-04-2022) A lot of knowledge also comes from private consultancies, who bring in technical knowledge: 'we have an office at [name company] that has algorithms that can run the machine to say, well, "the sea will come this far, it will stop here. The shape of the landscape will be like that,"—[we realize that us] we were very much mistaken. In any case, they [consultancy] can tell us. We don't have the skills, we don't have the tools, so we can't ignore the consultancy firm' (interview, 07-06-2022)
	England (UK)	**Flanders (BE)**	**France**
Common policy enterprise	Flood risk modelling is among the standard operating procedures to find a solution to sufficiently reduce risk. However, there are efforts to integrate social and economic information into modelling with the move towards the National Flood Risk Assessment 2 (Nafra2) (Lukey, 2023). Based on modelling results, mapping is an often-used strategy—also at the local level—and these have significantly improved in detail and nuance over the last years Participatory processes are well embedded into standard practices to engage a range of stakeholders. However, the extent to which these represent all interests varies. For example: 'the FCERM Strategy was developed collaboratively, and we were one of the collaborators, over a couple of years. But the final draft that communities were involved in [...] and what came back out of DEFRA are	Determining the optimal measure is often based on hydrological modelling: 'on the basis of modelling, we make maps to assess where risks come from and where those risks are located. [...] Then we have the financing component, where we look at the budget needed to take the necessary measures, and where resources will be coming from' (interview, 03-04-2023). This illustrates a focus on risk reduction as well as economic efficiency. When deciding on (the optimal mix of) measures, CBAs are often used to minimise costs and maximise people/properties protected (interview, 30-09-2022; 03-04-2023) Flood hazard maps are made to assess which areas are at risk of flooding and where vulnerable institutions (hospitals, schools, etc.) are located (CIW, 2011). This is based on two groups of data: 1) hydrologic and	Modelling plays an important role, especially in the creation of flood hazard maps (Barbier & Charpentier, 2022). Based on the highest known historic flood, or floods with a 100-year return period (whichever is higher), models calculate the areas at highest risk of flooding—based on which measures are chosen to reduce that risk CBAs are an important tool to decide on the (mix of) measures to be implemented in the context of the PAPIs (interview, 12-04-2023). There is a very strict methodology to follow in relation to the CBAs, 'which needs to be based on detailed studies of the hazards and knowledge of the issues' (interview, 04-04-2022)

(Continues)

TABLE A1 (Continued)

	England (UK)	Flanders (BE)	France
	two rather different things. In two main ways. Firstly, the level of ambition is not there... And the second thing was that it got rewritten. So, the language got changed from being collaborative and more sympathetic, to being very ministerial and top-down' (interview, 30-03-2022)	hydrodynamic models and 2) a high-resolution digital elevation model. The result shows the physical extent of flooding and its return period (Kellens et al., 2013)	

TABLE A2 Summary of the main characteristics of the epistemic community supporting the strategy of flood risk prevention in the three countries included in the analysis. The table provides information on the type of actors, their education and professional background, their shared norms and values, causal beliefs, notions of validity and common policy goals.

	England (UK)	Flanders (BE)	France
Type of actors	National-level policy actors focus on strategic policy making and are led by the government Department for Levelling Up, Housing, and Communities (DLUHC). There are also statutory and non-statutory consultees for changes to housing policy, including various interests (e.g., environmental) but involved experts will depend on the specific policy At the local level, there are strategic planners as well as those deciding on planning applications. The former will be done by Local Planning Authorities, but technical flood risk questions will be outsourced to consultants or advice will be requested from the EA. Local planning applications will be handled by local planners, elected officials, and local communities (especially those affected). Flood risk assessments are commonly conducted by environmental and engineering consultancies (Alexander et al., 2016)	Spatial planning in Flanders is mainly conducted by regional, provincial, and municipal government administrations. Issues relevant for the regional scale are included in plans drafted by the Environment Department of the Flemish government, whereas local authorities can draft their own plans within those constrains (Tempels, 2016). This division also applies to issuing building permits Other important experts include the Agency for Nature and Forest and the Flemish Land Agency, both from the regional government. Planners from universities, research institutes, and consultancies can also be involved in strategic policy making for planning in the context of FRM	National-level spatial planning is conducted by the Ministry of Environment, which includes the Division on General Risk Management and Planning (Larrue et al., 2016). The experts and stakeholders involved in flood defence partly overlap with those part of flood risk prevention, such as DREAL and DDT At the local level, municipalities carry responsibilities in spatial planning for their territory, as well as for PPR applications and they are involved in drawing up PAPIs. Inter-municipal stakeholders play an important role too, who assume planning responsibilities for projects that cross administrative boundaries of municipalities (Larrue et al., 2016)
Education and professional background	Experts at the national policy planning level are diverse in their educational and professional backgrounds. Government policy makers tend to come from many different areas and move around amongst departments. They can sometimes be without a clear background in the policy domain they are working in At the local level, actors have spatial planning backgrounds and flood risk will be only one of the issues planners have to take into consideration. Local planners may have specialisms (e.g., transport planning) but local authorities are often resource-stretched, and so planners are often generalist and know a little bit about a lot of different topics. This may vary per Local Authority depending on the size/resources available (interview, 30-11-2021) 'capacities vary...it can be very difficult with smaller units'	Multidisciplinarity is at the core of planning. There is no bachelors' programme in spatial planning, only a masters' degree. 'The people joining the [masters'] program have very diverse backgrounds. It is often related to architecture, but we also see [...] human geography, social sciences, etc. So, it is very broad [...] and when we talk about the program itself, it is often closer to humanities than to engineering' (interview, 04-05-2023) The result is that experts in have diverse backgrounds, ranging from 'history to political sciences, communication, architecture, archaeology, sociology, planning, as well as (bio)engineers' (interview, 09-05-2023)	Generally, state-level experts have the same engineering background as experts in flood defence (Gueben-Venière, 2014) Disciplinary backgrounds are more diverse when looking at those responsible for planning from a perspective larger than risk. Experts within the Planning Division of the state services are multidisciplinary, such as architects, urbanists, engineers, political sciences, social sciences, etc. Similarly, at the (inter-) municipal level, experts also have diverse backgrounds and are often multidisciplinary. However, they often 'continue to bring in [physical] geographers. [...] People in planning in France have no training in risks and the temporality of risks, all that does not mean anything to them' (interview, 08-11-2022)

(Continues)

TABLE A2 (Continued)

	England (UK)	Flanders (BE)	France
Shared norms and values guiding action	Coordination is an important value guiding spatial planners' activities. Experts have to ensure that flood risk is viewed and applied as a material consideration when making planning policy and decisions (DLUHC, 2022, 2023) and the EA is a statutory consultee (Environment Agency, 2020b). However, flood risk is considered alongside a host of other issues. Planners consider many different interests and competing aspects. Integration is therefore important as well. All interests should be considered and integrated in policy making and when planning applications are being reviewed (DLUHC, 2023) Ultimately, the goal is to allow for development and building where appropriate and prevent development in areas at risk of flooding. This means allowing water and people to coexist in space, illustrating a desire for multifunctional land-use, or space that is designated and used for several purposes (e.g., a park can double as a flood storage area during heavy rainfall events) (Alexander et al., 2016). At the national level, planning needs to meet the needs of the nation in terms of development (e.g., housing, job creation, economic development, see Alexander et al., 2016)—however, at the local level, an important value is sustainable development and preventing development in areas at risk of flooding. National and local-level values may not align or even be conflicting (Geaves & Penning-Rowsell, 2016)	Important values guiding spatial planners' activities include coordination, coherence, and spatial integrity. 'The objective of spatial planners often lies in coordination, coordinating the "spatial" so that it is a beautiful whole, that there is coherence, and that it is spatially balanced. And that coordination, how are you going to measure it? [...] It's not like, 'now we've fine-tuned it and we're done. It is an ongoing process' (interview, 09-05-2023) In the context of floods, this often means designing space in such a way that water and people can coexist. Ultimately, spatial planners aim to provide a good public space, or what interviewees have described as an '"experienceable living environment," creating a pleasant place. And also creating a pleasant space for people who have less' (interview, 05-05-2023). The goal is to 'give everyone equal capabilities to use space. [...] That is about basic accessibility. Well, it is more socially just if everyone has access to public transport, for example' (interview, 04-05-2023)	Values guiding planning include spatial coherence and integrity. Planners have to consider various interests, perspectives, and other laws/regulations, and make this into a coherent, balanced plan. 'Geographically, [...] we're in a valley, we have the sea, the coastal law applies outside urbanised areas, we have protected areas, so that's a no-go. We have agricultural areas where, in order to repurpose agricultural land, you have to have strong arguments [...]. We have to comply with the SRU laws, the housing laws, where we can't expand and we have to build the town on top of the town. To sum up, there's a geographical aspect that's holding us back a little. And also a political aspect that doesn't want us to expand, because it means a network, which means development, which means high costs [...]' (interview, 08-06-2022) In the context of flooding, the aim is to develop a shared strategy, based on in-depth assessments of risk, from which an action programme will emerge, dealing in a balanced and coherent way with all the areas of flood risk prevention policy (MTE, 2023)
Shared causal beliefs	Ultimately, flood risk prevention aims to minimise exposure to flood risks by keeping people and properties away from water (Alexander et al., 2016). This is achieved by prohibiting or discouraging development in flood risk areas. Planners often consider a wide perspective of the local environment and seek to work with potential developers and other authorities such as the EA to manage flood risks through restricting permits for development based on the sequential test (interview, 30-11-2021).	The goal of flood risk prevention is to prevent damage from flooding by building in harmony with your environment (VMM, n.d.). It is believed that the exposure of people and properties to flooding can be reduced through structural adjustments to existing properties, and reducing building in flood risk areas (or at least stimulate flood resilient building) (Hegger et al., 2016). Flood risk used to not be an active consideration in planning; little was done to control development in flood	The goal of flood risk prevention in France is to prevent damage from flooding through planning, and thus through zoning (PPRI), characterised by restrictions on urbanisation of floodplains (Février, 2008); however, public policy instruments have not sufficiently prevented land use in flood prone areas (Guerrin et al., 2014) Planners go beyond the technical perspective of engineers: 'they are very good in defence works, let's be clear about that [...]. They have real

TABLE A2 (Continued)

	England (UK)	Flanders (BE)	France
	The long-term effects are considered to ensure sustainability of any permitted development (DLUHC, 2023) Planning for FRM is often understood as a process, rather than the production of a solution being seen as the sole purpose of spatial planning. The process serves the purpose of producing some agreed upon vision for the future, in which humans and floods both use space (Green, 2017)	risk areas (De Vos et al., 2012; Tempels, 2016). At present, various instruments have been introduced that strengthened the capacity of planners to reduce building in flood risk zones and to inform residents of their risks (interview, 26-08-2023) In general, where flood risk engineers mostly look at rivers and how water can be contained to reduce risks, planners have 'more interest in the interaction between the environment of the river and what happens around it, how the surroundings develop, and how flood risks can fit into this' (interview, 09-05-2023). This means that making space for river water to flow freely without impacting people and infrastructure is the core of planning for FRM. This 'idea of integrality is ingrained in spatial planning' (interview, 09-05-2023). The ultimate goal is 'to create an efficacious, area-oriented adaptation strategy to water and climate-proof spatial planning in Flanders' (De Smedt, 2014, p. 108)	expertise. I'm not questioning that at all. But when it comes to urban approaches, strategies, and operational set-up, they brought in someone who was good at legal work, which isn't the point, but on dikes and all that. This wasn't what was expected' (interview, 08-11-2022) The objective of planning is to propose a long-term strategy, in which local authorities can further plan for their territory (interview, 12-04-2022). The plans should identify areas at risk of flooding where further building should be prevented, to keep people and properties away from water. What is important here is that the environment is considered in its entirety: 'Population and human health, biodiversity (with particular attention to protected species and habitats), land, soil, water, air, and climate, material assets, cultural heritage, and landscape, as well as interactions between these elements' (MTE, 2023)
Shared notions of validity	Planning decisions are often taken at the very local level, meaning that decisions are close to local communities that are being impacted. Local voices are considered during consultation processes, illustrating the importance of lay and situational knowledge (Green, 2017) However, there is still a strong reliance on technical and scientific knowledge. Both national planning policy and local strategic planning relies on technical flood risk assessments to identify areas at risk, and to determine the potential positive or negative impacts of planning applications. This is reinforced by the opportunity for the EA to object to development based on existing or potential estimated flood risks. Furthermore, if planning disputes arise, it will often be the technical or scientific knowledge which will justify decisions (Alexander et al., 2016)	Although a technocratic perspective prevailed in spatial planning in Flanders during the 1950s and 1960s (interview, 04-05-2023), this has shifted to a focus on deliberation and a high democratic level of planning. As a result, local knowledge is important: 'we always try to work in a participatory way, and I think that is typical for spatial planning. So, in many of our projects, we provide participation opportunities both at the start and at the end, and often also in intermediate phases' (interview, 05-05-2023) Multidisciplinary knowledge is also important in flood risk prevention, as planners work on a range of topics and need to bring together diverging perspectives and experiences: 'as an expert, you must consult with stakeholders and organise participation. This has become known as the paradigm of collaborative planning' (interview, 04-05-2023). Although there is a stronger focus on	Multidisciplinary knowledge is important, as the capacity to be able to work on different subjects is seen as crucial. 'We do get involved in issues, whether they be environmental management issues or others, that go beyond the scale of a single municipality, or even issues of coastline or climate change, or risk' (interview, 28-07-2022). Planners underline the importance of sensitivity to different types of issues and knowledges. 'They have an approach [...] that is much more sensitive, much more... of course, They integrate engineering knowledge, but also urban issues, social issues, landscape issues, etc.' (interview, 28-07-2022). This shows that the engineering perspective is not completely omitted in flood risk prevention; rather, it is combined with other types of knowledge Lay and contextual knowledge is also considered as important, as planners aim to increase the awareness of the

(Continues)

TABLE A2 (Continued)

	England (UK)	Flanders (BE)	France
		local, contextual and multidisciplinary knowledge, planners sometimes still rely on technical knowledge of flood risk engineers when it comes to complicated decisions (interview, 09-05-2023)	population of the problem and to also incorporate their perspectives into decision making
Common policy enterprise	There are some standard processes that need to be undertaken when considering flood risk and development, such as the sequential test, Flood Risk Assessments at the level of planning applications, as well as more Strategic Flood Risk Assessments to aid in decision making (DLUHC, 2022, 2023) An important common policy enterprise is integrating and reconciling conflicting objectives and constraints. A large part of spatial planning in England is conducted by Local Authorities, and ultimately these plans delimit what land owners and land users can do within the context of various constrains (Green, 2017). The interaction between these potential land uses requires a systemic approach to balancing interests and needs. Local governments are required to promote stakeholder engagement in making plans and when planning applications are being reviewed (Green, 2017). Planning is understood as a process that should deliver an agreed-upon vision for the future	Experts in flood risk prevention make plans. 'The water managers, they are hard engineers with a nice budget to realise things. Budgets within spatial planning are more for study work and policy preparation. And that's less visible, isn't it? [...] Spatial planners are "policy-preparing stakeholders"' (interview, 09-05-2023). In those plans, planners integrate perspectives and experiences. 'We are not highly specialised, you always look at space with a holistic view [...]. This requires learning to talk to other disciplines' and integrating their perspectives into a coherent plan (interview, 09-05-2023) Sometimes, models are used. For example, in environmental impact assessments, for which the responsibility lies with planners. Multi-criteria analyses are also used to decide on social costs and benefits, but this is associated to what has been called technocratic planning (interview, 04-05-2023). Two other instruments central to flood risk prevention are the 'water assessment' and 'signal areas' (Tempels, 2016), the latter being undeveloped areas at risk of flooding where building should be prevented (De Smedt, 2014) Stakeholder engagement is also often used in planning. It is in their 'modus operandi' (interview, 09-05-2023) because they are planning the living environment, and people live in and actively use that environment. This makes their perspectives and experiences highly valued. The planner's duties are therefore about mediating, and distilling productive solutions from conflicting positions of various experts and inhabitants (Boussauw & Lauwers, 2020)	Some tools often by experts in flood risk prevention include the drafting of spatial plans, prevention and regulation of building through planning, risk paragraph in purchase deed, expropriation and acquisition policy, and general information flooding through flood maps (Larrue et al., 2016). Mapping is still a major element, 'the keystone of the system, it's based on different types of knowledge... To get all the players on board, to have something tangible to say, look, this isn't the green terrorists there is a reality out there, so we're actually objectifying the erosion of biodiversity, the erosion of the coastline with observatory mapping' (interview, 02-03-2023). Maps are then often combined with CBAs Experts are characterised by their efforts to integrate diverging perspectives, illustrated by the central role given to stakeholder engagement which can result in intensive negotiation processes: 'it is a titanic job. We worked 80 hours a week. [...] So, we negotiated everything line by line. In the end, we got close [to other stakeholders and agencies], because we had I don't know how many exchanges with, for example, water agencies' (interview, 08-11-2022)