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RETHINKING FLOODLABEL:

A SITUATIONAL APPROACH TO HOMEOWNER INVOLVEMENT IN FLOOD RISK MANAGEMENT

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Rethinking Floodlabel: A Situational Approach to Homeowner Involvement in Flood Risk Management

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ACRONYMS

ACIW	Flemish Coordination Committee Water Policy (Coordinatiecommissie Integraal Water Beleid)
DWIP	Decree Integrated Water Policy (Decreet Integraal Waterbeleid)
EC	European Commission
EPC	Energy Performance Certificate
FD	Flood Directive
FRM	Flood Risk Management
FRG	Flood Risk Governance
GTI	Interdepartmental Flood Group
HKC	Hochwasser Kompetenz Center
HWP	HochWasserPass
MLS	Multi-layered Safety (Meerlaagse veiligheid)
MLWS	Multi-Layer Water Safety (Meerlaagse Water Veiligheid)
PLFRA	Property-Level Flood Risk Adaption
TMA	Tailor-Made flood risk Advice
VMM	Flanders Environment Agency (Vlaamse Milieu Maatschappij)

SUMMARY

Background

Flooding is one of the most damaging natural hazards in Europe, and it is increasingly becoming a societal problem. Influenced by climate change and ongoing urbanization, flood risks will increase in the near future. This will cause more damage for citizens and their homes, businesses, and infrastructure.

To counter these risks, traditional organized government-led flood protection is transforming into multi-actor flood risk management. New discourses and policies are being introduced. First, traditional flood protection is transforming into a risk-based approach. This risk-based approach is not only focused on reducing the probability of a flood but is also determined by an attempt to reduce financial impact or losses. Second, the concept of resilience is being introduced. This discourse roughly entails an acceptance that not all floods can be prevented, resulting in a focus on the reduction of flood consequences, and expects communities to absorb a flood when it occurs, and adapt or transform, instead of ‘bouncing back’ into old habits of resistance and protection. Based on these new discourses, new strategies and are being developed, such as Multi-Layered Water Safety. This strategy aims for smart combinations of instruments and solutions that prevent, protect, and prepare communities for flood risks. In this way, flood risk management is diversifying.

These new strategies require active involvement of new actors, because citizens, businesses, and other land users can also contribute to flood resilience. Homeowners, for instance, can implement property-level flood risk adaption (PLFRA) measures to reduce the flood risks of their private properties. Examples of these relatively low-cost PLFRA measures include mobile barriers, backwater valves in the sewer, or actions such as sealing building openings or alternative use of vulnerable rooms and spaces in the houses.

However, the implementation of PLFRA measures by homeowners remains marginal. Homeowners perceive flood risk management as a governmental task, or are not aware of their flood risks, or do not recognize the advantage of PLFRA, or lack the knowledge and capacity to reduce their risks. To inform about flood risks and motivate homeowners to implement PLFRA measures at home, new instruments are currently being developed, such as the floodlabel.

To trigger adaptive behavior, a floodlabel can inform, motivate, and bind flood-resilient behavior. The floodlabel provides tailored information on flood risks and possibilities to reduce these risks when implementing PLFRA. The label can motivate by providing cost-benefit comparisons of the costs of PLFRA and potential damage calculations, or by comparing labels among houses. A floodlabel can become binding when certain maximum levels of risk are required for a house to be sold, rented out, or insured.

Because of this, floodlabel might be able to motivate homeowners in the implementation of PLFRA and become a useful instrument in flood risk management. However, changing the behavior of homeowners is a complex issue, that not only depends on the internal appraisals of the homeowners, but is also influenced by external factors. Therefore, behavioral change is highly context dependent.

Research design

Based on these observations, this dissertation investigates how floodlabel can be effective in flood risk management. Therefore, the following research question has been raised:

"Does the introduction of a floodlabel contribute to flood risk governance? If so, what contextual conditions are conducive for the implementation of a floodlabel?"

To answer this question, this study adopts a relational approach to the complexity of behavioral change of homeowners in flood risk management. A floodlabel cannot be effective in motivating homeowners without considering the context of its application. Flood risk management needs to be encapsulated in a larger and wider relational policy context. Therefore, the theoretical framework considers risk, resilience, and multiple actors as a co-evolutionary process of undefined becoming that is unique for each space/time configuration. These notions provide a context where actors, factors, and institutions as a system continuously interact, adapt, and evolve with each other and with other systems. So, to understand if the introduction of a floodlabel contributes to flood risk governance, this study is not only focusing on the impact of flood risk advice on homeowners, but also considers the contextual factors, institutions, and actors which are conducive for the introduction of a floodlabel. Therefore, the following sub-questions have been formulated:

RQ A: How can homeowner behavior, floodlabel, and flood risk governance be related to each other? See Chapter 2.

RQ B: To what extent do homeowners become more motivated to implement property-level flood risk adaption (PLFRA) by a floodlabel? See Chapter 4.

RQ C: What contextual conditions are conducive for the implementation of a floodlabel?

C1: What *factorial* conditions are conducive for the implementation of a floodlabel?

See Chapter 5.

C2: What *institutional* conditions are conducive for the implementation of a floodlabel? See Chapter 6.
C3: What actors are conducive for the implementation of a floodlabel? See Chapter 7.

A final research question considers operationalization of the floodlabel in flood risk governance:

RQ D: How can a floodlabel be implemented in flood risk governance in order to stimulate adaptive behavior among homeowners? See Chapter 8.

Results

To analyse if homeowners become more motivated to implement PLFRA, this study considers a unique case study of tailored expert advice for homeowners, in Flanders, Belgium. The pilot of tailored advise contains multiple elements of overlap with the concept of floodlabel. Both instruments aim to inform and motivate homeowners to implement PLFRA measures, and both use an expert that provides information specifically tailored to each individual house. The case study shows that, thanks to the dedicated efforts of experts, 15% implement all PLFRA measures that are suggested by the experts, and another 32% implement some proposed measures. These are promising results for future pilot projects. The case study illustrates how tailored expert advice in Flanders is currently mostly focused on the inner decision-making process and is not focused enough on the externalities. We assume that even more homeowners might consider the implementation of PLFRA measures when a more relational perspective is incorporated and practised. Therefore, the remainder of the study focusses on these contextual factors, institutional settings, and other actors in the four countries that are part of the JPI Floodlabel research project: the Netherlands, Belgium, Austria, and Germany.

An analysis of the contextual factors in these countries shows how flood risk changes over space and time and is influenced from the outside-in. Risk is constructed through the complex interaction between the climate system, the terrestrial/hydrological system, and the socio-economic system. Through complex interactions within and among these systems, a manifold of indicators contributes to flood probability, exposure, and vulnerability. Examples of these indicators include seasonality of floods, flood typology, catchment size, urbanization, building typology, (un)employment, and tenure status. Influenced by different external factors and indicators, flood risk management cannot be universal, but it is tailored to a local spatial context. This also has implications for the configuration of the floodlabel.

The institutional analysis shows how institutional transformations are shaped 'from the outside in' by the context of risk, and the interactions with and between actors. The institutional design influences the way citizens engage in flood risk management, and has an influence on the usability of a floodlabel. The cross-country comparison of institutionalization of flood risk management shows how conceptualizations of risk, governmental responsibilities, risk perceptions, flood risk insurability, and spatial planning differ in the Netherlands, Belgium, Austria, and Germany. Consequently, these institutional conditions influence the usability and configuration of the floodlabel in each of the countries.

A focus on the behavior of other actors, associated with, or potentially associated with homeowner involvement in flood risk management, illustrates how most interviewees have limited interest in other or additional roles in flood risk management and prefer to go on with businesses as usual. Arguments that are mentioned include a lack of urgency or a lack of demand from clients (i.e. homeowners) who ask their representative to become involved. Other actors do not want to act first or alone and instead wait for their sector or others to show initiative. However, some local governments realize that the involvement of homeowners in flood risk management also requires new roles of governments. All governmental interviewees are aware of these changing roles, but they act differently in their interactions with homeowners. The development of multiple tools, instruments, and communication channels seems to be required, and a floodlabel or tailored advice could be one of the instruments for local governments to use in the communication with homeowners on flood risk management.

Implications for the floodlabel

The specific contextual factors, institutions, and involved actors imply that the configuration of the floodlabel varies in the four countries. Based on these factors, in the Netherlands, a floodlabel is more useful as an informative tool. The Netherlands, characterized by coastal and large-scale fluvial flood risk, deals with low probabilities but high exposure in case of a flood. This has resulted in a very specific institutional setting, forming a contrast with the other floodlabel countries, where pluvial and fluvial flood risks tend to dominate. In these countries, PLFRA will be more effective due to the smaller scale of floods and the higher probability of floods. Here motivational configurations of floodlabel can become more successful.

This leads to the following conclusion: for floodlabel to contribute to flood risk governance, the label should be tailored to the situational institutional settings. Suggestions for implementation include:

- Align the configuration of floodlabel with the direction of resilience evolutions.
- Couple advise with incentives to motivate homeowners to invest in PLFRA measures; this requires direct involvement of actors from government, businesses, and civil society.
- Create quality control mechanisms on the implementation and effectiveness of the measures in place
- Provide education for the expert offering flood risk advice or a floodlabel
- Legally enforce aforementioned suggestions

New roles for citizens imply new roles for other actors too. Floodlabel is not a tool to move responsibility towards citizens, but it could be an instrument to mediate on these responsibilities between multiple actors. Governance arrangements for floodlabel should therefore specifically search for collaborations with multiple parties.

SAMENVATTING

Achtergrond

Overstromingen behoren tot de schadelijkste natuurrampen in Europa en vormen in toenemende mate ook een maatschappelijk probleem. Onder invloed van de klimaatverandering en de voortschrijdende verstedelijking zullen de overstromings-risico's in de nabije toekomst toenemen. Dit zal meer schade veroorzaken aan de huizen van burgers, bedrijven en infrastructuur.

Om deze risico's het hoofd te bieden, transformeert de traditionele, door de overheid geleide, en op kansenbeperking gebaseerde protectie tegen overstromingen langzaam-aan in overstromingsrisicobeheer in een governance setting van meerdere actoren. Dit gaat gepaard met de introductie van nieuwe discoursen en nieuw beleid. Ten eerste verandert de traditionele protectie tegen overstromingen in een risico gebaseerde aanpak. Deze op risico gebaseerde aanpak is niet alleen gericht op het verminderen van de kans op een overstroming, maar eveneens wordt geprobeerd om de financiële gevolgen of verliezen te beperken. Ten tweede wordt het begrip "veerkracht" geïntroduceerd. Dit discours houdt een aanvaarding in dat niet alle overstromingen kunnen worden voorkomen. Dientengevolge focust deze benadering op de vermindering van de gevolgen van overstromingen. Dit betekent dat gemeenschappen een overstroming kunnen absorberen wanneer deze zich voordoet, en zich als gemeenschap aanpast of transformeert, in plaats van "terug te keren" in oude gewoonten van het water buiten houden en weerstaan. Op basis van deze nieuwe discoursen worden nieuwe strategieën ontwikkeld, zoals Meerlaagse Waterveiligheid. Deze strategie streeft naar slimme combinaties van instrumenten en oplossingen die gemeenschappen voorkomen, beschermen en voorbereiden op overstromingsrisico's. Op deze manier wordt het beheer van overstromingsrisico's veelzijdiger.

Deze nieuwe strategieën vereisen actieve betrokkenheid van nieuwe actoren, aangezien ook burgers, bedrijven en andere grondgebruikers kunnen bijdragen aan de veerkracht tegen overstromingen. Huiseigenaren kunnen bijvoorbeeld schade beperkende maatregelen (PLFRA) implementeren om het overstromingsrisico van hun woning te verminderen. Voorbeelden van deze relatief goedkope PLFRA-maatregelen zijn mobiele barrières, terugslagkleppen in het riool, of acties zoals het afdichten van openingen in gebouwen of alternatief gebruik van kwetsbare kamers en ruimten in de huizen.

De toepassing van PLFRA-maatregelen door huiseigenaren blijft echter beperkt tot een minimum. Huiseigenaren zien overstromingsrisicobeheer als een overheidstaak, of zijn zich niet bewust van hun overstromingsrisico's, of zien de voordelen van PLFRA niet in, of missen de kennis en capaciteiten om hun risico's te verminderen. Om huiseigenaren te informeren over overstromingsrisico's en hen te motiveren om thuis PLFRA-maatregelen te nemen, worden momenteel nieuwe instrumenten ontwikkeld, zoals het overstromingslabel.

Om het gedrag van huiseigenaren te veranderen, kan een overstromingslabel bijdragen. Het label zou kunnen informeren over, aanzetten tot en verplichten van de implementatie van deze PLFRA maatregelen. Het overstromingslabel biedt informatie op maat over overstromingsrisico's en de mogelijkheden om deze risico's te verminderen middels de implementatie van PLFRA. Het label kan motiverend wanneer het label helpt de kosten van PLFRA te vergelijkingen met de kosten van de mogelijke schade. Ook een vergelijken van de labels tussen woningen onderling kan op de woningmarkt een motiverend effect hebben. Een overstromingslabel kan een verplichtende aard krijgen, wanneer bepaalde maximale risiconiveaus vereist zijn om een huis te mogen verkopen, verhuren of verzekeren.

Op die manier kan een overstromingslabel huiseigenaren motiveren voor de invoering van PLFRA en zo een nuttig instrument worden voor overstromingsrisicobeheer. Gedragsverandering bij huiseigenaren is echter een complexe zaak, die niet alleen afhangt van de interne inschattingen van de huiseigenaren, maar ook wordt beïnvloed door externe factoren. Gedragsverandering is dan ook in hoge mate afhankelijk van de context.

Opzet van het onderzoek

Op basis van deze observaties wordt in dit proefschrift onderzocht hoe floodlabel effectief kan zijn bij overstromingsrisicobeheer. Daarom is de volgende onderzoeksvraag gesteld:

"Draagt de introductie van een floodlabel bij aan aan overstromingsrisicobeheer? Zo ja, welke contextuele condities zijn bevordelijk voor the implementatie van een floodlabel?"

Om deze vraag te beantwoorden, hanteert deze studie een relationele benadering van de complexiteit van gedragsverandering van huiseigenaren bij overstromingsrisicobeheer. Een overstromingslabel kan niet effectief zijn in het motiveren van huiseigenaren zonder rekening te houden met de context van de toepassing ervan. Overstromingsrisicobeheer moet worden ingekapseld in een grotere en bredere relationele beleidscontext. Daarom beschouwt het theoretisch kader risico, veerkracht en meerdere actoren als onderdelen van een co-evolutionair proces van 'ongedefinieerde wording', dat uniek is in elke ruimte/tijd-configuratie. Deze concepten vormen een 'context' waarin actoren, factoren en instellingen als een systeem voortdurend met elkaar en met andere systemen interageren, zich aanpassen en evolueren. Om te begrijpen hoe een floodlabel kan bijdragen aan overstromingsrisicobeheer, richt deze studie zich dus niet alleen op de impact van overstromingsrisicoadvies op huiseigenaren, maar kijkt deze studie ook naar de contextuele factoren, instituties en actoren die voorwaarden scheppen waarmee eenfloodlabel een bijdrage levert aan overstromingsrisicobeheer. Daarom zijn de volgende deelvragen geformuleerd:

RQ A: Hoe kunnen gedrag van huiseigenaren, floodlabel en overstromingsrisicobeheer met elkaar in verband worden gebracht? Zie hoofdstuk 3.

RQ B: In hoeverre raken huiseigenaren door een floodlabel meer gemotiveerd om schade beperkende aanpassingen aan hun huis (PLFRA) toe te passen? Zie hoofdstuk 4.

RQ B: Hoe kan de effectiviteit van een floodlabel worden verbeterd?
B1: Onder welke contextuele factoren is een floodlabel nuttig, of wordt het (meer) nuttig? Zie hoofdstuk 5.
C1: Welke feitelijke omstandigheden zijn bevorderlijk voor de implementatie van een floodlabel? Zie hoofdstuk 5.
C2: Welke institutionele voorwaarden zijn bevorderlijk voor de implementatie van een floodlabel? Zie hoofdstuk 6.
C3: Welke actoren zijn bevorderlijk voor de implementatie van een floodlabel? Zie hoofdstuk 7.

Een laatste onderzoeksvraag behandelt de operationalisering van het overstromingslabel in de governance van overstromingsrisico's:

RQ D: Hoe kan een floodlabel worden geïmplementeerd in overstromingsrisico governance om adaptief gedrag bij huiseigenaren te stimuleren? Zie hoofdstuk 8.

Resultaten

Om te analyseren of huiseigenaren inderdaad gemotiveerd raken om PLFRA te implementeren, beschouwt dit proefschrift een unieke case study van deskundig advies op maat voor huiseigenaren, in Vlaanderen, België. De proef waarbij experts advies op maat geven aan huiseigenaren bevat meerdere overlappende elementen met het concept van floodlabel. Beide instrumenten hebben tot doel huiseigenaren te informeren en te motiveren om PLFRA-maatregelen uit te voeren, en maken gebruik van een expert die informatie verstrekt die specifiek is afgestemd op elk individueel huis. Uit de case study blijkt dat, dankzij de toegewijde inspanningen van de deskundigen, 15% van de huiseigenaren alle PLFRA-maatregelen uitvoert die door de deskundigen worden voorgesteld, en nog eens 32% van de huiseigenaren voert een aantal voorgestelde maatregelen uit. Dit zijn veelbelovende resultaten voor toekomstige proefprojecten. De case study illustreert hoe deskundig advies op maat in Vlaanderen momenteel vooral gericht is op het interne besluitvormingsproces van de huiseigenaar, en te weinig rekening houdt met externe effecten. We gaan ervan uit dat nog meer huiseigenaars de implementatie van PLFRA-maatregelen zouden kunnen overwegen, wanneer een meer relationeel perspectief wordt opgenomen en geprakkiseerd. Daarom richt de rest van de studie zich op de contextuele factoren, institutionele setting en andere actoren die van invloed zouden kunnen zijn op het gedrag van huiseigenaren. Daarvoor nemen we de context onder de loep van de vier deelnemende landen van het JPI Floodlabel onderzoeksproject: Nederland, België, Oostenrijk en Duitsland.

Een analyse van de contextuele factoren in deze landen laat inderdaad zien hoe overstromingsrisico verandert in ruimte en tijd. Risico's worden geconstrueerd door de complexe interactie tussen het klimaatsysteem, het terrestrisch/hydrologisch systeem en het sociaaleconomisch systeem. Door complexe interacties binnen en tussen deze systemen draagt een veelheid van indicatoren bij tot de kans op overstromingen, de blootstelling aan overstromingen en de kwetsbaarheid. Voorbeelden van deze indicatoren zijn seizoengebondenheid van overstromingen, overstromingstypologie, omvang van het stroomgebied, verstedelijking, bebouwingstypologie, (on)werkgelegenheid en eigendomsstatus. Onder invloed van verschillende externe factoren en indicatoren kan ook het overstromingsrisicobeheer niet universeel zijn, maar wordt het afgestemd op een lokale ruimtelijke context. Dit heeft ook gevolgen voor de configuratie van het overstromingslabel.

De institutionele analyse laat ook zien hoe institutionele transformaties 'van buiten naar binnen' vorm krijgen door de context van het risico, en de interacties met en tussen actoren. De instituties beïnvloeden daarmee de manier waarop burgers zich bezighouden met overstromingsrisicobeheer, en heeft daarmee invloed op de bruikbaarheid van een overstromingslabel. De vergelijking tussen landen op de institutionalisering van het overstromingsrisicobeheer laat zien hoe conceptualiseringen van risico's, overheidsverantwoordelijkheden, risicopercepties, verzekerbaarheid van overstromingsrisico's, en ruimtelijke ordening verschillen in Nederland, België, Oostenrijk en Duitsland. Bijgevolg beïnvloeden deze institutionele omstandigheden de bruikbaarheid en configuratie van het overstromingslabel in elk van de landen.

Een focus op het gedrag van andere actoren, geassocieerd met, of potentieel geassocieerd met de betrokkenheid van huiseigenaren bij overstromingsrisicobeheer, illustreert hoe de meeste geïnterviewden beperkte interesse hebben in andere of aanvullende rollen in overstromingsrisicobeheer, en er de voorkeur aan geven om gewoon door te gaan met de gang van zaken. Argumenten die worden genoemd zijn onder meer een gebrek aan urgentie of een gebrek aan vraag van klanten (d.w.z. huiseigenaren) die hun vertegenwoordiger vragen betrokken te raken; en andere actoren willen niet als eerste of alleen optreden en wachten tot hun sector of anderen initiatief tonen. Sommige lokale overheden beseffen echter dat de betrokkenheid van huiseigenaren bij het overstromingsrisicobeheer ook een nieuwe rol van de overheid vereist. Alle geïnterviewde overheden zijn zich bewust van deze veranderende rol, maar handelen anders in hun interacties met huiseigenaren. De ontwikkeling van meerdere hulpmiddelen, instrumenten en communicatiekanalen lijkt nodig, en een overstromingslabel of advies op maat zou een van de instrumenten kunnen zijn die lokale overheden kunnen gebruiken in de communicatie met huiseigenaren over overstromingsrisicobeheer.

Implicaties voor het floodlabel

De specifieke contextuele factoren, instellingen en betrokken actoren impliceren dat de configuratie van het overstromingslabel in de vier landen verschilt. Op basis van deze factoren is een overstromingslabel in Nederland vooral nuttig als informatief instrument. Nederland, dat gekenmerkt wordt door een grootschalig overstromingsrisico, zowel aan de kust als in het binnenland, heeft te maken met een lage kans op overstromingen, maar met een hoge blootstelling in geval van een overstroming. Dit heeft geleid tot een zeer specifiek institutioneel kader, dat in contrast staat met de andere landen met een overstromingslabel, waar het pluviale en fluviatiele overstromingsrisico doorgaans overheerst. In deze landen zal PLFRA doeltreffender zijn wegens de kleinere schaal van overstromingen en de grotere waarschijnlijkheid. Motiverende configuraties van floodlabel kunnen hier succesvoller worden.

Dit leidt tot de volgende conclusie: om het nut van het floodlabel te vergroten, moet het label worden afgestemd op de situationele institutionele setting. Suggesties voor implementatie zijn onder meer:

- Afstemmen van de configuratie van het floodlabel met de richting van de evoluties in veerkracht.
- Koppelen aan stimuleringsmaatregelen om huiseigenaren te motiveren te investeren in PLFRA-maatregelen; dit vereist directe betrokkenheid van actoren uit de overheid, het bedrijfsleven en het maatschappelijk middenveld.
- Mechanismen voor kwaliteitscontrole op de uitvoering en doeltreffendheid van de ingevoerde maatregelen
- Opleiding voor de deskundige die overstromingsrisicoadvies verstrekt of een overstromingslabel
- Wettelijke handhaving van bovengenoemde suggesties

Nieuwe rollen voor burgers impliceren ook nieuwe rollen voor andere actoren. Het overstromingslabel is geen instrument om de verantwoordelijkheid naar de burgers te verschuiven, maar kan een instrument zijn om te bemiddelen tussen deze verantwoordelijkheden van verschillende actoren. Governance-afspraken voor floodlabel moeten daarom gericht zoeken naar samenwerkingsverbanden met meerdere partijen.

ZUSAMMENFASSUNG

Hintergrund

Überschwemmungen sind eine der schädlichsten Naturgefahren Europas und werden zunehmend zu einem gesellschaftlichen Problem. Durch den Klimawandel und die fortschreitende Verstädterung beeinflusst, nehmen Hochwasserrisiken in naher Zukunft zu. Die resultierenden Schäden betreffen Bürger(innen), Gebäude, Unternehmen und Infrastruktur.

Um Risiken entgegenzuwirken, verwandelt sich der traditionell organisierte, von der Regierung geführte Hochwasserschutz in ein Hochwasserrisikomanagement mit mehreren Akteuren. Neue Diskurse und Richtlinien werden eingeführt. Der traditionelle Hochwasserschutz verwandelt sich in einen risikobasierten Ansatz. Dieser konzentriert sich nicht nur auf die Verringerung der Wahrscheinlichkeit einer Überschwemmung, sondern wird auch durch den Versuch bestimmt, finanzielle Auswirkungen oder Verluste zu verringern. Darüber hinaus wird das Konzept der Resilienz eingeführt. Der Diskurs um die Thematik beinhaltet unter anderem die Akzeptanz, dass nicht alle Überschwemmungen verhindert werden können, was zu einem Fokus auf die Reduzierung der Folgen von Überschwemmungen führt, und erwartet, dass Gemeinden Überschwemmungen, im Falle ihres Auftretens, absorbieren. Statt in alte Gewohnheiten von Widerstand und Schutz zurückzukehren, geht es darum, sich anzupassen. Basierend auf diesen neuen Diskursen werden Strategien entwickelt, beispielsweise die der mehrschichtigen Wassersicherheit. Diese Strategie zielt auf intelligente Kombinationen von Instrumenten und Lösungen ab, die Gemeinden vor Hochwasserrisiken zu schützen und auf Überflutungen vorzubereiten. Auf diese Weise nimmt die Diversität im Bereich des Hochwasserrisikomanagements zu.

Die neuen Strategien erfordern die aktive Einbeziehung neuer Akteure, da auch Bürger(innen), Unternehmen und andere Landnutzer(innen) zur Widerstandsfähigkeit gegen Überschwemmungen beitragen können. Hausbesitzer(innen) können beispielsweise Maßnahmen zur Anpassung des Hochwasserrisikos auf Immobilienebene (PLFRA) implementieren, um das Hochwasserrisiko ihrer privaten Immobilien zu verringern. Beispiele für diese relativ kostengünstigen PLFRA-Maßnahmen sind mobile Barrieren, Rückstauventile im Abwasserkanal oder Maßnahmen wie das Verschließen von Gebäudeöffnungen oder die alternative Nutzung gefährdeter Räume und Räume in den Häusern.

Die Umsetzung von PLFRA-Maßnahmen durch Hausbesitzer(innen) ist jedoch marginal. Hausbesitzer(innen) betrachten das Hochwasserrisikomanagement als eine Regierungsaufgabe oder sind sich ihrer Hochwasserrisiken nicht bewusst. Teilweise erkennen sie den Vorteil von PLFRA nicht an oder verfügen nicht über das Wissen und die Kapazitäten, um ihre Risiken zu verringern. Um über Hochwasserrisiken zu informieren und Hausbesitzer zu motivieren, PLFRA-Maßnahmen zu Hause umzusetzen, werden derzeit neue Instrumente wie der Hochwasserpass entwickelt.

Um adaptives Verhalten auszulösen, kann ein Hochwasserpasses zum Thema informieren und zum hochwasserbeständigen Verhalten motivieren. Der Hochwasserpass bietet maßgeschneiderte Informationen zu Hochwasserrisiken und zeigt Möglichkeiten auf, diese Risiken bei der Implementierung von PLFRA zu reduzieren. Er kann mit Kosten-Nutzen-Vergleichen der Kosten von PLFRA und potenziellen Schadensberechnungen oder durch den Vergleich von Etiketten zwischen Häusern motivieren. Der Hochwasserpass kann verbindlich werden, wenn ein bestimmtes maximales Risiko für den Verkauf, die Vermietung oder die Versicherung eines Hauses erforderlich ist.

Auf diese Weise kann ein Hochwasserpass möglicherweise Hausbesitzer(innen) zur Umsetzung von PLFRA motivieren und damit zu einem nützlichen Instrument für das Hochwasserrisikomanagement werden. Die Änderung des Verhaltens von Hausbesitzer(innen) ist jedoch ein komplexes Problem, das nicht nur von ihren internen Einschätzungen abhängt, sondern ebenso von externen Faktoren beeinflusst wird. Daher ist eine Verhaltensänderung stark kontextabhängig.

Forschungsdesign

Basierend auf diesen Beobachtungen untersucht diese Dissertation, wie Hochwasser-pässe im Hochwasserrisikomanagement wirksam sein können. Daher wurde folgende Forschungsfrage aufgeworfen:

> ***„Trägt die Einführung eines Hochwasserpasses zur Hochwasserrisikosteuerung bei?Und falls ja, welche Rahmenbedingungen sind für die Einführung eines solchen Passes förderlich?“***

Um diese Frage zu beantworten, wird in dieser Studie ein relationaler Ansatz zur Komplexität von Verhaltensänderungen von Hausbesitzer(innen) im Hochwasserrisikomanagement verwendet. Ein Hochwasserpass kann Hausbesitzer(innen) nicht effektiv motivieren, ohne den Kontext seiner Anwendung zu berücksichtigen. Das Hochwasserrisikomanagement muss in einen größeren und umfassenderen relationalen politischen Kontext eingebunden werden. Daher betrachtet der theoretische Rahmen Risiko, Belastbarkeit und die Vielfalt an Akteuren als einen koevolutionären Prozess des undefinierten Werdens, der für jede Raum / Zeit-Konfiguration einzigartig ist. Diese Begriffe bieten einen Kontext“, in dem Akteure, Faktoren und Institutionen als System kontinuierlich miteinander, mit anderen Systemen und mit anderen Systemen interagieren, sich anpassen und weiterentwickeln. Um zu verstehen, ob die Einführung eines Hochwasserpasses zur Hochwasserrisikosteuerung beiträgt, konzentriert sich diese Studie nicht nur auf die Auswirkungen der Hochwasserrisikoberatung auf Hausbesitzer(innen), sondern berücksichtigt auch die Kontextfaktoren, Institutionen und Akteure, die für die Einführung eines Hochwasserpasses förderlich sind. Daher wurden folgende Unterfragen formuliert:

RQ A: Wie können Hausbesitzer(innen), Hochwasserpass und Hochwasserrisikosteuerung in Bezug gesetzt werden? Siehe Kapitel 2.

RQ B: Inwieweit werden Hausbesitzer(innen) durch einen Hochwasserpass motivierter, die Anpassung des Hochwasserrisikos (PLFRA) auf Immobilienebene umzusetzen? Siehe Kapitel 4.

RQ C: Wie kann die Wirksamkeit eines Hochwasserpasses verbessert werden?
C1: Welche faktoriellen Bedingungen sind für die Einführung eines Hochwasserpasses förderlich? Siehe Kapitel 5.
C2: Welche institutionellen Bedingungen sind für die Einführung eines Hochwasserpasses förderlich? Siehe Kapitel 6.
C3: Welche Akteure sind für die Einführung eines Hochwasserpasses förderlich? Siehe Kapitel 7.

Die letzte Forschungsfrage befasst sich mit der Operationalisierung des Hochwasserpasses in der Hochwasserrisikosteuerung:

RQ C: Wie kann ein Hochwasserpass in der Hochwasserrisikosteuerung implementiert werden, um das Anpassungsverhalten der Hausbesitzer(innen) zu fördern? Siehe Kapitel 8.

Ergebnisse

Um zu analysieren, ob Hausbesitzer(innen) motivierter werden, PLFRA zu implemen-tieren, wird in dieser Studie eine einzigartige Fallstudie mit maßgeschneiderten Expertenratschlägen für Hausbesitzer(innen) in Flandern, Belgien, betrachtet. Der Pilot der maßgeschneiderten Beratung enthält mehrere Elemente, die sich mit dem Konzept des Hochwasserpasses überschneiden. Beide Instrumente zielen darauf ab, Hausbesitzer(innen) zu informieren und zu motivieren, PLFRA-Maßnahmen umzusetzen, und eine/n Expert(in) einzusetzen, der/die Informationen bereitstellt, die speziell auf jedes einzelne Haus zugeschnitten sind. Die Fallstudie zeigt, dass dank der engagierten Bemühungen von Expert(innen) 15% alle von Expert(innen) vorgeschlagenen PLFRA-Maßnahmen umsetzen und weitere 32% einige vorgeschlagene Maßnahmen umsetzen. Dies sind vielversprechende Ergebnisse für zukünftige Pilotprojekte. Die Fallstudie zeigt, wie sich maßgeschneiderte Expert(innen)beratung in Flandern derzeit hauptsächlich auf den inneren Entscheidungsprozess und nicht genug auf die externen Effekte konzentriert. Wir gehen davon aus, dass noch mehr Hausbesitzer(innen) die Umsetzung von PLFRA-Maßnahmen in Betracht ziehen könnten, wenn eine relationale Perspektive einbezogen und praktiziert wird. Daher konzentriert sich der Rest der Studie auf diese Kontextfaktoren, institutionellen Rahmenbedingungen und andere Akteure in den vier Ländern, die Teil des JPI FLOODLABEL-Forschungsprojekts sind: Niederlande, Belgien, Österreich und Deutschland.

Eine Analyse der Kontextfaktoren in diesen Ländern zeigt tatsächlich, wie sich das Hochwasserrisiko räumlich und zeitlich ändert und von außen nach innen beeinflusst wird. Das Risiko entsteht durch die komplexe Wechselwirkung zwischen dem Klimasystem, dem terrestrischen / hydrologischen System und dem sozioökonomischen System. Durch komplexe Wechselwirkungen innerhalb und zwischen diesen Systemen tragen eine Vielzahl von Indikatoren zusammen zur Hochwasserwahrscheinlichkeit, Exposition und Vulnerabilität bei. Beispiele sind die Saisonalität von Überschwemmungen, die Hochwassertypologie, die Einzugsgebietsgröße, die Urbanisierung, die Gebäudetypologie, die (Arbeits)Beschäftigung und der Beschäftigungsstatus. Beeinflusst durch verschiedene externe Faktoren und Indikatoren kann auch das Hochwasserrisikomanagement nicht universell sein, sondern ist auf einen lokalen räumlichen Kontext zugeschnitten. Dies hat auch Auswirkungen auf die Konfiguration des Hochwasserpasses.

Die institutionelle Analyse zeigt auch, wie institutionelle Transformationen durch den Risikokontext und die Interaktionen mit und zwischen Akteuren „von außen nach innen" geprägt werden. Das damit verbundene institutionelle Design beeinflusst die Art und Weise, wie sich die Bürger(innen) mit dem Hochwasserrisikomanagement befassen, und hat damit Einfluss auf die Verwendbarkeit eines Hochwasserpasses. Der länderübergreifende Vergleich der Institutionalisierung des Hochwasserrisikomanagements zeigt, wie sich die Konzeptualisierungen von Risiko, Regierungsverantwortung, Risikowahrnehmung, Hochwasserrisikoversicherung und Raumplanung in den Niederlanden, Belgien, Österreich und Deutschland unterscheiden. Folglich beeinflussen die institutionellen Bedingungen die Verwendbarkeit und Gestaltung des Hochwasserpasses in jedem der Länder.

Ein Fokus auf das Verhalten anderer Akteure, die tatsächlich oder eventuell mit der Beteiligung von Hausbesitzer(innen) am Hochwasserrisikomanagement verbunden sind, zeigt, wie die meisten Befragten ein begrenztes Interesse an anderen oder zusätzlichen Rollen im Hochwasserrisikomanagement haben und es vorziehen, wie gewohnt mit Unternehmen zusammenzuarbeiten. Zu den genannten Argumenten gehören mangelnde Dringlichkeit oder mangelnde Nachfrage von Kund(innen) (d. H. Hausbesitzer(innen)), die ihren Vertreter auffordern, sich zu beteiligen. Andere Akteure wollen nicht zuerst oder allein handeln und warten darauf, dass ihr Sektor oder andere Initiative zeigen. Einige Kommunalverwaltungen erkennen jedoch, dass die Einbeziehung von Hausbesitzer(innen) in das Hochwasserrisikomanagement auch eine neue Rolle der Regierungen erfordert. Alle Regierungsbefragten sind sich dieser sich ändernden Rollen bewusst, verhalten sich jedoch im Umgang mit Hausbesitzer(innen) unterschiedlich. Die Entwicklung mehrerer Instrumente und Kommunikationskanäle sowie ein Hochwasseretikett oder eine maßgeschneiderte Beratungen können Instrumente sein, welche die Kommunalverwaltungen bei der Kommunikation mit Hausbesitzer(innen)zum Hochwasserrisikomanagement verwenden können.

Schlussfolgerungen für den Hochwasserpass

Die spezifischen Kontextfaktoren, Institutionen und beteiligten Akteure implizieren, dass die Ausgestaltung des Hochwasserpasses in den vier Ländern unterschiedlich ist. Aufgrund dieser Faktoren ist in den Niederlanden ein Hoch-wasserpass als informatives Instrument nützlich. Die Niederlande, welche durch ein starkes Hochwasserrisiko an der Küste gekennzeichnet sind, verfügen über eine hohe Exposition im Falle einer Überschwemmung. Dies hat zu einem sehr spezifischen institutionellen Umfeld geführt, das einen Kontrast zu den anderen Hochwasserländern bildet, in denen das pluviale und das fluviale Hochwasserrisiko tendenziell dominieren. In diesen Ländern wird PLFRA aufgrund des geringeren Ausmaßes an Überschwemmungen und der höheren Wahrscheinlichkeit effektiver sein. Hier können Motivationsanregungen von Hochwasserpässen erfolgreicher werden.

Dies führt zu folgender Schlussfolgerung: Damit der Hochwasserpass zur Hochwasserrisikosteuerung beiträgt, sollte das Label auf die jeweiligen institutionellen Rahmenbedingungen zugeschnitten sein. Vorschläge für die Implementierung umfassen:

- Ausrichtung der Gestaltung des Hochwasserpasses in Richtung Resilienzentwicklung.
- Einsatz von Anreizen, um Hausbesitzer(innen) zu motivieren, in PLFRA-Maßnahmen zu investieren. Dies erfordert die direkte Einbeziehung von Akteuren aus Regierung, Unternehmen und Zivilgesellschaft.
- Qualitätskontrollmechanismen für die Umsetzung und Wirksamkeit der vorhandenen Maßnahmen.
- Schulung für Expert(innen), die Hochwasserrisikoberatung oder einen Hochwasserpass bereitstellen.
- Die rechtliche Durchsetzung der oben genannten Vorschläge.

Neue Rollen für die Bürger(innen) bedeuten auch für andere Akteure neue Rollen. Der Hochwasserpass ist kein Instrument, um die Verantwortung gegenüber den Bürger(innen) zu verlagern, sondern könnte ein Instrument sein, um sie zwischen auf mehrere Akteuren auszuweiten. Governance-Regelungen für Hochwasserpässe sollten daher speziell nach Kooperationen mit mehreren Parteien suchen.

1

INTRODUCTION

1.1 From Flood Protection to Flood Risk Management

Flooding is one of the most damaging natural hazards in Europe (Kundzewicz et al., 2018; Paprotny et al., 2018). It has also increasingly become a social problem that affects urban communities across the whole of Europe (Winsemius et al., 2016). All four countries subject to this study (Belgium, Austria, Germany, and the Netherlands) have experienced major flood events over the last decade. In Belgium, approximately 50% of the Flemish municipalities have been affected by flooding (CIW, 2017). In May and June 2016, Austria, Belgium, and Germany struggled with pluvial and fluvial floods. In 2013, Germany and Austria as well as Czechia, Switzerland, Slovakia, Poland, and Hungary made the news due to major flood events (Paprotny, 2017). The Netherlands has not experienced any major impact of pluvial floods over the last decade, but it experienced a regional dike breach caused by draught in Wilnis in 2013 (Floodlist, 2021; Ministerie van Infrastructuur en Waterstaat, 2018). Elsewhere in Europe, major flood events have occurred over recent years. In August 2019, Madrid was hit by a major precipitation event, and even Romania suffered impact from major floods in May and June 2016. Most recently, Germany, Belgium, UK and the Netherlands, have struggled with the consequences of heavy rainfall in summer 2021 (Floodlist, 2021).

IPCC states with high confidence that damages by pluvial and fluvial floods will substantially increase in Europe, due to unpredictable, more intense, and frequent precipitation. This increase also accounts for pluvial floods, or floods due to rising ground water level and overloaded sewers (Alfieri, Burek, Feyen, & Forzieri, 2015; IPCC, 2014). The expected increase of flood events will result foremost in more financial losses (Field, Barros, Stocker, & Dahe, 2012). In comparison, urban heat mostly causes welfare problems (Musco, 2016), and drought causes both economical and welfare problems (Musolino, Massarutto, & de Carli, 2018). Besides climate change, urbanization also forms a driver for an increase of pluvial and fluvial flood risks (Miller & Hutchins, 2017; O'Donnell & Thorne, 2020). The impact could multiply substantially until 2050 due to ongoing socio-economic development in flood-prone areas (Jongman et al., 2014).

Traditionally, these urban areas are protected due to government-managed flood protection infrastructure (Butler & Pidgeon, 2011). However, with the increasing pressure of flood frequency and damage, maintaining safety levels based on these conventional flood protection approaches is no longer economically or technically viable. Especially in times of climate change, not all floods can be prevented by public authorities through traditional defense infrastructures (Johnson & Priest, 2008; Meijerink & Dicke, 2008). Therefore, the management of floods must be diversified (Hegger et al., 2016), resulting in new discourses and policies (e.g. Fekete, Hartmann, & Jüpner, 2020; Kuklicke & Demeritt, 2016; Wiering et al., 2017); this includes a shift of responsibility-sharing and as a consequence the involvement of new actors (e.g. Johnson & Priest, 2008; Mees, Tempels, Crabbé, & Boelens, 2016b; Rauter, Kaufmann, Thaler, & Fuchs, 2020). Moreover, it includes the introduction of new instruments (e.g. Attems et al., 2020b; Filatova, 2014; Snel, Witte, Hartmann, & Geertman, 2019).

With the involvement of multiple governmental actors, a shift from traditional flood protection strategies towards a more complex flood risk management becomes visible (Schanze, 2006). When perceiving flood risk management as a joint task of individuals, communities, businesses, and governmental authorities, the domain is more and more referred to as flood risk governance (Ishiwatari, 2019; Wiering, Liefferink, & Crabbé, 2018).

1.2 New Discourses and Policies

Over recent decades, innovative approaches and policies have been discussed in literature and practiced in the field in order to tackle flood risks. First, traditional flood protection is transforming into a risk-based approach. This risk-based approach is not only focused on reducing the probability of a flood but is also determined by an attempt to reduce financial impact or losses. The risk-based approach offers a rational way of balancing the costs of mitigation and adaptation measures (Dale et al., 2014; Kuhlicke, 2019). Based on a cost-benefit analysis, it becomes possible to decide on traditional flood protection infrastructure or other solutions that could be more efficient. These other solutions involve spatial planning or measures taken by actors beyond or aside from governmental actions. However, a difference of framing risk results in two conceptualizations of flood risk that varyacross European countries (Klijn, Kreibich, De Moel, & Penning-Rowsell, 2015). On the one hand, there is 'flood risk as consequence multiplied by flood probability'. Due to this interpretation, flood risk management still predominantly focuses on flood defense instruments. On the other hand, 'flood risk as an overlay of hazard and vulnerability' leads to an interpretation to act in the most vulnerable areas (Klijn et al., 2015). This interpretation of flood risk results in an emphasis on a responsibility transfer to individuals (Nye, Tapsell, & Twigger-Ross, 2011), local communities (Forrest, Trell, & Woltjer, 2019) or insurance and recovery industries (Penning-Rowsell & Priest, 2015) as flood risks cannot be ignored. Independent of the way flood risk is framed, the risk-based approach generally involves a toolbox of measures as well as the actors that could be actively involved.

Second, a shift towards a resilience discourse in risk management, urban planning, and climate change adaption influences the management of floods. The risks stemming from unpredictable and more frequent hazards highlights the need for new approaches, such as the resilience discourse (Kundzewicz et al., 2017). This can roughly be defined as an acceptance that not all floods can be prevented, resulting in a focus on the reduction of flood consequences (Liao, 2012). This discourse expects communities hit by floods to 'bounce back' and 'live with floods', instead of 'fighting the floods' (Restemeyer, Woltjer, & van den Brink, 2015). By focussing on the shock-absorbing qualities of a community or system, resilience embraces the uncertainties that come along with climate change (Holling, 1996; McClymont, Morrison, Beevers, & Carmen, 2019).

The discourses used in flood risk management and governance will be discussed further in this thesis. Nevertheless, this introduction already illustrates similarities and differences between the risk-based approach and the resilience approach. Whereas risk-based management focuses on proportionality by transferring uncertainties in calculable risks, resilience emphasizes openness and flexibility, promoting governance that includes organization and self-learning. In this way, communities or actors become more responsible for maintaining or improving their own resilience (Disse, Johnson, Leandro, & Hartmann, 2020; Kuhlicke, 2019). According to Disse et al. (2020), combining flood risk and resilience measures results in more effective management of floods.

Adding to the previous two governance discourses, a third discourse can be recognized. Flood risk management is becoming more a multilevel and multi-stakeholder practise, turning into flood risk governance (den Boer, Dieperink, & Mukhtarov, 2019; Gupta, Pahl-Wostl, & Zondervan, 2013). Whereas traditional flood risk management has been a task of governmental water engineers, due to climate change and the impact of volatile and intense floods, governments recognized that public authorities are no longer able to defend solitarily its inhabitants against the effects of climate change. Therefore flood risk governance nowadays is including more governmental levels ranging from national to local, aligning with multiple policy disciplines such as planning and environment, and collaborating with non-governmental actors to adapt to the new situations (Dieperink et al., 2018).

The aforementioned three discourses have together resulted in a transition where policies are shifting from flood protection to flood risk management and governance. This also represents a shift from a robust protective approach towards a more flexible, adaptive, and resilient flood risk management approach (Bubeck et al., 2017; Hartmann & Driessen, 2017; Restemeyer et al., 2015; Tempels & Hartmann, 2014). Whereas this traditional protective approach focuses on technical engineered interventions in the water system itself, it is recognized that these interventions are insufficient by themselves. Therefore, they need to be combined with interventions in flood-prone areas to reduce damage. Based on a publication by Restemeyer et al. (2015) and Tempels (2016), differences are highlighted between the traditional and new approaches in table 1.

TABLE 1: COMPARING TRADITIONAL FLOOD PROTECTION AND FLOOD RISK MANAGEMENT. BASED ON: *TEMPELS (2016) & RESTEMEYER ET AL. (2015)*

	Traditional flood protection	**Flood risk management & Resilience**
General attitude	Resisting/avoiding the flood Restricting the water flow	Accepting natural behavior of rivers and risks and adapting to them. Living with water
Paradigm	Protect-and-control	Resilience
Based on	Fixed (and calculable) safety levels and hazards	Risks and statistical uncertainties
Aim	Reduce flood probability with engineered measures	Reduce flood risk with a mix of cost-efficient measures

Resilience is gaining more attention in many countries, as the discourse is embraced by the United Nations in the Hyogo Framework for Action (2005-2015) and the Sendai Framework for Disaster Reduction (2015-2030) which propose a people-centred communication on risk reduction tailored to the needs of its users (UN-ISDR, 2005; Valdes & Purcell, 2013). Other international initiatives include the UNDRR's 'Making Cities Resilient' campaign, and the '100 resilient cities network' (100 Resilient Cities Network, 2019 ; Valdes & Purcell, 2013).

The risk-based approach became more institutionalized following the introduction of the European Floods Directive (2007/60/EC) (European Commission, 2007). The EU flood Directive recognizes the need to reduce vulnerabilities. Therefore it directs member states towards a flood risk approach that complements prevention through risk reduction with the spatial strategy of protection and a strategy of preparing communities.

Multi-Layered Water Safety

Based on the European Directive of 2007, many EU member states have introduced a risk-based approach for dealing with floods (Kellens, Terpstra, & De Maeyer, 2013). For instance, both Flanders and the Netherlands have implemented the concept of multilayered water safety; hereafter referred to as MLWS. The interpretation of this MLWS model[1] differs somewhat in both countries. Belgium follows the directive closely and interprets MLWS as follows (Kaufmann, Mees, Liefferink, & Crabbé, 2016a): the prime focus is put on a ***Prevention*** agenda (level 1); avoiding water to inundate ny constructing engineered flood defense mechanisms. These reduce the probability of a flood occurring. Measures are considered at a large scale, are mostly government-driven, and are technical by nature. MLWS proposes to complement these 'prevention-measures' by ***Protective*** impact-reduction strategies (level 2). These are mostly based on spatial measures, such as the relocation of buildings from flood prone areas, restoring the natural courses of rivers, or eventually 'making room for rivers' themselves. These measures should reduce the impact of a potential flood. Alongside this, MLWS also proposes a third group of strategies focused on ***Preparedness*** (level 3). By preparing actors in flood prone areas, the damage could be reduced if a flood occurs. The Directive also mentions a fourth (and fifth) level: emergency response and ***Recovery***. These levels explicitly focus on damage control during and after a flood event as well as any redevelopment required (Thieken, Kreibich, Müller, & Merz, 2007). These measures will not be discussed in further detail in this thesis, since these strategies only consider impact reduction and are partly already included in the preparedness level (level 3). This third level not only requires adaptive behavior of its users, but also the need for specific emergency information in order to implement recovery measures (Vlaamse Overheid, 2012). Moreover, the purpose of the recovery can be questioned. This will be discussed further in this thesis alongside the resilience approaches.

1 Also referred to as triple-p-model in policy

The Dutch use a similar approach, albeit using different terminology relating to aspects of MLWS[2]. For probability reduction, the term 'prevention' is used when referring to technical measures used in the water system. For impact reduction, the Dutch use the terms 'spatial solutions', and 'crisis management' is used for damage reduction (Deltacommissie, 2015; Hoss, Jonkman, & Maaskant, 2011). This thesis will build on the terminology of the Flemish approach, which comes nearest to the EU Directive.

Together, the three layers of MLWS aim to enhance 'smart combinations' of preventive, protective, and preparative measures based on a regional planning approach. For each case, new tailor-made agreements are needed between actors covering the tasks, responsibility, and costs (Deltacommissie, 2015). The introduction of MLWS emphasizes the importance of a wide range of complementary measures on multiple scales, such as creating space for water and mitigation measures. As a consequence, it addresses multiple policy domains besides diehard water managers and addresses actors from civil society to take responsibility (Begg, 2018; Forrest et al., 2019; Johnson & Priest, 2008; Rauter et al., 2020), including homeowners (Snel, Witte, Hartmann, & Geertman, 2020).

Consequently, this could mean that interventions at the local level (amongst private buildings) are more effective than and therefore preferred over more large-scale engineered interventions (Hoss et al., 2011; Kaufmann et al., 2016b). This makes the MLWS instruments part of a cost-benefit analysis, providing the critical argument to shift responsibilities to other actors. Here not only the discussion about social or ecological justice is considered, but also the discussion about a fair distribution of incentives (Adger, Paavola, Huq, & Mace, 2006; Begg, 2018; Forrest, Trell, & Woltjer, 2020b; Jhagroe, 2016; Latour, 2018; Thaler & Hartmann, 2016).

1.3 New Actors: A Shift of Responsibilities

The prevention of floods has long been considered as a governmental responsibility (Meijerink & Dicke, 2008; Nye et al., 2011). They are responsible to protect their national or regional society from hostile interventions from foreign nations, climate, earthquakes, or other (man-made) hazards. However, as flood risks are expected to rise, governmental water managers have started to acknowledge that they cannot manage floods by themselves anymore. In order to guarantee flood safety in all circumstances, they need assistance from other (societal) actors, such as homeowners, businesses, and other land users. This is to manage the expected intensity

2 The Netherlands uses 'multi-layered Safety' (in Dutch: Meerlaagsveiligheid) and distinguishes 1. Prevention though flood defence, 2. Spatial solutions, and 3. Crisis management. Flanders uses 'multilayered water safety' (in Dutch: Meerlaagse waterveiligheid) and distinguishes 1. Protection (i.e. engineered solutions), 2. Prevention (spatial planning) and 3. Preparedness (i.e. measures if flooding is imminent). The Flemish terminology is taken from the European Flood Directive. Even though the use of 'prevention' differs from the Dutch strategy, the content of both strategies is similar in both countries.

and recurrence of the effects of climate change. Following the idea that flood risks emerge from societal interaction with nature, and that climate change is man-made, this means that land users also have an important role in the increase and reduction of flood risks (Begg, 2018; Bubeck, Botzen, & Aerts, 2012b; Wachinger, Renn, Begg, & Kuhlicke, 2013). Their contributions to flood risk 'might be formal or informal, direct or indirect, positive or negative' (Tempels, 2016, p. 35). As such, citizens are able to take property-level flood risk adaption measures to reduce their flood risks. Therefore, flood risk management redirects towards a more multi-actor approach, becoming flood risk governance. This requires a shift of responsibilities, resulting in a share among 'water managers, spatial planners, emergency planners, the insurance sector, and citizens' (Mees, 2017, p. 144). Consequently, this would result in flood risk governance; meaning that societies as a whole are able to cope with current and future flood risks (Driessen, Hegger, Bakker, van Rijswick, & Kundzewicz, 2016; Hegger et al., 2014; Wiering et al., 2017).

A Historical Perspective on Multi-Actor Water Management

The additional responsibility taken by civil actors in flood risk management is not new. Although water management has been regarded as a governmental responsibility since the beginning of industrialization, Boelens (2018) describes how water management of the first polders in Flanders evolved out of the interactions between a manifold of actors, (informal) rules and agreements, and local circumstances. Water management was not a governmental responsibility at all, but neither was it an initiative of civil society alone.

In a historical analysis of the behavior of many involved actors, Boelens explains how in the marshlands of the Flemish lowlands in the tenth and eleventh century, flood protection against the coastal storm surges and drainage of high ground water levels became 'somewhat collectively organized'. Flemish counts acclaimed neighboring marshlands, and monks used these lands for sheep breeding, erecting walls and canals to protect these lands against water. To maintain and enlarge these lands, and to avoid regular disputes between neighboring farmers on the water levels on these lands, agreements were created between counts, farmers, and monks. The latter two received the responsibility of maintenance and received the right to use the lands or canals according to their desires in return. For example, they were able to use them for agricultural purposes and fisheries. This resulted in the first polders, and formed 'an enormous incentive to reclaim more lands from the sea' (Boelens, 2018). This maintenance became more professional due to the specialization of experts and outsourcing by farmers and land owners. Soon thereafter, professional polder and water management organizations were born, which still exist in the low countries. This includes Belgium and the Netherlands (the so-called waterings or water boards), albeit with a changing focus and organizational layout over time.

This short historical overview shows how water management has not always been a prime governmental responsibility, even though government-driven from a distance (e.g. the Flemish counts in the tenth and eleventh century). Instead, it has mainly been a shared responsibility and has involved endless interactions between various actors. Many similarities can be drawn from this history and the ambitions of flood risk management.

Flood risk governance becomes most effective when civil actors, market stakeholders, and governments collectively cooperate (Renn, Klinke, & Van Asselt, 2011). This co-productive process of flood risk governance (Mees, 2017) not only requires actions from new actors, but also requires new roles from governmental actors (Mees, Uittenbroek, Hegger, & Driessen, 2019). This process requires awareness of the responsibilities and opportunities of all involved actors, and a change in behavior in respect to the current situation. What can they do, and what can they gain? What could trigger adaptive behavior? Despite the ambition to perceive flood risk management as a multi-actor responsibility, municipalities and citizens struggle with the shift of such responsibilities. So far, flood risk management remains largely a concept for water managers and planners (Mees, Crabbe, & Suykens, 2018; Mees et al., 2016b).

Homeowners as New Actors

Now that flooding has become a 'critical issue' under the influence of climate change and urban developments (Rosenzweig et al., 2018), an increasing role for citizens and communities in local flood risk governance is expected (Begg, Ueberham, Masson, & Kuhlicke, 2017). This is gradually becoming more visible (Edelenbos, Van Buuren, Roth, & Winnubst, 2017; Forrest et al., 2019; Forrest, Trell, & Woltjer, 2020a; Mees et al., 2016b; Scolobig, Prior, Schröter, Jörin, & Patt, 2015; Seebauer, Ortner, Babcicky, & Thaler, 2019). Forrest et al. (2020a) identified societal contributions in flood risk governance, including gathering and communicating knowledge, advocacy activities, and physical action. Citizens are able to gather and update local knowledge, can campaign for authorities to change certain management strategies, or raise awareness of an issue amongst fellow citizens. Flood risk management can allocate more responsibility to homeowners through physical actions (Holub & Fuchs, 2009; Osberghaus, 2015). Homeowners in flood-prone areas could contribute to flood resilience in and around their property, using so-called property-level flood risk adaptions (PLFRA). This can be implemented in case governmental flood protection fails or is more costly. Examples of PLFRA measures include installing barriers and backwater valves, sealing building openings, using special coating paint for walls, and moving sensitive activities and electrical equipment above likely flood level (Attems, Thaler, Genovese, & Fuchs, 2020a).

Nevertheless, the implementation of PLFRA measures is still in its infancy (Attems, Thaler, Genovese, & Fuchs, 2020c). Although many homeowners could adapt their homes in order to reduce their flood risk, the implementation is a slow process. Governmental water management has been a process for centuries, and the active involvement of civil society is relatively new (Mees et al., 2016b). This is because homeowners are not always willing or able to adapt their homes. There are several reasons for this being discussed in the academic debate such as: the perception that flood risk management is purely a governmental task (Lechowska, 2018), a lack of awareness on individual flood risks (Burningham, Fielding, & Thrush, 2008), not recognizing the benefits of PLFRAs (Joseph et al., 2015), forgetting previous flood experiences over time, thereby losing the urgency to act (Kuhlicke et al., 2020a), or a lack of capacity to reduce the risks (e.g. Bubeck, Botzen, & Aerts, 2012a; Kuhlicke et al., 2020b; Snel et al., 2019). In addition, false incentives from financial flood recovery schemes are discussed as a reason contributing to the inertia of homeowners (Slavíková et al., 2020). Research also shows that risk-based insurance premiums do not work sufficiently as an incentive to adapt (Hudson, Botzen, Feyen, & Aerts, 2016).

Despite this slow uptake of measures, homeowners do consider contributing to flood resilience (McClymont et al., 2019; White, Connelly, Garvin, Lawson, & O'hare, 2018). The introduction of PLFRA measures at home allows quicker recovery and reduces damages (Disse et al., 2020). This way, the homeowner gradually shifts from having a recipients' role to a key-stakeholder role (Snel et al., 2020).

1.4 New Instruments

To target the inertia of homeowners, flood risk communication strategies are widely considered as a way to raise awareness (Attems, Schlögl, Thaler, Rauter, & Fuchs, 2020; Kellens et al., 2013; Snel et al., 2019). The EU-Directive (2007/60/EC) demands the introduction of flood risk maps to communicate flood risks among land users. A diversification of flood risk communication strategies is required to inform, motivate, or oblige these new actors to participate in flood risk governance. Therefore, new experiments on targeted flood risk communication strategies should be executed according to Bubeck et al. (2012a). A greater diversity of these strategies enhances the responsibility shift from water managers towards a more governance-driven approach with a range of stakeholders (Hegger et al., 2016), including homeowners (Mees et al., 2016b).

Until now, flood risk communication strategies are often limited to brochures, flyers, apps, and websites. These hardly target individual homeowners and remain unidirectional (Snel et al., 2019). New experiments to inform, motivate, or oblige homeowners are being introduced (Attems et al., 2020b). In Flanders, these innovative flood risk instruments include (Coördinatiecommissie Integraal Waterbeleid, 2020):

- Flood risk maps and specific flood maps for pluvial risks based on refined methodology to assess the impact of sewerage infrastructure during intense rainfall.
- 'Water Assessment'. This instrument investigates the potential harmful effects on the water system that may be caused by the construction of a house or an infrastructure project.
- Duty to inform: This instrument obliges sellers and landlords to inform potential buyers and tenants if the property is located in a flood-prone area (based on aforementioned flood risk maps). Nowadays this information is shared in housing advertisements, together with, among others, the Energy Performance Certificate. This instrument should contribute helpful information for buyers about the risk of their future property and may contribute to a well-considered choice.

This outline of instruments shows a shift towards the involvement of citizens. More recently, governmental actors started to provide tailored advice for homeowners in flood-prone areas (Davids, Boelens, & Tempels, 2019; VMM, 2017), and began development of a floodlabel for buildings (Hartmann & Scheibel, 2016).

Floodlabel

A Floodlabel is an initiative that is designed to increase the implementation of PLFRA measures in individual homes in flood-prone areas. The label seems to be an instrument of a prime governmental-led policy approach. As such, the label seems controversial in relation to the trends mentioned before, forcing adaptive behavior among homeowners. However, this dissertation tries to find out if a floodlabel could also play a major role in the interplay between multiple actors at multiple levels in flood risk governance. Although a floodlabel is still conceptual, first experiences with the tool exist in Germany (called Hochwasserpass) and a similar concept will be tested in the Netherlands (called Bluelabel). In Flanders, there are some experiences with tailored flood risk advice, where an expert suggests specific PLFRA measures to the homeowner during a home visit. (VMM, 2017). Although all of the concepts somewhat differ from another, they generally aim to trigger adaptive behavior of homeowners and contribute to flood resilience in cities. This is achieved in three ways (Hartmann & Scheibel, 2016):

1. **Inform**: Informing homeowners of the flood risks present for their specific building. As such, the floodlabel is complementary to flood risk maps, which only provide information on the area. A web-based self-check or flood information system (FIS) collects general but basic information about the surroundings and the building itself, such as information about previous flood events, distance to rivers, etc.
2. **Motivate:** By identifying PLFRA measures tailored to their homes, homeowners learn how to reduce their flood risk. Based on an experts' visit, a building receives a certification. This label communicates tailored flood risk and identifies these tailored measures to reduce the flood risks, but also makes flood risk measurable (e.g. readable) and comparable.
3. **Bind:** Encouraging adaptive behavior among homeowners, through the development of governance arrangements within current flood risk management. These arrangements include incentives or initiatives to force or tempt adaptive behavior, including facilitation and monitoring of the implementation. This requires the involvement of citizens, since they are suffering the damage resulting from a flood. It also involves governments, as the interest of an elected body is to care for their citizens. In addition to the government, market actors are involved too, such as in providing insurance to reduce vulnerabilities to floods.

Based on these three characteristics of the floodlabel, a comparison can be made with other labels that improve certain aspects of housing quality. The European Energy Performance Certificate (EPC) promotes energy efficiency among residential buildings and uses a scaled system to express the levels of energy reduction (Taranu & Verbeeck, 2018). The EPC is obligatory during a housing transaction, and the indications on the label reflect energy usage. This is calculable and therefore more concrete compared to measuring flood risk. The label has been available since 2002 and was updated in 2010.

A second label deals with the risks of burglary. Such crime prevention standards have been developed to reduce the risk of burglary in residential buildings and are available in various European countries. This standard is binary organized: a homeowner only receives it when all crime prevention instruments have been installed (Stummvoll, 2012). The label has been developed and used by regional police departments since the 1980s. Both labels are 'footloose': the calculation (of usage or crime risk) is based on the qualities of the building, and influences from the surrounding are ignored. The floodlabel however, is including the source of risk. This means that the location of the building (e.g. in relation to the proximity of water) influences the final calculation of risk. Similar to the contributions of these labels to housing quality, floodlabel perhaps can offer ways to trigger adaptive behavior and contribute to urban flood resilience. More roles for a floodlabel can be identified during this research. Nevertheless, when involving homeowners and triggering adaptive behavior, a change of behavior (i.e. a new role) of other actors involved in flood risk governance is also required. For example, a shifting role of local governments facilitating citizen participation to organizing government participation (Mees et al., 2019). A floodlabel could also have a role here: floodlabels in a neighborhood can be used by the municipality to evaluate if further municipal interventions are needed, and therefore can be considered in local MLWS cost-benefit analyses. It is a reciprocal intervention; one actor (for instance a homeowner) only starts to act when they are given sufficient incentives to do so (for instance by governments or the insurance sector). So, floodlabel is not just a one-directional tool, but can be an instrument for multiple actors, among a set of multiple instruments. The historical example of Boelens (2018) already demonstrated how the early water boards were a result of on-going pragmatic interactions between various stakeholders, instruments, and an adaptive legal framework, and not just the result of actions of one single actor. In this respect, some authors link the introduction of a floodlabel or certificated flood risk reduction to new actors, such as insurers, property owners, or mortgagers. These actors could benefit from property flood mitigation (Hartmann & Scheibel, 2016; Kleindorfer & Kunreuther, 1999; Kunreuther, 2001). Nevertheless, it also has to be enhanced and facilitated by focused legislative actions.

1.5 Perspectives on Behavioral Change in Flood Risk Governance

With this introduction, the development of new instruments in flood risk governance (such as floodlabels, tailored advice, new online flood mapping, etc.) will be researched on how these instruments — and specifically a floodlabel, might affect behavioral change. Many studies have so far focused on the intrinsic behavior of these actors in the (peri-)urban flood-prone areas (such as agrarians, homeowners, businesses, etc.); mostly turned down to only homeowners. These contributions have been predominantly focused on protection motivation theory (Rogers, 1975). They have successfully identified the socio-psychological factors contributing to behavioral change, such as elements of risk appraisal (e.g. risk perception, awareness, potential damage, previous exposure) and coping appraisal (e.g. self-efficacy, resources and outcome expectation, cost-benefit ratio) within respective institutional contexts (e.g.

political focus and reliance on public protection) (Botzen, Kunreuther, Czajkowski, & de Moel, 2019; Bubeck et al., 2012b; Bubeck, Botzen, Kreibich, & Aerts, 2013; Filatova, Mulder, & van der Veen, 2011; Grothmann & Reusswig, 2006; Kreibich, Christenberger, & Schwarze, 2011; Parker, Priest, & Tapsell, 2009; Siegrist & Gutscher, 2008; Waterstone, 1978). However, they have hardly taken the (socio-political) context for action into account. The model as presented by Grothmann and Reusswig (2006) mentions external barriers, but sets these aside and predominantly focuses on the socio-psychological factors. Although these socio-physical considerations provide useful insights into the mechanisms behind the motivations for homeowners, their application in real-life situations remains unclear. These applications focused predominantly on the question of whether homeowners are willing to take action to protect themselves from the consequences of flooding. As such, they offered some concrete leads or starting points for flood risk managers, who want to support and enhance the protective behavior of homeowners. However, in these cases it also became clear that homeowners' motivations are low when they have never experienced floods. Their motivation diminishes rapidly as the months and years go by (Wachinger et al., 2013). Moreover, since protection motivation theory focuses predominantly on socio-psychological factors, these models only provide insights into influencing the willingness to act through socio-psychological mechanisms. Even then, these insights are limited to relations that are not restrained by other elements aside from stakeholders and government control.

All of these contributions are focused on how the current situation has become a reality, and not so much on what planners or policy makers in flood risk management should do or plan to enhance mutual-responsible situations, in respect to the individual behaviors of homeowners (Barendrecht et al., 2020; Kellens et al., 2013). While some researchers have successfully translated certain aspects of protection motivation theory into flood risk management action (Buchecker et al., 2013b), it is generally problematic for it to act as a guideline to influence protection motivation. There is no direct or simple relationship between the actions of policy makers, flood risk managers, or planners and behavioral change. The effect of these actions is highly unpredictable and volatile. First, both climate and behavioral change have a complex nature of uncertainties and dynamics. And second, the effects are highly situational in time and space (Boelens, 2018, 2020). This also relates to the information that they provide and the outcomes in terms of socio-psychological effects, involvement, behavioral change, and other aspects. Planning actions do not necessarily lead to the desired results and can also have unforeseen or even unwanted outcomes. This is especially the case in respect to the subject of climate change, which is characterized by uncertainty and complexity. For behavioral change, research should focus both on the internal appraisals of a homeowner, as well as on the contextual dimensions that influence homeowner behavior.

This also counts for the use of policy instruments such as floodlabel to influence homeowner behavior. Such policy instruments are often only presented as static and bounded blueprints to trigger change. However, these instruments "have a life on their own" (Voß & Simons, 2014, p. 736). Policy instruments are related to and dependent on social actors and the context they function in. Instruments influence their surroundings and are influenced by their surroundings (Voß & Simons, 2014). Thus, instruments become a reflection of dominant discourses and political struggles. To point out these two characteristics of a policy instrument, Voß (2007) distinguishes two ways of approaching policy instruments: the instrument as a model and the instrument as reflection of policy. To cause change, both perceptions of an instrument mutually reinforce each other. The model legitimizes public policy, and policies steer the calculations of the model. Together these perceptions of an instrument contribute to the functional and structural premises of an instrument. The functional premises include the ability of an instrument to achieve public goals, and the structural premises refer to the ability to change the context the instrument is used in. This can result in new roles for actors, for example, and lead to a shift in responsibilities.

The development of an instrument goes hand in hand with the formation of so-called constituencies (Voß & Simons, 2014). These entangled practices of actors and institutions manage the linkages between the 'instrument as a model' and the 'instrument as policy implementation', and ultimately provide conditions for the configuration of an instrument. These conditions include the drivers, markers, and connection within these practices (Boelens & de Roo, 2016) that support, in this case, homeowner involvement in flood risk governance using floodlabels.

The internal and external dynamics of behavioral change and the development of instruments both illustrate how contextual settings cannot be ignored. Nevertheless, the external context is hardly taken into account in research on influencing homeowner behavior. Therefore, when evaluating if and how a policy instrument is causing change, we need to delve into both the instrument itself as well as the conditions within the contextual settings that contribute to the new instrument.

1.6 Problem Statement and Research Questions

To summarize, this dissertation observes three on-going and interlinked trends to improve flood risk management and prepare (peri)urban areas for the future consequences of a changing climate: the development of new discourses and policies, the desire to involve new actors from outside of traditional flood management and the development of instruments to involve these new actors. These new tools are diverse: they have different objectives, different target groups, serve different audiences, and differ in methodology. One of these new tools and instruments is the floodlabel. This instrument is being developed to involve homeowners in flood risk governance by better informing them about flood risk management, as well as to motivate these homeowners to implement PLFRA measures in their houses.

A floodlabel might be able to motivate homeowners in the implementation of PLFRA and therefore become a useful instrument in flood risk management. However, changing behavior of homeowners is a complex issue, as behavioral change is dependent on the internal appraisals of a homeowner, and it is highly context-dependent. This duality of internal and context-dependencies is also visible in policy instruments such as floodlabel. A floodlabel might be able to influence a homeowner's behavior, and the context of flood risk governance influences the label. Finally, both the instrument and the behavior of a homeowner could also influence the context of flood risk governance in return. This line of argumentation is schematically visualized in figure 1. Therefore, to understand the role of floodlabel in flood risk management, we need to focus both on the instrument as well as the context it is applied in, as the floodlabel is shaped by the context it will be used in.

FIGURE 1: LINKING HOMEOWNERS, FLOODLABEL AND CONTEXT

Consequently, this research hypothesizes that a floodlabel cannot be effective as a stand-alone instrument, but a floodlabel does contribute to flood risk management by stimulating adaptive behavior, when applied in a fitting context of multiple actors and legal framework. This requires not only considering the new instrument, but also the context in which it would be applied. For floodlabel, this requires a focus on the motivational aspects among homeowners, as well as a focus on the context of risk, the institutionalization of flood risk management, and the actors involved.

Other sectors that introduced labels and certificates to trigger homeowner behavior, such as the European Energy Performance Certificate (EPC), also lean on a governance structure of multiple actors and legal frameworks to become more effective. According to van Middelkoop, Vringer, and Visser (2017) the EPC is dependent on well-informed and competent decision-makers and experts. Moreover, the introduction of the EPC into the tax system for residential buildings improves the effectiveness of this informative tool. Following the comparison with the EPC, for a floodlabel to be an effective tool in flood risk management, we cannot only consider the behavior of the homeowners. Other actors, factors, and institutions also need to be actively considered (Boelens, 2018). The responsibility shift as described by Mees et al. (2016b) is not just a shift from public to private, but should be a redistribution of responsibilities in general with all the consequences in its slipstream. Hence, the objective of this research project is to investigate how floodlabel can be beneficial for flood risk governance. A floodlabel can contribute to flood risk governance if homeowners become motivated to implement PLFRA and if the floodlabel motivates other actors in flood risk governance to support homeowners' actions to reduce flood risk. To operationalize floodlabel as a tool in flood risk governance, the following main research question can be formulated:

> ***"Does the introduction of a floodlabel contribute to flood risk governance? And if so, what contextual conditions are conducive for the implementation of a floodlabel?"***

To answer this question, this research is divided in a set of sub-questions. The first sub-question focusses on the theoretical conceptualization of the relations that have been outlined before in this introduction:

RQ A: How can homeowner behavior, floodlabel, and flood risk governance be related to each other?

A second question focusses on the relations between the instrument of floodlabel, and its effect on homeowners, and is formulated as follows:

RQ B: To what extent do homeowners become more motivated to implement property-level flood risk adaption (PLFRA) by a floodlabel?

However, as stated before, we will not only look at the floodlabel and its relation to homeowners. For a floodlabel to contribute to flood risk governance, we should not only consider the 'internal' behavioural trigger points (e.g. coping appraisals, etc. from the protection motivation model) of homeowners, nor focus on the only the instrument itself. To understand the full picture of the floodlabel as an innovative policy development, "the development and adoption of novel approaches within particular contexts of policymaking would need to be studied in connection with processes that establish these approaches as viable" (Voß & Simons, 2014, p. 749). So, to understand the role of the floodlabel, we should focus on the context as well, including factors of importance, institutional arrangements, and actors (Barendrecht et al., 2020; Boelens, 2018, 2020; Renn, 2008). Consequently, the aim is to answer this research question through addressing the following sub questions:

RQ C: What contextual conditions are conducive for the implementation of a floodlabel?

C1: What *factorial* conditions are conducive for the implementation of a floodlabel?

C2: What *institutional* conditions are conducive for the implementation of a floodlabel?

C3. What *actors* are conducive to the implementation of a floodlabel?

And the final research question considers operationalization of the floodlabel in flood risk governance, taking the interaction between homeowners, floodlabel, and context into account:

RQ D: How can a floodlabel be implemented in flood risk governance in order to stimulate adaptive behavior among homeowners?

1.7 Outline of this research

This thesis aims to explore the floodlabel as an instrument to involve homeowners in flood risk governance. To answer the research questions outlined previously, the thesis is organized as follows.

Chapter 2 elaborates on how resilience, flood risk management, and a situational approach are related when homeowner involvement is needed. This chapter reports on the fundamental theories on resilience, risk, co-evolution, and their interrelations. To be able to look beyond the 'internal' triggers for the implementation of PLFRA, this chapter constructs a relational approach to homeowner involvement in flood risk management. Chapter 3 presents an operationalization of this research, presents the methods of data collection, and introduces the study areas. Chapter 4 zooms in on an experiment with homeowner involvement through tailored expert advice in three case study areas in Flanders. The chapter is illustrative of how a floodlabel can motivate homeowners to implement PLFRA. Chapters 5, 6 and 7 look from the outside inwards at the conditions that are conducive for the floodlabel in flood risk management. Chapter 5 focusses on the factors of importance, chapter 6 continues with the institutional design of the floodlabel countries, and chapter 7 elaborates on the potential new actors and roles of current actors linked to the effective use of floodlabel. Finally, chapter 8 draws the previous chapters together and reflects on the thesis findings to answer the main research question –Does the introduction of a floodlabel contribute to flood risk governance? Moreover, this final chapter responds to the question regarding the operationalization and implementation of a floodlabel; it deals with recommendations for policymakers, flood risk managers, and future research paths. The outline of research, linked to the research questions, is visualized in figure 2.

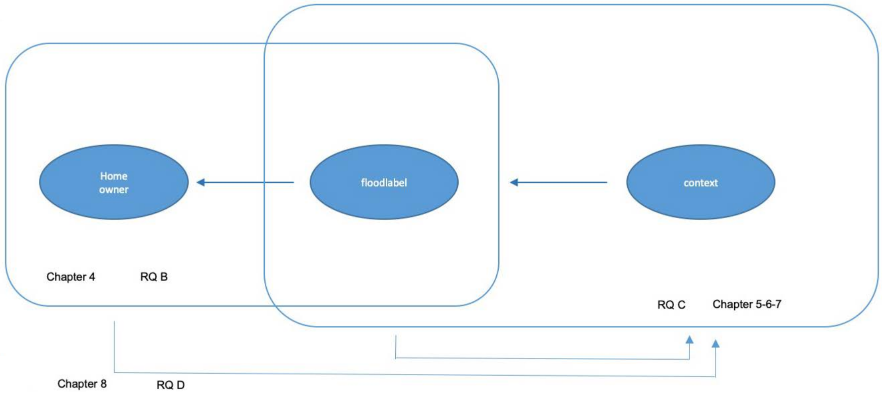


FIGURE 2: OUTLINE OF RESEARCH

2

RELATING RISK, RESILIENCE, AND CO-EVOLUTION: TOWARDS A THEORETICAL FRAMEWORK

2.1 **Introduction**

In the previous chapter we have described how a risk approach to flood management requires an inclusion of multiple (new) actors such as homeowners and businesses. To involve new actors, new measures, strategies, and instruments are being developed, such as floodlabel. The previous chapter suggested a relationship between homeowner behavior, floodlabel, and flood risk governance. This chapter will investigate how these concepts are related.

To trigger behavioral change of these new actors, there has been a strong focus on the socio-psychological factors that influence these actors. However, to influence the decision-making process of a homeowner to implement PLFRA measures, we should look beyond the 'internal' appraisals of risk perception (Buchecker et al., 2013a; Rözer et al., 2016; Rufat et al., 2020), and also consider the context that influences this decision-making process (Mees et al., 2019; Rufat et al., 2020). These externalities contribute and shape the complex web of relations between actors, rules, agreements, processes and mechanisms of flood risk governance (Renn, 2008; Van der Brugge, Rotmans, & Loorbach, 2005). They make it difficult to realize adaptive measures that are perceived as legitimate (van Buuren, Driessen, Teisman, & van Rijswick, 2014). Motivation is a complex activity, in which agency is both restricted and enabled by the relationship to the specific subject, stakeholders, objects, restraints, etc. within their specific environment (Boelens & de Roo, 2016). Thus, motivation is relational and needs to become adaptive to changing situations. Practical experiments to involve and motivate residents exist in Austria, Belgium, Germany, the UK, and other countries(Attems et al., 2020b; Davids et al., 2019; Forrest et al., 2019). All examples experiment with a community-based approach to raise awareness, using local social events, education programs and interactive design (Hegger et al., 2016; Mees, 2018).

Therefore, in this chapter, we will look at the theories and concepts that help us to understand how flood risk governance, homeowner involvement, and the instrument of floodlabel are related. This requires an exploration of the relations between concepts of (flood) risk (Rosner, Vogel, & Kirshen, 2014; Schanze, 2006), flood risk managements and its strategies (Hegger et al., 2016; Priest et al., 2016b) resilience (Disse et al., 2020; Morrison, Westbrook, & Noble, 2018) and a multi-actor approach (Butler & Pidgeon, 2011). Moreover, this requires a focus on the diverse and dynamic interactions between actors, with institutions and factors in which flood risk management is developing (Boelens, 2018; Renn, 2008). A better understanding of the interplay of actors in flood risk governance could help to identify if and how new instruments could be implemented in existing flood risk governance. To understand these interactions for flood risk management, we will bridge the concepts of the relational approach with the state-of-the-art concepts of flood risk management. Therefore we turn towards the origins of relational planning, grounded on post structuralism. Van Ache, Beunen & Duineveld (2013) describe relational approaches as *'a manifest for analysis of governance as a meeting ground of different worlds. Governance appears as a process wherein worlds collide, fight for pre-eminence, mutate, transform, and recombine. Governance absorbs,* *reflects, and creates realities (p. 11)*. To understand how a floodlabel can contribute to flood risk governance, beyond a mere socio-psychological approach, including the internal actor's appraisal and the situational externalities mentioned above, this chapter will construct a theoretical background using a relational approach combining: (1) the actors of flood risk governance, (2) the situational risk approach that has been introduced in the previous chapter, and (3) co-evolutionary resilience approach that binds things together.

2.2 From a physical starting point to a relational approach

To understand the shift towards a relational approach in flood risk governance, we first need to grasp some notion of post-structuralism and its relation to structuralism. Post-structuralists criticize structuralists for their strong urge to find structure in the seemingly complex, chaotic activities and events in our everyday lives in order to explain these activities and events. Smith and Riley (2011) state that such 'generative mechanisms' can easily be studied by focusing on these systems and by assuming these systems are closed in their nature. In addition, planners and geographers use or have been using such a deterministic notion of space (Graham & Healey, 1999). Although usually represented by two-dimensional maps, planning describes space with help of three-dimensional axes where points and objects are located. Objects are bounded identities, forming mosaic location patterns, separated from each other by distance. As such, spatial planning has focused on calculating the factors that explain the location patterns of buildings, parks, transport, landscapes, and communities, shaped as elements of planning on maps, and which would influence each other back and forth through physical proximity (Murdoch, 2006; Healey, 2007). This absolutist perspective assumes space exists independently, and an individual has only limited influence, as the meanings and actions that arise are shaped by the mechanisms of this spatial system rather than by the behavior of individual societal actors (Murdoch, 2006). This technical approach can be recognized in the domain of spatial planning too. De Roo (2010) describes this post-war period of technical-rational planning as object-oriented creating and shaping a desired physical environment based on certainty, with the possibility to predict our future. This approach is based on the systemic and explicit relation of means and ends, setting well-defined, obvious goals leading to extensive plans or blueprints (Healey, 1983, 2003). As such, planning aimed merely to 'tame time and space' instead of resonating with it (Murdoch, 2006; Thrift, 1999).

It has been argued that this structuralism perspective of 'Cartesian or engineering model' of the perception of space has encouraged technical approaches in practices of planning (Friedmann, 1993). Reflections of this quantitative model of planning are also seen in traditional flood management. In Belgium, for example, flood risk management has been 'deeply rooted in flood defense' (Mees et al., 2018). Belgium and the Netherlands have a long tradition of engineering defense works including dikes, levees, and floodplains to reduce the probability of flooding (Van Buuren, Ellen, & Warner, 2016). As such traditional flood risk management mainly focuses on rational calculations of river fluxes and weather models, resulting in the development of new flood defense objects, rather than on the uncertainties and complexities of climate change in the long term or the impacts of flood events (Hegger et al., 2016; Restemeyer, van den Brink, & Woltjer, 2017).

Critiques on this quantitative approach were based on these relational approaches of flood risk management. They emphasized that the lack of attention to uncertainties and complexities made flood risk management not as controllable and unambiguous as expected. There was a lack of attention to the social aspects within this technical rational approach of flood risk management. Society is not a logical structure to be designed by engineers, but consists both of logical and illogical relations (Webber, 1983). This also became visible in the technical-rational approach of planners to create, shape, and control a physical environment that is certain, safe, and predictable; however, it is difficult or even impossible to develop and implement such plans (de Roo & Silva, 2010). In flood risk management, traditional flood prevention was criticized for its extensive administrative and expensive process, and its predominant focus on engineered measures (Hegger et al., 2013). Therefore, a call is made for a shift from flood defense towards a more risk-based management of floods, including the (social) consequences of hazards. More people are impacted by floods and could get involved in flood risk management. Moreover, the technical approach of governments has outsourced flood risk management from land users and land owners, and thus contributed to a decoupling of risk awareness among land users and land owners.

Therefore, moving towards post-structuralistic approaches, we need to study the *'sources of identity and the way multiple forms of identity flow from the complex systems that surround social actors'* (Murdoch, 2006, p. 22). The emphasis is less upon flood prone areas and where things can be located and arranged or not, but more based on a flood risk management generated by inter-relationships, both within and beyond discrete areas and time periods (Davoudi & Strange, 2009). As such, flood risk management should be focused more on the analysis of politics, economics, governance, and power relations. This 'relational turn' (Murdoch, 2006; Amin & Thrift, 2000) seems to form a sharp contradiction with previously described structural perspectives.

To analyze politics, economics, governance, and power relations, Beunen, Van Assche, and Duineveld (2016) have proposed the idea of (co-)evolutionary governance. From this perspective they describe three types of dependencies that influence future actions and behavior of actors: path dependency, interdependency, and goal dependency. First, ***path dependency*** describes certain developments over time as the legacies from the past impact the course of governance. An interpretation within the field of flood risk management might be found in, on the one hand, a tendency of holding on to traditional defense instruments and on the other hand aiming for a new toolbox. Path dependency concentrates on the transaction costs and the cultural aspects that form the bases of past choices and will determine to some extent future options. It focuses on the capacity to adapt to the changing environment. In contrast, ***interdependency*** reorients the focus from the self to other players and the accompanying 'rules of the game' (thus the institutional settings). Anticipating on these other's ideas and future 'moves' or 'game making', becomes ever more important in a networked society since you are never playing alone. These interactions between various other actors and between their arrangements also influence the paths that can be followed. Last but not least, ***goal dependency*** refers to the interfering paths of actors when sharing a goal or vision; this can also enable or restrict certain future options. In reference to our subject, aiming for new approaches in flood risk management where cities should adapt and absorb floods, results in other strategies and solutions (e.g. mitigating measures) than when aiming for more traditional approaches of trying to resist and withstand a flood (resulting in protecting measures).

Space is a social phenomenon. Lefebvre and Nicholson-Smith (1991) stated how 'lived space' describes how local knowledge, narratives, and experiences influence space. It also includes informal rules and communications. These experiences influence the city as well. Multiple spaces can exist next to each other, due to the myriad of relations between entities. The spaces that are being developed interact; they can overlap, conflict or harmonize depending on their varying physical, social, economic and cultural configurations (Amin and Thrift, 2002; Massey et al., 1999). Spaces are characterized by their relations, activity, and multiplicity (Massey, 1999). In an endless on-going process, they are produced on multiple scales based on a complex web of intertwining relations (Massey, 2005).

Based on this, new ideas came up, influencing the planner and the planned continuously, reciprocally entangled in heterogeneous processes of spatial becoming (Boelens, 2009; Hillier, 2007). In this respect for flood risk management, tantalizing links between these post-structuralistic relational ideas of heterogeneous becoming and the recent approaches in flood risk management can be found (Hartmann, 2012). For instance, the complex effects of climate change, the risk approach to floods that indirectly introduces new actors to flood risk management, and the clash and interplay of multiple interests may all be involved in the creation of a sense of space in flood-prone areas at any given location and moment (Hartmann, 2012; Tempels & Hartmann, 2014). Moreover, the introduction of a risk approach, including both probability reduction and impact reduction, demands an active involvement of new actors (Mees et al., 2016b). For, despite the dominance of its rationalist epistemological base, flood risk management holds the seeds of relational praxis in its socio-ecological framework. Human knowledge and experience on floods, informing this framework, may also steer planning more strongly towards a greater sense of relationality in its understanding of space than has so far occurred with regard to the more traditional engineering approach of flood defense (Mees et al., 2016b).

Therefore, when talking about a shift from public to private responsibilities and the implementation of PLFRA, we should not only focus on behavioral change of citizens, but rather talk about a redistribution of responsibilities among many actors in flood risk management. This also implies a changing role and expertise for the flood risk expert, government, and businesses. Whereas this traditionally had a strong focus on engineering, in the near future more communication and networking skills might be needed to realize a flood-resilient city. Also, when developing a floodlabel, this tool should not only focus on behavioral change amongst homeowners, but should imply interaction amongst heterogeneous actors (human and non-human; for instance with climate change or topographical differences), and imply new roles for existing actors in flood risk management to cope with that.

2.3 Towards a Relational Approach in Flood Risk Management

Relational planning starts with the idea that space is not a pre-given, just a platform for action, but that spaces are made by people, agencies, and other actors, just as these people and actions are reciprocally influenced or 'made' by space itself (Amin, 2001; Crang & Thrift, 2000; Doel, 1999; Massey, 2005). Therefore, spaces are not so much composed out of things, people and processes, but spaces are predominantly composed by the specific relations between these entities and processes. Moreover, these relations are not fixed, but change over time and therefore remake space, as these are remade by the changing space themselves. Even more there are multiple relations who all meet in space. Sometimes there can be conflicts as sets of relations jostle for supremacy, at other times or places various relations could merge into consensus as alliances are built and new spatial identities come into being, which in turn etc. (Murdoch, 2006, p. 22).

For our subject this would mean that flood risk management may not rely anymore on engineering per se. Instead, one should focus more on the relation between the various spaces. From these insights a relational flood risk manager would realize that an exclusive focus on blueprints or engineering makes no sense in a context of complexity and uncertainties. In that respect, flood risk management is simply too dynamic, volatile, and thus unpredictable. Therefore the action domain of flood risk management has become far more open, contested, complex, and multidisciplinary than it was in recent times. Moreover, one has to recognize that flood risk management cannot operate anymore as the main or only source for a dynamic management of flood-prone areas. It needs to react on and interpenetrate other flanking management areas (see Luhmann further on). Moreover – if socially engaged – it cannot only become the only supercharger or facilitator of a meaningful participatory risk management. For that purpose, the present forces and relations that make water management are too multi-dimensional and multi-layered. Instead one has to recognize that flood risk management is just one of the many forces in this dynamic process of spatial becoming (Boelens, 2009; De Roo, 2012; de Roo & Silva, 2010; Hillier, 2011). This would also mean that flood risk managers should not solely focus on engineering solutions, but should also develop skills to notice potential within flood risk management dynamics (Van Den Brink, 2009). Similarly, Murdoch (2006, p. 156) has called for planning to develop 'a new spatial imagination', drawing particularly on ecological understandings of relations, especially those between humans and non-humans. We could interpret the approach of a flood-resilient city as 'a new imagination' within flood risk management. Against this backdrop, issues of flood risk management, especially in relation to a spatial planning context, need to be understood as complex, multifaceted, open-ended and unpredictable activity (Tempels, 2016). This complexity in flood risk management emerges because of the focus on risk reduction, instead of probability reduction. As explained in the introduction chapter, any actor in flood-prone area contributes positively and/or negatively to the impact a flood could have in flood risk management. Research and policy development, starting from the EU Directive (2007/60/EU) (European Commission, 2007), try to inform new stakeholders about their responsibilities, incorporate these new stakeholders in flood risk management, empower communities to take their share in the management of flood risks, and explore new innovative financial and economic and business models to finance flood risk management (e.g. Hartmann, 2012; Hegger et al., 2016; Mees, 2017; Thaler, Priest, & Fuchs, 2016). But this is not enough. Since a diversity of actors contributes to a diversity of values and beliefs, and therefore judge potential risk management strategies differently, the decision-making process needs to become more inclusive and collaborative. Although that would bring more uncertainties in flood risk management, one needs to address this increased complexity in flood risk management in order to create engaged and dynamic processes of connectedness, collaboration, and trust. As such, this kind of flood risk management needs to become more adaptive. Thus, in order to meet this increased complexity, there is now a quest for an adaptive flood risk management approach, which involves the community, and includes a coalition of stakeholders and their ideas on flood risk management.

To summarize, *"flood management strategies can no longer be based on the conventional linear methods of risk assessment, which evaluate alternative measures to implement the optimal solution. The inherent uncertainty and associated complexity with respect to changes in the physical and social components of flood risks require more flexible schemes to be incorporated into decision processes and management choices"* (Tempels & Hartmann, 2014, p. 121). For this reason, Tempels (2016) argues for a co-evolutionary approach to deal with complexities in flood risk management; we will elaborate on this on the next pages. Besides, Mees (2017) questions in her aptly titled dissertation 'How co can you can go?' when it comes to citizen involvement in the flood risk management processes. However, flood risk managers can desire to involve new actors in the field of flood risk management, but not all actors are willing to implement PLFRA. Therefore both authors recognize a deadlock between governmental actors on the one hand and unwilling citizens on the other.

2.4 The actor relational approach and co-evolution

To open up this deadlock, Boelens (2018, 2020) presented a planning approach building on the relational traditions previously mentioned. This actor-relational approach (ARA) analyses the development of actors, networks, or systems from the outside-in, instead of the more commonly used method from the inside out (Boelens, 2010, 2018). It tries to clarify actions and behaviors of actors, based on the interactions from the environment to the actor. As such, the actor-relation approach builds upon actor-network theory (ANT) (Callon, 1984; Latour, 2005, 2012) that starts with social networks wherein no distinction is made between human and non-human actors. This means that 'things' or 'phenomena', such as flood prone buildings, pavements, climate change, etc., have a certain agency and are fundamentally heterogeneous. All these phenomena are unpredictable and not fixed in form, space, or time, and even the identity of these phenomena can change. For example, if there is no flood risk, or no recent flood experience, there will not be any urgency to act, but this can change as soon as 'no risk' turns into a high risk and becomes a threat and causes a reaction among other actors. To point out that an 'actor' can be a 'thing' or 'phenomena' as well, the term actant is also used. Whereas ANT focuses on the analysis of these social networks in retrospect, ARA focuses on these social networks in prospect, which makes more sense for the planning discipline that deals with the development of the spatial future (Boelens, 2010) (Boelens, 2010). In this respect Boelens (2015) distinguishes between several gradations of complexity, and the way to deal with that. Figure 3 shows how co-evolution as a planning approach fits complex and dynamic systems.

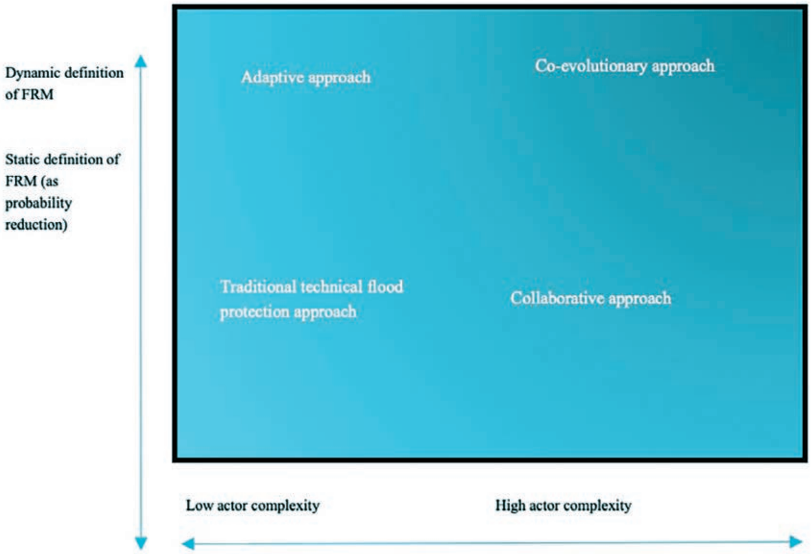


FIGURE 3: FOUR APPROACHES ON THE GOVERNANCE OF COMPLEXITIES *(SOURCE: BOELENS, 2015; TERRYN, 2016; VAN BRUSSEL, 2018)*

By looking at the complex interactions within the context of a range of changing heterogeneous actants and changing or fuzzy objectives, a lens of co-evolution is needed to understand how these actants, through their interactions, evolve (Davoudi et al., 2012; Mees et al., 2016b; Tempels & Hartmann, 2014). Actors, institutions, and context interact and can co-evolve within this process of undefined becoming. But what is exactly meant by co-evolution? Beyond generalized Darwinism, with its linear notions of inheritance-survival of the fittest-natural selection-variation (Darwin, 1859; Campbell, 1960), co-evolution is described as the process of interaction between two (or more) systems, where these interactions cause change in the nature of these systems (Kallis, 2007). Ehrlich and Raven (1964) discovered that organisms not only evolve in specific biotic circumstances, but also through reciprocal selective interaction with other (related or unrelated) organisms. Moreover, Barkow (2006) and Durrant and Ward (2011) have discovered that these reciprocal evolutions not only occur in a more or less static milieu, but that this milieu adapts in reference to these reciprocal evolutions, as this milieu influences the specifics of those evolutions in return. Based on these notions, the concept of the continuous emergent co-evolution come to the fore. Within this concept three major parallel forces are at play: the species (or actors) themselves, their interrelations (or networks) with other species, and the specific changing context (or milieu) wherein this process is occurring (Boelens, 2018). Together these forces interact, either in a positive direction leading towards success for one or multiple actors or a negative direction leading to a lock-in.

It was Norgaard (1981) who introduced this idea of co-evolution to social sciences. According to Norgaard, humans reciprocally change environments both materially and cognitively. Kemp et al. (2007) and Beunen et al. (2016) describe how co-evolutionary systems on the one hand depend on each other, through cause and effects. Effects for one system become cause for another system (or even within the same system). On the other hand, these systems are self-organizing systems, as they partly operate independently and determine their own direction of development. Kemp et al. (2007) call this relative autonomy and acknowledge how this internal contradiction is fruitful for an analysis of social and governance evolutions.

But floods and flood risk management can also be described as a co-evolutionary process between socio-spatial and natural-physical systems (Folke et al., 2002). Flood risks influence land use, and land use influences flood risks. An example from flood risk management is the dike paradox or levee effect (Bubeck et al., 2017) or how flood experience among homeowners influences the decision-making process to implement PLFRA measures (Begg et al., 2017). In this case the development of flood defense infrastructures has stimulated spatial development behind the dikes, which in return demanded even more pronounced and elevated defense structures. These kinds of co-evolutions in a negative sense (leading to a lock in) are plentiful and can be related to spatial demands, real estate markets, insurance systems, risk perceptions, and knowledge of floods, just to name a few (Botzen, Aerts, & Van Den Bergh, 2009; Bubeck et al., 2012a; Kousky & Shabman, 2015). But how can we also come to a positive co-evolutionary interplay? As there are so many interactions possible between flood risk management and other actors or systems, the challenge for flood risk management *"is not restricted to innovative measures or processes that lead to resilience as such. But it extends to achieving more fruitful interactions between water managers and other actors so that multiple actors constructively manage flood risks"* (Tempels, 2016, p. 62); these interactions are not limited to flood risk management itself, but beyond that to new political and institutional systems, as will be explained using Luhmann's systems theory in a later section.

2.5 Flood Risk Management from a Social Systems Approach

With the introduction of the Floods Directive of the European Union (2007) member states are to incorporate risk in their flood approach to flood risk protection, and no longer solely focus on probability reduction through structural defense. The directive states: *"Flood risk management plans should focus on prevention, protection and preparedness. With a view to giving rivers more space, they should consider, where possible, the maintenance and/or restoration of floodplains, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity. The elements of flood risk management plans should be periodically reviewed and if necessary updated, taking into account the likely impacts of climate change on the occurrence of floods"* (Floods directive, 2007/60/EC, p. 2). Here, flood risk management becomes a 'game of give and take', offering safety in exchange for esteem and inclusiveness (Kaufmann et al., 2016a), not only though general taxes, but by active involvement of less traditional flood risk actors.

This has been translated into concepts of multi-layered water safety in Flanders and the Netherlands. As explained in chapter one, smart combinations of the preventive, protective, and preparing measures should lead to a redistribution of responsibilities and costs. This integration of measures also significantly increases the complexity of flood risk management because it attracts new players to flood risk management that have shared responsibilities, with the introduction of adaptive and flexible planning concepts and conditions of coevolution between three layers of divergent strategies (Hoss et al., 2011; Tempels & Hartmann, 2014). But although this approach still differs fundamentally from the more traditional approach of engineering safety, Hoss (2010) still calls these approaches a 'Safety Chain approach', whereby protection, prevention, preparation, and even aftercare is more or less regarded in series, distinguished from each other; thus it is not handled as complex, but is at its best a complicated issue. A real relational flood risk management approach would not perceive these strategies as sequential, but as highly interactive and dynamic. However, Hoss stresses that the measures do not function like safety nets, coming into effect when others fail, but come into effect simultaneously (Hoss, 2010). In table 2, the author explains how certain measures of flood risk management complement each other.

Against this backdrop Hoss et al. (2011) links multi-layered water safety to an integral system sciences approach. Hoss refers to Leveson: *"The objective is to integrate the subsystems into the most effective system possible to achieve the overall objectives. Complicating matters is the fact that a system may have multiple objectives and some of these may conflict with other objectives such as ease of operation and maintenance or low initial costs. A goal of systems engineering is to optimize the system operation according to prioritized design criteria"* (Leveson 1995: 141). However, from a complexity perspective, there is no such thing as 'the optimal solution' or equilibrium. Instead, complex systems are difficult to predict and in a continuous state of change (Boelens & de Roo, 2016). The risk equation (Risk = probability * Impact) also fails to fully cover and incorporate the complexity of risk. Even though this equation illustrates the interaction between risk, probability, and impact, the equation remains linear, seeking an optimum balance between probability and impact. In this way, the formula ignores the ongoing dynamics among risk, probability, and impact, and among actors from within that are linked to flood risk management. Consequently, this perception of flood risk management is unable to tame the complexity of flood risk.

That being said, Hoss perceives the three different sets of measures in MLWS-levels as different subsystems that should contribute collectively to flood resilience. Collectively means that these systems also (need to) interact. Generally, combining probability-reducing measures with impact-reducing measures decreases the effect of the impact-reducing measures and *vice versa*. After all, prevention makes a flood less likely, so that the impact-reducing measures will be called upon less often. The converse is that, if the consequences of a flood are more severe, stronger prevention is needed to gain a similar level of risk. As a consequence, the cost-efficiency of any additional measures depends on the initial risk level (Hoss, 2010). In this respect the approach of Hoss covers tradeoffs and conflicts within the system. After all, tradeoff between layers in terms of things such as funds, attention, and space are expected. This approach is useful when considering the interaction between the layers, and even for the effectiveness of the layers. But it is remarkable that Hoss in table 2 mainly focuses on technical measures, and not on flood risk management as socially produced sets of manifolds, and ignores local specific context in space and time. As multi-level water safety makes an appeal to multiple actors, the concept of multi-layered water safety indirectly wants to trigger behavioral change amongst involved actors on and between each of these MLWS-levels. Pure systems theory does not provide answers to that. Thus, in order to include behavioral change among involved actors within and between those systems, we might consider Luhmann's ***social systems*** theory to be incorporated in MLWS.

Luhmann identified neither people nor actions as social systems, but rather communications as the main source for change (Luhmann, 1995). Social systems (according to Luhmann) are nothing other than on-going processes of interpretation and reinterpretation of internal and external environments. These social systems are in continuous friction, and through this friction these systems can evolve themselves through self-reference or through reference to their environment, in so-called autopoesis (Luhmann, 1997). It is impossible to grasp these frictions and system as a whole; it is too chaotic, plural, capricious and therefore complex. Only fragments are observable. By approaching this complexity in parts—or in Luhmanns' words, subsystems—systems become manageable (Luhmann, 1997). Examples of these subsystems include: law, economy, politics, religion, science, and education. Each of these subsystems plays a role in the reproduction of society as a whole. *"Social systems for Luhmann are cognitively open yet operationally closed; they continuously learn from their environment, yet under their own conditions"* (Beunen et al., 2016). These subsystems are defined by their own common language, traditions, habits, and codes. For example, law sees reality according to schemes grounded in the distinctions of legal/illegal, science deploys the distinction true/untrue, economy calculates in terms of value/no value, while politics operates by means of the distinction power/powerless (Beunen et al., 2016). As these systems are conditioned at their own self-referentiality, and oriented towards their own function, they cannot take each other's place. When returning to our subject of flood risk management, we can recognize in the risk-based approach of multi-layered water

TABLE 2: FRAMEWORK TO ANALYZE THE EFFECT OF FLOOD MANAGEMENT MEASURES AND CATEGORIZATION OF MLS MEASURES BY THEIR EFFECT; SOURCE: HOSS ET AL. (2011)

General strategies to deal with hazards (Haddon Jr, 1973)	Corresponding strategies in flood risk management	Flood risk parameter effected	Layer 1: Prevention	Layer 2: Spatial Solutions	Layer 3: Crisis management
Reduce hazard source (water overload)					
1. Eliminate hazard source	NA	NA			
2. Lower diminish reduce hazard source	NA	NA			
3. Prevent release of hazard	Prevent extreme amounts of water in system	Probability of hydraulic load	1-3: Redistributing discharge of river arms; retain run-off		
4. Modify rate of release of hazard source	Relief/alter extreme hydraulic situations	Water level	1-4: giving waterways more space		
Reduce exposure to hazard					
5. Separate in space and time hazard source and objects	Prevent object/people being in the endangered area	Number of exposed		2-5: Reconsider location of settlement	3-5: preventive organized evacuation
6. Erect a barrier between the hazard and the objects	Erect a barrier between water masses and objects/people	Probability of exposure/number of exposed	1-6: large-scale flood defences	2-6: compartmentalization	3-6: temporary flood defences
7. Modify contact surface of hazard source	Decrease the degree by which objects are affected	Inundation depth	1-7: flood defences allowing (controlled) overflow	2-7: alleviation of buildings	

Reduce Vulnerability					
8. Strengthen objects against hazard	Prevent damage from occurring among exposed	Vulnera-bility/ mortality		2-8: implement PLFRA at buildings	3-8: self-reliance; temporary PLFRA at buildings
9. Mitigation	Reduce occurring damage among exposed	Vulnerabil-ity/ mortality			3-9: Emergency relief, rescuing
10. Reparative strategies/ stabilization	Re-build what was damaged/ rehabilita-tion	Number exposed, probability of exposure, inundation depth, vul-nerability/ mortality			

safety a distinctive set of codes, that differ from the codes of flood protection. Again, the three layers of MLWS can be perceived as distinctive subsystems with their own codes of conduct. Each level requires a certain way of thinking, education, etc. Level one, on protection, is technical by nature and distinguishes itself through calculable probability reductions, such as safety standards for dikes that are built to withhold floods, including the probability that this would happen. Level two, regarding prevention, relates to impact reduction (especially through spatial planning) and 'communicates' through building permissions and plans. The third level, on preparedness and damage reduction, involves new actors, while also shifting responsibilities to them (Meijerinck & Dicke, 2008)[3].

Furthermore, like Luhmann, each of these levels do not stand on their own but interact in many ways. Besides learning from each other, each of these levels of MLWS can also 'irritate' at the outside and even 'interpenetrate' the others and cause change from within. These 'irritations' or 'interpenetrations' can stimulate the subsystem (Luhmann, 1992 in: Van Asche & Verschraegen, 2008). Luhmann suggests that if irritations or interpenetrations can lead to a response of the system in certain directions, these subsystems could indirectly be influenced using 'irritations' or 'interpenetrations'. Thus someone could be able to indirectly steer a self-steering subsystem (Van Assche & Verschraegen, 2008). However, it is hard to entirely predict how a system will respond to 'steering attempts'.

3 Hoss (2010) uses the Dutch structure of prevention, protection, and preparedness as layer 1-3. The remainder of this research follows the European (and Flemish) terminology of protection, prevention, and preparedness. Both structures refer to 1. Engineered protection 2. Spatial planning interventions and 3. Crisis management.

In this sense Andersen (2005) explains how one can indirectly steer a system. Modern society contains an array of organizations that are able to influence the self-steering of various systems. These are usually organizations that could belong to two subsystems, as these organizations share the codes, languages, and habits from two different systems. As such, these organizations can steer and be steered by creating 'structural couplings' between these systems.

A second method – the interpenetration – requires the distinction of programs from codes. Whereas codes are inherent to a system and cannot be changed, programs are the decision rules that confirm or reject a code. These programs can be influenced through irritations (Andersen, 2005). Van Asche & Verschraegen (2008) provide a clarifying example: A political system can influence programs of other (sub)systems in such a way that these (sub)systems have to (re)act. Although states cannot directly steer the system of spatial planning, politics can steer through financing, or include new conditions to building plans.

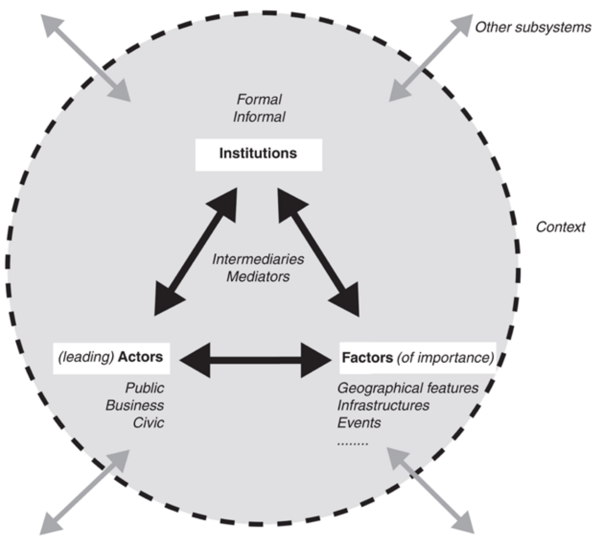


FIGURE 4: ACTOR NETWORK CONSTELLATION. THE DASHED OUTLINE OF THE SYSTEM REFERS TO THE OPENNESS OF A SYSTEM. SOURCE: BOELENS ((2018, P. 96))

So, in flood risk management it might also be possible to influence subsystems where flood protection dominates and direct these subsystems to alternative directions. When we approach the three layers of multi-layered water safety as three subsystems that interact and co-evolve, we need to find the hybrid organization that belongs to multiple subsystems in flood risk management. In case of this topic is research, we need an hybrid organization that is both involved in flood risk management, as well as in housing, or homeownership. Or, changes in subsystem A can lead to responses in subsystem B. So, if we want to involve homeowners in flood risk management, and change homeowners' behavior, we should not only look at the internal, individual factors that influence a homeowners' behavior, but foremost look at its surrounding context, the subsystems around the homeowner. Through interactions back and forth a co-evolution starts. Besides these interactions between subsystems, change can also be triggered from within the subsystem. Public, business, or civil actors can influence the subsystem; factors of importance, such as geographical features, infrastructure (or the absence thereof) can influence the subsystem; and formal and informal institutions can trigger change (Boelens, 2018). Together, these actors, factors and institutions form a context or milieu, and influence the direction of the ongoing co-evolutions of a subsystem as well (see figure 4).

2.6 The concepts of Resilience and co-evolution

Linking the concept of resilience to flood risk management is not new. Both in science and in practice the concept has been used and discussed (e.g. Aerts et al., 2014; De Bruijn, 2004; Disse et al., 2020; Fekete et al., 2020; Restemeyer et al., 2015; Tempels, 2016). The same goes for policy programs (e.g. Making Cities Resilient (UNISDR), Climate Resilient Cities (ICLEI), City Resilience Profiling Programme (UN Habitat) and research programs (e.g. StarFlood – EC 7th framework program)). Along with all these policies and research are divergent interpretations of what flood resilience is and how it generally evolves. Therefore, we have to move back to its beginning. In general Walker, Holling, Carpenter, and Kinzig (2004) define resilience as "*the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"* (Walker et al. 2004:4). More specifically for cities under influence of a disaster, urban resilience is often defined as "the capacity of a city to rebound from destruction" (Vale & Campanella, 2005). However, the concept of resilience is much older and was already introduced by ecologist C.S. Holling in the early 1970s. In his paper on resilience and stability in ecological systems he illustrated the existence of multiple stability domains or multiple basins of attraction in natural systems and how they relate to ecological processes, disturbance, and heterogeneity of temporal and spatial scales (Holling, 1973). According to Holling, stability was *"the ability of a system to return to an equilibrium state after a temporary disturbance"* (Holling, 1973: 17). He introduced resilience as the capacity to persist certain change and absorb shocks; therefore he proposes that ''*resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist*'' (Holling, 1973, p. 17). Next to this absorbing capacity, Folke (2006) and Walker et al. (2004) also stress the capacity for renewal, re-organization and re-development. Thus resilience remains not only a conventional force (keeping the original state of affairs), but also receives a pro-active force: *in a resilient social–ecological system, disturbance has the potential to create opportunity for doing new things, for innovation and for development.* In this respect Davoudi et al. (2012) emphasizes these resilience potentials for long-term capacity building.

However, due to evolving insights into emergent complex situations, the concept of resilience has also been approached from a number of substantive conceptual angles, including engineering, ecological and even socio-ecological approaches (Davoudi et al., 2012; Folke, 2006; Liao, 2012). Restemeyer et al. (2015) define these three forms of resilience respectively as robustness, adaptability, and transformability:

- Referring to Holling (1996), engineering resilience, or robustness is described as a single-equilibrium paradigm. It assumes a pre-determined stable state, to which all systems eventually return after a disturbance. The water protection system of dikes and dams could refer to such a system. Striving for a straightforward technical solution, this form of resiliency corresponds with the technical-rational approach to planning and the technical approach to flood protection.
- Ecological resilience, or adaptability, rejects the existence of such a single-equilibrium state, and according to Tempels (2014), acknowledges the dynamism of systems and the existence of multiple equilibrium states. Within a disturbance, there exists the possibility to flip to an alternative equilibrium domain, characterized by other actors, networks and strategies. The Dutch 'making room for a river' could fit in the second resilience approach.
- Finally socio-ecological conceptualizations of resilience, or transformability, goes even one step further (Berkes & Folke, 1998; Gual & Norgaard, 2010). They assume that resilience not only depends on the knowledge and action domain at matter, but also acknowledges that a domain is continuously under influence of time and context. Ongoing social and physical interactions influence a domain's resilience and is changing the domain itself. Moreover, other domains influence a domain to transform--or the other way around (McClymont et al., 2019). This form of resilience recognizes the complexity of interactions and associated uncertainties (Zevenbergen, Gersonius, & Radhakrishan, 2020). As evolutionary transformations can be observed, this form of resilience is also referred to as evolutionary resilience (Davoudi et al., 2012).

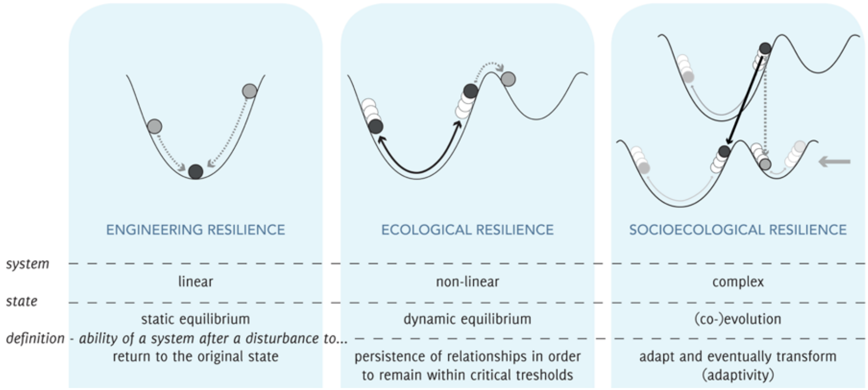


FIGURE 5: THREE TYPES OF RESILIENCE SOURCE: TEMPELS (2016, P. 45)

From these perspectives it is argued that resilience management enhances the likelihood of sustaining desirable pathways for development in changing environments where the future is unpredictable and novelties and surprise are likely (Walker et al., 2004). It is Davoudi (2012) that notes that the resilience concept offers a useful framework that is closely related to relational understanding of space and time; the concept of resilience rejects ideas of fixity and rigidity in the same way relational planning rejects the ambition to develop blueprints. Both advocate the exploration of the unknown and the search for transformation (Davoudi, 2012). As such the resilience perspective shifts policies from those that aspire to control systems as being stable, to enhance the capacity of socio–ecological systems to cope with, adapt to, and shape change (Berkes et al., 2003). Governing these resiliencies requires different attitudes or ambitions for governments and planners. In engineering resilience (or robustness) a planner or water manager can manage and control spatial developments through direct intervention and strong central coordination. Examples from flood risk management technical measures include dikes and dams (Tempels, 2016). Within ecological resilience (or adaptability) a planner or water manager still requires central coordination but allows self-regulation of the landscape within certain thresholds as well. An example from flood risk management would be retention basins or wadis (Tempels, 2016). Socio-ecological resilience requires a more adaptive planning approach, which fosters the capacity of a region to react to change (Hartman et al., 2011). *"This implies a mentality change from functional distribution of spatial developments towards a differentiated, location specific, qualitative approach….the central government is [more] than… a process mediator, supporting the development of the self-organizational capacity of regions"* (Tempels, 2016, p. 26). This allows other actors to intervene in the management process and provides new roles for governments ranging from inspiring and informing, to initiating and facilitating.

In this context Davoudi (2012) stipulates that resilience is not an argument for governments to withdraw governmental support for or from vulnerable communities. The concept of resilience is almost power-blind and a-political, partly because ecologists state that *"in nature no rewards or punishments, just consequences"* (Westley et al., 2001, p. 103). The consequences can be positive or not, being a matter of survival or not, but it is the survivor to turn a treat into a survival through adaption. Some people gain while others lose in the process of resilience-building. Moreover, resilience for some people or places may lead to the loss of resilience for others. Therefore, it is up to the governments (and perhaps other actors) to monitor an equal distribution of the burden and successes of resilience.

Although Davoudi (2012) emphasizes resilience as a concept of on-going transformation and dynamics, one cannot ignore the interpretations focusing on stability, the ability to quickly bounce back, and th ability to return to the status quo (Liao, 2012; Walker et al., 2004; Zevenbergen et al., 2020). Even though several papers call for common understandings on resilience to apply in practice (Disse et al., 2020; Parker, 2020), after years of scientific debate no single definition dominates (Rodina, 2019). The multiple interpretations of the concept of resilience can lead to vagueness in policy development (Forrest, 2020).

Similarities can be found between the three concepts of resilience and the flood risk strategies such as multi-level water safety. In fact, multi-level water safety is an attempt to translate resilience into flood risk policy (White et al., 2018). Robust resilience corresponds with the first level of prevention, trying to reduce the probability of a flood event through engineered interventions such as keeping the water out and bouncing back to the original state. Both entail a technical approach to flood risk management. For adaptive resilience, similarities are found with level two on protection; both concepts adapt within a certain frame, by creating space for water within certain thresholds and reducing the objects sensitive to floods within the thresholds: living with water, bouncing forward, and adapting the spatial plans. So, in terms of MLWS, this is where spatial planning intervenes. The third concept of socio-ecological resilience rejects working towards a stable state. Instead, it emphasizes the dynamic state of risk, and requests an adaptive capacity and a transformative attitude in flood risk management (McClymont et al., 2019; Restemeyer et al., 2015). On socio-ecological resilience Tempels (2016, p. 23) says: *"these systems do not return to their 'original state', but [co-]evolve"*. This third form of resilience accepts a disruptive event will happen and expects everyone to be able to deal with it. Those who cannot handle such an event need to adapt. This way, the third concept of resilience therefore could be best described as a co-evolution towards a smart combination of actions from all possible actors involved. This approach translates MLWS into crisis management and requests the participation of many more actors than engineers and planners, such as civil actors. A summary of the links between resilience, MLWS instrument, and the actors involved is provided in table 3.

TABLE 3: LINKING RESILIENCE TO MLWS AND ACTORS INVOLVED

Resilience	MLWS instruments	Actors involved
Engineering resilience Robustness	Protection	(governmental) flood risk engineers
Ecological resilience Adaptability	Prevention – spatial planning	Spatial planners and environmental discipline
Socio-ecological resilience transformability	Preparedness – crisis management	Government, civil society market

Disse et al. (2020) elaborates on the relation between flood risk management and resilience. Overlap between both concepts exists, yet they differ. Flood risk management on the one hand focusses on damage and efficient damage reductions. As a consequence, policy concepts such as multi-level water safety turn into a cost-benefit analysis (Mees et al., 2016b). Resilience on the other hand focusses more on the improvement of recovery, by discussing the speed of recovery and the direction of recovery (bouncing back, moving forward, or transforming). Resilience focusses on what communities can do, whereas a risk-based approach focusses on damage control (Disse et al., 2020; Twigg, 2007). In fact, both can complement each other (Disse et al., 2020); the risk approach helps to determine who can act, and the resilience approach determines how to act. The risk-based approach is more static, but able to optimize the management of floods (Kuklicke & Demeritt, 2016), while resilience is context dependent (e.g. influenced by actors, geography, and history) and can be a flexible and adaptive concept that is able to handle complexity and uncertainty (McClymont et al., 2019). As the three types of resilience (robustness, adaptability, and transformability) differ from each other in terms of ambition or strategy (respectively bouncing back, moving forward, or transforming), a choice to follow any of these types also results in another set of measures, and vice versa.

2.7 Constructing a relational theoretical framework

As described in the introduction chapter, traditionally flood risk management is perceived as a governmental task that mainly focuses on engineering solutions to reduce the probability of floods. However, the recent desired shift towards flood risk governance, involving other (new) actors in the field and sharing the responsibilities of flood risk reduction among governmental actors and these new actors, still results in a deadlock. Citizens are not always willing to participate in flood risk management. Moreover, current and new information instruments, such as floodlabel, cannot contribute to flood resilience among homeowners without considering the context of its application. Therefore the instruments of MLWS needs to be encapsulated in a larger and wider relational policy context.

As such and to overcome the deadlock, we have suggested in this chapter a relational approach to homeowner involvement in flood risk governance. This relational approach could contribute to flood resilience by supporting and stimulating more than just the homeowner; instead, a wide range of governmental, civil, and business actors that are related or could be related to homeowner involvement in flood risk management. As explained before, the appraisals and behavior of homeowners are influenced by a context of the behavior and actions of a wide range of actors, factors, and institutions. So, these homeowners continuously respond, react, cooperate, and compete to adapt to find balance within the changing circumstances to fit better to the actors and in the environment around them (Boonstra, 2015; De Roo, 2012). Together these actors co-evolve. Flood risk managers or planners cannot 'tame' and 'direct' these evolutions with content or process planning. Instead, they can co-create the conditions under which these evolutions occur and flourish (Boelens & de Roo, 2016). These conditions activate the self-organization of networks, thereby contributing to a better fit to the continuously changing circumstances (Boonstra & Boelens, 2011). This is where the floodlabel comes in. A floodlabel can create conditions that potentially contribute to this 'a better fit', i.e. contribute to the conditions that motivate homeowners to implement PLFRA measures. De Roo (2012) describes this 'fitness' as *'the ability of a system to survive between extremes – between order and chaos, coherence and diversity'* (De Roo, 2012, pp. 152-153), and the conditions include the drivers, markers, and connections within the practices that catalyze, in this research, flood resilient behavior of homeowners (Boelens & de Roo, 2016). The concept of floodlabel can create or strengthen such conditions.

Conditions influence the co-evolutions among actors, factors, and institutions. Floodlabel can operate in between multiple actors and institutional layers and support interactions between various subsystems by means of irritations or interpenetrations and can direct towards a resilience of bouncing back or forward, depending on the conditions. Settings of conditions in flood risk governance can influence floodlabel, and floodlabel directs homeowners towards certain forms of resilience. And the behavior of homeowners influences the context of flood risk governance and so on. This brings us to the coherence between the introduced concepts and theories in this chapter. A short answer to the question is "resilience". The relation as illustrated in figure 1 showed the baseline of the conceptual framework (see figure 6): a co-evolving process of becoming where certain conditions in the complex web of actors, factors, and institutions contribute to specific forms of homeowners' resilience. Certain conditions, formed by the interplay of actors factors, and institutions, direct more towards a homeowner's action of bouncing forward, while others direct more towards bouncing back. The form of resilience that the homeowner –consciously or unconsciously– pursues, is influenced by the form of resilience that is commonly accepted in the field, among the settings in the context. It is resilience that connects the context of flood risk governance with the behavior of the homeowner. Literature shows how homeowners often tend to aim for a quick return to normality (i.e. bouncing back, following robust resilience) (e.g. Slavíková, Hartmann, & Thaler, 2021) and ignore the possibility to implement PLFRA measures (Attems et al., 2020c; Fuchs et al., 2017a). So, to motivate homeowners towards a behavior of bouncing forward, i.e. motivating homeowners to implement PLFRA measures, a floodlabel needs to consider both the internal appraisals of a homeowner, as well as these conditions in the contextual settings that strengthen and weaken the decision towards the implementation of PLFRA.

The contextual settings influence the development of new instruments or solutions through resilience as well. A robust resilience approach directs towards new engineering solutions. Adaptive resilience directs towards the development of adaptive spatial plans and transformative directs toward crisis management and includes the involvement of other actors. Any of these directions towards resilience influence the level of homeowner involvement and the decision-making process for or against implementing PLFRA.

As it is hard to oversee the ongoing direction of the system or network as a whole, an analysis of the actors, factors. and institutions (see before in this chapter, and in Boelens, 2018) might offer insight on how the contextual settings and specific conditions) contribute to a homeowner's decision to implement PLFRA or not. For a floodlabel to influence this decision it should enhance certain conditions or create couplings between actors, factors, and institutions that contribute to a better fit. A floodlabel as a one-directional communication instrument from government to a homeowner will not change that. It will not solve the earlier described deadlock between citizens and governments. Instead, a floodlabel can create and enhance the conditions under which homeowners change behavior and start to implement PLFRA or create the couplings between homeowners and other actors. However, the label itself has no more value without couplings with policy or other actors than the user of the floodlabel. As van Buuren et al. (2014, p. 1030) says: "couplings enable the mobilization of resources for implementation. Couplings seem indispensable to achieve adaptation". So, it is up to the floodlabel to create these couplings between different actors; but the effectiveness of the floodlabel as a tool to create couplings between actors' behavior, does not only depend on the actors and their behavior. A focus entirely on the introduction of such a label as a tool for homeowners makes no sense without relating the label to the wide set of stakeholders, but also by relating the label to institutional and contextual settings that are involved with flood risk management.

This approach from the outside-in could explain more about the potential effect of the label on the distribution of responsibilities, as well as about how the floodlabel can operate in between multiple actors and institutional layers and support interactions between various subsystems. In this way, we can create and implement a floodlabel within flood risk governance to become most effective. This, however, requires a floodlabel to be variable in configurations across space and time.

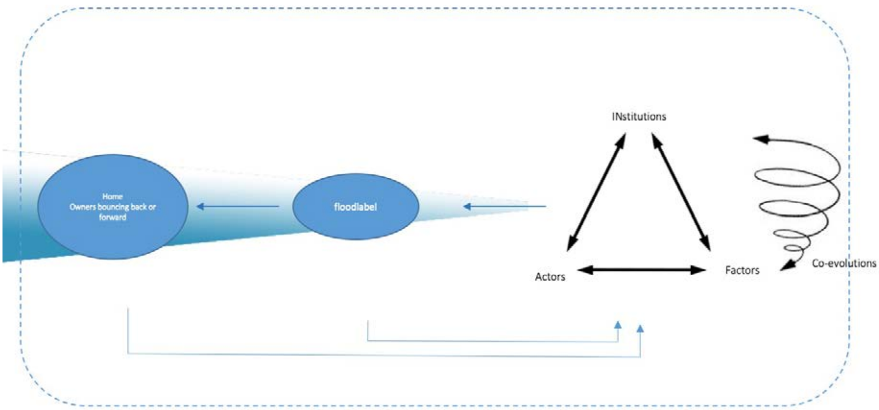


FIGURE 6: THE CONCEPTUAL FRAME VISUALIZED

This approach from the outside-in could explain more about the potential effect of the label on the distribution of responsibilities, as well as about how the floodlabel can operate in between multiple actors and institutional layers and support interactions between various subsystems. In this way, we can create and implement a floodlabel within flood risk governance to become most effective. This, however, requires a floodlabel to be variable in configurations across space and time.

3

OPERATIONAL FRAMEWORK

3.1 Introduction

In the previous chapters, we have highlighted how ongoing developments in flood risk management are counting on the involvement of homeowners in flood risk governance. To involve new actors, such as homeowners, new instruments are being developed. Here floodlabel can have a role to inform, motivate, and bind towards the implementation of PLFRA measures. Earlier this thesis stated that, based on Voß (2007), a floodlabel contributes to flood risk governance if it meets both functional and structural premises:

- A floodlabel motivates homeowners to implement PLFRA measures;
- A floodlabel changes the context of flood risk governance, e.g. the label triggers current and new actors to take other or new responsibilities

Investigating the contribution of floodlabel to flood risk governance, and meeting both premises, requires two different research approaches. Therefore, this chapter introduces the operational framework that consists of two parts.

The first part focusses on the relation between floodlabel and homeowner behavior and aims to answer the research question 'to what extent homeowners become more motivated to implement PLFRA by a floodlabel'. This study uses a more instrumental approach towards the floodlabel, following the functional premises of an instrument's ability in achieving public goals (Voß, 2007). To do so, we first zoom in on a case study of tailored expert advice to gain insights into the effect of expert advice on homeowners' implementation of PLFRA. This case study area, situated in Flanders, was selected based on its high flood risks and recent experiences with floods. Moreover, in the case study area, experiments have been running with tailored flood advice, an instrument that is closely related to floodlabel. This case study requires a deductive approach that assesses the arguments of homeowners to (not) implement PLFRA put forward in the Flemish case study. This requires a more closed structured interview strategy (Mortelmans, 2013), and includes semi-structured interviews, a survey, and short telephone interviews. The insights from protection-motivating theory on risk appraisals and coping appraisals formed the starting point for coding the interview data. Codes included elements of risk appraisal (e.g., risk perception, awareness, potential damage, previous exposure) and coping appraisal (e.g., self-efficacy, resources, and outcome expectation, cost-benefit ratio).

The second part of this research uses the relational stance to what contextual conditions are conducive for the implementation of a floodlabel. As researchers we cannot influence the processes of FRM, neither observe the behavior of individual actors without taking their context into account. Flyvbjerg (2006) notes that, through case study observations within their context, we are able to grasp the real-life behavior of actors. Therefore, this part of research will use exploratory case study research to answer the research questions. Using this approach, it becomes possible for researchers to explore a phenomenon where not much is known (Yin, 2003). As floodlabel is new in the context of flood risk governance, this approach can bring new variables to light. This research uses three 'shadow cases' of participating countries in the floodlabel project (the Netherlands, Austria and Germany) to illustrate how the socio-political context of actors, factors, and institutions is influencing the floodlabel, and compare these with the context of Flanders. By comparing the characteristics of the three cases with the Flemish case, it becomes possible to illustrate how variations in these cases also influence the configurations of the floodlabel. The interactions between these settings can be perceived as highly complex, but the actor-relational approach becomes helpful to organize and structure these interactions. By organizing the second part of this research according to the factors, institutions, and actors that influence homeowner involvement in flood risk management, it becomes possible to observe opportunities for floodlabel to enhance conditions and create couplings between homeowners on the one hand, and the context of factors, institutions, and actors on the other hand.

These conditions and couplings within flood risk management can be dynamic and diverse, and differ from case to case. To understand what contextual conditions are conducive for the implementation of a floodlabel, we should continue with an exploration of these contextual settings: the institutions and factors that influence actors' behavior in multiple countries. By conducting a comparative case study research in Belgium, the Netherlands, Austria, and Germany, the second part of this research aims to derive a more detailed understanding of the context and institutions that shape flood risk governance for each of these four countries and the potential role for a floodlabel. This part of the research specifically looks for the conditions for co-evolutions under which a floodlabel could function. These can include relations or networks, or in more theoretical terminology, couplings, irritations, or interpenetrations that provide the conditions for floodlabel to motivate homeowners.

3.2 Testing Floodlabel

A pilot on tailored expert advice by the Flanders Environment Agency

To understand to what extent homeowners become more motivated to implement PLFRA by a floodlabel, this research investigates a pilot project by the Flanders Environmental Agency (VMM) where tailored expert advice is provided to homeowners with flood experience. This pilot shows similarities with the concept of floodlabel. For example, both instruments aim to inform and motivate homeowners to implement PLFRA measures.

This pilot of the VMM has been organized in three municipalities in Flanders, Belgium in 2017: Sint-Pietersleeuw, Geraardsbergen and Lebbeke. In all these municipalities homeowners were regularly hit by pluvial and fluvial floods. Therefore, the VMM selected group of homeowners received a flood risk advice. The VMM introduced the pilot to increase flood prevention and adaption among homeowners. The strategy builds on "Multi-Layered Water Safety" (CIW, 2015), which suggests that an increase of PLFRA measures reduces future flood damage at the individual building level (CIW, 2020; Kaufmann et al., 2016a) from an expert advice tailored to the house. Indeed, according to scientific literature, PLFRA measures can be effective in avoiding flooding or in reducing the damage to the house (e.g. Attems et al., 2020a; Beddoes, Booth, & Lamond, 2018; Joseph et al., 2015; Kreibich, Thieken, Petrow, Müller, & Merz, 2005; Lamond, Rose, Mis, & Joseph, 2018; Poussin, Botzen, & Aerts, 2014).

For the project, the Agency selected 7,000 families out of 85,000 inhabitants, based on location on flood risk maps and recent flood data from the fire brigade. The Agency invited them for the first round in their respective city halls. In total, 209 homeowners expressed their interest in receiving such tailor-made advice (see table 4). They were visited by a flood damage expert and sewer expert in the summer of 2017. In the spring of 2018, the individual reports were distributed amongst the respective homeowners through e-mail, and the homeowners received a final invitation to discuss their personal report at their respective city halls. A total of 77 homeowners attended these events.

TABLE 4: HOUSES VISITED PER MUNICIPALITY BY VMM EXPERTS (HYDROSCAN, 2018)

	Sint-Pietersleeuw	Geraadsbergen	Lebbeke
Houses visited per municipality **(total = 209)**	89	83	37

The pilot primarily focused on tailored advice for buildings with a residential function; some houses had small businesses or offices. Homeowners did not need foreknowledge. This pilot was free of charge for the homeowners. The Agency covered the costs of each visit (VMM, 2017). Home visits took place in the summer of 2017; final reports were received in spring 2018. New pilots in other towns are planned for 2021.

Following homeowners receiving tailored expert advice

To understand the influence of flood risk advice on homeowners' behavior, this research project has followed homeowners receiving tailored flood risk advice by the experts of the VMM. To do so, several methods have been used to collect data on their behavior. First, the participants of the VMM-project on tailored advice were followed in 2017, using in-depth semi-structured interviews while the homeowners were having the experts visiting. Also, three interviews were conducted in the project area among homeowners that did not participate in the project. Second, a survey was held among the participants directly after receiving the final advisory report. Third, the participants were contacted two years later during a short telephone survey (see table 5).

TABLE 5: OVERVIEW OF INTERVIEWED & SURVEYED HOMEOWNERS

Method	Month, Year	Interviewees / survey participants
Semi-structured interviews among homeowners that received advice	June 2017	13
Semi-structured interviews among homeowners that did not receive advice	August 2017	3
Survey among participating homeowners	January –March 2018	26 (out of 77)
Telephone survey among participating homeowners	October 2019	148 participated 175 were reached out of 209

Semi-structured interviews and survey

From September 2017 until April 2018, this research analyzed to what extent homeowners were motivated to implement PLFRA measures after receiving tailored advice. The Agency provided the necessary databases and allowed accompaniment in joining the house visits by the flood risk experts, enabling interviews to be conducted right after the experts' visit. The advising process involved a meeting between the homeowner and expert at their property. Here, a conversation with the homeowner took place and a technical survey was done in and around the house. These provided the input for a so-called advisory report, which included proposals for PLFRA measures and cost implications for each of these solutions, to be deliberated by the homeowners themselves. During the thirteen house visits that were subjects of this research, the interaction between experts and homeowner was observed, before starting the interviews. A participant as observer stance was taken (Dewalt & Dewalt, 1998), allowing the researcher to learn about the expert-homeowner interactions through observing and participating in the house visits. Observations were used in the analysis in chapter 4. In a final meeting between homeowner and expert in the city hall, final advisory reports were presented and clarified. We performed in-depth interviews during the home visits of the experts to the homeowners. The interactive approach of semi-structured interviews allows the inter-viewer to explore an issue through open-ended questions, and allows the interviewee to ask follow-up questions to probe deeper into a topic (Creswell & Creswell, 2017). Since the interviews took more time than the expert visits themselves, we could perform only 13 interviews. The in-depth interviews included open questions in line with the relational approach about their experiences with floods, their relationship with the municipality and neighborhood in regards to floods, the influence of their behavior on the surroundings, the willingness to adapt, and their arguments for or against participating in the pilot project. To prevent putting words into their mouths, interviewees had the chance to speak freely on their flood experiences at the start and end of the interview. Interviews were recorded and transcribed and were inductively coded and analysed (Creswell & Creswell, 2017).

Secondly, we performed a survey amongst the 77 homeowners visiting the city hall during the final meeting, since specific questions were also focused on the overall procedure of the pilot. From these, we received 26 surveys in return. Although the response rate is small, the two methods complemented each other well. While the in-depth interviews provided background in regards to the decision-making process of homeowners, the survey identified recurring patterns in the choices homeowners make about protection measures. The survey contained similar questions and statements about the experiences with flooding and willingness to take action, but also about the functionality of the advice and the usefulness of such advice for a wider public. As such, and although the response rate is too small to give scientifically sound conclusions, we can construct a qualitative storyline on the influence of tailor-made flood risk advice and the effectiveness of the pilot.

Telephone Survey

Two years after offering tailored advice to the homeowners, the homeowners were contacted again for a short telephone survey. For this survey, in total 175 out of 209 project participants were contacted, others did not pick up the phone or could not be reached. 148 were willing to participate in the short telephone survey. The phone calls took c. 10 minutes. The main goal of this telephone survey was to measure the uptake of PLFRA measures after the expert advice, and participants were asked to reflect on the advice, and tell if the tailored expert advice motivated them to adapt their homes.

3.3 Contextualizing Floodlabel

To gain insights on the co-evolutions occurring among the contextual conditions of factors, institutions, and actors that could influence the floodlabel, this study is executing a country comparison on the flood risk management of the Netherlands, Austria, and Germany. These countries were part of FLOODLABEL, a JPI Urban Europe project that was supported by the European Union's Horizon 2020 research and innovation programme, which included these four countries. These countries have been selected for this research project because they provide a mix of comparable variables (e.g. these countries are all subject to the European Floods Directive, and are Western democracies, with middle to high economic development) and differing ones (flood risks, physical and social geography, etc.). Also the institutional settings show similarities and differences, so flood risk management in each of the countries varies. Flyvbjerg (2006) distinguishes two methods to select case studies: either random or as information-oriented sampling. The selection of our four countries is based on this second method, as the governance processes in flood risk management in these four countries seem to differ at first glance. A random sampling would not help to gather the specific and diverse information we are looking for. Instead, a case study selection gives an overview of possible similarities and varieties in floods with the contextual and institutional conditions for a floodlabel to become more useful. All countries struggle with flood risk, but differently. Flanders and Austria had large scale and strong pluvial floods in recent years, the Netherlands has not. However, the Netherlands has a strong focus on coastal and fluvial flood protection, whereas Austria has a wider approach and includes mud flows and avalanches in their risk management approaches. Flanders and Austria are doing some first experiments on tailored flood risk advice, while in the Netherlands the first concepts of floodlabels are being developed.

Contradictory to the first part of this research, this situational approach requires a more exploratory approach for researching the conditions for a floodlabel. As it concerns a new instrument, this part of research is highly exploratory, resulting in a more open interview approach. A diversity of data collection methods is used to triangulate and combine data from policy documents, and expert and stakeholder interviews. As the four countries differ from each other, so do the interviewees that have been selected differ. All interviewees were selected based on a short screening of reports, newspapers, policy documents, and academic journals or through suggestions by other interviewees, so-called snowball-sampling. For the selection of interviewees, extra attention is given to the shadow cases that show contextual and institutional differences with the Flemish case.

Explorative expert interviews were carried to gain a general understanding of flood risk management in a specific country, and to grasp how flood risk management is shaped through the factors and institutions that 'apply' in each country. These explorative interviews were carried out to be able to select suitable stakeholders for interviews later on. Experts were contacted to explore how flood risk management is currently situated in each of the countries. These experts were chosen because of their 'overarching' view on flood risk management in each of the four countries.

Stakeholder interviews were used to gain in-depth information on institutional and actors' conditions that relate to homeowner involvement in flood risk management. As such the interviewees provided a more detailed narrative from their viewpoints on homeowner involvement in flood risk management and the potential of instruments such as a floodlabel. Examples are insurance companies, umbrella agencies of homeowner associations, municipalities, and water authorities, all actors in 'the surrounding' of homeowners.

Interviews were semi-structured and questions were open, and topics slightly differ for various actor-groups and countries. Following Lune and Berg (2016), the process of data collection in every study site included three key steps: (1) taking semi-structured interviews which were recorded, and additional notes were taken during and after the interview, (2) transcribing the recorded data, and (3) categorizing the text. The semi-structured interviews were conducted face-to-face or by phone and transcribed in the months afterwards (Mortelmans, 2013). Coding took place manually. Codes were identified in the data set and linked to the co-evolutions and conditions for evolutions that influence the introduction of a floodlabel, e.g. actors or actants, networks and couplings, and irritations or interpenetrations to trace conditions that provide or block the introduction floodlabel. In a second step a link towards the homeowner behavior is made, as the data will be linked with the types of resilience and MLWS strategies (see table 3) to see if analyzed conditions have a conducive effect on homeowner behavior.

TABLE 6: CODING SCHEME FOR INTERVIEW AND DOCUMENT ANALYSIS

Coding scheme for the interview and document analysis of the contextual cross country comparison	
Actors / Actants	Role & Responsibility, Instruments available type of knowledge available Activities being performed
Networks & couplings	Relations collaborations organization of FRM
Irritations & interpenetrations	Involving new actors/instruments, or becoming involved Changing circumstances new roles, expectations foreseen links and interpretations of floodlabel innovations

3.4 Operationalizing Floodlabel

The final research question on the operationalization of a floodlabel brings all the results together to formulate policy implementations and recommendations for the implementation of a floodlabel. Based on the observations throughout the thesis, this chapter reflects on the floodlabel as an instrument itself as well as on the context in which it is applied. For the latter, we will return to the context of the Flemish case study. Towards operationalization, this chapter reflects both on the instrumental as well as the contextual side of the research. The instrumental side discusses what implementation could look like, whereas the contextual side reflects on the theoretical concepts of resilience and co-evolution, PLFRA and use of a label in sustainability transitions.

TABLE 7: OVERVIEW OF KEY INTERVIEWEES

	Organisation & Role	**Interviewee(s)**	**Date**
Belgium	Flanders Environmental Agency – policy advisor, involved in tailored advise Flanders	1	June 6, 2017
	Homeowners receiving tailored advise	13	June 2018
	Homeowners not receiving tailored advise	3	September 2018

The Netherlands	Municipality of Dordrecht – Policy Advisor Water	1	March 20, 2019
	Municipality of Rotterdam – Policy Advisor Water, involved in application of Bluelabel	1	May 19, 2019
	Vereniging voor Nederlandse Gemeenten – policy advisor, involved in municipal taxes	1	May 20, 2019
	Ministry of Infrastructure & Environment, DG Space & Water, senior policy advisor	1	May 20, 2019
	Ministry of Infrastructure & Environment, involved in 'Alliantie financiele prikkels voor klimaatadaptatie' (Alliance for financial incentives in climate adaption)	1	August 5, 2019
	STOWA – Foundation for Applied Water Research & Unie van Waterschappen, policy advisor	1	May 24, 2019
	Water Authority "Hollandse Dleta" policy advisor on water safety & policy advisor on crisis management	2	April 24, 2019
	Dutch Association of Insurers – policy advisor water & climate	1	June 4, 2019
	Achmea Insurance – Innovation team, involved in Bluelabel	2	June 4, 2019
	Advisor European Committee – involved in Energy Performance Certificate	1	October 16, 2017
	Centre for Crime Prevention and Safety – policy advisor, involved in Dutch Burglary Certificate	1	November 23, 2017
Austria	Stadt Dornbin – Head of natural hazard commission, involved in tailored advise Vorarlberg	1	January 30, 2019
	Bundesanstalt für Bergbauernfragen – policy advisor, involved in flood risk management	1	February 7, 2019
	Umweltbundesamt – policy maker, Involved in risk communication and governance	1	February 5, 2019
	Insitut für Raumplanung, Umweltplanung und Bodenordnung, policy maker & researcher	1	February 7, 2019
Germany	Flood risk experts, involved in tailored advise in Germany, linked to Hochwasser Kompetenz Center	3 (focus group)	April 2, 2019 (jointly organized with Karin Snel, Marie-Sophie Attems & Magdalena Rauter)

4

CASE STUDY ON TAILORED EXPERT ADVICE IN FLANDERS

4.1 Introducing Active Homeowner Involvement through Tailored Expert Advice

This chapter considers the research question: "To what extent do homeowners become more motivated to implement property-level flood risk adaption (PLFRA) by a floodlabel?" To answer this question, we will consider a case study of tailored expert advice for homeowners, in Flanders, Belgium. The pilot of tailored advise contains multiple elements of overlap with the concept of floodlabel. Both instruments aim to inform and motivate homeowners to implement PLFRA measures and use an expert that provides information specifically tailored to each individual house. Both instruments point out possible risks and weaknesses in the house and provide strategies to reduce these risks by introducing specific PLFRA measures. Therefore, the outcomes of this case study provide some clues for the future development of the floodlabel.

4.2 Introducing tailored expert advice

To reduce damage from residual risks, tailored expert advice for homeowners in Flanders was organized by the Flanders Environmental Agency. This pilot project arose out of the policy makers' incentive to include homeowners actively in flood risk management. During a house visit, experts would inform homeowners about their risks and inform them about tailored PLFRA measures to reduce these risks. According to the agency these experts' visits would motivate homeowners to adapt their house and thus contribute to the preparation strategy of multi-layered water safety. As such, the tailored advice shows similarities to the main intentions of a Floodlabel: informing about risk and risk reductions, and motivating homeowners to adapt to or bind to adaptive behaviour.

Originally, the Flanders Environment Agency had been involved in protection (through the development and maintenance of water retention basins, canals, dikes, etc.), but more recently had also taken up policies aimed at preparedness, such as publicizing flood risk maps, developing tools for flood awareness and introducing an obligation to disclose flood risks in real estate transactions. These measures should already enhance the willingness of homeowners to adapt. The pilot on tailored advice for homeowners was regarded as a next step to involve residents in flood risk management.

4.3 Introducing the three pilot areas

The landscape of the pilot areas is shaped by valleys of small rivers and brooks and susceptible for small-scaled pluvial floods. Here the Flanders Environment Agency as well as local governments have already taken protection measures and will take additional protective measures in the near future. However, the valley areas are occasionally characterized by such major flooding problems that even after all cost-benefit measures have been taken by the watercourse manager, a large part of the houses are still flooded.

So far, a pilot among 210 homeowners that has been running from 2017 to 2018 in the municipalities of Sint-Pieters-Leeuw (around 30,000 inhabitants), Lebbeke (c. 19,000 inhabitants) and Geraadsbergen (c. 33,000 inhabitants; here in total some 0.03% of the total population) has been considered for this research. The agency selected the municipalities of Sint-Pieters-Leeuw, Lebbeke and Geraadsbergen as they all experienced multiple pluvial flood events over de last decade (e.g. 2010, 2014 and 2016) which created local flash floods and impounding water from the sewers.

Sint-Pieters-Leeuw

The municipality is located in Flanders in the urban fringe of Brussels. The area is part of the hilly landscape of the Pajottenland. Combined with the erosion-prone soil (sand and loam), this ensures rapid precipitation drainage, which makes the area very vulnerable to flooding. The municipality is connected to the Zuunbeek (length of 19km), part of the Zenne basin (103km). It is a typical spate river, strongly influenced by rainwater flows. Sint-Pieters-Leeuw recently experienced multiple flood events in 2010 and 2016. During the 2010 flood, the available retention basins on the Zuunbeek were filled to capacity but could not prevent large parts of the Negenmanneke district from being flooded. The flood caused damage to 600 houses; 70 houses were actually flooded in-house and 13 houses were condemned (CIW, 2010b).

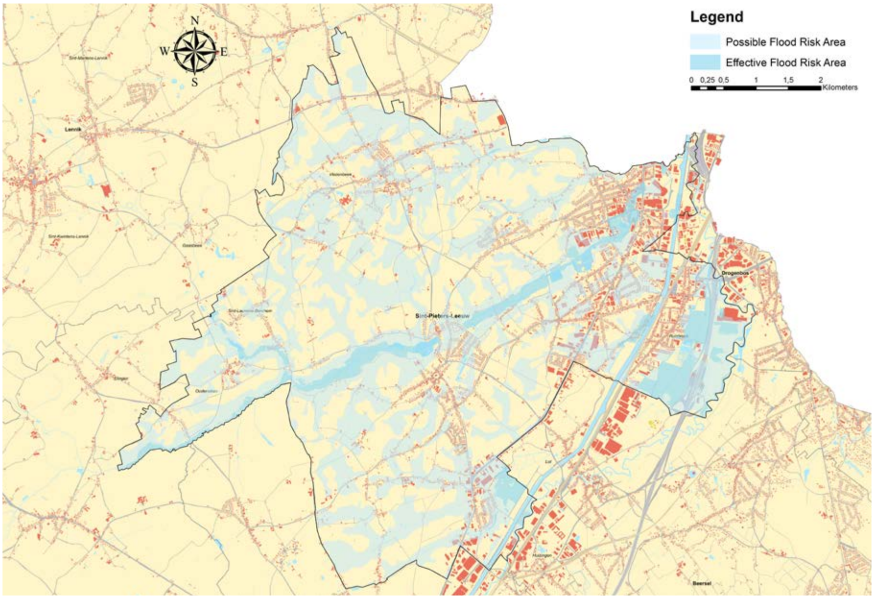


FIGURE 7: THE MUNICIPALITY OF SINT-PIETERS-LEEUW AND ITS FLOOD PRONE AREAS.

The origins of these floods in Sint-Pieters-Leeuw are diverse. A large part of the flooding is caused by rainwater runoff due to the strongly sloping landscape; moreover, this is sometimes accompanied by mudslides. In addition, there are locations where watercourses and sewers cannot discharge the water quickly enough. Depending on the location, this results in flooding directly due to rainwater runoff (in strongly sloping areas and in homes with underground garages with a sloping entrance), flooding from the watercourse, or flooding due to backflow from the public sewer system (Hydroscan, 2018).

Geraardsbergen

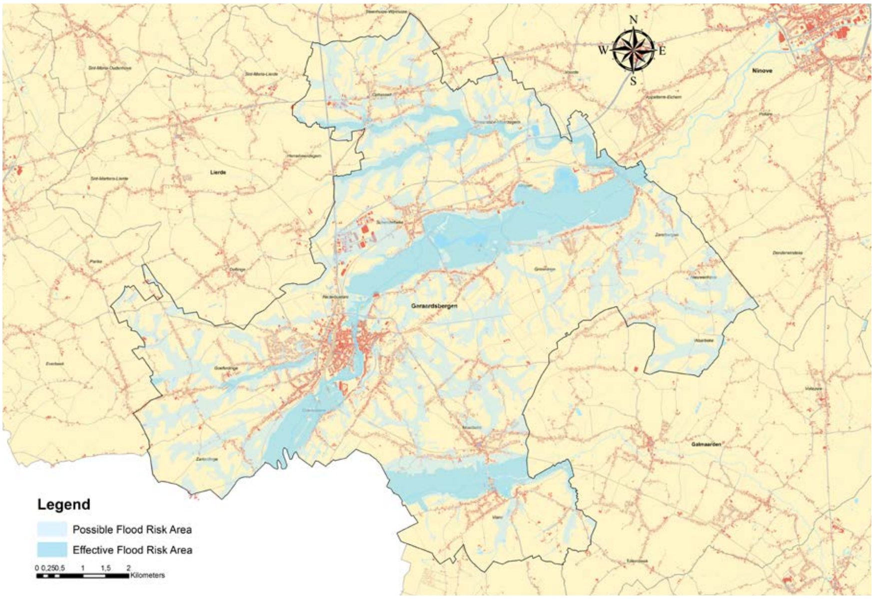


FIGURE 8: THE MUNICIPALITY OF GERAADSBERGEN AND ITS FLOOD PRONE AREAS

Geraadsbergen is situated in a rural and hilly landscape, in between the cities of Brussels and Ghent, bordering the adjoining Walloon region from which the Dender springs. The town offers affordable housing and is situated in the Dender basin (length 69km). Parts of it are canalized, and the Dender is partly accessible for vessels. It is a typical spate river, strongly influenced by rainwater flows. In the municipality several retention basins have been constructed in recent years, which have increased upstream storage on the unnavigable watercourses. Despite the fact that these retention basins significantly reduce the probability of flooding in several places, they appear to be too small to prevent flooding in case of extreme precipitation (Hydroscan, 2018). The city recently dealt with floods in 2002/03, 2010, 2014 and 2016. Floods in these municipalities were caused by flash floods due to running rainwater, river floods from the watercourses the Dender and its tributary the Molenbeek, and to a lesser extent impounding water from sewer systems. During the floods of 2010, 400 houses were damaged and 51 houses were flooded (CIW, 2010a). In February 2021 the Molenbeek flooded again, causing local damage (Standaard, 2021).

Lebbeke

Lebbeke is situated along the Dender, like Geraaardsbergen, but more downstream near the river mouth in the Scheldt. In 2010 and 2016 the city was struggling with high water, resulting in floods in 19 houses that year (CIW, 2010a). Several retention basins have been constructed along the watercourses and have provided storage capacity for 300,000 m³. Despite the fact that these retention basins significantly reduce the probability of flooding at various locations, they appear to be too small for more extreme events such as those that occurred in January 2016. The flooding of the houses in Lebbeke is mainly caused by floods from the watercourses (Vondelbeek, Kleine Beek, Heibeek and Nijverseelbeek). Sometimes the overflow of these courses causes problems with backflow from the sewer system as the sewer system is strongly linked to the watercourses (Hydroscan, 2018).

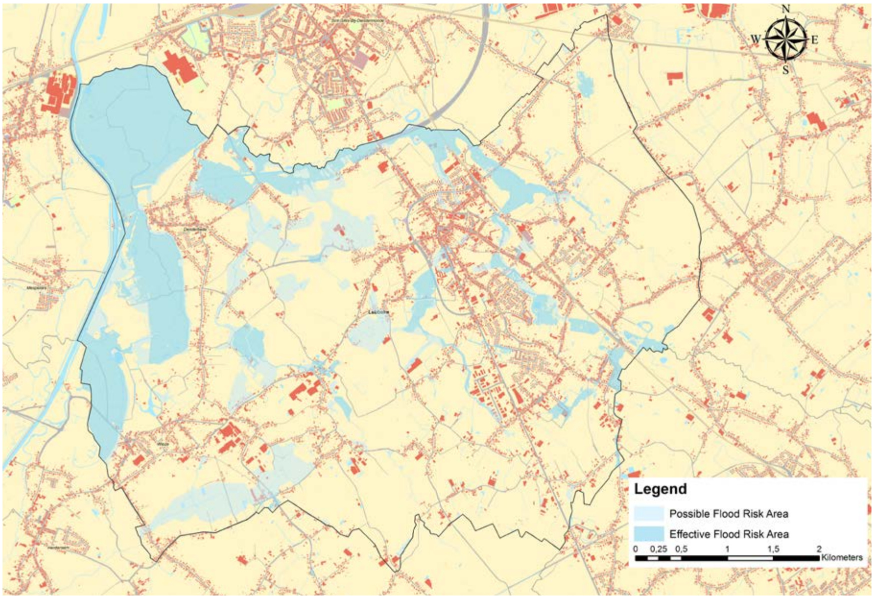


FIGURE 9: THE MUNICIPALITY OF LEBBEKE AND ITS FLOOD PRONE AREAS

Process of a house visit

Within these municipalities the Flanders Environment Agency selected households based on location on flood risk maps and recent flood data from the fire brigade; the latter usually provide first support during a flood and therefore owns local and precise data on flood damage. For some of the participating homeowners their flood experience was limited to the doorstep (but feared incoming water a next time); others experienced one or multiple floods in the basement or garage with water levels up to the ceiling, or water levels up to 50cm in the living room. Homeowners had already implemented some provisional PLFRA measures.

The advising process included a meeting between homeowner and two experts at the home. One expert had a background in loss-adjusting for insurances, the second had expertise in urban water management. During a conversation between homeowners and experts, the first could explain about recent flood damage. The experts briefly explained the project once again and more background was given on the concept of multi-layered water safety with regard to the specific property. Subsequently, a tour in and around the house was carried out with the two experts. Here one expert was responsible for mapping the sewerage system, including any bottlenecks and height measurements, and the other was responsible for mapping bottlenecks with regard to possible floodwater inflow. Afterwards, ideas for PLFRA measures were discussed. The necessary information brochures on the proposed protective measures were handed over to the homeowner.

All this input contributed to a so-called advisory report that was shared with the homeowners after half a year and included proposals for tailor-made flood prevention solutions and cost indications for each of these solutions. In a final meeting between the homeowner and expert in the city hall, nine months later, these reports were presented, clarified, and discussed between expert and homeowner. In most cases the experts advised on the introduction of a pump to remove incoming water, or floodwalls, or back-up valves, or a combination of these (see table 8). Average costs for the introduction of PLFRA for one household were € 5,578 (Hydroscan, 2018), but the advice itself was free of charge for the homeowners as the agency covered the costs of each visit. Conversations between homeowner and experts were open and interactive.

TABLE 8: SUGGESTED PLFRA MEASURES FOR HOUSEHOLDS IN EACH MUNICIPALITY SOURCE: HYDROSCAN (2018)

	Flexible walls needed		**Pumps needed**		**Back-up valve needed**	
	Number of house-holds	**Percent-age (%)**	**Number of house-holds**	**Percent-age (%)**	**Number of house-holds**	**Percent-age (%)**
Geraardsbergen (N=83)	55	68,8	23	28,8	35	43,8
Lebbeke (N=37)	22	59,5	3	8,1	13	35,1
Sint-Pieters-Leeuw (N=89)	48	55,8	31	36,0	55	64,0
Total	**125**	**61,6**	**57**	**28,1**	**103**	**50,7**

4.4 Ambitions of tailored advising in Flanders

According to the project leader, the agency had three ambitions for the project. The first was to provide custom information on risk and risk reduction for individual households. Although homeowners are already obliged to share information about flood risks of building plots (based on flood risk maps) when selling or renting a house (so they are already informed), information about the impact of water on the building itself is limited. Tailored advice should provide this information in detail, enabling the implementation of flood mitigating measures for each house.

Second, the advice (and forthcoming flood proofing adaptations) should ensure an objective negotiating basis for consultation with the insurance company. Ideally, owners of a flood-protected house should be able to negotiate lower insurance fees. Nevertheless, insurance companies were not involved in this pilot. Third, the overarching goal was to motivate homeowners to adapt their house to reduce the damage costs of floods. Therewith the pilot should contribute to the overall multi-layered water safety objectives.

The advice meets the specific needs of homeowners with flood experience:

- The advice describes the risk for an individual property and provides new, custom solutions for homeowners. These hands-on suggestions are in most cases easy to implement and affordable, and as such contribute to the coping capacity of a homeowner. A homeowner having planned large renovations confirmed, '*We had already made plans with a construction company. According to [the expert], the solutions appear to be easier and cheaper to solve.'* (homeowner 13 experienced 1 flood)
- The advice provides access to a network. Homeowners learn where to buy their flood proofing solutions and who can implement them.
- The agency offers independent advice on solutions, free from commercial interests. Citizens feel more empowered when this objective advice is freely available.
- For most homeowners, the home visit is their first encounter with a flood risk expert. Homeowners take advantage of the opportunity by sharing their problems and suggestions on flood risk management, either for their homes, or for their neighbourhoods. Because they feel heard, this interaction contributes to a sense of trust and self-esteem.
- Personal attention from an expert or governmental representative contributes to willingness to adapt the house. Experts take time to listen to the personal stories and base their advice on the personal (e.g., financial) situation of a homeowner. Homeowners also feel supported by the effort that the agency puts into the pilot project, and therefore tend to be more willing to invest as well. Homeowners see flood risk management as a shared responsibility.

The project leader stipulated that, for them, the experiment was already relevant as a learning trajectory. The more residents joined, the more insight the agency would get into the usefulness of their tailored advice. Then they could refocus the communication and further analyse the results. In the coming years, for example, they want to install a kind of internet tool to enhance the behavioural transition and improve the effectiveness of the measures taken. The project leader stipulated that they distributed brochures, but that these brochures only improved the technical know-how of the target groups. So, for future projects, the agency wants to expand the information beyond those exclusively technical matters, to facilitate education among the residents in a more proactive way.

4.5 How did the homeowners respond?

All participants recently experienced one or multiple floods, yet their responses differ. The first interviewee (Homeowner 13) indeed emphasized that the recent floods in his house or direct environment was the direct motivation to participate; it also enhanced his idea to act accordingly. He stated that *"above all, we have the fear that a flood would happen again. After the previous flood, we had everything renovated, but it could happen again in no time"*. This quote illustrates that this respondent recognized the urgency of the problem and that he is willing to adapt his house. It is for this reason that he became interested in the experts' opinion. *"The advantage of the project is that experts tell us what we can do, which craftsmen are needed, which techniques. This is an opportunity, all of a sudden. Experts come by, who know a lot about our flood problems. And, well, the investments are for us, but all the information we have received today, I think it's fantastic, now we know how to act"*. The main benefits of asking a flood risk expert according to this interviewee is to receive trustworthy tailored advice. He explains: *"[So far] any people who advised us of anything, the insurer, the architect, and the professionals of the water supply company, they all provide various, even contradictory advice. We just didn't know who to believe. That's why it was nice to get some solid advice now"*. After all, this interviewee did not know where to start to solve his problems even though he wanted to. However, eventually, after the experts' visit, he is not only willing to adapt his house, but also is more confident to act, thanks to the experts. Once more the quality of the advice is highlighted by the following quote: *"Beforehand I did not expect us to get so much tailored information, I thought it would remain more general". (Homeowner 13 in 'area without flood risk', experienced 1 flood).* Similar findings we see at the interviews with homeowners 3, 5, 7 and 12. Homeowner 12 wanted to protect his house already but did not know who to contact to adapt his house: *"What kind of expert does such a job?"* (Homeowner 12 in 'no flood-prone area', experienced 8 floods). Homeowner 5 confirms this idea of how and who to contact. Indeed, he distrusts the suggestions of the construction companies, and rather wants to have objective advice: *"We want independent neutral advice. We had already received several suggestions from construction companies, but now we understand the problem much better. Moreover, the problem is different than we thought, than what we were told by third parties"*. (Homeowner 5 in 'possible flood-prone area', experienced 1 flood). Homeowner 3 is convinced by the advice and wants to start as soon as possible. "*Hopefully, they suggest some contractors. We will continue to work with the parties they recommend. If someone can install a non-return valve, they may do so, and the sooner the better*. (Homeowner 3 in 'possible flood-prone area', experienced 3 floods).

Other homeowners have been able to adapt their houses already and installed things such as pumps, or back-valves, or selected some of the PLFRA measures. For example, interviewee 9 (Homeowner in 'no flood-prone area', experienced 3 floods), who adapted the house already as he experienced multiple floods and expects floodings to happen more often. "*I would like to know whether the investments I have already made have been the right ones. And perhaps there are additional ideas*". This quote shows how this homeowner had more expectations from the expert. Instead of hoping for new solutions, this homeowner hopes for confirmation on the adaptions he had already implemented or selected to implement in the near future. The experts have been able to show some alternative ideas as the original ideas of the homeowner "*turn out to be more expensive than the suggestions [the experts] now come up with. So apparently, we wanted to invest more than necessary. It is nice that they confirm possible solutions, and even come up with simpler and cheaper ideas.* (Homeowner 9 in 'area without flood risk', experienced 3 floods).

Similarly, homeowners 1, 4, 8 and 11 are seeking confirmation of their own ideas. They have been implementing adaptions at their house already, or they have selected a number of measures after a thorough investigation. One interviewee proudly says "*We are famous in the neighbourhood. Neighbours visit us to see our solutions. And I created it all* myse*lf! If I still get confirmation from these experts, that would be nice*" (Homeowner 1, in 'possible flood-prone area', experienced 5 floods). However, this homeowner did not implement a back-up valve yet, as he doubted the effectiveness of this measure. *"It is just a piece of plastic, would it work? But now these experts do suggest it. They say it does the job. So that is the main reason why we participate. I would like to ask a few people who have the expertise, are we doing a good job or not...?*". However, interviewee 8 was more sceptical about the experts' visit. "*The advice is not an extra stimulus, nothing new has been told. Maybe I expected other advice"* (Homeowner 8 in 'area without flood risk', experienced 2 floods). Yet, this is not stopping him from continuing to implement his own ideas: *"Our ideas seem to be right, useful. We just give it a try"*.

Nevertheless, not all the homeowners are immediately willing to adapt their home. Some interviewees point out how costs of PLFRA measures do not fit into their budget, and some point out how local flood problems could be solved elsewhere in the neighbourhood. Interviewee 2 explains that the costs should be in balance with the flood risk. *"I am especially worried about the costs, so if the costs are low, I will consider it. The floods also do not happen very often...I don't want to make large investments"* (Homeowner 2, in 'area without flood risk', experienced 3 floods). Interviewee 3 elaborates on the costs of PLFRA and points out how subsidies could be an extra stimulus: *"My refurbishments have also been made with subsidies, so I'm going to study that. Before I begin these works, I need to know more about possible subsidies* (Homeowner 3 in 'possible flood-prone area', experienced 3 floods). Moreover, some interviewees mention the role of the government. Homeowner #4 for instance sees flood risk adaption at his house as a game of give and take. The interviewee points out how several parties should be involved to manage the flood risks locally: "*the residents and the municipality as well as the people from the water companies, and they can all contribute" (*Homeowner 4 in ' possible flood-prone area', experienced 3 floods). He continues: *"We could install a non-return valve and disconnect the rainwater [from the sewer]. But what we expect is that the problems will be tackled upstream, where the flood comes from. Then perhaps we are also willing to look for solutions here at home"*. He participated in the project because he appreciated how all actors are involved in this expert advice: "*All the parties involved had been brought around the table by the municipality to jointly look for solutions"*.

Interviewees 6 and 13 expect the municipality to act, for example to intervene in the nearby retention basin. "*The municipality has to tackle the problem, one kilometre from here"* (Homeowner 6 in 'possible flood-prone area', experienced 4 floods). Interviewee 10 underlines this: "*I will also take measures, but not the extreme ones. I thought 50cm high bulkheads were a rather extreme proposal from the experts, while if the municipality takes measures for the neighbourhood at the basin, then those bulkheads are no longer necessary...then I do not need extreme measures and ditto investments...I also make my decision on costs, aesthetics, and feasibility"* (Homeowner 10, in 'flood-prone area', experienced 1 flood). All in all, interviewees 2, 4, 6 and 10 expect a kind of governmental involvement, before these homeowners tend to adapt their houses.

The last observation shows how some interviewees are overwhelmed by the problem and doubt whether their flood risks can be reduced at all. For example, interviewee 2 sees the floods as "*an act of God,*" and doubts if the experts can solve the problems at the house: "*I hope that there will be a solution, that there will be no more water in the basement. Or at least less. But we do live in flood plains, so I think we won't be able to solve the problem at all"* (Homeowner 2, in 'area without flood risk', experienced 3 floods). Specifically, on the experts the interviewee says, while sighing: *"Well, inviting the experts, there is no harm in trying, but I have yet to see if they can do anything. These floods will just happen"*. Other interviewees, including 6, show this sceptical and reluctant behaviour, although less explicitly than in the case of interviewee 2. Interviewee 6 is convinced that he cannot reduce his flood risks with PLFRA measures but participated in this pilot project *"to continue the discussion with the municipality so that they will solve the problems in the neighbourhood"*.

This section illustrates how homeowners have plural perspectives on their flood risk. Homeowners perceive various challenges in reducing their flood risks. Some homeowners are willing to take action but are challenged to find a trustworthy expert or construction company. Some are willing to take action and have good ideas after some investigation, or even already executed these ideas. But either way, these homeowners are seeking confirmation about their ideas, or look for even better ideas (e.g. cheaper) or the perfect solutions. Others are less willing to act and feel challenged by the question of why to adapt at all. They feel limited by the costs or rather see the government needs to intervene. Also, there are homeowners that feel overwhelmed by the floods and do not believe flood risks can be reduced at their houses at all.

4.6 Reflection on tailored expert advice

The uptake of PLFRA measures

Half a year after advising, the agency is positive about the results, as 11% of the consulted households have started to adapt their houses. Although the percentage of activated residents is low, it is only six months after receiving the advice and the vast majority of the surveyed homeowners feel better informed. Most of the respondents indicated they had learned from the home visit and accepted the expert's report as a welcome contribution to their considerations. Some of the respondents even indicated that they would implement the proposed adaptations within the next six months. A minority were not convinced by the advice and were not (yet) inspired to adapt their homes.

Two years later, the uptake of measures has been increased. according to the telephone survey we performed in the summer of 2019. Among the 139 participants of the telephone survey, 32% of homeowners have already implemented parts of the suggested PLFRA measures, and 15% have fully implemented the PLFRA measures as suggested by the experts. The figure shows how time has a positive influence on the implementation of PLFRA measures. In twelve cases (9%), the advice was not applicable, for example because all possible PLFRA had been implemented already, or no PLFRA could be implemented.

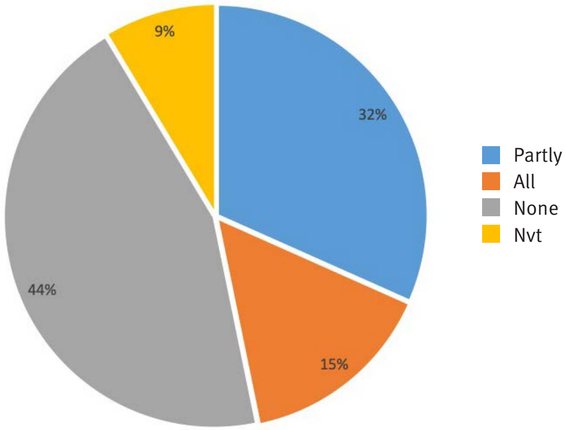


FIGURE 10: UPTAKE OF PLFRA IN SINT-PIETERS-LEEUW, LEBBEKE AND GERAARDSBERGEN

Based on these results, we can conclude that the advice motivates homeowners with flood experience to to adapt their houses. Therefore the experiment seems to be positive. The experts' advice contributes to some of the risk appraisals (e.g. risk perception and awareness) and coping appraisals (e.g. self-efficacy and resources) from protection-motivation theory. Following this model, we can recognize components that contribute to the protection motivation of a homeowner. The expert provided answers on the effectiveness of PLFRA measures (contributing to the protective response efficacy), questions on implementation of these measures (contributing to the perceived self-efficacy), and questions on the costs of such measures (contributing to the protective response costs).

The project has predominantly met the needs of a group of homeowners who were already willing to adapt their homes but lacked the know-how. Thus, even though these results are considered to be successful by the Flanders Environmental Agency the project merely provided information for those who were already eager to adapt their house to flooding. In the three sections that will follow, we will reflect on the qualities of the project, also in relation to floodlabel, and discuss the improvements that can be made.

The role of the expert in relation to floodlabel

One of the main qualities of the project is the role of the expert as a means to be heard. Homeowners praise them for their independent advice, tailored to the needs of the individual homeowner. An interviewee summarized: *"When I knew that the technical advice would come . . . it made me very happy. It is a huge advantage that professionals come straightaway to say what and how, and that even with names of 'bulkheads' and 'non-return valves' and so on, I don't have to figure it out on my own; that's very nice. Now I don't have to listen to all the myths and advice of salesmen, I already know where I stand"*. (Resident in 'possible flood-prone area', experienced 3 floods). However, the responses from the homeowners in the previous section illustrate how the participating homeowners deal differently with their flood risks. These plural perspectives can roughly be organized in four groups:

- A homeowner is aware of the risks, and he has a high threat appraisal. Moreover, this homeowner has a low self-efficacy because he lacks contacts or knowledge to adapt.
- A lay expert is aware of the flood risks and acts proactively by considering property-level protection flood risk adaptation measures. This homeowner has a high threat appraisal and has the knowledge (self-efficacy) and financial means (adequate protective response costs) to reduce the risks at home. However, this homeowner questions the protective response efficacy as he wants the best solutions.
- A homeowner, who counts on rules and regulations and governmental responsibilities. Although this homeowner has a high threat appraisal, he is not considering his coping appraisals if the government is not acting.
- A fourth perspective of a homeowner tends to withdraw himself from further action. He considers his house to be well-protected and feels overwhelmed by his flood experiences. However, he is not recognizing that the flood risks can be reduced at his home.

A quality of the expert is that he not only tailors solutions to a house, but also in his communication to each individual homeowner in order to motivate the homeowner to implement PLFRA measures. In the words of a flood risk expert that is involved in tailored expert advice: *"individual risk communication played an important role, just to talk to those people and listen to their stories"*. Also, in another risk labelling business, a Dutch representative of the *"Burglary Prevention Label"* (in Dutch: Politiekeurmerk

Veilig Wonen (PKVW)) explains, based on his twenty years of experiences: *"[Convincing and installing burglary prevention] was customized work. Sometimes the people even knew the local police officer, which inspires confidence. They sometimes scored as much as 80% in some streets. Trust and tailored communication helped the residents across the thresholds."*

Nevertheless, a structure is needed to make individual house visits comparable. According to the interviewed flood risk expert, comparability can be both useful for the flood risk expert as well as for the individual homeowner: *"A system for the homeowner itself is important so that he can clearly visualise how he can improve his house. Otherwise you just give technical advice and well, it´s just more technical advice"*. Comparability provides value to the advice that is given. Moreover, expert advice can become very costly, and is an extra barrier for homeowners, according to both the German and Belgian flood risk experts. Introducing floodlabel could provide some opportunities. Indeed, for the reasons of standardization, the representative of the Flanders Environmental Agency is currently considering the formal introduction of some kind of floodlabel, next to the tailored advise that his agency is running already: *"I think the principle of floodlabel is good, because you need a certain agreement between all the people at least in your country that they go to a house, that they look at the house in more or less the same way. So you need some kind of standard."* The German expert also confirms how he *"gained some structure through my excel-sheet with questions. You really need a structure to tell the similar story. And for me at the moment, it´s not a very good technical tool. But just a table in Excel."*

In contrast to these notions for structure, the representative of the Burglary Prevention Label explains how institutionalization over time changed the nature of the Burglary Prevention Label. Whereas ten years ago the Label was organized by regional police forces, nowadays the Centre for Crime Prevention and Safety (in Dutch: Centrum voor Criminaliteitspreventie en Veiligheid) is managing the Label. At this institute *"we are trying to include some sort of structured social cost-benefit analysis in our presentation of the label to involve homeowners", but she observes how "enthusiastic, dedicated representation by police officers has led to more labels, because their influence and impact was much greater"*.

The elaborate process of tailored advice invests in the relationship between homeowners. Yet, the question remains of what is the precise role of the expert in this process and to what extent could this be automated through a label. In summary, balancing the role of the expert and the role of an automated label is not easy at all. At least, the feedback of homeowners diminishes as their opinions are not considered. The tailoring dedicated role of the expert seems to be crucial in the communication of flood risk advice for people with flood experience. Nevertheless, the expert is costly, and these experts need some sort of structure to organize and compare individual advice.

Tailoring instruments to the audience

For the tailored expert advice in Flanders the agency selected in the municipalities of Sint-Pieters-Leeuw, Lebbeke and Geraadsbergen households that recently experienced floods. As explained before, the Agency selected households based on location on flood risk maps and recent flood data from the fire brigade. Although the impact of the flood varied — some homeowners had only damage in the basement, while others even had water on ground level — all participants were curious about how they could prevent future damage. These homeowners were already aware of the risks, through experience. So tailored advice seems not be able to target homeowners in flood-prone areas that are unaware of their risks. Targeting the unaware needs other more risk informative instruments, instead of instruments or experts that inform about risk reductions. Or, in the words of the representative from the municipality of Dordrecht: *"You can't do that with a tool alone. You have to create awareness and start a dialogue with your citizens"*.

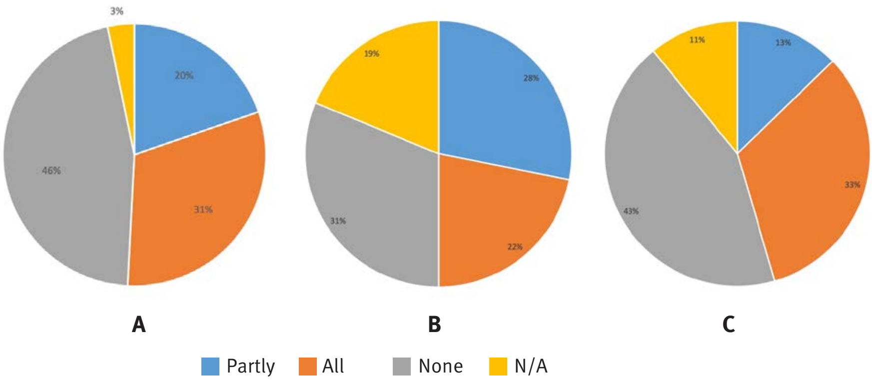


FIGURE 11: A: UPTAKE OF PLFRA IN SINT-PIETERS-LEEUW, B: LEBBEKE AND C: GERAARDSBERGEN

In Sint-Pieters-Leeuw there have been ample opportunities for subsidies to implement the experts' advice, yet there are not significantly more interventions compared to the other two municipalities where limited or no subsidies were available. Thus, this observation tends towards the cautious conclusion that subsidies seem to make little difference. Tailored technical advice seems to have more effect than a generic subsidy policy. Participants of the pilot mostly need information and self-esteem to adapt. Nevertheless, this does not mean that no subsidies are needed anymore.

Tailored expert advice seems unable to break the impasse between some homeowners and the government. Even though the project was linked to the broader objectives of multi-layered water safety, and tried to proactively motivate homeowners to more resilient behaviour, still a large group of homeowners is not convinced (yet) to implement PLFA, and as explained in the previous section, even a larger group of unaware homeowners is not approached for advice at all.

The arguments that homeowners raise to ignore the advice seem to not only be linked to risk appraisals and coping appraisals of protection-motivation theory. Analysing through protection-motivation arguments does not provide all explanations for homeowner behaviour. Figure 12 illustrates how indeed, some people need more information, and others need more time, just to refer to some coping appraisals. Also, more relational arguments are brought up: 20% think that first the government should act; 40% says that first the risk should further increase. So the homeowners' decision-making process to (not) implement PLFRA measures not only depends on his inner appraisals, but is also influenced from the outside inwards, by factorial and institutional settings.

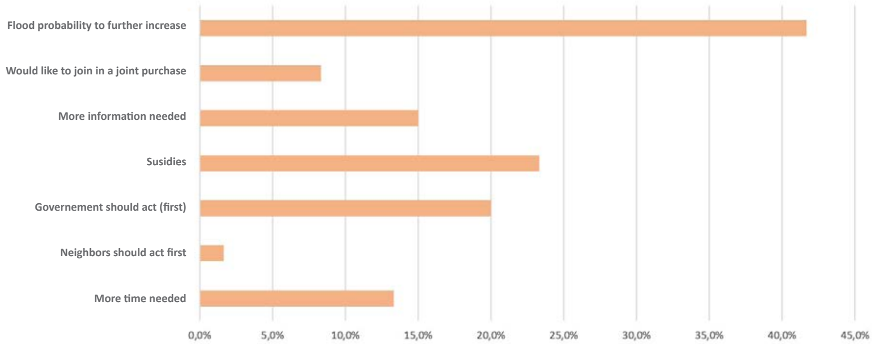


FIGURE 12: GAMECHANGERS FOR 'NAY-SAYERS' AND DOUBTERS TO IMPLEMENT PLFRA LATER ON

The tailored expert advice in Flanders is currently too focused on the inner decision-making process, and not enough focused on factorial and institutional settings. For example, the project lacks the ability to mediate between homeowner and other actors in flood risk management. The agency wanted to provide a firmer negotiation position between homeowners and insurance companies when discussing insurance premiums for flooding. To use the flood risk advice in negotiations with insurance companies, the project should address these market parties as well to find out under what conditions these parties would like to modify insurance premiums. However, these actors have not been involved in the pilot at all.

4.7 Conclusion

To answer the research question in this chapter — "To what extent do homeowners become more motivated to implement property-level flood risk adaption (PLFRA) by a floodlabel?" — we have looked at the unique experiment on tailored expert advice for homeowners in Flanders, which has many similarities with the floodlabel. The case study shows that, thanks to the dedicated efforts of experts, 15% implement all PLFRA measures that are suggested by the experts, and another 32% implement some proposed measures. These are promising results for future pilot projects, however, we assume that even more homeowners might consider the implementation of PLFRA measures, when the context of actors, factors, and institutions is taken into consideration. After all, dominant arguments for homeowners to not implement the advice are contextual arguments, referring to the low risks, lack of governmental involvement, or the need for subsidies. These arguments all contain a relational component, relating to certain factors, actors, or institutions. Therefore, a more relational perspective is incorporated and practised.

Based on these results, we therefore argue that the tailored expert advice by itself will not be fully effective in the diversification of leading actors in flood risk management. However, it could become more effective, when the (social and institutional) context and/or the actions of other leading stakeholders are taken into account. To further improve the impact of tailored expert advice (or floodlabel) future pilots should involve other actors, such as market parties, and try to establish a strong network and coordination between them to achieve a more resilient situation.

Therefore, in the remainder of this manuscript, we will elaborate on these instruments to involve homeowners in relation to the current and possible roles of these other actors based on the interviews with these other actors involved in flood risk management governance, including (local) governments, market parties such as insurance companies, and civil actors.

5

FACTORS PROVIDING CONTEXT FOR FLOOD RISK AND THE FLOODLABEL

5.1 Introduction

The previous chapter has illustrated how there is room for improvement to make a floodlabel, or tailored advice, effective instruments that trigger behavioral change. However, the theoretical framework has illustrated how behavior and behavioral change are also dependent on the context of factors, institutions, and actors. Therefore, in this chapter, the following research question will be discussed: What *factorial* conditions are conducive for the implementation of a floodlabel? To answer this question, the factors of importance that shape the settings for flood risk management in general will be investigated. This will focus on the possible functionality of a floodlabel specifically, and how the factors of importance differ among the floodlabel countries.

Following the actor-relational approach (Boelens, 2018), flood risk governance changes over time and is influenced from the outside-in. This influence originates from factors of importance, institutions, and leading actors. Though influenced by different external factors, flood risk management cannot be universal, as it is tailored to a local spatial context. This context differs from place to place (Krieger, 2013). To understand what conditions are conducive for a floodlabel, this chapter will begin with an outline of the factors that influence a floodlabel, flood risk management governance, and flood risks. The flood risks in the floodlabel countries differ, and therefore flood risk management differs in each of the countries. Furthermore, this chapter details a comparative analysis of these factors in each of the floodlabel countries. The analysis provides some clues about the functionality of a floodlabel as a tool to motivate homeowners in flood-prone areas.

5.2 Which Factors?

Before we can provide clues on how a floodlabel could be useful for each country, we need to focus on the factors that influence floods, flood risk, and flood risk management. To do so, the conceptualization of risks provides structure to analyse and organize the factors of importance. The figure of Klijn et al. (2015) provides an overview of the construction of risk (see figure 13). The figure provides two existing definitions of risk in terms of probability, hazard, consequence, exposure, and vulnerability. It also provides a third definition, shown in the middle row of the figure, emphasizing the role of exposure.

The first definition in the figure explains risk as a multiplication of probability and consequences. When the probability increases, the risk increases. In addition, the risk also increases when the possible consequences become more severe. The second definition (third row in the figure) defines risk as the result of an overlay between hazard and vulnerability. Only areas that are vulnerable to a hazard can be harmed or damaged. Therefore, Klijn et al. (2015) use the overlay symbol in the second definition of risk. The difference between these two definitions lies in the incorporation of flood characteristics, such as flood type, water type, and extent of the flood. These could be included in the definition of 'hazard' together with 'probability', as well as in the

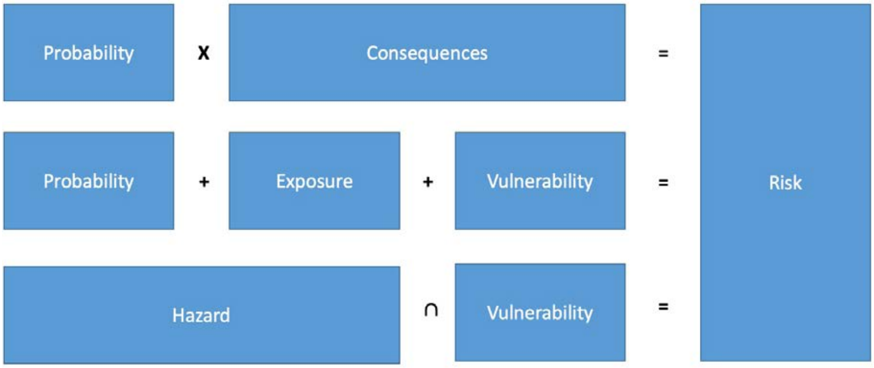


FIGURE 13: RISK DEFINED BY THREE KEY ELEMENTS: FLOODING PROBABILITY, EXPOSURE DETERMINANTS AND VULNERABILITY OF RECEPTORS (KLIJN ET AL., 2015, P. 850)

definition of 'consequence' that is formed by these flood characteristics in combination with (economic) damage and fatalities. To reduce the ambiguity of these definitions of risk, Klijn et al. (2015) introduces 'exposure'. Exposure can be determined as the presence of receptors (such as people and buildings) as well as the characteristics of flooding. This results in the third definition of risk as a sum of probability, exposure, and vulnerability. These definitions will be used in this chapter to determine and organize the factors of importance that are of influence on flood risk at the household level. Nevertheless, all three definitions suggest a linear calculable perception of what risk is. Both Klijn et al. (2015) and Disse et al. (2020) comment on these equations, in the respect that they are rarely explicitly applied due to a lack of data, imprecise estimations of certain inputs, or the complexity that arises when putting all possible inputs together in the equations. 'Consequences' are more subjective, as the level of impacts of a flood can differ from person to person, and therefore are more difficult to measure; whereas 'probability' can be measured more precisely and objectively. Moreover, in line with Boelens' actor-relational approach (Boelens, 2010, 2018, 2020), the construction of risk is more plural, a-linear, volatile, and therefore complex and relational and not linear. The factors of importance shape (together with the institutions and actors, see Chapters 6 and 7) the risk and flood risk management in an area, and continuously change under the influence of socio-economic developments and the continuously changing climate. Therefore, a complex web of involved factors, actors, and institutions influence, evolve, and enlarge the construction of risk and flood risk management. So, although the linear presentation of the construction of risk might conflict with this actor-relational approach to risk and flood risk management, the building blocks of 'probability', 'exposure' and 'vulnerability' that are presented by Klijn et al. (2015) can be useful to determine the factors of importance. How these factors influence 'probability', 'exposure' and 'vulnerability' is visualized in figure 14 (Kundzewicz et al., 2018). It shows how the climate system influences flood probability, how the terrestrial and hydrological system influences flood exposure and flood probability, and how the socio-economical system influences flood vulnerability and flood exposure. Moreover, these three systems interact with each other, and in return vice versa.

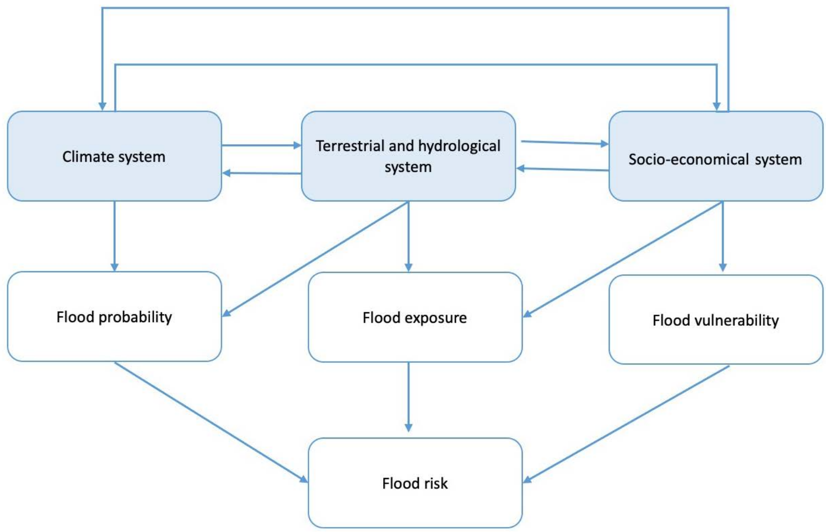


FIGURE 14: FACTORS AFFECTING FLOOD RISK AND ITS COMPONENTS (KUNDZEWICZ ET AL. (2018, P.295)

Flood Probability and the Climate System

Probability refers to the likelihood of a flood occurring in a given area, such as through an embankment breaching or overflowing within the next year. Probability is more abstractly defined as the likelihood of a flood event occurring in a given time frame (Disse et al., 2020). Climate and climate change have a major influence on flood risk and probability. This is similar to other risks, which are also climate-driven and caused by a temperature rise, sea level rise, and weather extremes (Field et al., 2012). The probability for extreme weather events increases, as well as the intensity of these weather events. However, the probabilities for certain weather events to occur are highly diverse between regions (Masson-Delmotte et al., 2018). In Europe, studies show an increase of heat waves (Fischer & Schär, 2010; Russo, Sillmann, & Fischer, 2015), wildfires (Bedia, Herrera, Camia, Moreno, & Gutiérrez, 2014), streamflow droughts (Forzieri et al., 2014), and windstorms (Outten & Esau, 2013). The increase of flood risks in Europe is also shown in studies on pluvial floods (Guerreiro et al., 2017), fluvial floods (Alfieri et al., 2015; Blöschl et al., 2019; Kundzewicz et al., 2018) and coastal floods (Hinkel et al., 2014; Nicholls & Klein, 2005).

Floods are influenced by the climate system through various characteristics, including the intensity, duration, timing, amount and type of precipitation. Moreover temperature variation plays a role, as this is responsible for snow and ice melting, or soil freezing (Bates, Kundzewicz, & Wu, 2008). These characteristics may trigger flood-generating mechanisms such as intense and long rainfall, rainfall of short duration but high intensity, and high volumes of water being released due to snow melting (Kundzewicz et al., 2018). These three mechanisms result in more pluvial and fluvial floods on the European continent. However, floods generated by snow melting might decrease as raising temperatures in mountainous areas may result in reduced snowfall (Kundzewicz et al., 2018). Temperature increases earlier in the year could cause floods due to snow melting during early spring in northeastern and alpine Europe. Earlier soil moisture increases have led to earlier winter floods in western Europe. Therefore climate change shifts the timing and distribution of floods in Europe (Blöschl et al., 2017). The expected rise in temperature due to climate change may cause a shift in risk over time from spring to winter (Kundzewicz et al., 2014; Kundzewicz et al., 2018). Based on this climate description and expectations, direct climate factors that have influence on pluvial and fluvial flood risks include:

- Precipitation patterns and precipitation extremes. Precipitation here includes:
  - Rainfall (Guerreiro et al., 2017; Kundzewicz et al., 2014; Scheid et al., 2013)
  - Snowfall and snow cover (Kundzewicz et al., 2018; Madsen et al., 2014)
- Seasonality of floods (Kundzewicz et al., 2018; Madsen et al., 2014)

However, flood risk is not only caused by pluvial and fluvial hazards. In Europe, storm surges form a hazard in coastal areas. Under the prediction of the IPCC, the global sea level will rise and this will have an influence on coastal flood probabilities (IPCC, 2014). Therefore, we will also consider sea level rise (Paprotny et al., 2019; Vousdoukas, Mentaschi, Voukouvalas, Verlaan, & Feyen, 2017). Based on these indicators, we can recognize a certain flood typology.

Flood Exposure and the Terrestrial and Hydrological System

Following the arrows in Figure 14, flood probabilities are also shaped by the terrestrial and hydrological system. Only considering the climate factors would oversimplify the construction of flood probabilities. Hydrological variables such as soil moisture, groundwater levels, and surface water levels also influence the probability of a flood happening. If groundwater levels are already high in 'pre-flood' conditions, possible storage capacities during a flood will be limited, and moderate rainfall can cause flooding. Also, after long periods of drought or wildfires, a developed crusty soil cannot absorb much rainfall, and moderate rainfall can cause runoff and flashfloods. This description of Kundzewicz et al. (2014) shows that multiple risks could interact and have an accumulative effect. Moreover, it shows how complex the relationship between rainfall intensities and catchment capacities can be. Therefore, Kundzewicz et al. (2014) emphasizes indicators including elevation, land cover and land use, and catchment size as having a most pivotal role in the construction of flood probability.

- Elevation forms an indicator in relation to temperature and winter precipitation. Below freezing point, an increase of snow cover at high altitudes might result in floods during early spring (Kundzewicz et al., 2018; Madsen et al., 2014).
- Land cover indicates exposure of floods as well. Alterations in the catchment surface affect runoff (Balica & Wright, 2010). The runoff coefficient is much higher for paved, urban areas, compared to absorbing vegetated land. This means that, when forested land is converted into urban land, there is less evapotranspiration because of the trees, and runoff can seep less into the surface. This can result in higher discharge downstream (Kundzewicz et al., 2018). Both cropland as well as forestland have a runoff reducing effect, however the effect of forestland is stronger (Brody, Blessing, Sebastian, & Bedient, 2014).

- Catchment size contributes to flood probability, as it strongly determines the type of flood. Intense and long rainfall in large river basins lead to fluvial floods, whereas short but intense rainfall in small basins leads to pluvial floods (Kundzewicz, 2019).

Exposure is a more hybrid term and can be perceived as part of the consequences as well as part of the hazard. Exposure in terms of "hazard" emphasizes the characteristics that makes a landscape more prone to flood risks than others. When perceiving it as part of "consequences", it focusses on economic damage or loss of life (Klijn et al., 2015). The United Nations Office for Disaster Risk Reduction (UNDRR) links the presence of people and buildings to risk-prone locations by defining exposure as "the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas" (UN General Assembly, 2016). Following this definition and the information conveyed in Figure 14, the factors of importance that influence the flood exposure include the terrestrial and hydrological system. Some indicators within this system have already been discussed as influencers of flood probability. These include elevation, land cover and land use, and catchment size. These generate a type of flooding and also have an influence on exposure (Bates et al., 2008; Kundzewicz, 2019; Kundzewicz et al., 2018). Alongside these landscape characteristics, the literature mentions three more indicators that have a major influence on the exposure of floods:

1. Levels of urbanization have a major impact on flood exposure (Kaźmierczak & Cavan, 2011; Kundzewicz, 2019). Floods behave differently in urban and rural areas. The high density of impermeable surfaces in urban areas leads to high peak discharge, compared to more rural areas. Moreover, the point of peak discharge is reached faster (Kundzewicz, 2019). For this reason, it is essential to consider the geographical dispersion of the population when analyzing variances in flood exposure.
2. On a more detailed level, we could consider that houses having a lower floor at the ground level are more exposed to floods. Also, referring to individual property-level protection flood risk adaptation measures, these are easier to implement in detached houses (Johnson & Priest, 2008; Kaźmierczak & Cavan, 2011).
3. Furthermore, the exposure of flooding depends on engineered alterations in river courses. These interventions include dams and canalizations of river course for the drainage of water, as well as protective interventions such as dikes and levees to protect the hinterland. However, these interventions might have effects further downstream. Reservoirs intended for water storage can reduce the exposure to floods, but peak discharge can become higher downstream, and if the reservoir fails the damage can be disastrous (Foudi et al., 2015; Kundzewicz et al., 2018).

Flood Vulnerability and the Socio-economical System

Vulnerability is defined by the UNDRR as "the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" (UN General Assembly, 2016). To distinguish the thin line between exposure and vulnerability, some authors focus on the vulnerability characteristics of urban and rural communities, and the individual ability of citizens to cope with, anticipate, resist, and recover from floods (Crichton, 2007; Kaźmierczak & Cavan, 2011). Generally, vulnerability can be reduced through the presence of property level flood risk adaption measures (wet- and dry-proofing for buildings) (Attems et al., 2020c; Kazmierczak & Bichard, 2010), or by improving flood safety education (Disse et al., 2020). Determinants to measure the ability to implement these measures and therefore reduce vulnerability have been taken into consideration in many flood vulnerability assessment studies (Clark et al., 1998; Cutter et al., 2010; Foudi et al., 2015; Hinkel, Nicholls, Vafeidis, Tol, & Avagianou, 2010; Lee, 2014). Indicators that are frequently highlighted include wealth (income, tenure status), physical and mental resilience (age and (un)employment), and social capital (influenced by migration) (Coninx & Bachus, 2008; Kaźmierczak & Cavan, 2011; Tapia et al., 2017). These aspects of vulnerability also return in studies on property-level adaption measures, as they could have an influence on a homeowner's motivation to adapt their house (Beddoes et al., 2018; Brown & Wedawatta, 2015; Kazmierczak & Bichard, 2010). Therefore, the following aspects of the socio-economic system are focused on to analyse vulnerability:

- Age (Cutter et al., 2010; Lee, 2014)
- Average disposable Income (Koks et al., 2015)
- (Un)employment (Cutter et al. 2010; Lee, 2014)
- Immigration (Cutter et al., 2010; Lee, 2014)
- Tenure status (Kaźmierczak & Cavan, 2011; Tapia et al., 2017)

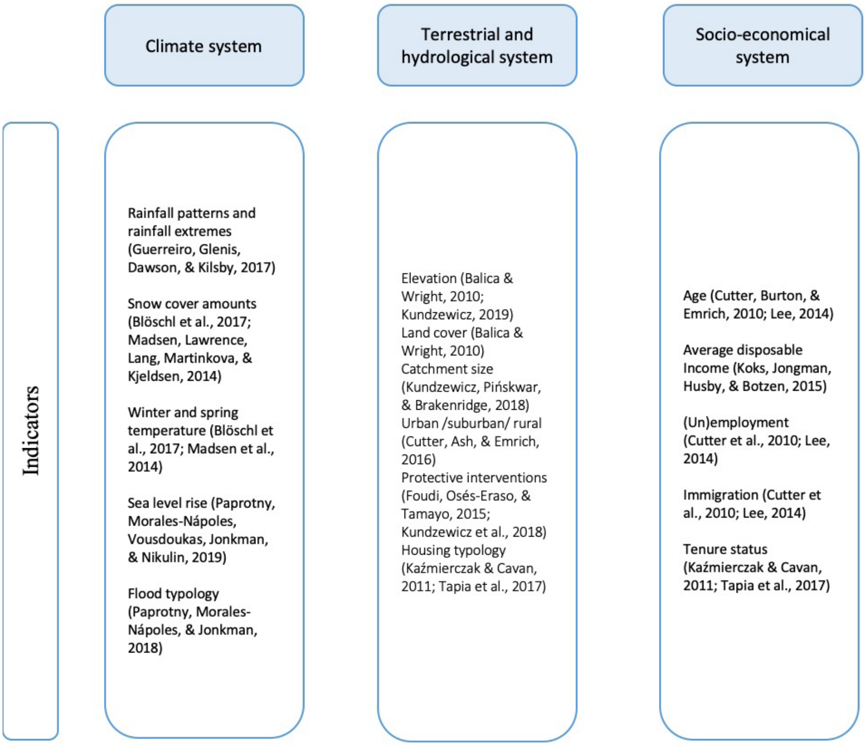


FIGURE 15: AN OVERVIEW OF INDICATORS THAT SHAPE THE THREE SYSTEMS THAT DETERMINE RISK

Some of these indicators are difficult to measure, visualize, or link with the functionality of a floodlabel in this cross-country comparison. However, on a more regional level, studies try to link vulnerability with community characteristics through flood justice (e.g. Goosse, 2020; Walker Gordon & Burningham, 2011). Therefore, to analyze the functionality of floodlabels, this chapter emphasizes that a diversity of flood risks across Europe calls for a specific flood risk management system and therefore site-specific floodlabels.

In the following section these factors will be discussed in detail.

5.3 Climate System Indicators

Rainfall Extremes and Rainfall Patterns

Guerreiro et al. (2017) shows a rough estimation of rainfall intensities for a 10-year period across Europe. The map shows how the Mediterranean area experiences more short but intense showers compared to the Atlantic coast (Figure 16). The analyses of this data shows that floods in cities are predominantly caused by the interplay of these rainfall patterns, elevation of the cities, and the available flow paths for water in the city (such as insufficient capacity of sewer, canals, and drainage systems). These showers can result in sewer floodings, floodings from small channels and other water courses, or run-off from slopes in hilly landscapes. Pluvial floods are predominantly caused by short duration intense rainfall, occurring suddenly and locally. This makes these floods difficult to forecast, warn against or prepare for (Falconer et al., 2009).

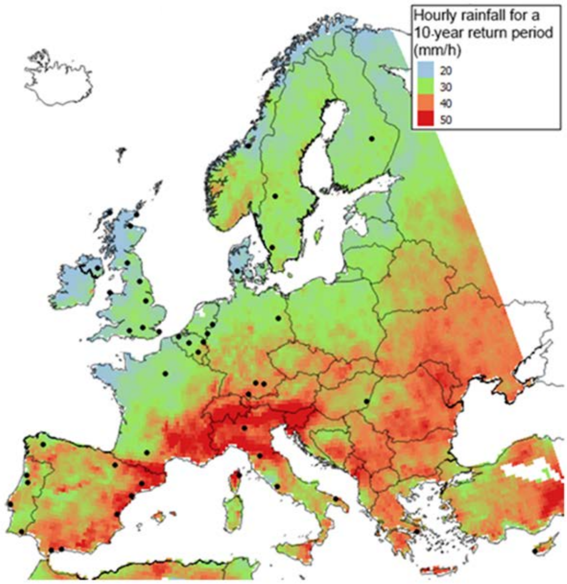


FIGURE 16: RAINFALL INTENSITIES ACROSS EUROPE. GUERREIRO ET AL. (2017, P. 296)

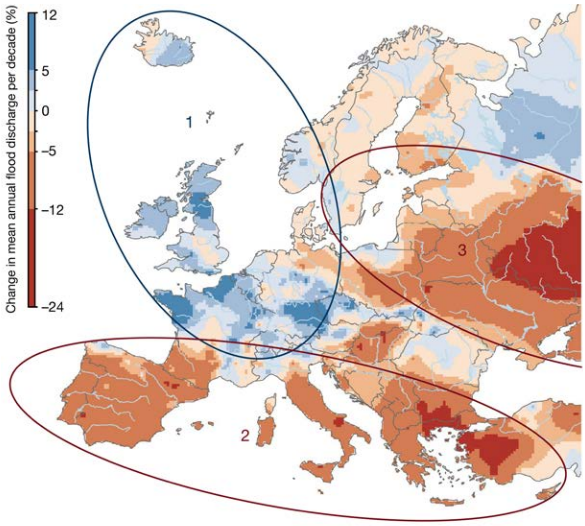


FIGURE 17: PATTERNS IN PRECIPITATION LEADING TO INCREASING (BLUE) AND DECREASING (RED) FLOOD DISCHARGE IN PER CENT OF THE MEAN ANNUAL DISCHARGE PER DECADE). THE FIGURE INDICATES THREE DISTINCTIVE AREAS, RESULTING IN MORE FLOODS (REGION 1) OR LESS (REGIONS 2 AND 3). DRIVERS ARE 1, NORTHWESTERN EUROPE: INCREASING RAINFALL AND SOIL MOISTURE. 2, SOUTHERN EUROPE: DECREASING RAINFALL AND INCREASING EVAPORATION. 3, EASTERN EUROPE: DECREASING AND EARLIER SNOWMELT (BLÖSCHL ET AL., , P. 109).

While Figure 16 compares extreme intensities, Figure 17 Blöschl et al. (2019) shows patterns of flood increase and decrease in European regions, based on increase and decrease of precipitation and soil moisture. The figure shows how the Netherlands, Belgium, Austria, and Germany all experience an increase of flood discharge due to increasing rainfall and increasing soil moisture. Focussing on the distinct region (region 1), the figure shows an increase particularly in the regions of Southeast Germany and Belgium.

Snow Cover

Huge amounts of precipitation are stored in snow cover accumulated over the winter season and are released within a short timeframe as soon as the temperature rises during spring. This results in multiple types of flood generation mechanisms in alpine regions (Gaál et al., 2015). As snow melt is linked to temperature patterns, snow cover and melt could become affected by climate change. This might result in a reduction of long-duration snow cover in the near future and snow melt floods earlier in the spring. Figure 17 shows how snow cover reduction is already leading to fewer floods in eastern Europe (Blöschl et al., 2017; Blöschl et al., 2019).

Seasonality of Floods

Precipitation is highly seasonal. Certain types of floods belong to certain seasons, as shown in Figure 18. This results in temporal flood occurrence. Winter and spring temperatures dictate when snow melt begins and causes floods at the foot of mountainous areas. Mountainous areas experience floods mostly during the summer, caused by snow melt at high altitudes (Hall & Blöschl, 2018). In eastern Europe, including the east of Germany, snow cover is involved in the flood-triggering mechanism. Floods occur predominantly in the spring period due to snow melt, between February and April (Hall & Blöschl, 2018). Under the influence of climate change these snowmelt-induced peak flow patterns reduce, or occur earlier in the spring, as snow cover reduces under higher spring temperatures. This is especially in eastern Europe (Figure 17) (Blöschl et al., 2017; Madsen et al., 2014). In Northwestern Europe, floods in the main river systems mostly occur during the winter season, from November to February. These are induced by the storm season and long periods of rainfall and cause long duration fluvial floods downstream. In summer, regions in Northwestern Europe suffer from short-term extreme rainfall event, causing local but intense pluvial floods in upstream areas (Hall & Blöschl, 2018).

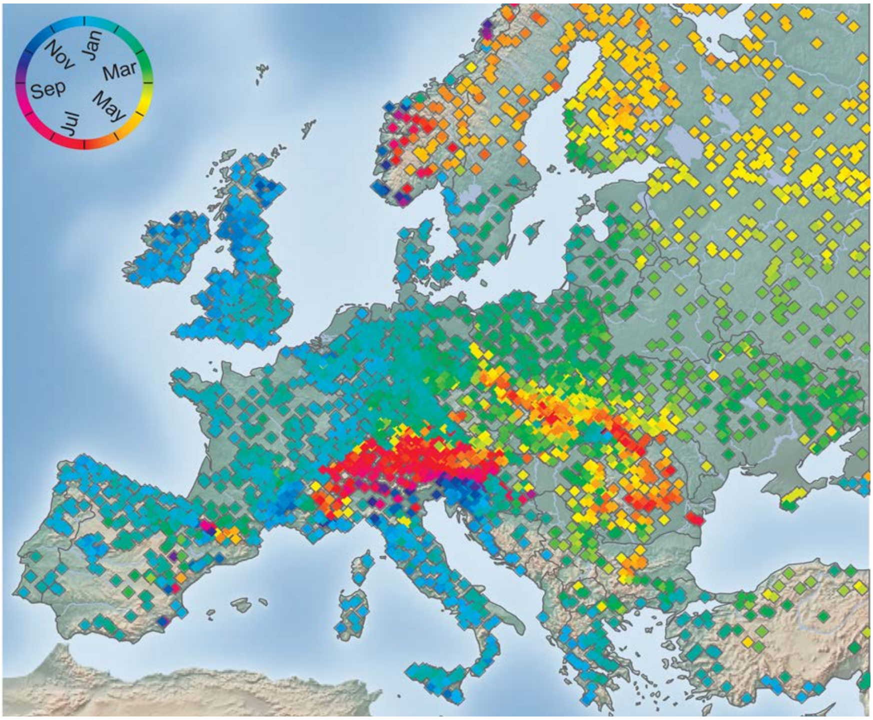


FIGURE 18: SEASONALITY OF FLOODS IN EUROPE FOR 1960–2010. MEAN DATE OF FLOOD OCCURRENCE (HALL & BLÖSCHL, P.3888).

Sea Level Rise

The physical phenomena behind global average sea level rise are predominantly related to ocean thermal expansion and the melting of glaciers (Martínez-Graña, Boski, Goy, Zazo, & Dabrio, 2016). Most recent observations in ice-sheet melt show parallels in sea level rise with the upper range predictions of the most recent IPCC Fifth Assessment Report. This results in a 1 m sea level increase by 2100 for the North

Sea coast (Slater, Hogg, & Mottram, 2020). The predictions of future coastal flood risks remain an uncertain process, and depend on very local coastline characteristics such as ground subsidence, erosion and accumulation effects, waves, tides, and tide-surge interaction, collectively contributing to marine flood risks (Di Marcantonio et al., 2018) However, for pan-European models these data are missing and calculations are based on dominant storm patterns, mean sea level rise that results from glacial melt, and thermal expansion (Paprotny et al., 2019). The North Sea region is expected to face the highest increase in sea level rise in Europe. This region is expected to experience a sea level increase of nearly 1 m under the high-end IPCC predictions by 2100 (Vousdoukas et al., 2017). As a land-locked country, Austria will not experience the direct impact of sea level rise.

Paprotny et al. (2019) has visualized how sea level rise affects the European continent spatially. Moreover, table 9 compares the impact of current flood defense. The Netherlands and Belgium have reduced their flood risk completely (for 100-year coastal floods), thanks to coastal protection. In Germany, small areas are still under the influence of coastal effects. However, Paprotny et al. (2019) does not provide clarifications for such details.

TABLE 9: 100-YEAR FLOOD HAZARD ZONE BY COUNTRY, WITH AND WITHOUT INCLUSION OF FLOOD PROTECTION, IN KM² (FRAGMENT FROM: PAPROTNY ET AL., 2019, P. P13).

	Without flood defense	With flood defense
The Netherlands	16816	0
Belgium	1772	0
Austria	0	0
Germany	11363	1207

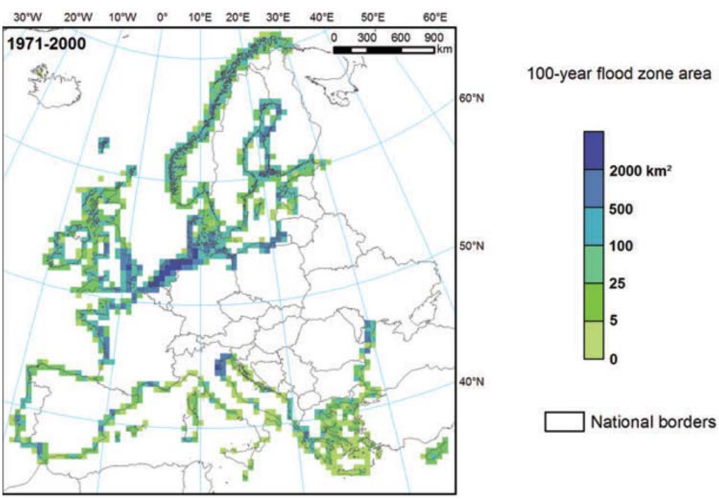


FIGURE 19: AREAS UNDER INFLUENCE OF SEA LEVEL RISE, COASTAL PROTECTION NOT TAKEN INTO ACCOUNT (PAPROTNY ET AL., P.11)

Flood Typology

Among these various factors contributing to flood probabilities and factors of exposure, three types of floods can be determined:

- Fluvial floods caused by excessive precipitation (or snow melt) over an extended period of time, causing a river to exceed its capacity downstream. Examples of this are the Rhine floods of 1993 and 1995 in the Netherlands and Germany, and more recently the Elbe and Danube floods in 2013 in Austria and Germany. Financial losses are usually higher than during pluvial floods (Paprotny, 2017).
- Pluvial or Flash floods: a flood caused by excessive precipitation lasting less than a day, leading to the inundation of streets and buildings. Failure of the drainage systems increases damage (Rözer et al., 2016). These floods can happen anywhere, are not necessarily linked to a river system or elevation, and can be very local. Sometimes these floods are described as 'invisible hazards' compared to the other flood risks, due to their small size and rapid development in urban areas (Houston et al., 2011). Recent examples have occurred in all four floodlabel countries.
- Coastal floods caused by storm surges, an example of which is a flood in February 1953 in the Netherlands and Belgium. Scale and exposure of these floods can become large, causing high economic damage and fatalities.

5.4 Hydrological and Terrestrial System Indicators

FIGURE 20: EUROPEAN DIGITAL ELEVATION MAP (EUROPEAN ENVIRONMENTAL AGENCY (EEA), 2020)

Elevation

Elevation and slope are often mentioned as a basic indicator for flood exposure (e.g. Fischer & Schumann, 2019; Kundzewicz et al., 2018; Madsen et al., 2014). Obviously, elevated areas have no struggle with sea level rise. Secondly, catchments with a higher slope suffer from short and intense rainfall. Lowlands are more susceptible to rain events with high volume over a longer period of time. Thirdly, in the high mountains snow accumulates, which can lead to floods in the spring as soon as temperatures rise. However, climate change predictions predict that snow cover will reduce in the future in certain regions, and therefore flood risk will also reduce (Blöschl et al., 2019).

Land Cover

Land cover can both enhance and reduce flood exposure. As previously mentioned, less seepage into the soil is observed in sealed urban areas, which results in higher discharge. Rural or forest areas absorb more water through the soil, which results in lower discharge. On the contrary, drainage of flood plains, wetlands, lakes, and other retention areas reduces water storage capacity, along with deforestation (Kundzewicz et al., 2018). The land cover map indirectly provides information about the water storage capacities on a pan-European scale (see figure 21). It shows a clear distinction between the Netherlands and Flanders as being highly urbanized (artificial land in figure 21), while Austria, Germany, and the rest of Belgium are roughly dominated by cropland and several types of forestland.

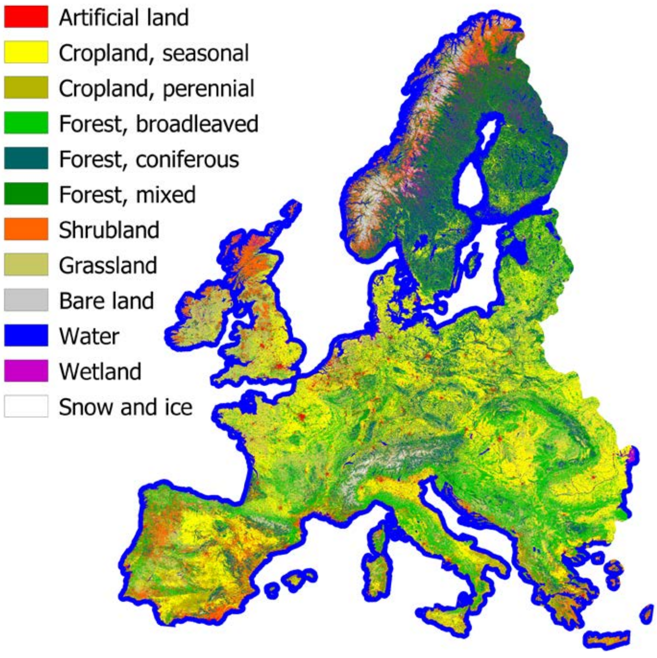


FIGURE 21: PAN EUROPEAN LAND COVER MAP (PFLUGMACHER, RABE, PETERS, & HOSTERT, 2019).

However, a distinction is made between landscapes in the next figure (22). This map, LANMAP, combines data on elevation and land use, together with climate regions and parent soil material. Based on these inputs, Mücher, Klijn, Wascher, and Schaminée (2010) developed a map of the European landscape. Although European countries have developed their own landscape typologies and classifications, these classifications differ in their methodology, data sources, and scale of application. This makes it difficult to compare landscape classifications between the Netherlands, Belgium, Austria, and Germany based on nationally produced classifications. LANMAP offers an internationally consistent approach (Mücher et al., 2010). These inputs all have an influence on the exposure to floods, and the different landscapes contribute to various levels of flood exposure. Generally, mountainous and hilly landscapes experience more runoff due to slopes, and lowlands possess more water absorbing capacities (Balica & Wright, 2010; Kundzewicz, 2019).

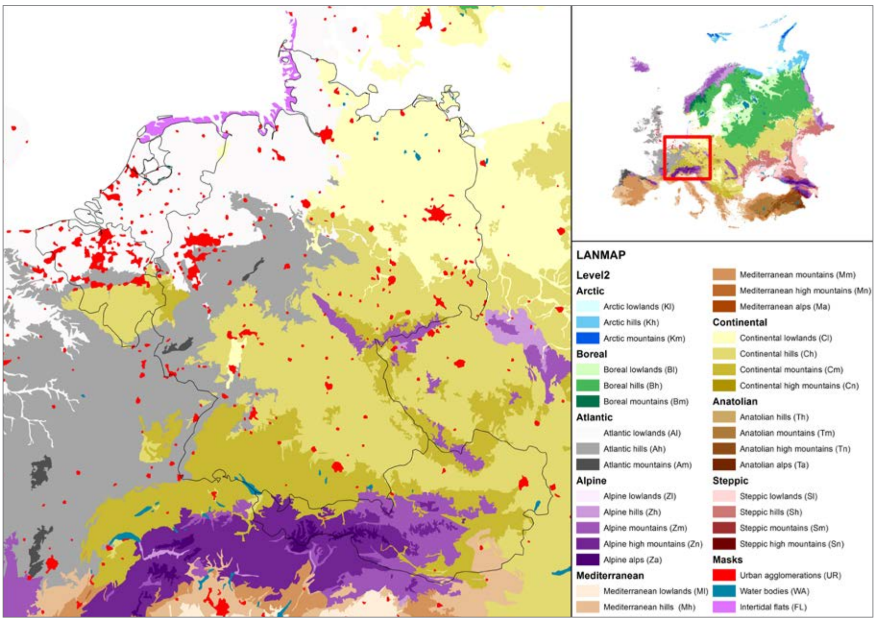


FIGURE 22: EUROPEAN LANDSCAPE TYPES (MÜCHER ET AL., 2010). © WAGENINGEN ENVIRONMENTAL RESEARCH (WENR)

The LANMAP (Figure 22) shows how the Netherlands are dominated by Atlantic lowlands, with major parts of the land lying below or around sea level. Belgium consists of similar Atlantic lowlands in Flanders, as well as Atlantic hills towards the south and east of the country. For Austria, the map shows a clear division between alpine landscapes in the west (Alpine Alps, Alpine high mountains, and Alpine mountains) and more continental mountains and hills towards the east. Germany has a wider variation in landscapes, including Atlantic and Continental lowlands in the north, Atlantic hills in the west, and Continental hills and mountains in the center and east of the country. In the south, the country has some Continental high mountains and Alpine mountains.

The different landscapes also reflect a difference in flood behaviors. According to Gaál et al. (2015), Alpine regions struggle with a wide variation of flood types. This is due to the combination of snow melting over a longer time period, and flash floods caused by short and intense rain showers. In the lowlands, the variation in flood types is limited because of higher buffer capacities resulting from the co-evolution between land cover, climate, and soils.

Catchment Size

Landscape typology is not the only factor to consider. Variations in catchment size also influence the exposure to floods. As shown in the Figure 23, Vogt et al. (2007) provides an overview of the main river catchments systems across Europe. Large river catchments generally only overflow after long and spatially extended rainfall, whereas small catchments or sub-catchments lying upstream can overflow after short and intense rainfall (Fischer & Schumann, 2019). Due to the pan-European scale, it is difficult to identify small-scale regional catchments in the figure below. Nevertheless, they exist and feed into the larger river systems. The figure shows how the Netherlands are at “the end of the line” of the Rhine, Meuse, and Scheldt river catchments. This contributes to flood susceptibility following long and spatially extended rainfall. Belgium is also part of the Meuse and Scheldt Delta and is potentially exposed to long and spatially extended rainfall, but also is exposed to short intense rainfall in the sub-catchments in the more hilly areas.

FIGURE 23: THE EUROPEAN RIVER CATCHMENTS (VOGT ET AL., 2007)

Austria is part of the upstream Danube catchment, and has a number of large sub-catchments. Germany is divided into four catchments. Although the north of the country is part of a downstream large river catchment, the south provides space to the source of the Danube and the upstream parts of the Rhine catchment. Therefore, Germany also has sub-catchments, albeit smaller than those in Austria.

Urbanization

The possible impact of flooding is higher in urbanized areas due to the higher economic value and higher amount of possible injuries or fatalities (Cutter et al., 2016). Moreover, due to the large surfaces of urban areas covered by buildings and infrastructure, heavy rain showers need to be drained through the urban drainage system of sewers and channels. The lack of green space hinders natural infiltration through the ground and evapotranspiration through the air. This makes urban areas more susceptible to floods due to land cover and the limited capacity of their drainage systems (Kaźmierczak & Cavan, 2011). Urbanization, when expressed as inhabitants per km², shows that the Netherlands is the most densely populated with 504 inhabitants/km². The Netherlands is followed by Belgium with 375 inhabitants/km², Germany with 235 inhabitants/km² and then Austria with 107 inhabitants/km². Germany and Austria also have regional variations in densities. Figure 24 shows the geographical dispersion

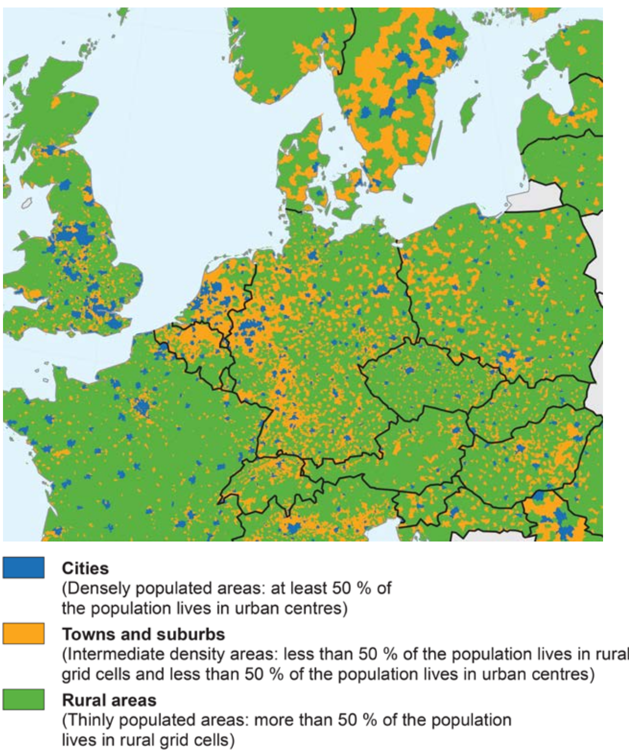


FIGURE 24: POPULATION DENSITIES ACROSS EUROPE (EUROSTAT, 2019).

of the population across Europe. This is organized based on cities (blue represents areas where at least 50% of the population live in urban centers), towns and suburbs (orange; intermediately populated), and rural areas (green; over 50% of the population lives in rural areas). The Netherlands and Belgium are mostly blue and orange, whilst Austria is mostly green. These densely populated urban areas could become more susceptible to floods. Germany has areas comparable to the Belgian and Dutch situation having more densely areas (such as the Ruhr), as well as more greener areas.

Protective Interventions

Protective interventions reduce the probability of exposure to floods. Coastal defense mechanisms protect coastal areas from damage caused by storm surges, and the construction of dikes and dams protects the hinterland in river catchments. However, these engineered interventions, as well as other engineered interventions in the water system (e.g. river regulation through canalization and embankments), alter the stream of a river in such a way that flood risk can increase locally or further downstream (Foudi et al., 2015; Kundzewicz et al., 2018).

The Netherlands, Belgium, and Germany have invested in protective measures along the coast over the past few decades. These measures have been implemented in lower river catchments or in upstream catchments. The Dutch coastal defense works are internationally known (Deltacommissie, 2015), as well as the spatial interventions in the river delta (Stumpe & Tielrooij, 2000). This is also the case for Belgium (Crabbé, 2008) and Germany (Meurer, 2000); Austria generally combines flood risk protection in the mountainous areas with avalanche protection (Fuchs, 2009; Fuchs, Röthlisberger, Thaler, Zischg, & Keiler, 2017b).

The future costs for flood risk management will increase when considering the IPCC climate scenarios. Studies show that, even though the future climate is uncertain, the damage costs in flood-prone areas will increase (Field et al., 2012). Nevertheless, investing in flood protection is a highly cost-effective investment for both coastal and river areas. This is the case despite the fact that the calculation of costs depends on many variables (Abadie, Galarraga, Markandya, & de Murieta, 2019; Rojas, Feyen, & Watkiss, 2013). Figure 26 shows that the main coastal cities of the floodlabel countries (Amsterdam in the Netherlands, Antwerp in Belgium, Hamburg in Germany) require the highest levels of protection and will incur the highest protection costs against future sea level rise. In particular, Amsterdam stands out in the figure (Abadie et al., 2019). Table 10 highlights how the Dutch spend €12.22 per capita per year on coastal protection, which is almost double compared to Belgium, and eightfold compared to Germany. Table 9 provides an overview of the estimated costs of reducing future fluvial flood risks. This is shown for the floodlabel countries under the most extreme IPCC scenario (Rojas et al., 2013). The table indicates that Austria would potentially have to spend a significant share of their current GDP to adapt to the future impacts of fluvial flooding. These impacts would result from future climate change, although the expected costs are still lower than the EU average. Rojas et al. (2013) does not provide an explanation for the high costs predicted for Austria, but this may be related to the multiple flood triggering mechanisms Austria is facing.

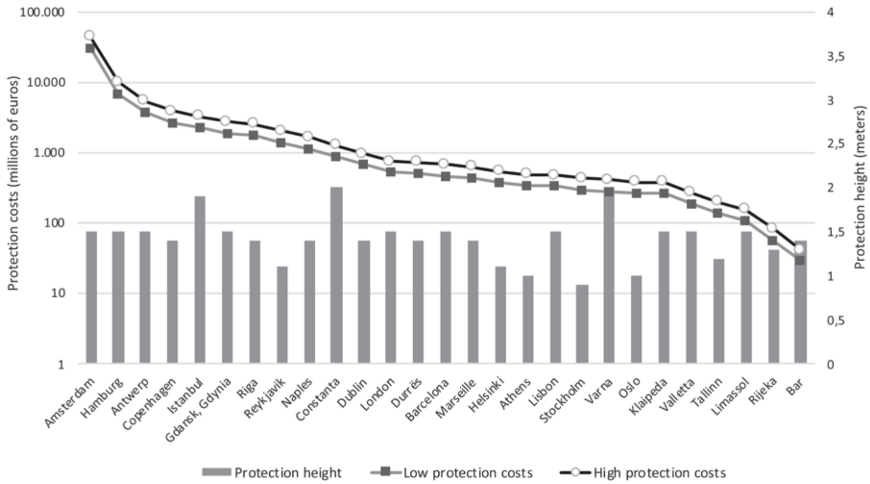


FIGURE 25: ESTIMATED PROTECTION COSTS AGAINST SEA LEVEL RISE FOR MAIN EUROPEAN COASTAL CITIES (ABADIE ET AL., P.7).

TABLE 10: TOTAL COSTS OF ADAPTATION TO FLUVIAL FLOODS IN MILLIONS €/YEAR, AND AS €/YEAR/ PER CAPITA IN 2013 AND AS A PERCENTAGE OF THE CURRENT GDP FOR EU AND FLOODLABEL COUNTRIES ASSUMING FLOOD PROTECTION UPGRADE FROM CURRENT TO FUTURE 100-YEAR FLOOD EVENT. MONETARY VALUES ARE IN CONSTANT 2006 PRICES, UNDISCOUNTED (ADAPTED FROM: ROJAS ET AL., 2013).

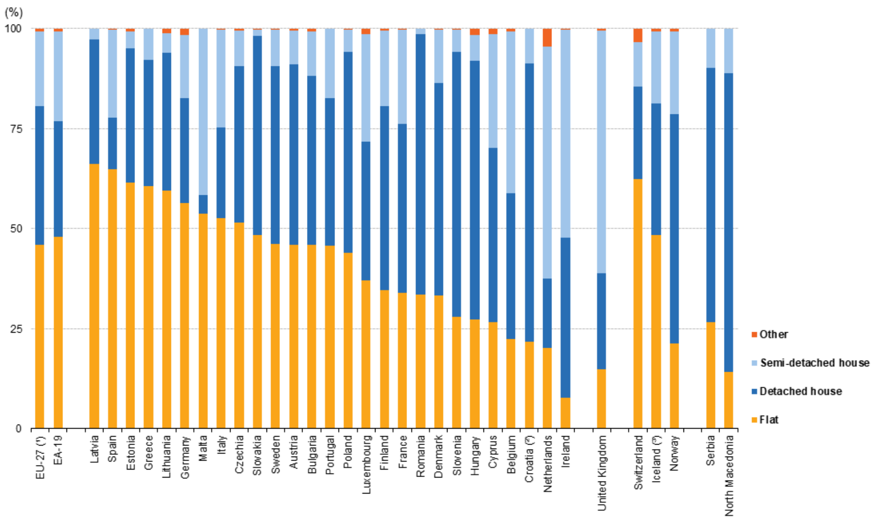
	Costs of adaption (millions €/year)	Costs of adaption (millions €/ year/per capita in 2013)	% of GDP
The Netherlands	256.9	15.31	0.05
Belgium	178.1	15.99	0.06
Austria	314.5	36.82	0.12
Germany	169.8	2.11	0.01
EU(27)	7882.1	15.73	0.07

TABLE 11: TOTAL COSTS OF ADAPTATION TO COASTAL FLOODS IN MILLIONS €/YEAR AND AS €/YEAR/ PER CAPITA IN 2013 AND AS A PERCENTAGE OF THE CURRENT GDP FOR EU AND FLOODLABEL COUNTRIES, ESTIMATIONS BASED ON NATIONAL COASTAL DEFENSE PLANS *: DELTAPROGRAM-MA 2020 (2020)**: KUST (2011) ***: BUNDESMINISTERIUM FÜR ERNÄHRUNG UND LANDWIRT-SCHAFT (2019). IT SHOULD BE NOTED HERE THAT THE NETHERLANDS HAVE ALREADY MADE MAJOR INVESTMENTS IN COASTAL DEFENSE AND WATER MANAGEMENT IN THE PAST FEW DECADES.

	Costs of adaption (millions €/year)	Costs of adaption (millions €/ year/per capita in 2013)	% of GDP
The Netherlands	205*	12.22	0.04
Belgium	75**	6.73	0.02
Austria	0	0	0
Germany	127,9***	1.59	0.01

Building Typology

Building characteristics also influence the exposure of a building to a flood. To conceptualize a floodlabel, it is essential to consider building characteristics. Angela, Norbert, and Jochen (2013) list a number of parameters that play a particular role, such as building height, building size, building form, roof structure, and basement availability. In addition, the parameters also include relational aspects such as the topological relation to the neighbours and the topological relation to the open space. In more general terms, experiences from the 2002 Elbe floods in Germany demonstrate that residents at the lowest floors of buildings are more exposed to floods than residents on the higher floors (Kreibich et al., 2005). The building typology also affects the implementation of property level flood risk adaptation measures. According to Kaźmierczak and Cavan (2011), these measures are easier to implement in detached houses compared to flats and semi-detached houses. This is because water can seep in through adjacent properties. Referring to Johnson and Priest (2008), one could alternatively consider solutions based on building block level, as they can be more effective and more feasible in such occasions. Figure 26 shows the distribution of the population by dwelling type across Europe. A difference is visible between Belgium and the Netherlands on the one hand, and Austria and Germany on the other. The latter two have more flats in the housing stock, and only lesser semi-detached (row) houses.



Note: ranked on flat.
(¹) Estimates.
(²) Other: no significant values.
(³) 2016.
Source: Eurostat (online data code: ilc_lvho01)

FIGURE 26: DISTRIBUTION OF THE POPULATION BASED ON HOUSING TYPE ACROSS EUROPE (EUROSTAT, 2019).

5.5 Socio-Economical System Indicators

Age

Studies have shown that individuals aged 65 and over are more vulnerable to floods (e.g. Cutter et al., 2010; Lee, 2014). According to the literature overview of Wachinger et al. (2013), the influence of age on risk perception remains unclear. A number of studies have investigated the influence of age on flood risk perception, and the willingness to take action. A portion of these studies (e.g. Grothmann & Reusswig, 2006; Kellens, Zaalberg, Neutens, Vanneuville, & De Maeyer, 2011) have shown that older individuals are showing more interest in what they can do to protect their property. Other studies show a negative relationship between age and risk perception, as individuals over 65 tend to be less aware and willing to adapt their property. Higher age tends to be complimented by reduced self-efficacy, as elderly homeowners are afraid of not being able to adapt their property (e.g. Burningham et al., 2008). The percentage of individuals aged 65 or over in the Netherlands, Belgium, Germany and Austria are considered in the table below. The percentages are relatively comparable on country level. The percentage in Germany is slightly higher, and the percentage increase in the size of the group aged 65 or over has been larger in the Netherlands compared to the other three countries. Regional or local statistics are likely to show a more differentiated age distribution (e.g. on neighborhood level), but these have not been considered in this cross-country comparison. However, these statistics do not provide an argument to distinguish the four countries from each other.

TABLE 12: AGE DISTRIBUTION OF 65+ CITIZENS IN THE FLOODLABEL COUNTRIES (EUROSTAT, 2019)

	% 65+	Increase over 2008-2018 (%)
The Netherlands	18,9	4,2
Belgium	18,7	1,6
Austria	18,7	1,6
Germany	21,4	1,3

Average Disposable Income

Low income communities are perceived to be more exposed to flood risk compared to wealthier communities (Kaźmierczak & Cavan, 2011; Koks et al., 2015). This is due to the possibility that some communities may be unable to afford flood insurance (Browne & Hoyt, 2000; Clark et al., 1998) or property-level flood protection measures (Beddoes et al., 2018; Kazmierczak & Bichard, 2010). The map of Europe (Figure 27) highlights differences in disposable income between regions of the Netherlands, Belgium, Germany, and Austria. Disposable income is lower in eastern Germany and southern Belgium. Inhabitants in western Germany and Austria tend to have a higher disposable income compared to those in Belgium and the Netherlands. Studies highlight that households with a higher income tend to have a higher risk perception (Kellens et al., 2011; Wachinger et al., 2013) and are more willing to adapt their property (Burningham et al., 2008).

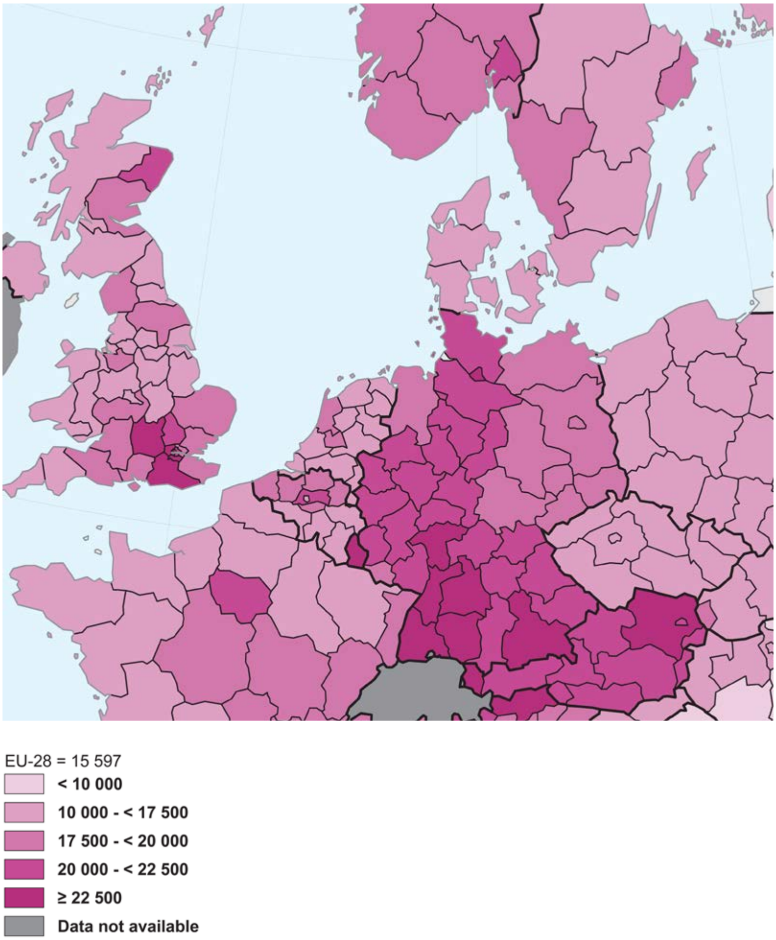


FIGURE 27: DISPOSABLE INCOME PER HABITANT IN 2016 (EUROSTAT, 2019)

Unemployment

A limited number of studies consider the roles of employment and unemployment in relation to flood risk perception and willingness to adapt (Balica & Wright, 2010; Cutter et al., 2010; Grothmann & Reusswig, 2006; O'Neill, Brereton, Shahumyan, & Clinch, 2016). The results of these studies conclude that the unemployed population could be more vulnerable to floods. However, none of these studies delve deeper into this topic. Nonetheless, unemployed homeowners could be limited in financing property-level protection measures.

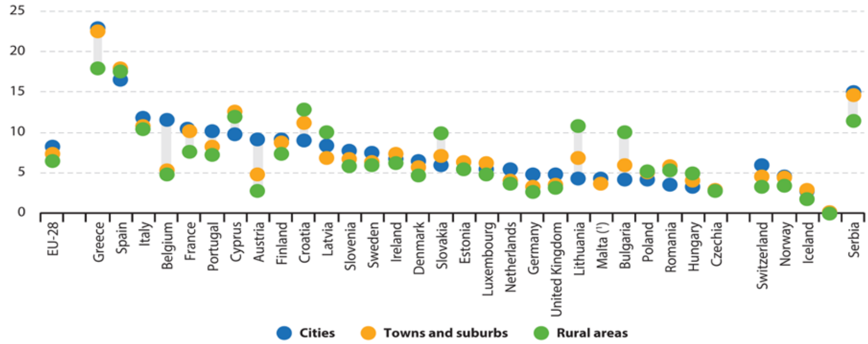


FIGURE 28: UNEMPLOYMENT RATE IN 2017 (EUROSTAT, 2019)

Immigration

Immigrants can become more vulnerable to the impact of flooding due to a possible language and cultural barrier. This could be an instance of flood preparation and flood evacuation (Fothergill, Maestas, & Darlington, 1999). Based on this statement, a migration background could also hinder possible action in the organization of property-level protection measures. Figure 29 shows that immigration figures are relatively similar in the Netherlands, Belgium, Germany, and Austria.

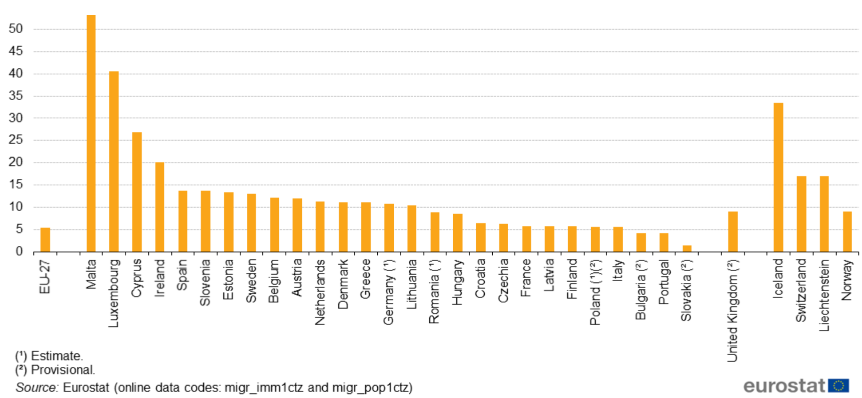


FIGURE 29: OVERVIEW OF IMMIGRANTS PER 1000 INHABITANTS PER COUNTRY IN 2018 (EUROSTAT, 2019). BE: BELGIUM, AT: AUSTRIA, NL: THE NETHERLANDS, DE: GERMANY.

Tenure Status

Regarding housing tenure, O'Neil et al. (2016) point out that those renting from a private landlord are more likely to perceive their property to be at risk of flooding compared to those who own their property (O'Neill et al., 2016). This is possibly because tenants may have less influence on the installation of property level flood risk adaptations (Brown & Wedawatta, 2015). As shown in Figure 30 some differences are visible when comparing the tenure status between the Netherlands and Belgium (resp. +/- 70% owning the house and +/- 30% renting, and +/- 73% owning the house and +/-

27% renting) and between Austria and Germany (resp. +/- 55% owning the house and +/- 45% renting, and resp. +/- 55% owning the house and +/- 45% renting).

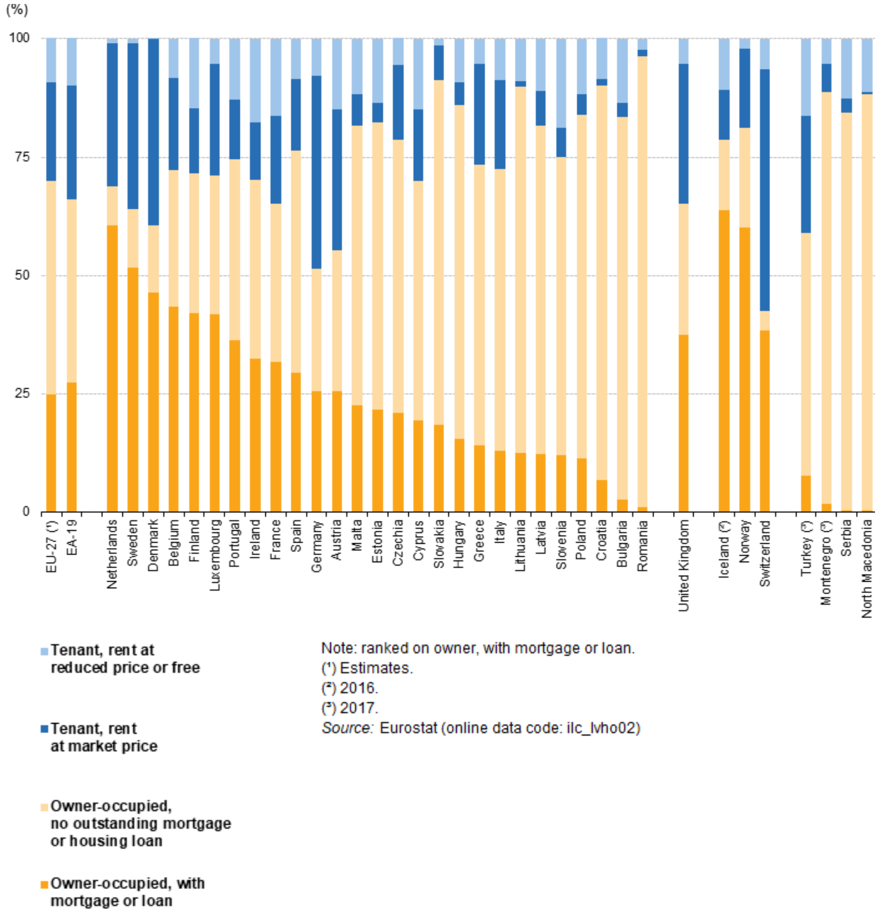


FIGURE 30: DISTRIBUTION OF EUROPEAN POPULATION BY TENURE STATUS.

5.6 Observations on Risk in the Netherlands, Belgium, Austria, and Germany

Risk is constructed through the complex interaction between the climate system, the terrestrial/hydrological system and the socio-economic system. Through complex interactions within and among these systems, a manifold of indicators contributes to flood probability, exposure, and vulnerability. For example, the flood typology is an indicator of whether there is a low probability (coastal floods) or a higher probability (pluvial floods). Moreover, flood types also inform potential flood exposure. Coastal floods generally have larger exposure in terms of damage and fatalities, while the exposure of pluvial floods is mostly local.

Flood exposure is also highly influenced by levels of urbanization. In urbanized areas, floods have more 'momentum' compared to rural areas where the water easily seeps away in the unpaved green areas. Moreover, more economic value is accumulated in urban areas, resulting in more damage in case of a flood. Finally, the appearance of flood protection reduces the risk of exposure, but also has a second influence, namely when there is a dominant role for governmental-led flood protection (e.g. high governmental financed adaption costs per capita), the perceived role for other actors appears smaller. The vulnerability indicators have shown to be less distinctive among the countries, especially on a pan-European scale. Based on the aforementioned vulnerability indicators, only a small distinction can be made between vulnerable and less vulnerable areas. Based on this grouping, a floodlabel could play a slightly different role in vulnerable or less vulnerable areas. Nevertheless, tenure status can make a difference in relation to a floodlabel.

When decomposing the complex interactions between the systems behind probability, exposure, and vulnerability, differences in risk are observed across Europe. This is especially true in terms of probabilities and exposure. In addition, variations between the four floodlabel countries become visible. Through analyzing flood risk across the national boundaries, how regional floods fit within a continental perspective can be better understood. For example, a regional flood in the Netherlands is different from a regional flood in Austria. As shown in Table 13, the flood risk indicators are summarized for the Netherlands, Belgium, Austria, and Germany.

The Netherlands is exposed to coastal, pluvial, and fluvial floods, although it has experienced minimal flood events over the past decade. This is thanks to the high level coastal protection infrastructure that has been constructed over the past 100 years. The country now faces a low probability of coastal and fluvial floods due to the large-scale protective measures to protect the coast and the Dutch river Delta. Nevertheless, the country still faces relatively high exposure due to the fact that 26% of the country is below sea-level. In addition, it is also part of a major European estuary and has the most dense urban developments in the low areas of the country. Although the Netherlands is the most densely populated country among the floodlabel countries, the impact of urbanization on exposure appears to be relatively low. The general lack of hills, slopes, and valleys also results in less accumulation of pluvial floods. The Netherlands has the highest investment on protective (coastal and fluvial) measures per capita, indicating a strong governmental role in flood protection. This corresponds to a low experience with floods and responsibility uptake among other actors, and a low awareness of the risks and impact of floods. A dominance of semi-detached and detached houses could require other or more uniform property-level measures, or measures on building block level (as an alternative for tailoring measures to individual houses). The relatively high amount of social housing in the country could also require another approach or contact between flood risk managers and homeowners.

In Belgium, an increase in extreme precipitation has been observed (Ntegeka & Willems, 2008). This has led to more flash floods over the past 100 years, as well as river floods along the Scheldt and Meuse to a lesser extent (Paprotny et al., 2018). Nevertheless, some recent local but intense pluvial flood events in Belgium are not present in this dataset. This includes floods in the west-Flemish regions of Hooglede, Wingene, Ardooie, and Ruiselede in July 2014 (Koninklijk Meteorologisch Instituut, 2020). Compared to the Netherlands, the probabilities in Belgium appear higher, but the exposure to potential floods is much lower. Although the Flemish part of Belgium has some areas below sea level, Belgium struggles with minor pluvial floods more often. These flood events occur locally in small catchments but cause serious material damage. Therefore, Belgian flood risk management has a more targeted focus on flood risk, and residents are already more aware of flood risks, as small-scale pluvial floods in sub-catchments occur more often. As the size of floods tends to be smaller, residents can do more to adapt their individual property rather than relying solely on the government. In Belgium, there is more variation between housing types, which forms an extra argument for tailored flood risk advice and labelling. Like the Netherlands, tenure status in Belgium is strongly dominated by homeowners instead of renters. Here, an approach linked to housing prices can have an extra motivating effect. Pluvial and fluvial flood risks are present across Austria, varying in scale and impact. In Austria, floods have caused serious material damage and casualties. Flood events in 1997, 2002 and 2013 have been some of the most costly in Europe since 1988 (Insurance Europe, 2020). Austria also experiences stronger rainfall intensities (Guerreiro et al., 2017), and faces a higher incidence of floods induced by snow melting in spring (Madsen et al., 2014). Bard, Renard, and Lang (2012) observe an earlier start and a longer duration of the snow melting period. This results in varied flood risks and requires Austria to prepare for multiple types of floods. Floods are caused by local but intense rainfall, as well as floods caused by snow melting. Moreover, the regional geographical differences between the east (mountainous, torrents, less urbanized) and the west (hilly river basins, more urbanized) of Austria, demands for a more regional site-specific flood risk management system for upstream and downstream regions. Upstream, the probabilities of a flood are higher, but the exposure is lower. Downstream, the opposite situation is observed, with lower probabilities but higher exposure in the urbanized areas situated along the rivers. However, this could also mean that large protective measures have more flood-reducing effects in the downstream regions (affecting more inhabitants). Upstream governmental interventions could be more expensive, and property-level measures in these areas may be therefore needed. The cost of protection measures per capita is relatively high in Austria, which could mean that flood risk management is mostly governmental driven, or the production costs of individual houses in sparsely populated areas is relatively high.

TABLE 13: OVERVIEW OF INDICATORS OF FLOOD RISK FOR EACH COUNTRY AS HAVE BEEN DISCUSSED THROUGHOUT THIS CHAPTER

	The Netherlands	Belgium	Austria	Germany
Rainfall Patterns and Extremes	Extremes of 30 mm/h; Expected increase of long rainy and moisty periods leading to max 2,5% more floods	Extremes of 30 mm/h; Expected increase of long rainy and moisty periods leading to max 5% more floods	Rainfall extremes of 40 to 50 mm/h; Expected increase of long rainy and moisty periods leading to max 5% more floods	Extreme rainfall in the south of 40 mm/h; in the north 20-30 mm/h; Expected increase of long rainy and moisty periods leading to max 12% more floods in the south
Snow Cover	None	None	Stable	Reduction in the east
Seasonality	November to February; induced by storm and long rainy periods	November to February; induced by storm and long rainy periods	July: snow-melt-induced and intensive rainfall	Northwest: November to February; induced by storm and long rainy periods East: February to April; snow-melt-induced South: July: snowmelt-i nduced and intensive rainfall
Sea Level Rise	Up to 1m sea level increase by 2100	Up to 1m sea level increase by 2100	None	Up to 1m sea level increase by 2100
Dominant Flood Typology	Coastal floods and fluvial floods	Pluvial and fluvial floods	Pluvial and fluvial foods	Coastal, fluvial, and pluvial floods
Elevation	Lowlands	Lowlands and hills	High mountains in the west, hills in the east	Lowlands in the north; hills and mountains in the center and south
Land Cover & Landscape	Atlantic lowlands; dominated by artificial land and cropland	Atlantic lowlands and hills; Dominated by artificial and cropland	Alpine alps, high mountains, mountains and hills; dominated by bare land and forest	Atlantic lowlands and hills, and continental lowland, hills and mountains; Dominated by forest and cropland

Catchment	Lower catchment	Lower and middle catchment	Upper and middle catchments	Low catchments in the north; upper and middle catchments in the south
Urbanization	Highly urbanized, 504 Inhabitants /km²	Highly urbanized, 375 Inhabitants /km²	Relatively rural; 107 Inhabitants /km²	Moderately urbanized 235 Inhabitants /km²
Protective Measures	Expected costs for SLR: +/- 60.000 millions € (Amsterdam) Costs for fluvial risk: 256.9 million €/year per capita?	Expected costs for SLR:5.000 millions € (Antwerp) Costs for fluvial risk: 178.1 million €/year	No expected costs for SLR: Costs for fluvial risk: 314.5 million €/year	Expected costs for SLR: 10.000 millions € (Hamburg) Costs for fluvial risk: 169.8 million €/year
Housing Types	Dominance for semi-detached houses (55%)	Detached and semi-detached houses (resp. 35% and 40%)	Detached houses and flats (both 45%)	Dominance of flats (55%)
Age (% 65+)	18.9	18.7	18.7	21.4
Average Disposable Income	17500-20000 €/year	17500-20000 €/year	20000-22500 €/year	20000-22500 €/year
Unemploy-ment	+/- 5% in urban areas; 4% in suburban and rural areas	+/- 12% in urban areas; 5% in suburban and rural areas	+/- 9% in urban areas; 4% in suburban and rural areas	+/- 5% in urban areas; 3% in suburban and rural areas
Immigration	+/-12 per 1000 inhabitants	+/-12 per 1000 inhabitants	+/-12 per 1000 inhabitants	+/-11 per 1000 inhabitants
Tenure Status Distribution (Owned/ Rental) (in %, approx.)	70/30	73/27	55/45	55/45

Germany faces coastal, pluvial, and fluvial flood risks, varying in scale and impact. These risks depend on the region and the geographical context. Pluvial floods in 1997, 2002, and 2013 caused serious damage and fatalities. The scale of the country contributes to a high variation among flood risk indicators and results in high regional differentiation. Whereas the other floodlabel countries can be characterized though factors such as dominant landscapes and levels of urbanization, Germany is instead characterized by its great diversity. Parts of the country overlap in typology with the Netherlands, parts with Belgium, and parts with Austria. No nationwide trends in water discharge or flood frequency could be observed. Instead, differences in factors such as extreme rainfall can be observed on a more regional scale (in the south of 40 mm/h; in the north 20-30 mm/h).

The variation in flood risk across Germany requires us to raise the question over whether floods should be considered and compared on a national or a pan-European level. Alternatively, a more regional approach could be required, based on similarities among factors such as landscapes, levels of urbanization, flood types, or a combination of these. Nevertheless, certain risk profiles can be clearly identified for each country or can be based on similar regions.

5.7 Conducive conditions for the floodlabel

PLFRA measures could reduce flood risk among individual homeowners, and a floodlabel could be used as a tool to encourage their implementation. The floodlabel was introduced in the first chapter as a tool that can inform about flood risk, motivate the implementation of tailored PLFRA measures, and motivate homeowners to adapt.

This chapter has shown how risk is constructed. The construction of risk determines the flood type and dynamics of a flood and, as such, the flood risk. Flood risks can include high water levels from the sea or large rivers and can result in low water levels in the case of small-scale pluvial floods. PLFRA measures are not a solution for every flood. If the water levels reach too high, PLFRA are useless, if there is no (or extremely low) flood risk, PLFRA measures are not needed. Therefore, the type of risk seems to be the leading condition for a floodlabel to motivate the implementation of PLFRA. Nevertheless, a floodlabel can have a more informative role in warning people of more extreme events.

A floodlabel could indirectly be used as a tool to inform individuals about the probabilities and consequences of various flood types in relation to the individual situation and property. As such, the informative function of a floodlabel could be linked to probability reduction. On exposure, a floodlabel might be able to inform about the relationship between urbanization and sealed surfaces as well as flood damage in a property or its direct surrounding. Moreover, the instrument could motivate and incentivize a reduction of paved land on the plot of the homeowner. Certain houses are more prone to floods compared to others, due to the building characteristics. In these cases, a floodlabel can inform about risks, inspire homeowners to make tailored risk reductions, and motivate them to adapt. In terms of vulnerability, a floodlabel can inform and motivate or bind homeowners by involving extra vulnerable communities. Moreover, a floodlabel can have specific roles in the cases of rental housing and homeownership. In the context of rental housing, the label can be used as a tool to communicate between owner and tenant to reduce flood risks. In the case of homeownership, the label can be used as a tool to inform and motivate buyers and owners about the risks and possible risk reductions through implementing property-level measures. Furthermore, there are fewer homeowners in countries with a greater proportion of social housing, which could make the contact between flood risk management and homeowners simpler.

TABLE 14: LINKING FLOOD RISK FACTORS TO FLOODLABEL FUNCTIONS

	The Netherlands	Belgium	Austria	Germany
Risk Profile	Coastal and large-scaled fluvial flood risk dominates; Low probabilities, high exposure	Pluvial and fluvial flood risks dominate Medium probabilities, low to medium exposure	Pluvial and fluvial flood risks dominate High probabilities, low to medium exposure	All flood risks exist in regional variations All probabilities and exposures possible
Consequences for the Application of Floodlabel	Used as informative tool	Used as informative and motivational tool	Used as informative and motivational tool	A combination of all, depending on the region

A universal one-size-fits-all label is difficult to realize under regional flood risk variations within and between countries. Flood risk is highly contextual and seasonally shaped. Moreover, these risks change over time through the influence of climate change. Based on the comparison carried out between the Netherlands, Belgium, Germany, and Austria, some floodlabel functions should be highlighted or prioritized in certain countries. In the Netherlands, the informative character of the label could be highlighted, as it is difficult to adapt a property against sea level rise though property measures. Instead, the label could function as an informative tool on risk, and could focus more on preparedness and recovery strategies (e.g. evacuation and insurability). In Belgium, a homeowner seems to be able to reduce the smaller pluvial risks. In this case, the tool could be implemented to motivate homeowners to adapt. In Austria, the wide variation in flood size and exposure requires the tool to be both informative and motivational. In Germany, the regional variation on flood types determines how a floodlabel could become more useful. In areas facing large fluvial and coastal risks, the tool should be more informative. In areas facing fluvial and pluvial floods, the tool could be more motivational.

6

CROSS-COUNTRY COMPARISON OF THE INSTITUTIONAL SETTINGS

6.1 Introduction

This chapter will provide an overview of institutionalized flood risk management in each of the Floodlabel countries and analyze what institutional conditions are conducive for the implementation of floodlabel. The institutional transformations are shaped 'from the outside in' by the interactions with and between actors. They are also shaped by the interactions with factors of importance, such as the aforementioned geographical features. Through these influences, institutions can evolve, combine strengths with other institutions, and then involve certain actors (Boelens, 2020). However, "risk-based flood management is not universal nor does it result in a uniform risk-based approach to governance" (Krieger, 2013, p. 252). Therefore, we need to zoom in on each individual floodlabel project country before we can overview the conducive conditions in each of the countries.

For each country, a narrative will be provided that clarifies the evolutions in flood risk management over time. These narratives will illustrate the processes of institutionalization and innovation of flood protection, via flood risk management, in relation to flood risk governance. Through the narrative, involved actors, networks, and evolutions become visible that are conducive conditions for the implementations. As this chapter will illustrate, these historical overviews are directly related to the geographical features that shaped flood risk for each of the four countries.

These narratives explain the direction of the institutional evolutions –evolving towards more robust, adaptive, or transformative resilience. These directions become visible in the conceptualization of flood risk management, in the distribution of governmental responsibilities and differences in the perceptions of floods among inhabitants, as well as the presence of flood insurance and the role of spatial planning. This thematic selection is based on the outcomes in the Flemish case study on homeowner involvement through tailored advice (see chapter 4). Homeowners that did not wish to implement PLFRA measures, referred to these contextual topics as argument to bounce back, instead of forward.

In the overview of the historic institutional evolution that follows, the aforementioned themes will be touched on to describe the institutional design of flood risk management in each of the four countries and links the narratives with homeowner behavior through the various forms of resilience. All of these countries have now moved from flood protection towards flood risk management to a certain extent, incorporating certain resilience perspectives and developing their own toolbox. This results in differences within the institutions considering actor involvement, responsibility sharing, risk perceptions, formal and informal agreements, citizen participation and so on. The institutional influences the way citizens engage in flood risk management. Moreover, the institutional design influences the usefulness of a floodlabel as an instrument to involve citizens. Therefore, the institutional design creates conditions that are conducive and influences the configuration of the floodlabel.

6.2 The Netherlands

Early flood protection traditions

Due to its location in a delta with four major rivers and 26% of the land below sea level, the Netherlands is highly prone to fluvial and coastal flooding and therefore has a long history of flood protection. As the motto goes, prevention is better than cure (Van Heezik, 2007). Historical analyses of flood risk management in the Netherlands often start with the storm surge of 1953, which affected large parts of the country and caused more than 1800 fatalities (Van Heezik, 2007). However, early forms of water management date back to the middle ages where 'polders' in the lowlands of Holland were developed and managed by water boards. This historic development described by Boelens (2018) was already touched upon in the introduction of this manuscript. From the middle ages onwards, new land reclamations resulted in more and larger polders, created under the pressure of coastal storms and peat mining and the need for agricultural land (De Bont, 2008). Until the beginning of the 19th century, these polders (or 'droogmakerijen'[4]) were usually developed by private enterprises that could use or sell the land after reclamation. Rising prices of farm produce played a dominant role in the willingness of private investors to finance the drainage projects (Thurkow, 2013). However, after perceived failure of some of these developments, the governments, including water boards, local authorities, and provinces, became more strongly involved in the polder developments, drainage, and flood protection (Renes & Piastra, 2011). An example is the reclamation of the 'droogmakerij' of 'Bleiswijk en Hilligersberg'. Here, stronger governmental involvement happened in 1772. The government provided support through loans to finance the reclamation during that year, since private investors failed to finance the reclamation based on expected agricultural revenues (Thurkow, 2013). Moreover, initiators of land reclamations were exempted from several taxations for a fixed period of 15 to 50 years (as defined in the draining permits provided by the government). Generally, no monetary support was provided[5] and the government had no influence on the layout or design of the polders (Thurkow, 2013).

To manage supra-local flood issues, in 1798 the 'Bureau voor den Waterstaat' (from 1848: Rijkswaterstaat) was established. After numerous flood events in the Rhine delta in the 18th century, and international pressure from Prussia to solve the river bottlenecks, this Directorate-General for Public works and Water management was developed after thorough deliberation with and between the 7 provinces of the Dutch Batavian Republic. First engineers of this new institute were surveyors, or mill builders. Later, the first water authority training course was established in 1805, and moved to

4 A 'droogmakerij' is reclaimed land and was originally a lake or other large open water. A polder is an area surrounded by dams, whose water level can be regulated artificially. A 'droogmakerij' is therefore a type of 'polder' (Van de Ven, 2003).

5 Reclamation of the Stavorensche Zuidermeer polder in the 17th century is an exception. This polder was situated near the coastline and therefore reclamation (and specifically the reinforcement of the ring dike) was considered to be of public interest (Thurkow, 2013).

the Royal Military Academy in Breda in 1829 (Lintsen, 2006). After the development, water boards continued to operate on a local and autonomous level. Before the Constitution of 1848, the provinces held the responsibility for coastal defense and river dikes. After that, the national government took the lead on the supervision of water management across the country, specifically with regards to coastal defense and river dikes of national importance. The Directorate-General for Public Works and Water Management cooperated with national and provincial levels, sometimes being actively involved in concrete waterworks (e.g. De nieuwe Waterweg, 1872), sometimes only in a supervisory role (e.g. development of the 'Noordzeekanaal' in 1876(Lintsen, 2006; Van Den Brink, 2009).

Influenced by these administrative reforms and technical novelties, this finally resulted in the idea for the enclosure of the Zuiderzee. An 'Afsluitdijk' (in English: Enclosure Dam) was needed to reduce flood damage from northwestern storm surges in the coastal cities and towns of the Zuiderzee. Plans were developed from the mid-19th century on and resulted in Plan-Lely in 1891. However, Plan-Lely resulted in major objections from the former VOC cities of Amsterdam[6], Enkhuizen, Hoorn and other harbors (such as Urk and Harderwijk). After the coastal storms of 1916, these ideas gained momentum and the Zuiderzeewet (1918) was developed. This law stated that the government would be responsible for the development of a dam to enclose the Zuiderzee, which resulted in the Afsluitdijk in 1932 thanks to Keynesian policies to tackle the massive unemployment of the thirties (Walsmit, Kloosterboer, Persson, & Ostermann, 2009).

The coastal storms and subsequent floods of 1953 caused momentum again for further development of coastal defense works. The first Delta Committee (1953-1960), consisting of twelve civil engineers, an agricultural engineer, and an economist, proposed the development of the Deltaworks. The Deltaworks are a system of flood surge barriers along the coast of the country in order to reduce the chance of future flooding. The construction of the Deltaworks began in 1954 and finished in 1997. Alongside these technical protective works, the committee also introduced a system of differentiated safety standards for each dike ring depending on the economic value of the hinterland. Safety standards were determined based on the costs of dike reinforcements and the potential impact within the dike rings. A higher potential impact leads to higher standards (Deltacommissie, 1960). At present, these standards are legally anchored and financed by national and regional authorities and vary from 1:1250 to 1:10,000 for the most vulnerable areas. This means that, once in every 1250 or 10,000 years a flood might occur. Responsibilities for flood protection are allocated within Directorate-General for Public works and Water management and the regional water boards (Van Buuren et al., 2016).

6 When Amsterdam had received a canal connection to the North Sea in return, and objections were silenced.

From Protection to flood risk management

Through the construction of dikes and dams, and the introduction of floods protection standards, the country strongly focused on probability reduction, and has therewith a centuries' long tradition of fighting and controlling water (Restemeyer et al., 2015; Van Buuren et al., 2016; van den Brink, Termeer, & Meijerink, 2011). However, (near) flood events in the past decades have shown that the country does not have the water under full control and has not limited flood risk to an absolute minimum. In 1993 and 1995, high water levels in the Meuse and Rhine rivers caused the evacuation of more than 250,000 people (Van Heezik, 2007). These and some smaller regional flood events (e.g. a dike break after drought in Wilnis, 2003) showed "the symptoms of a deeper underlying problem", (Van der Brugge et al., 2005, p. 164). This was namely an on-going clash between the users of the Dutch landscape and the water system itself, contributing to the complexity of flood risk management. The Dutch have placed an increasing number of claims on water defence measures through their increasing spatial claims of agriculture, industry, housing, and infrastructure. However, the on-going subsidence of soil, the decreasing capacity to retain water due to pavement of the urban environment, sea level rise and climate change all contribute in a counter pressure from water to those 'landclaims' (Van der Brugge et al., 2005).

Already before the near floods of 1993 and 1995, new ideas beyond the age-old dike reinforcements were arising. Through the incorporation of planning and of natural processes about the river system, more linkages between water management and planning were implemented. Amongst others, this culminated somewhat the Eo-Wijers price winning 'plan Ooievaar' (Bruin et al., 1987) and 'Living rivers' (WWF, 1992). As part of these plans, agriculture and dike reinforcements in the river floodplains made place for natural overflow areas. These new perspectives on flood management were formalized through the 'Third Memorandum on Water Management' (Ministerie, 1989), but the ideas of incorporating nature remained far from the practices of water boards, which mainly focused on water management for agricultural purposes (Van der Brugge et al., 2005). Through the fluvial flood threats of 1993 and 1995, these new ideas came into vogue and became operationalized within the 'Room for the River' project in 2000 (Buuren, Ellen, van Leeuwen, & van Popering-Verkerk, 2015). As a possible explanation, Van der Brugge et al. (2005) and Wiering et al. (2017) pointed at the transformation in Dutch policy making in the 1980s and 1990s. Generally, but also in the field of planning and water management, decentralization and liberalization have led to some more space for multidisciplinarity and input from 'outside' the water management scene.

The formal introduction of flood *risk* management (instead of flood management) followed in 2009 through the committee-Tielrooij. This committee analyzed the upcoming challenges in water management in times of climate change. Most of the advice from the committee is now adopted, except for the reformation of the insurance system for floods. Special attention was drawn to pluvial flood risks (after high precipitation damage in 1998 (Jak & Kok, 2000)), and the concept of Multilayered Safety (MLS) was introduced (Correlje, Broekhans, & Roos, 2010; Stumpe & Tielrooij, 2000). The management of risks, instead of the management of floods, formally includes an impact reduction component alongside a probability reduction component, and therefore includes the concept of residual risk. Residual risk is the risk that remains after the erection of dikes and dams to prevent flooding. Therefore, MLS distinguishes three layers: (1) Prevention (dikes, etc.); (2) Spatial Solutions (flood-proofing houses, elevating houses, re-locating, etc.); and (3) Crisis Management (evacuation, warning systems, etc.). Through the introduction of this concept, multi-layered flood risk management aims to focus on a combination of probability- and loss-reducing measures (Hoss et al., 2011). However, MLS leaves a bad taste among water managers and citizens, according to an interviewee from the municipality of Dordrecht. When mentioning multilayered safety, people sometimes interpret this as moving away from traditional prevention strategies. Therefore nowadays, the municipality prefers to use a more general "impact reduction" (in Dutch: gevolgbeperking) avoiding a distinction between the three layers. All in all, impact reduction is easier to explain to citizens.

Whatever it may be, as a general result the links between flood risk management and planning have become tighter. Examples include integrated water management that has been formulated in the Water Act (2009) and policy principles that have been developed to steer 'the role of water' in spatial planning (Fifth Memorandum on Spatial Planning, 2004):

- water should be leading in spatial planning;
- water should preferably be retained, stored, and finally drained;
- water should be given as much space as possible.

These principles try to find links with other policy domains, such as planning and emergency management. The cooperation has resulted in the so-called 'water assessment'. This is an obligatory tool that enables water managers to advise spatial planners on the effects of new developments on water management. In practice, this tool remains dependent on the willingness to act as sanctions for not following the outcome of the assessment. This also applies to the Water Act: as sanctions are missing, municipalities and water management are not forced to cooperate (Kaufmann et al., 2016b).

Current Dutch Flood risk management

Flood risk management remains dominated by flood defense. Flood risk management policy is only slowly becoming interlinked with other domains, but flood defense strategies are still mostly the only highly institutionalized and legally embedded strategies. This institutionalization manages a stable execution of flood protection strategies, but also hinders the development of a more collaborative approach that integrates a wider set of problems, perceptions, and solutions (Hegger et al., 2016; Wiering et al., 2017).

Even after the introduction of multilayered water safety in 2009, and despite the ongoing influence of climate change, institutional change towards a more flood resilient risk management remains a difficult process (Van Buuren et al., 2016). More authors have pointed out a lack of institutional change: the Netherlands have limited room to maneuver (Wiering et al., 2017), innovative adaptation strategies lack resources and are viewed as 'something extra' (van den Brink et al., 2011), or flood risk management is strongly influenced by a path dependency because of past investments in structural defense infrastructure (Van Buuren et al., 2016). Multiple interviewees confirm this conservative approach to flood risk management in the Netherlands. As one interviewee phrases it: *"Just because we have already invested so much in the dikes, it is actually very difficult to do something in layer 2 [spatial interventions], because we will immediately have meters of water if the dikes will not hold, and the costs of damage control are so high that you are always cheaper with just another layer of clay on the dikes [layer 1]"*. Also the collective risk perception hinders the application of MLS. In the Dutch collective memory, the coastal floods of 1953 are retained. Pluvial floods are considered a nuisance. Floods come from the sea or from the river estuary. Therefore, Dutch citizens expect the government to manage the flood risks and neglect pluvial risks or water nuisance. This results in a generally passive attitude of citizens to challenge flood risks themselves (Kaufmann, Priest, & Leroy, 2018). As one interviewee explains: *"Residents are responsible for the water that falls on their own property. As soon as it flows from the street into the garden, the government intervenes as the responsible party, and citizens pass on the costs to the government in 100% of the cases for flood threat or damage"* (interviewee municipality of Rotterdam). Interviewees from the municipality all struggle to correct this collective Dutch flood perception.

Formal flood recovery mechanisms are hardly present in The Netherlands (Kaufmann et al., 2016b; Van Rijswick & Havekes, 2012). However, we need to refine this image. In the Netherlands, it has been possible to insure against damage from direct pluvial flooding (rain falling directly on the roof of a house) in the Netherlands since 1998. The market penetration seems to be relatively high because the insurance is combined with house (fire) insurance for a property. On the other hand, the state covers flood damage through the Calamity Compensation Act, but only in cases of failure of primary flood defense. This leaves a gap for minor fluvial flood damage or indirect pluvial flood damage. The committee--ielrooij—proposed in 2000 to reform the insurance system by making insurers responsible for damage coverage of incoming flood water from the direct surroundings of a building. However, this proposal was rejected in the ongoing societal debate. Insurers refuse the responsibility and argue that such an insurance system would not function if flood insurance is not obliged for every homeowner, meaning that these reformations have not been introduced. From 2012 until recently, one insurance company was offering such insurance. However, without much success, the market penetration remained marginal (Kaufmann et al., 2016b): *"they only have sold a few thousand polices, and almost all around Wilnis... that's where people have the experience (interview policy advisor Verbond voor Verzekeraars)*. Therefore, government and insurers should communicate more effectively about the uninsured state of properties (Verbond van Verzekeraars, 2017).

Under specific circumstances, flood damage can be compensated for on the basis of the Calamities Compensation Act. However, among potentially injured parties, it is unclear who can get compensated and when (Verbond van Verzekeraars, 2017). The Calamities Compensation Act was partly used after the flood incident in Wilnis in 2003, but compensation after flood events remains rare in Dutch flood risk management. This is also due to the low frequency of flood events (Kaufmann et al., 2016b).

Nevertheless, there is a growing understanding of the need to accept residual risk and strengthen societal and spatial resilience, especially since the latest revision of the Delta program (2018). The Delta program not only focusses on water safety (coastal and fluvial risks) but also discusses spatial adaptation (including drought, heat, and pluvial floods). This Delta program for spatial adaptation is a collaboration between the Ministry of Infrastructure and Water and municipalities, water boards, and the provinces. It also aims to involve non-governmental partners. The program contains three strategies that overlay each other. The 'stress test' is the starting point of adaptation in order to get a better grip on local problems and effects of (pluvial) flood risks and climate change in general. The vulnerabilities and possible solutions are then locally discussed in the 'risk dialogue', together with relevant local partners such as housing corporations, nature conservationists, farmers, and so forth. An implementation agenda forms a third step (interview policy advisor, Ministry of Infrastructure & Water Management; interview policy advisor, Unie van Waterschappen).

The municipality of Dordrecht is one of the cities that is currently applying the strategies of the Delta program towards spatial adaption. The municipality uses the risk dialogues to find out what struggles are present in each neighborhood and tries to formulate tailored solutions together with local associations. "*We see it as a neighborhood dialogue. Not only climate, but also for other transitions, we search for what the problems are in the neighborhood. We try to provide tailor-made solutions for each neighborhood*" (interview, policy officer on Water, municipality of Dordrecht). In conversations with district representatives, and less so with individual citizens, a taskforce tries to recognize these local driving forces (i.e. local associations or groups) that are engaged with water, green, participation, and biodiversity groups engaged in vegetables gardens and so on, and link these activities with climate adaptation. He states: *"measures for climate adaptation should not only be functional when the climate is in a state of chaos but should also be useful on a daily basis here and now as a benefit for the environment. We broaden our task by finding connections with other spatial assignments. Green. Blue. Sports. Health. And so on"*. Dordrecht sees it as a task to inform and to construct bridges between multiple spatial assignments, but it is up to the active citizen to take action and ask the municipality for support through advice and financial support.

The Deltaplan for spatial adaptation provides a high level of freedom for municipalities to design their own communication with the inhabitants. According to an interviewee (policy maker at Vereniging van Nederlandse Gemeenten), some municipalities use strict numerical norms per household while others remain more abstract and flexible (e.g. Dordrecht) or experiment with behavioral change. The municipality of 'Son en Breugel' uses sewer tax modification for houses that decouple the rainwater from their sewage connection. Households can obtain a subsidy of €350 to decouple the rainwater and receive a yearly tax discount of €50 for the next 10 years. More market-based incentives to stimulate adaptive behavior are presented by Bor and Meesters (2018). For the Dutch 'Deltaplan on spatial adaption' and 'National Climate Adaptation Strategy'[7], Bor and

7 In Dutch: Deltaplan Ruimtelijke Adaptatie & Nationale Klimaatadaptatiestrategie

Meesters (2018) provided a wide range of hands-on incentives to be applied in Dutch climate policies: exemption on taxes, VAT-modifications, subsidies, organizing cost-sharing, crowdfunding, donations in kind, organizing financing schemes for common investments. Businesses can also contribute with resilient loans, resilient mortgages, or the previously mentioned modified insurance premiums (Bor & Meesters, 2018).

The city of Rotterdam is the first city to incorporate labels in their local operationalization of the Delta program. The policy document describes an integral approach for multiple climate issues that manifest in the city, such as drought, heat, and pluvial floods. The program includes an incentive fund for climate-proof measures developed by citizens on private space, a risk app for heat stress, as well as several labels linked to water issues (Gemeente Rotterdam, 2019). The city has already been working with the "waterlabel" to stimulate decoupling of rainwater from the sewer system. The city recently started using the Bluelabel, which focusses on pluvial floods. The interviewee from the municipality elaborates: *"Bluelabel is actually a result of the stress tests...in which you simulate a heavy rain shower over your city, and then you look where a water flow is causing water nuisance...is that considerable then you have a low Bluelabel...So it's actually a risk label, and the water label is more of a performance label. (...) People can check both labels via the website huisboompjebeter.nl, and, if necessary, change the label. They immediately get some kind of action perspective"* (interview policy maker, Municipality of Rotterdam). The city council wants to use the label as a benchmark to increase the number of water-robust dwellings in the city from 88% to 90%. However, according to the interviewee, the city needs a large range of measures to communicate during the risk dialogues and *"the label will certainly be one of those. The label has an informative character...we are thinking about linking it to the application for subsidies to stimulate and tempt our citizens*". The city of Dordrecht is not currently considering the use of a label, and prefers to focus on the creation of a climate-minded network of citizens that help each other: *"Early adaptors could then shine with their protection measures at home...and you could put those people in the spotlight. And we can refer to them... take a look at that house!"*

How Dutch institutions shape flood risk management

Dutch flood risk management is an exceptional case due to the vulnerability of the land and the extremely low flood probabilities due to the high norms for the dike rings. This influences the perceptions of flood risk managers and inhabitants. Flood risk managers tend to hold on to these flood protection strategies; spatial and especially emergency strategies (layers two and three in MLS) need a long time before there is an uptake in the institutional framework. The government holds this responsibility, as it has taken full responsibility for at least the last hundred years. This strong historical narrative on governmental flood protection contributes to a governance setting that hardly encourages property level risk protection measures amongst homeowners. Inhabitants count on the government's protective approach of large defense infrastructures to keep their feet dry, which limits their willingness to challenge it (Kaufmann et al., 2018). The perception of flood risks (among both government and inhabitants) is dominated by a focus on coastal and large fluvial flood risks.

All in all, the indicators from the introduction that shape Dutch flood risk management today illustrate how the national government still dominates flood risk management by taking the responsibilities on flood risks. The toolbox of engineered flood protection appears to be part of the national patrimony, but is nowadays supplemented by a strong spatial planning discourse. Through these instruments the government aims to nullify flood risks, but residual risks remain for pluvial flood damage in particular. Market initiatives for flood risk insurance have not been able to influence the strong conviction that followed from the historical narrative.

Nevertheless, when it comes to pluvial risks, governments (national and local) become aware that inhabitants perhaps can contribute to the residual risks. For example, inhabitants could contribute through the implementation of PLFRA measures. To explain this message to inhabitants, some interviewees suggested a re-branding of the MLS strategy towards a distinction between coastal and fluvial risks on one hand, and pluvial risks on the other. They also discussed that impact reduction instead of "layer two and three" might contribute to awareness-raising among citizens that they could also contribute. Following the most recent Delta program, municipalities start to involve citizens, although this forms a sharp contradiction to flood management in the century. As a result, some municipalities experimented with a wide variety of strategies. Dordrecht tries to connect climate adaptation to other goals and provides space for citizens to come up with good ideas; the municipality of 'Son en Breugel' uses behavioral change strategies and Rotterdam experiments with a bluelabel. Nevertheless, these initiatives are still in their infancy. The interviewees underline that involving citizens in flood risk management should start with communication before coercion or financial incentives will be employed. A floodlabel can be a tool here, but rather as a communication instrument to raise awareness than as an instrument to push or pull adaptive behavior.

6.3 Belgium

History of Belgian flood risk management

From the late 10th century on, the climate in northwest Europe has been improving for agricultural purposes, which leads to abundant harvests and prosperity, and results in the growth of cities. Abbeys, responsible for the main food production, invested their profits into the construction of dikes and the reclamation of wetlands to increase their food production (Soens, 2009; Van de Ven, 2003). From the 12th century on, this has led to a tradition of wateringues and polders. These early forms of water management were initially united in private associations of landowners forming water boards. Later these water boards were allowed to raise taxes and make decisions for the community, which served the interests of the local agricultural community (Boelens, 2018; Soens, 2011).

Meanwhile, and also triggered by this prosperous period, cities started to grow. These developments occurred along rivers and in the surrounding coastal areas. The connection with the river was used to boost trade over water towards the sea, and channels were dug to drain adjacent swampy grounds. The development of a network of channels through the city was supported by the urban aristocracy and clergy, and soon the network proved its importance for the economy as it supported the development of a flourishing craft industry. Rivers such as the Zenne fed the network of channels through the city of Brussels and became a source of energy, basic hygiene, and an open sewer. As a result, rivers contributed to the growth of medieval cities all over Belgium (Mahaut, 2009). So, both in cities and in the countryside, water management was locally organized and managed by local stakeholders serving the local water interests (Crabbé, 2008).

During the Napoleonic era (from the late 18th century onwards) and due to the early industrial needs, these boards slowly lost their power and water management became hierarchically organized by municipalities, provinces, and the state at the time (this later became the regions of Flanders and Wallonia after the second state reform). Flood management thus lost its site-specific approach and became a governmental responsibility executed by water engineers. Navigable waterways became a responsibility of the provinces, and management of unnavigable waterways were anchored in the "Code Civil". Landowners along these waterways became responsible for the maintenance and municipalities had to supervise its compliance. Later, in 1877, the unnavigable waterways became a responsibility of municipalities as landowners insufficiently maintained the banks of the waterways, and the management of navigable waterways also centralized from a provincial level to a national level (Crabbé, 2008).

From 1830 onwards, after the creation of Belgium and different from its former 'motherland', the new government put all its cards on industrialization. For example, this was done by the construction of its vast rail network (Boelens & Pisman, 2020), as well as major investments by the Belgian Ministry of Public Works in renewal and extension of the network of waterways. During this period, the government took more and more responsibility in water management, and centralized the decision-making processes (Crabbé, 2008).

In the years after World War II, flood risk management rapidly fragmented in various sectors and departments. First, the management of unnavigable waterways and navigable waterways grew apart. Unnavigable waterways were managed by the Ministry of Agriculture in order to maintain efficient water levels for agricultural purposes. Navigable waterways became the responsibility of the Ministry of Public Works, focusing on water transport (Crabbé, 2008). Second, the substantial institutional state reforms from 1980 and 1988-1989 flood risk management (as well as spatial planning) became regionally organized by the Flemish, Walloon, and Brussels Regions. These, as well as the Sixth Reformation from 2014 and reformations on regional levels, have led to *"a state of permanent change"* in the country and have formed a catalyst for flood risk policy development in Belgian flood risk management (Mees et al., 2018, p. 275). An example is the ecological approach to floods that gained more attention in traditional engineered flood management after merging ministerial disciplines. Moreover, through this regionalization, the management diverged and remained highly restricted to its region, although river catchments (e.g. the Zenne, and the Dender) cross these regional borders. For this purpose additional river basin organizations were established, although often without real power. Third, the dominating technical approach of flood protection slowly declined in terms of popularity. After the floods of 1976 (and sooner than those in the Netherlands), environmental groups pleaded for a more site-specific approach that integrates flood protection with nature management. At the time the environmental approach gained more attention, but also led to further divergence of policies between Flanders, Brussels, and Wallonia (Crabbé, 2008; Mees et al., 2018).

As a result, over the recent decades flood risk management has become more fragmented, but more diversified as well. Spatial interference involves the Sigma Plan that launched in the late 1970s but was mainly implemented in the 2010s (a second version integrated the concept of risk, instead of focusing on probability reduction), as well as controlled flood areas to cope with exceptionally high water levels in the event of a storm tide. Other examples are the introduction of flood risk maps and the Flemish 'water assessment' in the decree on Integrated Water Policy (2003, reformed in 2013). The water assessment obliges spatial planning authorities to request advice from the relevant water manager about the impact of a permit, plan, or program on the water system (Mees et al., 2018).

Flood risk management today

At present, in federally organized Belgium (the regions of Flanders, Wallonia and Brussels), both water management and spatial planning are clearly regional responsibilities. In the region of Wallonia, the coordination of flood risk management comes from the Interdepartmental Flood Group (GTI). The main instruments are Plan PLUIES (2003) and the Water Code (2004). Plan PLUIES introduces flood cartography to the region. The water code allows Walloon authorities to involve water managers in spatial planning projects (Mees et al., 2018).

In Flanders, this coordination is undertaken by the Coordination Commission on Integrated Water Policy (CIW). This coordination has been legally anchored since 2003 in the Decree on Integrated Water Policy (DIWP), which is a direct result of the European Water Framework Directive (Directive 2000/60/EC). Through these decrees a more integrated approach on flood risk management becomes institutionalized in Flemish flood risk management and requires active interaction between planners and water managers. This suggests the involvement of other actors (Mees et al., 2018; Tempels, 2016). Until the 1980s, water management was still based on a sectorial and mainly technical approach: protection through defense (Mees et al., 2018). Spatial plans that were drafted for Flanders in the 1970s and 1980s assigned residential functions to land, including in flood-prone areas. These plans only indicated residential locations, and without any binding legislation, landowners began to perceive these plans as rights. This then allowed the construction of houses in flood-prone areas. According to Mees et al. (2018) this has resulted in 'legislative and discursive lock-ins'. Governments in Flanders are not legally responsible for flood protection and are not always able to provide protection. Nevertheless, homeowners in flood-prone areas exclusively count on governmental flood protection (Mees et al., 2016b). The responsibility shift towards citizens is more visible when referring to pluvial floods. Here, provinces, municipalities, and drinking water suppliers[8] aim to involve citizens in cases on infiltration, rainwater re-use, and so on. Support among citizens for these measures is slowly growing (Mees et al., 2018).

In 2013, the Flemish Environment Agency (VMM) introduced the concept of multi-layered water safety (MLWS). Floods were not accepted at all before 2013, although this year marked the acceptance of multi-layered water safety residual risks within the government – and therefore other actors were also called upon. This concept already combined the use of flood prevention (i.e. spatial planning, property-level protection), protection (i.e. preventing floods) and preparedness (i.e. crisis management) measures. These measures were not limited to the governmental responsibility, as other actors (from the civic and business society) were also expected to contribute. Insurers for example could have additional roles in the preparedness and recovery layer (Mees et al., 2016b). The enthusiasm of regional water managers for the MLWS approach is countervailed by the reluctance of local authorities to implement it in practice. In general, municipal and provincial governments have a closer connection to their electorate, which makes the focus on shifting responsibilities and cost-efficiency politically hard to defend (Mees et al., 2018). In Wallonia a similar system has been developed, referred to as the 3Ps (referring to the similar concepts of prevention, protection, and preparedness). However, the active involvement of citizens is expected to a lesser extent (Mees et al., 2018).

In contrast to water management and spatial planning, policymaking in emergency planning and insurance policy is primarily situated at the federal level. However, some emergency planning activities are also developed at the provincial and municipal level. The link between prevention and recovery is made by the inclusion of natural risks — and thus, flood damage — in general fire insurance. This might offer promising opportunities to reinforce the flood risk prevention strategy in the near future. Flood damage not covered by insurance can in certain cases be compensated through the public disaster fund (Mees et al., 2018; Mees et al., 2016a). Mees et al. (2016a) highlight the acts that are related to the insurance system:

- The Land Insurance Contract Act (1992) describes the insurance agreements in general. The act sets out requirements and safeguards that must be respected when drawing up insurance contracts. It applies to insurance agreements mainly insuring simple risks against damage caused by fire, electricity, storm, natural disasters, water, and broken windows (Bruggeman, 2010 in Mees et al. (2016a)).
- A reformation of the Land Insurance Contract Act obliges residents to have an insurance policy for floods, regardless of the location of relevant buildings in risk zones. It accounts for all natural disasters, i.e. earthquakes, landslides, dike breakings, etc. The legislator states that these not only affect those living by a river, canal, or waterway, but on the contrary, they are also caused by events such as overflowing sewerages.

8 As a result of the Water Framework Directive, drinking water suppliers became responsible for waste water, and thus became involved in the water system, including as players in flood risk management.

- From 2006 onwards, the insurance policy against damage included flood damage as part of the fire insurance. 95% of owners and 89% of renters in Belgium have subscribed to fire insurance.

This has resulted in an insurance system for flood events, which is a mixed system of free market mechanisms and governmental interference. A balance was found by way of a system that leaves insurers the freedom to determine the premium rate they wish to apply themselves, up to the maximum tariff determined by the Office of Tariffication. For buildings built in flood-prone areas after 23 September 2008, they do not even have to take this maximum tariff into account. Finally, the insurers are backed up by the Belgian government with an intervention threshold per disaster. When this threshold is crossed, the excess will be reimbursed by the disaster fund (Mees et al., 2016a; Priest, Penning-Rowsell, & Suykens, 2016a).

Towards the use of protective flood risk adaption measures

Hence, until now, there is still a strong focus on engineered solutions. Preventive flood risk management, for example through planning, has gained more attention since the 1980s. Also in Belgium there is a narrative of strong governmental involvement; inhabitants have not had an active role in flood risk management for centuries, since the start of the Belgian State. The federal and regional governments were responsible. Thus the citizens expect the government to protect them, and they trust the current system to act accordingly since in their view they pay taxes for this. However, residents that have suffered flood damage do start to protect their houses, especially after multiple flood events.

Nevertheless, the process from government to governance is becoming visible in Belgian flood risk management. The main responsibilities in flood risk management are still at the government level, but it expands over several layers. There are also voices that call to include other stakeholders in this responsibility. The dynamics caused by the institutional state reforms over the past few decades have contributed to new windows of opportunities to change flood risk management. Through the introduction of MLWS, Flanders creates some primordial opportunities to share flood risk responsibilities. An increasing number of experiments are starting to raise awareness and actively involve residents in local flood risk management, for example through consultancy activities on PLFRA measures.

As such, current governance arrangements hint on the use of PLFRA, although the use of PLFRA measures are anchored nowhere in legislation or (regional) policy. Also, financial incentives are lacking in the ability to motivate the use of PLFRA measures. Finally, although experiments are carried out in Flanders, the experts in charge do not have any training or education for the work they must execute under this new regime. Instead, they gradually adapt their engineered expertise into counselling expertise. Towards the active use of PLFRA, fundamental transitions are still needed especially legally, among homeowners and their perceptions as well as with the involvement of market parties. However, first steps have been taken. Floodlabel could have a role here to inform and motivate homeowners.

6.4 Austria

Flood protection before 1884

Austrian alpine regions face multiple natural hazards, including floods, avalanches, and landslides. Therefore, policy often discusses natural hazard management in general, rather than flood management specifically (Keiler & Fuchs, 2018). Interventions in the alpine landscape in order to reduce the effects of floods and avalanches can be traced back to medieval times. First interventions were only sporadically and on a small scale (Fuchs et al., 2017b). Since circa 1800, at the start of the industrial era, the first structural protective water engineering measures were carried out on the river to improve the waterways for shipping and timber rafting. Interventions included dams and embankments. These were mostly timber constructions and organized by the forestry industry. From about 1875 on, this industry became even more intensively involved with torrent and avalanche control, and slowly developed a more systematic approach, especially for the upstream regions. The industry educated specialists in special training centers for foresters, to construct drift constructions and operationalize the river beds for the timber drift, and start reforestation projects in order to reduce landslides (Länger, 2003).

Meanwhile, from the late 18th century, scientists having a background in civil and hydraulic engineering began to focus more on research into floods and avalanches. Keiler and Fuchs (2018) provide an extensive overview. For example, Zallinger zum Thurn (1778) studied the causes and effects of floods in Tyrol. Duile (1826) focused on the implementation of measures to reduce the effects of floods and avalanches in his study, including both reforestation and engineering structures. Freiherr von Aretin (1808) studied the geomorphic causes of landslides and torrents and the effects on roads. He pointed out how land use such as agriculture, mining, and forestry can have an amplifying damaging effect. To reduce future damage, he suggested to legally redirect future land developments into areas that are not prone to landslides and floods. However, it would take years before the government would interfere in flood risk management.

Disastrous flood events in the 1870s and early 1880s led to the first institutionalizations of flood management in Austria from the 1880s onwards. In 1883 this resulted in the legal organization of subsidies for the losses of inundation in Tyrol (Österreichisch-Ungarische Monarchie, 1883). A year later, the first legal regulation for state-led flood and avalanche protection was formulated (Österreichisch-Ungarische Monarchie, 1884). The so-called Hydraulic Engineering Assistance Act legitimized official authorities in supporting the minimization of flood impacts and other natural hazards such as avalanches. This includes the Forest Engineering Service for Torrent and Avalanche Control, established in 1884 at the Hochschule für Bodenkultur in Wien (now called the University of Natural Resources and Applied Life Sciences in Vienna) (Länger, 2003).

Interventions that were proposed and implemented varied from natural solutions such as tree-planting on erosion-prone slopes to engineering structures in the catchment areas. Most measures were executed downstream, and included dams, canalizations, etc. Less frequently, measures were taken in the middle reaches of torrents. These were mainly dams in order to reduce the sediment flow. Only exceptional torrent measures were taken upstream to keep sediments in place. All of these measures were carried out by civil engineers, who were trained at the Military Academy since 1717, and later at the 'Hochschule' of Mödling. These engineers served primarily to regulate the river courses and protect the imperial roads (in German: Reichstraßen). These trading routes and military roads generated tolls for the government, and in return were protected from (amongst others) torrent and avalanche hazards. Hence, the government carried out maintenance on these roads (Länger, 2003).

Avalanche control became particularly important with the development of the mountain railroads, which began around 1870. As such, the railroad administrations were mostly in charge of avalanche control and the implementation of avalanche barriers.

Until the foundation of the Forest Engineering Service for Torrent and Avalanche Control in 1884, four characteristics that influenced present Austrian flood risk management are illustrated. First, flood risk management in these mountainous areas cannot be approached without consideration of avalanche management. Second, there is a dominant use of engineered solutions in Austrian hazard management. Third, hazard management was dominated by three actors, all protecting their own 'goods': the forestry industry maintaining the wood production and transport; multiple government layers protecting the imperial roads; and later the railroad administrations to manage the risk of avalanches. Fourth, there was a spatial divide between these actors: the forestry industry is predominantly active upstream, and the road engineers in the valleys downstream, while the railroads are active in both.

The Forest Engineering Service for Torrent and Avalanche Control (in those years part of the Ministry of Agriculture) generally propagated reforestation strategies for torrent control in the upper catchment. On the other side, the Ministry of Interior, which is responsible for the roads, propagated a hydro-technical approach of torrent control. Cooperation between both institutions developed over time, as both parties understood that reforestation measures in torrent catchments cannot be successful without the implementation of engineered flood protection measures, and vice versa. Nevertheless, the engineered interventions dominated over afforestation strategies. This was mostly because afforestation was perceived as a (obliged) task for land owners (and monitored by ministry of Agriculture) (Länger, 2003).

From flood protection to flood risk management

At the beginning of the 20th century, the Austrian countryside slowly transformed from an agricultural to a tourism-oriented landscape (Rauter et al., 2020). In addition, flood management slowly moved towards a more risk-based approach. In the first few decades, flood protection was characterized by development of larger technical measures in the upper parts of the catchments (Keiler & Fuchs, 2018). In the 1940s, more integrated perspectives on torrent management were being developed, including some first ideas on catchment-based approaches and more attention to nature in relation to flood protection (Länger, 2003).

From the 1950s onwards, governmental technical mitigation measures start to dominate under the influence of the introduction of new laws by the Austrian national government: the Water Act (1959), the Disaster Act (1966), and the Forestry Act (1975). Through these laws, the Austrian government took the responsibility for flood management (Fuchs et al., 2017b). In the 1970s, these engineering measures are supplemented with non-structural measures through the use of hazard mapping (following the introduction of the Directive on Hazard Mapping in Austria (1976) and the Forestry Act). Through this development, spatial planning gradually gained opportunities to direct future developments in flood-prone areas through hazard mapping (Holub & Fuchs, 2009), forbidding further building development in 'red zones'. Further developments in so-called 'yellow zones' were only allowed under strict restrictions, and developments were allowed in green 'safe' zones (Rauter et al., 2020). Since the mid-90s, flood management evolved towards a risk-based flood risk management, influenced by the European Union Floods Directive (European Commission, 2007). Nevertheless, despite the introduction of these laws to reduce the probability of flooding, the number of houses at risk has increased due to continuous building in flood-prone areas. The housing policy system encouraged private homeownership, even in risky zones, due to various interpretations of land use management regulations at the local level. Overall, this resulted in increases in vulnerability (Fuchs et al., 2017b).

Flood risk management today as a shared responsibility

Following the risk approach and a shift from government to governance, new stakeholders became involved, grassroots initiatives were supported, and experiments were carried out with catchment-wide partnerships (Fuchs, 2009; Fuchs et al., 2017b; Thaler et al., 2016). These experiments with more integrated upstream-downstream cooperation in flood risk management policy are gaining more attention in policy development, resulting in new collaborations with local actors such as dairy farmers and the local tourist industries (Thaler et al., 2016). An interviewee explained how in the 1950s, thanks to engineered flood protection, new arable land was created along the rivers in the mountains. Therefore, riverbeds were narrowed, which have recently resulted in more flood events. To prevent future floods from happening, farmers upstream are asked to give up their land during the high water seasons in order to have fewer problems downstream (interview civil servant at Dep. Bundesanstalt Bergbauern Fragen, Bundesministerium für Landwirtschaft, Regionen und Tourismus).

Despite these new collaborations and integrations (holistic approaches for that matter) institutionally, flood risk management in Austria is fragmented. Austrian flood risk management is organized in nine federal states, known as Länder. These states have a strong influence on and responsibility for flood risk management. Therefore, major differences in approach and strategy between states exist (Holub & Fuchs, 2009). Moreover, flood risk management becomes more fragmented as there are two public authorities responsible for specific basin control: the Austrian Service for Torrent and Avalanche Control (WLV) is responsible for the upper catchment, and in the lower catchment the Federal Water Engineering Administration (BWV) is active (Fuchs et al., 2017b). Since 2020, both administrative bodies are part of the federal ministry of Agricultures, Regions and Tourism (Rauter et al., 2020). This results in 'challenging' management situations, as the WLV is managed at the national level but the BWV is regionally managed (Thaler et al., 2016). In its turn, measures implemented by the Austrian Service for Torrent and Avalanche Control are partly funded by the federal government (disaster fund), the Länder, as well as local stakeholders (e.g. municipalities, private actors).

To complicate the situation even further, decisions in planning are mostly made on a community level (Holub & Fuchs, 2009). However, municipal spatial plans have to follow hazard zone plans from higher authorities, which sometimes leads to conflicts with land owners. Although flood protection is a responsibility of the land owner, they have a lack of awareness and/or willingness to act (Rauter, 2019). The states counter this by maintaining building standards, building bans, and guidelines for new developments and existing buildings. These standards differ from state to state. Rauter (2019) provides a detailed overview of the legal frameworks of all Austrian states and includes building codes and regulations in same cases. The building codes and regulations aim to reduce flood damage. For example in Styria:

- Areas can be designated for open land for the protection of nature or the (rural) landscape, or because of the natural circumstances such as ground water level, soil properties, avalanches, floods, mudslides, rock fall, landslides or emissions, and are to be kept free from buildings for matters of public interest;
- Development Plan: The local council can issue a development ban for the entire municipal district when objected by the local development concept, the planning scheme, or the development plan. In these plans, the following additional content can be specified: Environmental protection (noise, microclimate, heating), surface water (runoff and similar): measures to buildings, infrastructure-, business areas and properties as well as to protect from natural hazards;
- Building Ban: Hazard areas, conditional/reservation-indication areas (Vorbehalt- und Hinweisbereiche) according to forestry hazard zone plans; areas that are at risk of flooding, high groundwater levels, mudslides, rock fall, landslides, avalanches, etc.;
- Building regulations: Regarding the intended purpose, building structures have to be equipped to collect and remove waste water and rain water. They have to be permanently sealed against the penetration of water and moisture. Thereby, ground water as well as expected surface water (e.g. floods) are to be considered. The floor level in comparison with the outside terrain is to be planned in such a way that the health and well-being of the users is not compromised. In particular, surface water discharge e.g. flood events (Rauter, 2019).

PLFRA measures are not explicitly mentioned in these codes and regulations for new spatial developments, and regulations for retrofits of the present building stock is non-existent (Rauter et al., 2020). Generally, these policy instruments still seem to be unable to reduce the increase of flood risk exposure in Austria. According to Fuchs et al. (2017b), amongst others, the Austrian housing subsidiary system is to blame. This is because it previously allowed the development of new houses in flood risk zones. This is an argument for homeowners to shift responsibility onto the government.

In addition, the recovery schemes of the governmental disaster fund and private insurance solutions do not form an incentive for private risk reduction. Homeowners tend to count on the recovery system by the Austrian Catastrophe Fund. However, this fund only partly finances the recovery of individual houses, and financing is dependent on payment by the federal states. Payment can therefore differ from state to state, depending on the federal decision-makers. However, they never pay more than 60% of the losses of private property (Holub & Fuchs, 2009). Moreover, as homeowners count on governmental support for compensation, private insurance is voluntary and hardly used. The insurers also prefer governmental-led protective measures, instead of protection on a household-scale (Priest et al., 2016a). Adaptive behavior among homeowners therefore remains limited. PLFRA measures, such as flexible walls for door and window frames, are used to a limited extent but are desired to reduce residual risks (Rauter et al., 2020).

There is still a deadlock in Austria when it comes to mitigation measures for housing in risk zones. In addition, the introduction of innovative information tools attempted to break this deadlock between government and homeowners. Experiments on tailored flood risk advice and the implementation of PLFRA measures by individual homeowners are running in the state of Vorarlberg. This experiment is voluntarily organized by the municipal fire department, and is still an exceptional case in Austria. As the fire department has no responsibility in prevention, a legal base was missing. For this reason, the local government has been reluctant for a long time to get involved (interview policy advisor risk management, municipality of Dornbin).

The development of a floodlabel has already been selected as a possible solution by Holub and Fuchs (2009). The article states that: *"In analogy to the Energy Performance Certificate providing home owners, tenants and buyers information on the energy efficiency of their property, a similar certificate approving the meeting of certain building code standards could encourage the adoption of cost-effective local mitigation"* (Holub & Fuchs, 2009, p. 532). However, currently the institutional framework does not provide many opportunities to embed the label in governance through couplings with regional incentives, or to oblige a nationwide label. Flood insurance for private houses exists, but it is not common. The Austrian Catastrophe Fund deals with liabilities and recovery funding, but financing programs are not used for adapting measures. Therefore 'incentivization' through premium reductions is not possible. According to Holub & Fuchs (2009), a voluntary label would not be sufficient due to the high differences in risk. Moreover, until now the performance of local structural measures is often neglected or even ignored following the adage that such solutions cannot be effective.

How Austrian institutions shape flood risk management

The Austrian state has a long tradition in taking responsibility for flood risk management and for natural hazard management in general. This responsibility is strongly anchored in a legislative framework (Rauter, Schindelegger, Fuchs, & Thaler, 2019). Administrative bodies at the federal, state, and municipal levels actively take responsibility to protect the land from floods. These administrations do not strive for a redistributive shift of these responsibilities to other new actors (Rauter et al., 2020).

Under the on-going spatial developments in flood-prone areas, buildings depend more on technical mitigation measures as compared to the past. Even though zoning instruments have been introduced, technical mitigation measures still dominate the Austrian flood risk management 'toolbox' (Fuchs et al., 2017b). Individuals hardly seem to have a role in flood risk management, but instead have a strong trust in the interventions of the government. Furthermore, no binding or financial incentives towards individual adaption exist, resulting in a limited motivation to adapt. Homeowners hardly invest in PLFRA measures or insurance, as they strongly count on recovery funding from the state.

Based on this analysis, the role of a floodlabel is foremost an informative role. A shift of responsibilities towards homeowners is desired when PLFRA measures are an option to prevent floods at home. However, as there is a lack of awareness, a floodlabel first needs to inform risk and risk reduction options before it becomes a tool to motivate homeowners. In the words of Rauter et al. (2020, p. 5): *"responsibilities in the flood risk governance arrangements need to be clarified and/or established in the first place"*.

6.5 Germany

Flood risk management in Germany is considered a public good (Meurer, 2000). It is the state's duty to provide protection to its residents. Germany uses safety standards to provide equal levels of safety across the country. The level of the so-called HQ100 (protection against flooding that statistically happens every 100 years or more) is used as a norm for flood risk maps and building bans across the country. When it comes to providing protection, we need to take into account that this standard is a probabilistic standard and does not take into account potential economic damage. Thus areas with high risk probabilities receive money for protection from the German state based on population (Krieger, 2013). The states use the standard differently within federally organized Germany, as policy objectives for flood defence in Saxony for example (Socher et al., 2006 in: Krieger, 2013), or as a condition for obtaining funding for private flood protection projects in North Rhine-Westphalia (Krieger, 2012 in: Krieger, 2013). However, the German Bundesländer allocates funding within the regions based on population numbers, or based on ad-hoc compensation as a result of political negotiations (Krieger, 2013; Priest et al., 2016a). This results in a differentiation of flood risk management across the country.

After the 1993/95 floods in the Rhine river, and the 2002 floods in the Elbe river, Germany started to develop a more integrated and risk-based approach for flood management. In particular, the European Floods Directive and the German Flood Protection Act of 2005 are now drivers of change in flood risk management. The German Water Act (2009) emphasizes a change from purely technical defence measures towards additional non-structural preparedness measures, and therefore implements the requirements of the EU Directive (Thieken et al., 2016). Thanks to this Act, there is more attention towards raising awareness, forecasting, and spatial zoning. Aside from that act, the German Nature and Conservation Act of 2009 influences the protection of wetlands and floodplain areas (Thomas & Knüppe, 2016). The results of these institutional changes became visible after the (smaller) floods along the Elbe in 2005 and 2006. While in 2002 only 13% of the households had undertaken precautionary measures, 67% had by 2005. This resulted in significantly lower flood damages, although this is also influenced by the recent flood experiences of these households (Thieken, Petrow, Kreibich, & Merz, 2006).

Nevertheless, the transfer of European and national directives and laws towards regional and local practise remains challenging. Although flood risk management might be well-developed on a federal level, regional and local interpretation, understanding, implementation, and sharing responsibilities remain behind. Housing and agriculture are still dominant actors in floodplain areas, as well as protective technical measures compared to nature-based solutions (Thomas & Knüppe, 2016). According to Becker (2009) and Thomas and Knüppe (2016), more multi-level interaction is needed, both vertically (between government layers) as well as horizontally (between a high diversity of governmental and non-governmental stakeholders).

The role of residents in German flood risk management is limited. The state takes responsibility to provide protection to its inhabitants; and inhabitants expect the state to act in this way. The high amount of recovery compensation after recent floods from the federal government (e.g. Dresden, 2002) supports this idea of state responsibility. Nevertheless, as compensation is dependent on political negotiations and differs between Länder, compensations are highly unpredictable and contradict with the expectations of the inhabitants based on the public expectations of protection and recovery. The government perceives that residual risk is the only sorrow of the German population (Krieger, 2013). The study on the flood of 2013 compared to previous floods in 2002 (Thieken et al., 2016) still shows room for improvement. Preparedness measures, in this case protective measures, are still insufficient. Retention, property level measures, warnings, and disaster response need to be further improved. Initiatives to improve awareness received a boost after the recent flood experiences, and citizens in the Elbe region accept that flood protection is both a governmental and private duty. As such, the paper by Thieken refers to the need for expert advice from the Hochwasser Kompetenz Center for example, and their first experiences with the Hochwasserpass or floodlabel (Hartmann & Scheibel, 2016). The paper also points out the contradiction where households are obliged to keep themselves informed about flood risks and adapt their houses on the one hand, while on the other hand residents are often too late involved in planning processes about this matter. Therefore, dialogue is needed to integrate local and expert knowledge on floods in future flood management strategies.

In Germany, flood insurance is provided by private insurers and part of the building or fire insurance, but is not obligatory. Nevertheless, ad-hoc governmental recovery funding was also available to compensate for losses after floods over the past decades. Moreover, insurers may increase premiums and therewith could become unaffordable for those in flood-prone areas. According to Priest et al. (2016a), this financial support provides little incentive for homeowners to adapt their houses. Although federal ministries published information to encourage adaptive behavior among homeowners, the insurance companies do not provide any motivation for adaptive measures to individual buildings. Therefore, Thieken et al. (2016) suggests a more transparent, nationally consistent risk transfer system that includes adaptive strategies on property level. Therefore, new incentives are needed to motivate adaptive behavior. For example, banks should pay special attention to insurance coverage when providing loans to customers (Jakli (2003) in Thieken et al., 2006).

6.6 Linking institutional settings to resilience

The overview on the historical institutionalization of flood risk management in the Netherlands, Belgium, Austria, and Germany shows similarities and differences among the countries. The characteristics have been summarized in table 13. In all countries an evolution of flood risk, as well as an institutional evolution on the conceptualization of flood risk and flood risk management, are visible and reflect a type of resilience. Risk changes over time due to climate change, and the institutions change in response to recent flood events or anticipation based on the predictions of climate models. In all four countries the national government is still taking responsibility to protect the country against floods. However, there are differences in accentuation. In some of these countries a historic institutional space has evolved over time into the participation of the market and society (e.g. Belgium), which is linked to transformative resilience. However, this is not the case in other countries (e.g. the Netherlands and Austria), which focus more on robust and adaptive resilience. Sometimes the decision-making responsibility lies mainly with the 'higher government' (e.g. the Netherlands), while in other countries it does not (e.g. Belgium and partly Austria). Instead, local and regional authorities have the most decision-making power in the latter. In some countries water policy has been pursued for many years on the scale of river basins (e.g. the Netherlands), while elsewhere policy is more site-specific and tailored to the local situation (e.g. Austria). Hence, all institutional evolutions show a certain shift from engineered flood management focused on flood protection, to flood risk management focusing on spatial solutions and incorporating residual risks. Therewith they accept that a flood can happen within the barriers of the river floodplains. This is a practice of adaptive resilience, and is foremost linked to the responsibility and expertise of flood risk engineers and spatial planners.

A governmental desire to move towards a more transformative resilience approach—including the involvement of civil actors—leads to a lock-in in countries where a practice of adaptive resilience dominates the institutional settings. The practices of a country like the Netherlands have a mismatch with the desired direction of evolutions so far. Inhabitants were relieved from their responsibilities for decades, and following the path-dependencies of decisions in the past, they need support to change. The first experiments to overcome this deadlock between governments and inhabitants are taking place in each country. However, the configuration and design of these experiments differ. Some experiments focus on informing inhabitants of (their) flood risks (e.g. through apps such as overstroomik.nl in the Netherlands), while others focus on citizen involvement in planning processes (e.g. in spatial negotiations in river catchments in Austria).

TABLE 15: OVERVIEW OF INSTITUTIONAL CHARACTERISTICS

	The Netherlands	Belgium	Austria	Germany
Conceptualization of Risk	Fully risk-based objectives, still dominant focus on probability reduction	Fully risk-based objectives	Strong focus on probability reduction	Strong focus on probability reduction
Governmental Responsibility	Centralized - National government and water boards	Regionalized - National (main rivers) and regional	Regionalized - National (high Alps & main rivers) and regional	Regionalized - National (main rivers) and regional
Risk Perception	Focus on coastal and fluvial risks	Focus on pluvial and fluvial risks	Focus on mountainous and fluvial risks	Focus on coastal, fluvial, and pluvial risks, depending on the region)
Availability of Flood Insurance	Not available	Common (part of home insurance)	No compulsory insurance	No compulsory insurance
Spatial Planning	Link to flood risk management	Link to flood risk management	Link to flood risk management	Link to flood risk management

However, the utilities and necessities as well as the possibilities for these experiments to overcome the deadlock of responsibility is dependent on the institutions in each of the countries. The cross-country comparison shows differences in the perceptions of risk, differences in the perceptions on floods among inhabitants, differences in the use of concepts of risk and risk management, differences in the institutional organization, differences in the involvement of market parties (especially insurance), differences in the role of spatial planning, and differences in the scale of policy and the place of decision-making.

The previous chapter already concluded that the nature of floods differs from country to country, and even region to region. The flood risks also differ. The scale of risk in the polders of the Netherlands is not comparable to the risks in the other countries in terms of both probability and potential impact. This influences the perception of a flood by definition as well. Actors in the Dutch flood risk management landscape clearly differentiate between (coastal and fluvial) floods and (pluvial) floods which in the Dutch case are regarded as a nuisance. Thus they sometimes marginalize pluvial risks. The management of pluvial floods is mostly considered as a municipal task. But in Austria a differentiation is made between river floods and torrential floods and managed by two different institutes on different institutional levels. River floods are managed by the lander, and torrential floods are managed on the national level. In addition, the governmental structure of each country influences flood risk management too. Belgium, Austria, and Germany have a federal structure and have some management tasks organized nationally, and others regionally. The state guarantees the availability of recovery funding, but in both Germany and Austria the regions decide how this recovery money is used. In Germany the funding is organized ad-hoc, whereas funds have been organized ex-ante in case of a flood event in Austria and Belgium. In the Netherlands, this is ex-post organized by the state. These differences in recovery mechanisms have a major influence on the damage payments after a flood; and therefore also on the precautionary measures to deal with this.

This leads us to the differences in insurance. All countries have insurance for water damage; in Belgium, the Netherlands, and Germany this is bundled with other perils since it is part of the home insurance. For this reason, the penetration in the markets of these countries is relatively high, as the home insurance is obligated directly or indirectly (stipulated in the rental agreements or in the mortgage) by the state. However, in the Netherlands water damage is only covered when water comes from the building itself, while in Belgium water that directly flows into the house is also included in the insurance coverage to a certain extent. This leaves a wider gap in the Netherlands between what is insured and what is covered by the state (which is limited to damage caused by governmental flood defense structures). In Austria, flood insurance exists, but is not part of the home insurance. This has led to a much lower market penetration. The promotion of risk reduction measures is often a by-product for insurers. However, the Dutch umbrella organization of insurers shows that their insurers increasingly consider other services such as prevention next to recovery.
All countries have involved spatial planning mechanisms installed to prevent areas from flooding. In Flanders and the Netherlands, this is part of the multi-level water safety approach. Flood risk maps are used for guidance in the development of municipal spatial plans, and building plans are applied in the most risky zones. Although flood protection is mostly organized on the national or regional level, municipalities get more freedom to act through their spatial plans, but also in site-specific experiments on spatial upstream/downstream tradeoffs, or in the Netherlands through the design and application of risk dialogues tailored to their municipality.

6.7 Conclusions

The analysis of the institutional frameworks provides some generic ingredients that contribute to an answer for the question of this chapter, what *institutional* conditions are conducive for the implementation of a floodlabel? This chapter has shown a great variety of institutional settings among the four countries. Each of these institutional settings have a major influence on the resilience behavior of individuals in each country. In all four countries, inhabitants expect the government to protect them and their houses against the risk of flooding. Moreover in general they trust the system for protection and recovery.

However, the institutional settings direct to various forms of resilience, and these directions do not always match with the general desire to move towards transformative resilience. This especially becomes clear when comparing the Netherlands with Flanders. The Netherlands has a strong tradition of flood risk protection and prevention, based on the flood management of large rivers and coastal protection. This strong focus on robust and adaptive resilience leaves no space for individuals to be(come) involved in flood risk governance. To get homeowners involved in flood risk management, the Netherlands should start with awareness-raising on risk, e.g. information instruments such as the overstroomik-app, or education on crisis management to make individuals aware of the possibility of a flood.

On the other hand, Flanders flood risk management has already been moving towards governance. Individuals are more aware that floods can happen. In some individual cases in Belgium (and Germany) this has led to proactive behavior of homeowners with flood experience to install (home-made) PLFRA measures. Although flood risk management at first glance might be similar, the analysis has shown differences in the perceptions of risk among inhabitants, differences in the institutional organization, differences in the involvement of market parties (especially insurance), and differences in the role of spatial planning. These settings point towards transformative resilience. Here instruments such as floodlabel can move beyond the informative task, and become more motivational by proposing PLFRA measures to adapt properties.

So, all institutional settings provide conditions for the introduction of a floodlabel. However, the configuration of the label should differ for each country, based on the institutional conditions and settings available. A floodlabel should fit the resilience approach of a country and not strengthen a mismatch between governmental and civil perceptions of resilience. In all countries experts agree that PLFRA measures could reduce future flood damage. Moreover, they hope that citizens in flood-prone areas install certain PLFRA measures. Based on the level of (expected) involvement of citizens, managers can provide more information on PLFRA measures with citizens. In some cases this communication is no more than informative with regard to residual risks; in other cases communication is more persuasive, as citizens are already well-informed or experienced. Therefore, the role of floodlabel might diversify in each country, or even within regions of countries. Suggestions for the implementation of the floodlabel, based on this institutional comparison include:

- Align the configuration of floodlabel with the direction of resilience evolutions. This means that, in countries having a strong emphasis on robust or adaptive resilience, the floodlabel should be informative. In countries that practice a more transformative resilience, floodlabel can become more motivational or binding.

In countries that can implement a motivational floodlabel:

- Couple it with incentives to motivate homeowners to invest in PLFRA measures;
- Implement control mechanisms on the execution and effectiveness of the measures in place;
- Provide education for the expert offering flood risk advice or a floodlabel;
- Legally enforce aforementioned suggestions.

A floodlabel could also be an instrument to intermediate between actors and existing institutions, and perhaps influence a status quo of on-going flood damage. Under certain institutional settings, a floodlabel can be used to force adaptive behavior and thereby become an actor or factor of importance, not only from homeowners, but by forcing action from (local) governments or insurers.

7

THE ROLE OF ACTORS IN HOMEOWNER INVOLVEMENT AND FLOODLABEL

7.1 Introduction

The actor-relational approach dictates that the actions of actor A influence the behaviour of actor B. Therefore, this chapter considers these other actors that have — or could have — influence on a homeowner's behaviour, and vice versa. So, the introduction of a floodlabel should not only affect homeowners, but also the behaviour of other actors involved in flood risk management. These actors can be governmental, businesses or civic, and have, or could have a link with flood risk management. Examples of these actors include policymakers on various governmental levels, insurers, or advocacy groups of homeowners. To answer the research question 'What actors are conducive for the implementation of a floodlabel?', this chapter turns to these other actors that are or could be involved with the floodlabel and flood risk management to answer the research question.

7.2 Governmental actors

"The average citizen usually contacts the municipality in case of water problems". This is, according to two representatives from the water board Hollandse Delta, how how local flood issues usually start. For this reason, municipalities should act *'at the front side of the interface'* being the first contact point for their citizens. However, the role of the municipality in flood risk management is changing. Insights from the institutional chapter illustrate how in all countries, traditionally the municipalities are involved in area mitigation through the maintenance of the smallest local water bodies, such as ditches and brooks, as well as involvement and planning related to flood risk management, such as building bans and requirements.

However, the interviewed representatives of municipalities describe how these activities are extended with a mix of instruments to involve citizens in flood risk management. The representative of the municipality of Dordrecht states that they have to involve their citizens as 60% of the city is private land. 40% of the city is public, so we can do it ourselves, but a lot of problems take place on private land. People have to take action themselves. And how exactly, yes, that is another puzzle." The representative of the municipality of Rotterdam describes how his municipality is currently developing a set of carrots, sticks, and sermons: *"the carrot attracts people, others need more information, and the stick is law and regulation to enforce things (…) the stimulus fund is the carrot, the stick are the buildings bans and regulations in flood-prone areas, and the last component are the communicative strategies, giving information about why and how to act, on a very local level as well, talking with neighbourhoods, what do they need, what is needed according to us. These communication strategies have already started here in Rotterdam for topics including climate adaptation, water storage, water nuisance*". The communication expert of the Austrian Environmental Agency describes it as "a puzzle, you need different communication paths to convey the message, with various communicators and various instruments". Also, the representative from the Burglary Prevention Label confirms how the label is not the only tool to reduce burglary risks. *"We do not only develop a label, but we also think along with municipalities about* *the design of new residential areas to make them burglar-proof. For example, with fewer fire lanes [at the backside of a building block]. This way municipalities share the responsibilities with the residents"*. So according to these interviewees, a label should not be the only tool available. Instead, a mix of strategies is currently developed. A floodlabel could be one of these strategies. The municipality of Rotterdam experiments with the Bluelabel and describes how they would like to use it: *"A label is part of the palette, the label now has a mainly informative character. We are thinking about linking it to the subsidy application, but that is still in its infancy, both the link and the subsidy design itself, but we are already developing a legal framework for new buildings in order to set certain requirements and we can use the labels for that purpose. So in addition to the communicative function, you could also use the carrot and the stick"*.

On the contrary, the representative of Dutch Association of Insurers underlines the importance of awareness-raising among homeowners, otherwise homeowners will not use a floodlabel. In line with this idea, the municipality of Dordrecht claims that the introduction of a label currently has no priority at all in their policy: " (…) *We have been considering the development of such a tool specifically for Dordrecht. That would be an app with information tailored to our area, introducing appropriate measures, best practices, addresses to get advice, for your building plot, and where you could buy measures, etcetera. But, for the time being, we focus on awareness-raising. In doing so, we also want to make use of local organisations and use them as ambassadors"*. The municipality fears that a label would not function effectively when the local community lacks awareness. Moreover, "*such labels are somewhat top-down organized (…) we[would] rather work with the local community*". The municipality decided to first invest in the development of a network of ambassadors, which can be neighbourhood figures, local innovators, or local organisations. In this way, the municipality is not focussing on strategies to motivate citizens but develops searching techniques to recognize existing energy and motivations and cooperate with these key figures in local society. This municipality of Dordrecht can be in identified with transformative resilience. They actively aim to involve citizens, and experiment with multiple methodologies.

The interviewees from the water board Hollandsche Delta foresee in the introduction of a floodlabel some opportunities for municipalities: *"It would perhaps be a good way to achieve something in the third layer [of multi-layered water safety], to reduce risk by reducing consequential damage. With such a tool in hand, you can better target groups within the municipality. (…) . You can give a label per house, but also per neighbourhood. This way, a label could help the municipality to make flood-proof plans"*. Therewith, a floodlabel is not only useful for homeowners, but it also informs municipalities on where the local government perhaps should do something extra.

Nevertheless, it is not only the municipalities have possibilities, responsibilities, and tasks when involving citizens in flood risk management. Some waterboards in the Netherlands provide subsidies, for example to motivate homeowners to decouple rainwater from the sewer system. In the region of Vorarlberg, Austria, the regional fire department developed a pilot on tailored expert advice that has been running in 2017. This project was somewhat similar to the pilots in Flanders but was not as successful as in Flanders. Although the project was not successful, the project leader, working for

Regional Firebrigade Association of Vorarlberg, can clearly point out why the project failed and how governments could help improve it in the future. According to the project leader, he had been discussing the idea of tailored advice for years with insurers and his fire brigade. However, a legal base for responsibility sharing was missing. *"We first had to find consensus on who should give the advice? Everyone replied with 'I cannot do that, my agency doesn't want to do that'. So it was a struggling action between fire service and public administration. There is no real legal setting, as it is so new. These discussions went on and on…"*. Moreover, training for flood risk experts on the household level does not exist in Austria. However, flood risk advice should be provided by a qualified expert. The project leader went to an education program in Switzerland *"and then I developed my own tool. A checklist, starting with, a catalogue of questions, then going to check the risks, tailored to the property. (…) So, for the implementation of a label you need to take care of a legal basis for the label, and you need licensed experts to visit the houses, and therefore you need an education program for these people"*. This description shows similarities with the institutional development of the discipline of water and civil engineering in the 19th century, for example at Rijkswaterstaat in the Netherlands or at the Military Academy in Vienna (see Chapter 6). This would mean that national governments could take on the responsibility of organizing and authorise experts advising homeowners, by the means of education programs and a legal base of responsibility shares.

A more direct role for governments in the development of a label or tailored expert advice also implies a possibility to organize and initiate couplings between the label or tailored expert advice on the one hand, and other actors, instruments, and themes on the other hand. Here, the Dutch Centre of Crime Prevention might offer some inspiration. The representative explains that, to certify a house, you need to educate and certify the expert to create trust among homeowners, and you need to certify the measures that could be implemented in a house to create trust among insurers so that they can provide discounts on insurance of well-protected houses. (According to the interviewee, insurances sometimes question the correct use of burglary prevention by the homeowner). Also, the Centre cooperates with fire departments, as experts check for fire alarms and general fire safety. Together, *"this gradually leads to a system of a certificate, control on correct execution and compliance control, based on an education programme to enable more people to carry out the inspection"*. In case of the Burglary Prevention Label, the Centre of Crime Prevention guarantees the quality of the certifiers for homeowners and provides the certifiers with new customers. This example shows how a label does not exist on its own, but is a result of the interactions between actors, resulting in agreements, mutual trust and a divide in responsibilities; resulting in new institutions such as education programs and multiple certificates; and resulting in new cooperation on multiple themes, in this case fire protection.

Similar to this example, in flood risk management among homeowners, a system between multiple actors, agreements, and themes is needed for the development of certified tailored flood risk advise or the introduction of a floodlabel. Governmental actors could have a directing role by bringing together new actors, and couple incentives such as subsidies to a certified house. The Austrian organizer of tailored advice suggests the involvement of national disaster funds to support the financing of PLFRA.

The Austrian *"…disaster fund and regional agencies responsible for the distribution of the disaster fund would be the perfect partner to do this, (…) but the Fund did not want to organize it this way"*. In the Netherlands, a wide range of incentives to apply in Dutch climate policies have been collected. As described in the previous chapter, the first experiments are currently taking place in a few municipalities. Examples of these incentives are exemptions on taxes, VAT-modifications, subsidies, organizing cost-sharing, crowdfunding, donations in kind, and organizing financing schemes for common investments. Also businesses can contribute with resilient loans, resilient mortgages or the previously mentioned modified insurance premiums (Bor & Meesters, 2018). According to the representative of Dordrecht: *"such subsidy schemes [exist] in other places in the Netherlands. Especially organized by the water boards"*.

Thematic couplings with other (climate) topics are already actively created in the municipalities of Rotterdam and Dordrecht. The representative in Dordrecht explains about the involvement of homeowners: *"We are already putting a lot of effort into this: What can green and blue do for you? Green gardens, digging extra blue in your little garden...not only for water retention, but also for storage during drought, or for urban heat, and we coordinate this"*. But in the development of new housing as well the municipality includes climate requirements related to urban heat, floods, and drought: *"This set of requirements includes green locations, rainwater storage, water draining, and we are demanding an escape route on the roof"*. Rotterdam would like to couple the information from labels with spatial plans, infrastructure works and maintenance: *"With regard to asset management, a label is ideal. There you can integrate all your long-term infrastructure works that a municipality manages. (…) If an entire neighbourhood has a low label, you could consider intervening as a government rather than letting the citizens solve it. You will then see opportunities or not to make certain investments in a neighbourhood, for example on the road"*.

To summarize, the involvement of homeowners in flood risk management requires new roles of governments as well. All governmental interviewees are aware of these changing roles, but act differently in their interactions with homeowners. The development of multiple tools, instruments and communication channels seems to be required, and a floodlabel or tailored advice could be one of the instruments for local governments to use in the communication with homeowners on flood risk management. A floodlabel can advise, encourage, inform, motivate, sell, collect information, reward people, and if the necessary effect has not yet been achieved, be linked to a certain financing scheme and even make it compulsory. This implies that the floodlabel cannot be a stand-alone instrument. Instead, couplings to other actors, instruments, and themes are needed to make the label more effective. Perhaps governments could have a directing role in creating these couplings.

7.3 Business

Business actors can have various roles and perspectives in flood risk governance in general, and in floodlabel in particular. When asking interviewees what business actors are involved or should be involved, and what their role is or could be, the answers vary. The representative of the municipality of Dordrecht refers to project developers *"as they can promote new housing projects as flood proof living"*. Housing cooperatives are mentioned by the interviewed municipalities, as well as by the representative of the Dutch Centre for Crime Prevention. Housing associations are made aware of their social role: *"we remind them of the social importance, point out that if residents have a good sense of safety, they make less use of the cooperative's other services, which in turn saves money"*. Moreover, through these organisations it is easy to target large parts of the housing stock within a municipality.

The interviewee that was involved in the development of the Energy Performance Certificate points at banks. "*Banks want to give you a higher mortgage if you can demonstrate that your house is energy-efficient, they will want to give you a higher mortgage, because then you will have less expenses. The same goes for a floodlabel. That label reduces flood damage which has a certain added value to the house. You have lower risks and lowers costs which could be rewarded with a lower mortgage interest rate and a lower insurance premium"*. The representative of the Dutch Advocacy Group for Homeowner Associations (In Dutch: VVE Belang) goes a step further and states that *"in the end, flood damage to a house is a problem of the mortgage banks. If a property gets destroyed, the collateral disappears. So it is up to the banks to take here a share of responsibility"*.

A third group is formed by the insurers. Although the insurance industry functions slightly differently in each of the floodlabel countries, the insurability of homeowners is in all countries on the agenda (see chapter 5). Insurers have a role in the recovery, but they can have a role in risk prevention at home as well. However, "recovery is prioritized over prevention" (O'Hare, White, & Connelly, 2016, p. 14), as risk is their source of income. Nevertheless, this role can turn more preventative. This role of insurers is, indeed, changing. Encouraging prevention is becoming an essential part of ensuring small-scale flooding and other forms of flooding. More and more technical options are available, and with simple solutions, housing owners and users can prevent a great deal of damage. Doors and windows can be sealed watertight. Insurers can distinguish themselves by responding inventively to this with their products and conditions. In the words of the representative of the umbrella organization of Insurers: "*there is a complete shift in the world of insurance going on, so that you will increasingly become an insurer as a service provider...so with certain maintenance contracts, prevention tips, discounts, subscriptions, etcetera"*. Specifically, on the role of insurers in the implementation of PLFRA measures, he states: *"I see a role for insurers there. Insurers can compete with each other on this.* Multiple interviewees point at the insurers to provide discounts for homeowners that have implemented PLFRA measures, similar to how it was described for mortgage banks. The representative of the umbrella organization of insurers agrees, but points at the narrow margins in the estimated costs charged by insurers to their customers. The low premiums form a limiting factor in combination with the strong

competition among insurers. *"As soon as you involve an expert on site, the costs become higher than the revenue. This is why so many insurances are automated. For example, with the Burglary Prevention Label, this requires extra phone calls among homeowner and the insurer, which already results in higher costs for the insurer"*. The representative of the Burglary Prevention Label confirms this story. *"Insurers need a different business model; sending specialists is expensive in the case of burglaries. The insurer's business model does not benefit particularly from the label, because of all the hassle, (...) they try to make money otherwise, for example by having their own locksmith's webshop"*.
To take a more preventive role and create a new business model, insurer Achmea started to develop its own flood certification for housing, so-called Bluelabel. As such it forms a variation on floodlabel. The Bluelabel primarily aims to inform homeowners of their risks. This communication should be easier to understand than the already existing flood maps. Another requirement was a dynamic nature of the label, as a changing landscape or infrastructure, and changing climate predictions all influence the modelling of the floods. Moreover, the label intends to couple upstream and downstream information, so that flood issues downstream can be solved with interventions upstream. Bluelabel also intends to couple with other risks, including heat, climate, or crime and burglary. This information can be sold to municipalities, so that they can use it to improve the quality of living in their municipalities.

All in all, market parties can also have a role in the involvement of homeowners in flood risk management. However, the form of resilience is not always aligned with the ambitions of floodlabel. This requires new roles and business models for existing actors. All parties can both contribute and benefit from participation. Banks and insurers can contribute through the development of new instruments and incentives, and couple these to other actors or a floodlabel. Housing cooperation and project developers can profit from flood-proof building as a branding tool.

7.4 Civil actors

There is an emerging role for citizens in flood risk management. Forrest (2020) described how citizens are not just passive recipients of flood risk information or advice. Literature has described the contributions of citizens in flood risk governance, including organizing flood action groups (Geaves & Penning-Rowsell, 2015) and setting up bottom-up initiatives (Seebauer et al., 2019). Citizens can contribute with physical actions, providing local knowledge and organizing advocating activities to adjust flood risk strategies (Forrest et al., 2020a).

Various interviewees have shared their experiences with citizen involvement. The municipality of Dordrecht specifically invites local communities to become involved in flood risk management. The municipality invests in willing groups rather than pushing the unwilling citizens. The representative provides an example: *"We provided information on how to reduce water in the gardens and basement. In one building block the inhabitants were enthusiastic and we have supported them in the process. This has led to the implementation of some flood risk measures in that building block, while in a* *neighbouring building block no measures are taken, even though homeowners of both building blocks have been struggling with wet feet"*. Later on, he continues: *"It makes no sense to push unwilling citizens. That is why we invest so much in the development of an enthusiastic network of neighbours, local associations and communities"*. This way, they seek to contact a variety of groups, such as Sustainable Dordrecht, that deals with sustainability and climate issues, or a garden association that could deal with more biodiversity issues, and even sport associations could be targeted. *"Recently a new colleague started working on this participation network for each neighbourhood in Dordrecht. She makes contact with local organisations, local people who can circulate information about the neighbourhood, and act as ambassadors, and we link this to subsidy schemes, or the distribution of free plants"*. These fragments illustrate how the municipality provides space for interaction and experimentation for citizens. Citizens can have an active role in flood risk governance. This also has its consequence in the design and use of floodlabel. The label could have a tendency to perceive homeowners just as passive recipients of policy and instruments. However, they can contribute by providing local knowledge based on previous flood risk experiences. Floodlabel should be open for such feedback contributions. This case study in Flanders showed an example of such feedback loops. Here an expert had a conversation about past flood experiences, before providing flood advice. For a floodlabel to contribute to flood risk management, flood label should embrace such bilateral relations between homeowner and flood risk management. By listening to and understanding a homeowner's motivations to bounce back or forward, a floodlabel can be more than an instrument transferring information. Here an expert can be a mediator, or the floodlabel itself.

Other civil actors, such as the housing associations, currently pay no attention to flood issues. They follow the topic of climate change sideways, but according to the representative of an advocacy group of housing owners (in Dutch: Vereniging Eigen Huis) in the Netherlands *"there are hardly any questions about [climate] in our call centre (...) climate is becoming more extreme, which means that customers can also get more inconvenience. Sooner or later they will come to us with questions such as: What could I have done, could I have approached my local authority about this? But now our target group is not asking for attention on this matter (...) As soon as our target group comes to the defence, we will take action"*. According to the representative of the Advocacy Group for Homeowner Associations his association should start informing, raising awareness and perhaps consider the organization of collectively purchasing rain barrels, a collectively purchasing infiltration crates, or providing mediation between government and housing associations to get financial arrangements or support. However, he confirms that current flood issues are not brought up in the call-centre. These organisations have other perspectives and interests and do not foresee a role for them in flood risk governance.

7.5 Discussion and Conclusion

Answering the question of what actors are conducive for the implementation of a floodlabel is not easy. Possible actors to involve are numerous, and have various roles, interests, and ambitions. Moreover, the actors and their roles and ambitions are situational. Civil society seems to be underestimated as a provider of possible actors. Moreover, the floodlabel instrument can have the tendency to treat homeowners as passive subjects. Nevertheless, the municipality of Dordrecht promotes interaction with civil groups. They can be involved in plan-making and provide local knowledge. This is also where floodlabel can benefit from and contribute to flood risk governance. It can be a mediator between citizens and flood risk management, being a platform for local flood risk knowledge, useful for both homeowners and municipalities.

Mees et al. (2019) already pointed out that citizen participation requires new and other roles for governments. When it comes to the introduction of an effective floodlabel, civil and market parties need to adapt their current behavior for a floodlabel to be more effective. Just to name of few of these alternative behaviors: local governments can use floodlabel data to assess flood risk on the building block or neighborhood level, insurers can become more preventive and advise on qualitative PLFRA, and representative organizations of homeowners can organize group purchases. So introducing tailored advice or a floodlabel is not a matter of homeowner and flood risk experts, but requires the involvement of ,many more actors to become effective rather than just informative. The answers of the interviewees show how some of the interviewees see opportunities to become involved and take new roles and responsibilities in flood risk management. Several municipalities try new strategies to involve citizens and therefore also change their own role and behaviour. The Dutch insurer developing a kind of floodlabel is an example of this. However, most interviewees have limited interest in other or additional roles in flood risk management, remain in their status quo, and prefer to go own with businesses as usual. Arguments that are mentioned include a lack of urgency or a lack of demand from clients (i.e. homeowners) who ask their representative to become involved; and other actors do not want to act first or alone and wait for their sector to show initiative. Here the inclusion of flood risk in insurance is an example. As long as the whole sector is not covering flood risk, an individual insurer will not include it. Some actors would like to take a new or other role, but feel restricted by other actors, or (not) existing institutions. We can refer here to the aforementioned lack of quality control for PLFRA and experts that exist for the Burglary Prevention Label. Moreover, insurers have a tendency to focus on recovery over prevention of damage. Therefore the resilience strategies are aligned with the ambitions of floodlabel. To get them on board, new business models need to take charge. Floodlabel does offer some opportunities by providing the PLFRA measures for homeowners. However, it remains hard to make couplings with other actors that contribute to a floodlabel. From a co-evolutionary perspective, these actors might contribute in a later stage of development. The previous chapter has illustrated that — if it suits the context — an informative floodlabel might be sufficient. However, oftentimes an informative tool would not do the trick. So, as long as a label will not find support in its development from more actors than the government, the effect of a floodlabel as a tool to improve resilience remains marginal.

8

TOWARDS THE OPERATIONALIZATION OF FLOODLABEL: CONCLUSIONS & IMPLICATIONS

8.1 Introduction: Multiple Shifts in Flood Risk Management

In a context of increasing flood risks, new paradigms in flood risk management and the introduction of new actors and instruments in the field of flood risk management are being developed. This thesis explored if and how flood risk management can benefit within this changing context from the introduction of a floodlabel for homeowners. In this final chapter the various discussions and conclusions of previous chapters are combined and used to reflect on the possible implementation of floodlabel and coherent governance arrangements for the involvement of homeowners in flood risk management. This chapter will offer recommendations for future flood risk management and research.

Increasing floods and flood risks

All over Europe cities experience more intense, more frequent, and more damaging flood events (Guerreiro, Dawson, Kilsby, Lewis, & Ford, 2018). On the one hand this is caused by the effects of climate change. Increased precipitation is leading to more pluvial and fluvial floods and sea level rise increases the flood risk in coastal zones (IPCC, 2014). On the other hand, more land becomes prone to flood risks (Field et al., 2012), and there has been an increased urbanization in flood-prone areas (Kundzewicz, 2019).

This study deals with flood risk as a complex problem (McClymont et al., 2019; Renn et al., 2011; Tempels & Hartmann, 2014). Moreover, the issue of motivating homeowners to implement PLFRA can be perceived as a complex issue, as it deals with a range of actors having diverse values and beliefs on climate change and risk. Therefore, they perceive flood risk management differently. To understand if and how a floodlabel can be useful for flood risk management, this dissertation uses an actor-relational approach to unravel the interrelated notions of risk, resilience, and multi-actor responsibilities on the behavioral change of homeowners.

From flood protection to flood risk management

The risk increase triggered a shift from flood protection to flood risk management, emphasizing an introduction of a risk-based approach (Hartmann & Juepner, 2014). This approach puts more emphasis on 'living with floods', indicating that traditional flood protection measures cannot always cope with residual risks (Restemeyer et al., 2017). In this way, flood risk management incorporates notions of resilience (Disse et al., 2020; Liao, 2012). Moreover, this implies governments are no longer solely regarded as responsible, but flood risk management becomes a 'shared responsibility' among multiple actors (Johnson & Priest, 2008; Meijerink & Dicke, 2008; Rauter et al., 2020). This means that flood risk management is becoming more of a co-producing (Mees, 2017) or co-evolving process between citizens and governmental authorities (Mees et al., 2016b).

This study has considered these developments in four project countries: The Netherlands, Belgium, Austria, and Germany. The flood risk management history of these four countries has been considered in order to clarify the possible effectiveness of floodlabel for each of the countries.

New actors and new instruments

To embody this risk-based approach, flood risk management has been diversified, and is evolving towards flood risk governance (Hegger et al., 2016). This results in the involvement of new actors and the development of new instruments to involve these new actors. New actors include civil society (Forrest et al., 2019; Seebauer et al., 2019; Snel et al., 2020), and new roles are taken on by existing actors. For example, insurers are adopting more of a preventive approach instead of a responsive one (Hudson et al., 2016). Moreover, it results in the introduction of new tools and instruments to inform, motivate, and bind these new actors to become involved in flood risk management. Both new actors and new instruments contribute to a behavioural turn in flood risk management (Kuhlicke et al., 2020b). Previous research has begun to explore these new instruments and include flood risk maps (Falconer et al., 2009), communication strategies (Attems et al., 2020b; Snel et al., 2019) and the introduction of property-level flood risk adaption (PLFRA) (Attems et al., 2020a). PLFRA can help to reduce flood risks at home and can be a part of a strategy in flood risk management (Attems et al., 2020a).

Against the backdrop of these new developments in flood risk management, this study focuses on the contributions of floodlabel to flood risk governance, by supporting homeowners to implement PLFRA. Researchers often used protection motivation theory (e.g. Botzen et al., 2019; Bubeck et al., 2012a) to explain a homeowner's decision-making process. However, this behaviour not only depends on internal, individual factors, but also external factors that potentially have a major influence yet have been less studied (Barendrecht et al., 2020). Therefore, this study analyses the external factors that determine if, and how, a floodlabel is an effective tool to involve homeowners, using an actor-relational framework of actors, factors and institutions (Boelens, 2018).

8.2 Motivating Homeowners

To understand if and to what extent homeowners become motivated to implement PLFRA measures at home, a pilot project of the VMM on tailored expert advice in Flanders was closely considered and served as an example instrument to motivate homeowners. Tailored expert advice is closely linked to the concept of floodlabel. Both instruments aim to inform and motivate homeowners about possible PLFRA measures at home, and advice is specifically tailored to the individual houses.

The case study shows that, thanks to the dedicated efforts of experts, 32% of the participating homeowners implement some PLFRA measures that were suggested by the experts. Another 15% of the homeowners have implemented all suggested PLFRA measures. Experts contributed to a sense of urgency and risk awareness among the homeowners. Moreover, the expert advice removed some barriers and helped homeowners to reduce flood risks. After the advice, homeowners knew better what PLFRA measures fitted to adapt their house, and how to implement these measures. Also, homeowners had more of an overview regarding the costs of PLFRA for their house. These are promising results for future pilot projects, and for floodlabel as well. However, the results also show how a large groups of homeowners are still reluctant to implement PLFRA measures. Homeowners mention how they will only implement PLFRA when their flood risk increases further. Others mention that a (local) government should act first. Also mentioned are the high costs of PLFRA with nods linked to a call for financial incentives or subsidies. What these arguments have in common is that they are all relational: relating to other actors, institutions, or to certain factors of importance. Therefore, we conclude that even more homeowners might consider the implementation of PLFRA measures when a more relational perspective is incorporated and practised. Instead of just considering the internal barriers of a homeowner, a greater effect of tailored advice can be sorted when looking from the outside inwards, by assuming that behavioural change can also be triggered by contextual and institutional changes, or through behavioural change of other involved actors. Based on these results, the floodlabel would also become more effective when contextual, institutional, and actor conditions are considered.

8.3 Factors as Conditions

Chapter 4 has shown how a focus on appraisals of the homeowner, from the inside out, does result in some behavioral change. However, considering the costs and efforts of tailored expert advice, the results can be improved. Therefore, an approach from the outside in has more of an effect. This relational approach tells us how a homeowner's behavior is influenced by (and is influencing) other actors from businesses and the public realm, as well as site-specific institutional settings and the environment of pluvial and fluvial floods, flood risk, etc. This co-evolutionary approach provides the explanations for how specific settings contribute (or do not contribute) to behavioral change of homeowners. So, a floodlabel can become more effective when considering and incorporating these contextual, institutional, and actor conditions.
An analysis of the contextual conditions teaches us that the usefulness of a floodlabel is strongly dependent on the flood risk. These flood risks can differ from place to place and over time. This implies that a floodlabel cannot be used as a one-size-fits-all label, generically across Europe.

A closer look at the factors that shape flood risk shows how these factors that shape risks and a floodlabel are related. Probability is influenced by climate issues, such as rainfall extremes and patterns. Exposure is influenced by hydrological and terrestrial factors such as catchment size and urbanization. Vulnerability is influenced by the factors from the socio-economical system.

Results illustrate how the usability of floodlabel depends on these factors. For example, exposure factors that shape a landscape influence if a floodlabel is useful or not. PLFRA measures, suggested within the floodlabel, are more useful in a context of small-scale pluvial and fluvial floods. Nevertheless, floodlabels can have a more informative role in large scale flood risks, such as in coastal deltas. Thus, certain contextual conditions indirectly shape how a floodlabel should function in certain regions. Based on the contextual factors, in countries such as the Netherlands, a floodlabel is more useful as an informative tool, because the Netherlands, characterized by coastal and large-scaled fluvial flood risk, deals with low probabilities but high exposure in case of a flood. Therefore it forms a contrast with the other floodlabel countries, where pluvial and fluvial flood risks tend to dominate (see figure 31). In these countries, PLFRA will be more effective due to the smaller scale of floods and the higher probability. In these countries, the floodlabel can be more motivating, or even binding (See table 11). For Germany it is harder to distinguish a specific configuration of the floodlabel, due to its scale in a larger variety of landscapes. Probabilities and exposure differ from region to region. This illustrates how floodlabel cannot entirely be linked to countries, but rather to specific regional landscapes.

All in all, based on these notions of risk, this PhD thesis illustrates that the usability of a label partly depends on the landscape. So, as landscapes across Europe differ, the constructions of risk, based on probability and impact, differ from landscape to landscape. Therefore, the function of a floodlabel could differ across various landscapes or even across countries.

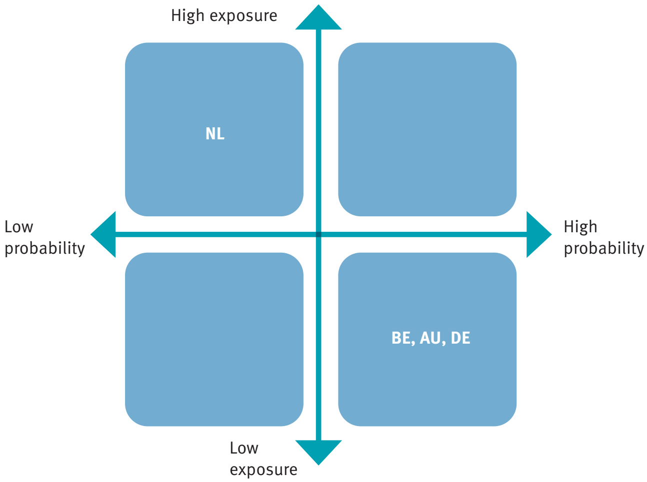


FIGURE 31: BASED ON PROBABILITY AND EXPOSURE A DISTINCTION BECOMES VISIBLE BETWEEN THE FLOODLABEL COUNTRIES. THESE DIFFERENCES HAVE IMPLICATIONS FOR THE CONFIGURATION OF THE FLOODLABEL IN THESE COUNTRIES.

8.4 Institutional Conditions

This dissertation also shows how differences in the institutional settings amongst the floodlabel countries influence the configuration and effectiveness of a floodlabel. Concepts of risk and resilience are interpreted differently across the countries and organization of flood risk management is sometimes predominantly national and sometimes more regional. Some of the countries offer a form of flood insurance while others do not. The perception of flood risk also differs, which is directly linked to the factors that shape risk. All countries went through an evolution from flood protection to flood risk management. However, as the directions of these evolutions slightly differed, the new strategies and instruments also differ. The Netherlands focusses on informing about risk, while Belgium and Austria have experiments that involve inhabitants more actively (See table 16).

TABLE 16: OVERVIEW OF INSTITUTIONAL CHARACTERISTICS THAT COULD INFLUENCE THE EFFECTIVENESS, USEFULNESS, AND DESIGN OF A FLOODLABEL.

	The Netherlands	**Belgium**	**Austria**	**Germany**
Conceptualization of Risk	Fully risk-based objectives, still dominant focus on probability reduction	Fully risk-based objectives	Strong focus on probability reduction	Strong focus on probability reduction
Governmental Responsibility	Centralized - National government and water boards	Regionalized - National (main rivers) and regional	Regionalized - National (high Alps & main rivers) and regional	Regionalized - National (main rivers) and regional
Risk Perception	Focus on coastal and fluvial risks	Focus on pluvial and fluvial risks	Focus on mountainous and fluvial risks	Focus on coastal, fluvial, and pluvial risks, depending on the region)
Availability of Flood Insurance	Not available	Common (part of home insurance)	No compulsory insurance	No compulsory insurance
Spatial Planning	Link to flood risk management	Link to flood risk management	Link to flood risk management	Link to flood risk management

These variations in institutional settings in the floodlabel countries also imply variations in the configuration of the floodlabel. When flood risk management is predominantly centrally managed by the government and insurance is not available (e.g. in the Netherlands) the possibility for a floodlabel making couplings with existing institutional settings is limited, and motivating and binding configurations of the floodlabel are harder to realize. However, an informative role of the floodlabel remains possible and might even be preferred for two reasons. As flood risk management is strongly a governmental responsibility, homeowners seem less aware of their own ability to act. An informative configuration of the floodlabel might be the best fit in this situation. In other countries, such as Belgium, it is already more common that flood risk management is partly a civil responsibility. Insurance is available, and the institutions are more dynamic, although there is more space for new initiatives and experiments.

However, independent of the institutional settings in each of the four countries, some suggestions can be made for floodlabel to become more useful when applied to an institutional context. Suggestions include:

- Couple with incentives to motivate homeowners to invest in PLFRA measures;
- Control mechanisms on the execution and effectiveness of the measures in place;
- Provide education for the expert offering flood risk advice or a floodlabel;
- Legally enforce aforementioned suggestions.

8.5 Actor Conditions

To trigger behavioral change among homeowners, other actors involved in flood risk management need to change their behavior. After all, the relational approach explains how the change of one actor causes change among another related actor. This means for floodlabel that involved actors from public, business, and civil backgrounds can all contribute to and benefit from floodlabel. Local governments can use floodlabel data to assess flood risk on the building block or neighborhood level, insurers can become more preventive and advise on qualitative PLFRA, and representative organizations of homeowners can organize group purchases.

However, the interviewees explained how a change in their behavior is not so straightforward. These actors perceive several diverse barriers. Arguments that are mentioned include a lack of urgency or a lack of demand from clients (i.e. homeowners); and other actors do not want to act first or alone and wait for their sector to show initiative. In this situation, less coupling to strengthen floodlabel is possible.

In fact, these interviews demonstrated how the deadlock between government and homeowners is not a deadlock between only these two actors, but the governance challenge stretches out over the whole actor field. Their behaviours are linked. Floodlabel as an intermediary — transferring information — would not do the trick. Instead, the floodlabel should also be able to get these actors interested and act as a mediator between these multiple actor groups, offering advantages for all who are involved.

8.6 Implementing Floodlabel

This dissertation has already illustrated how a co-evolutionary approach of actors, factors, and institutions contribute to homeowner behavior. Moreover, it has illustrated that a floodlabel should be an approach used while taking these actors, factors, and institutions into consideration. This leaves us with the final question of this research: "Does the introduction of a floodlabel contribute to flood risk governance? And if so, what contextual conditions are conducive for the implementation of a floodlabel?" Based on the results in this dissertation, we can list and explain some clues for operationalization:

- Floodlabel as situational condition planning;
- Anchoring the floodlabel in governance;
- The role of the expert.

Floodlabel as situational condition planning

The institutional designs influence the way citizens are, or are not, involved in flood risk management. This includes the effectiveness of a floodlabel in flood risk management. In Chapter 5, differences in the perceptions of risk, the conceptualization of flood risk management, the perceptions of floods among inhabitants, the institutional organizations, the involvement of market parties (especially insurance), and the role of spatial planning all contribute to various institutional settings across the project countries. These variations make it possible to apply certain floodlabel configurations and reject others. The Netherlands, having a strongly centrally organized government-dominated flood risk management and dealing with low risks and high impacts, is far from introducing a motivating or binding label, and first needs to inform her residents about their responsibility in flood risk management. On the other hand, countries such as Belgium and Austria, which are federally organized and deal with relatively high risks and low impacts, find more windows of opportunity to experiment with motivating and binding labels. These opportunities include raising flood awareness among homeowners as pluvial floods tend to happen every now and then, as well as a more dynamic flood risk governance (Mees et al., 2018; Rauter et al., 2020).

TABLE 17: CONFIGURATIONS OF THE FLOODLABEL FOR THE NETHERLANDS, BELGIUM, AUSTRIA, AND GERMANY

	The Netherlands	Belgium	Austria	Germany
Informative Label	X	X	X	Region-dependent
Motivating Label		X	X	
Binding Label		X	X	

Anchoring the floodlabel in governance

Moreover, for a label to become effective, the label should become institutionalized (see Figure 32). Details might differ depending on the configuration and local contextual settings of the label. However, this generally requires education of flood risk advisors. Future education of ‘the flood risk experts’ should therefore not only focus on technical engineering, but also explicitly pay attention to tailored communication. Moreover, we cannot speak of one type of expert, but multiple. When a floodlabel institutionalizes and a new system evolves, experts as well as advisors are needed to evaluate homes and to provide a risk-based label. Moreover an industry of PLFRA measures needs to exist and become accessible for homeowners, including a workforce available to install PLFRA at home. This requires, in return, auditors that are responsible for quality checks of PLFRA on site, installing companies, and flood risk advisors. Doing so, the quality checks add value and guarantee quality for this newly developed industry of PLFRA. These quality levels can be a prerequisite for governments to provide subsidies or certain permits, and for insurers to provide reduced premiums or insurance at all.

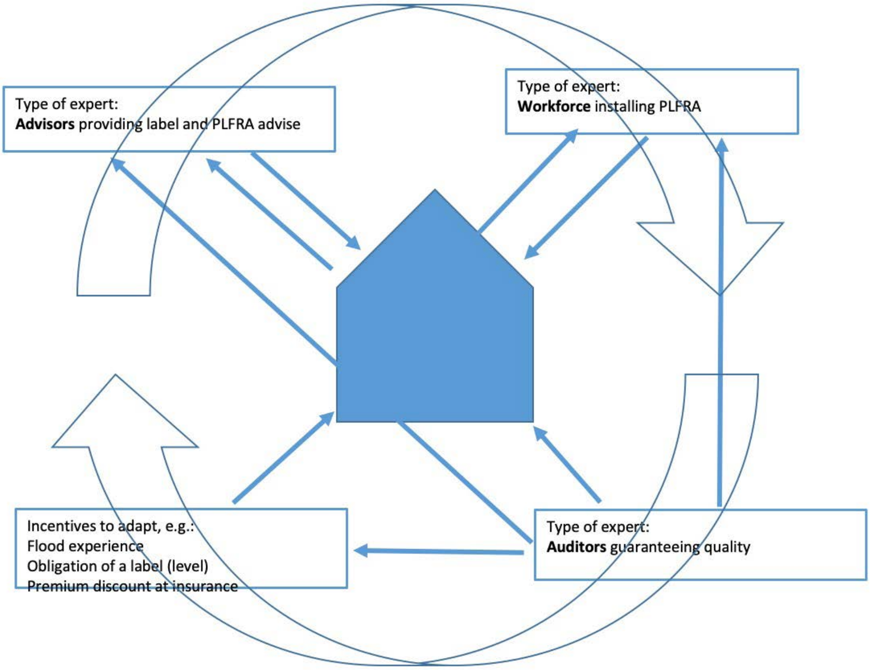


FIGURE 32: INSTITUTIONALIZATION OF FLOOD RISK EXPERTISE ON PLFRA

Returning to Flanders

Aforementioned suggestions remain somewhat abstract without applying these situationally. Returning to homeowner involvement in Flanders' flood risk management provides additional clues on implementing floodlabel in a more situational manner. The actor-relational settings of Flanders (see figure 33)[9] show a dominant focus on the actors and institutions. The contextual analysis has shown a dynamic flood risk governance, with space for actors to take up new roles and activities. Instruments such as recovery support and flood risk management strategies are developed and available. Also, actors beyond the traditional scope of flood risk management are involved.

Currently, the Flanders Environment Agency continues with tailored expert advice in municipalities that recently experienced floods. Although new pilots have been postponed due to the COVID-19 pandemic, a third pilot to advise c. 150 households will be running in the municipalities along the brooks of Zwalmbeek and Kerkebeek in the next year. Homeowners can now subscribe for participation. This instrument is part of a larger spectrum of instruments to involve citizens in Flemish flood risk management. For example, from January 2021 on the Agency contributes information on water management to the WoningPas (in English: Home Pass). This digital tool is developed by the Flemish government and aims to visualize the qualities and areas of concern of a property and can be useful in housing transactions. The Home Pass merges various information on a property, including energy use and isolation, building history, information on accessibility and distance to facilities, and recently has information on the water management of a property. From now on, this includes the water inspection certificates and sewer inspection certificates. A supplement with information on flood risks is currently under consideration. Even the results from tailored flood risk advice could be linked to the Home Pass.

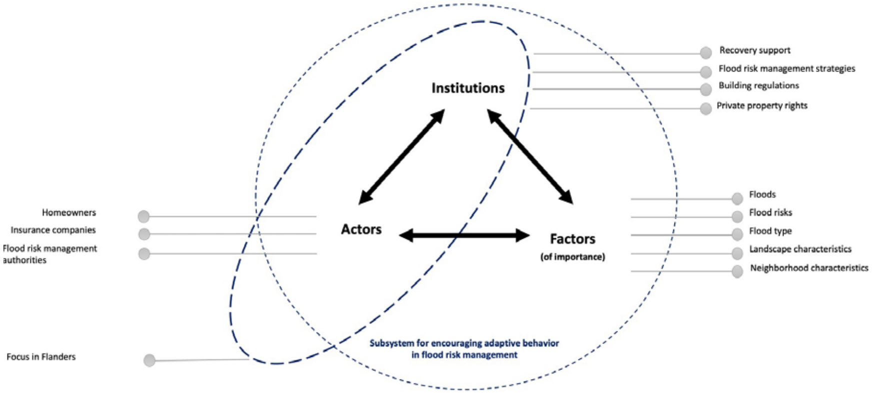


FIGURE 33: THE ACTOR-RELATIONAL SETTINGS OF FLOOD RISK GOVERNANCE IN FLANDERS

9 An adaptation of this figure also has been published as Davids and Thaler (2021)

Indeed, this contribution to the Home Pass shows similarities with the informative configuration of the floodlabel. In fact, the Flanders Environment Agency is expanding its informing strategy, and thus retains its responsibility in flood risk management. The information is non-binding and not explicitly motivational in its character. The instruments to involve homeowners remain limited to sermons, i.e. the Home Pass as a communicative instrument. No couplings are built, and the pass does not interact with other actors. It forms no incentive for other actors to change their behavior or even get involved in attracting homeowners, while the possibility does exist in Flanders. 'Carrots' and 'sticks' are not employed to incentivize the implementation of PLFRA measures. Even though the case study illustrated that the province and municipalities of Sint-Pieters-Leeuw and Geraadsbergen are offering some form of financial compensation for the implementation of PLFRA, this remains a local initiative and is not omnipresent. Together with new informative instruments, whether that is tailored expert advice or Home Pass or a floodlabel, initiating actors (in this case the Flanders Environment Agency) should also involve municipalities and provinces actively and structurally. Moreover, to motivate homeowners, the Flanders Environment Agency should also turn to insurers and suggest a redesign of the recovery schemes: one that is not only focusing on quick recovery, but also focusing on prevention as well (e.g. through PLFRA).

8.7 Reflections on this research

Reflections on resilience and floodlabel

Up to this point reflections on implementing a floodlabel in this chapter had a more instrumental approach. The strong focus on reducing vulnerabilities and enhancing the adaptive capacity is part of the concept of floodlabel, but the instrumental view on resilience which is the basis for the operationalization of floodlabel tends to overlook or ignore the underlying context that causes vulnerability, including the uneven power relations and structural inequity (Harris, Chu, & Ziervogel, 2018; Meerow, Pajouhesh, & Miller, 2019). On the instrumental viewpoint on new policy instruments Voß and Simons (2014) are cautious as innovative instruments produce unknown outcomes, including unexpected side effects. Therefore, implementing new instruments requires 'public scrutiny, critical debate and democratic decision as how they interfere with and transform the world' (p. 750). The concept of resilience also has political dimensions (Porter & Davoudi, 2012; White & O'Hare, 2014). Therefore, resilience should, in the words of White et al. (2018, p. 945) "be approached with caution [as well]; as whilst theoretically it has potential to depoliticize the dynamics of change in the harsh competition of practice it will bring both 'winners' and 'losers'". The instrumentalist approach of resilience leads to negative connotations and even resistance to the concept among communities (Davoudi, 2018).

Flood risk managers should also be cautious implementing floodlabel. The instrument could enhance the resilience of a city as a whole, but also emphasizes the 'winners', owning a flood-resilient property, and the 'losers', owning a property that cannot be flood proof. Floodlabel could widen the gap between the socially advantaged groups and the socially disadvantaged groups of homeowners. Floodlabel counts on the capacities of a homeowner, but not every homeowner is capable enough to be(come) resilient. Thus, questions of justice, fairness, and equity arise in flood risk governance (Slavíková et al., 2021; Thaler & Hartmann, 2016). Who benefits and who loses? And who should be supported with protection? The questions are highly political, and the floodlabel instrument inadequately addresses this political perspective on justice in homeowner involvement in flood risk governance. Ensor et al. (2021) notes that justice and equity in resilience is highly situational as it is distributed in a complex interplay of social, political, economic factors at multiple levels. The literature review of Slavíková et al. (2021) illustrates how socially advantaged households have higher physical damage (as this group usually has larger houses and higher monetary loses, however, socially disadvantaged groups suffer more from flood events and recover slower). Financial limitations can also result in regressive tendencies on the implementation of PLFRA. Here, subsidies for PLFRA implementations might offer a solution to contribute equally to flood resilience among homeowners. Also, a situational approach that investigates the differentiation in resilience can offer insight for further equitable resilience policies. This, however, is an avenue for further research.

Nevertheless, the issue of fairness and equity provides another argument as to why we cannot ignore the contextual sociopolitical factors when implementing a floodlabel. The use of labels in flood risk governance, or more general, the use of labels being part of sustainability transitions, is inherently political and are a result of shifts in flood risk governance. This research has illustrated how the development of the floodlabel is an outcome of a co-evolution itself, being a product of a web of complex interaction between actors, factors, and institutions in flood risk management. If governments were able to cope with risks, they would not make a call on the civil society. Moreover, these evolutions bounce back as well. The label also influences the context of flood risk governance. Floodlabel gets various meanings for different actors. Interpretations and interests can differ, which can lead to positive or negative evolutions towards implementation. Some homeowners will use it as a guarantee for being flood-resilient and perhaps use it as selling point on the housing market; other homeowners perceive it as a burden as it influences the value of their property. For insurers it can be a strategy to reduce the costs of flood recovery. For governments it can be a political strategy to improve flood resilience in a city or handling the uncertainty of flood risk, but floodlabel can also mean business or career opportunities for flood risk managers; for society it can be a solution to adapt to climate change.

By studying the interrelated practices of actors (potentially) involved in flood risk governance, these various roles of floodlabel become visible. For this reason, a situational approach, the context in which the floodlabel is being developed, cannot be ignored. The actors using the label, and their varying interpretations of the label contribute to the functionality of the label itself, as well as to the context of flood risk management: catalyzing new policies, new institutional settings and taking new actors into play. The effects of floodlabel, such as enhancing inequity through resilience, cannot be fully understood when ignoring these 'dynamics on the supply side of policy innovation' (Voß & Simons, 2014, p. 748).

Reflection on the implementation of PLFRA

This dissertation is constructed around the concept of PLFRA measures as solution for a homeowner's flood risk. Indeed, PLFRA measures help to reduce a homeowner's vulnerability, contribute to flood risk reductions (Attems et al., 2020a), and as such become a welcome complement to public flood protection measures (Kreibich, Bubeck, Van Vliet, & De Moel, 2015). However, a claim that the implementation always leads to less damage needs a critical reflection as well. The effectiveness of PLFRA depend on the flood type and flood dynamics (Proverbs & Lamond, 2017). The velocity of a flood increases the amount of debris, which could damage the PLFRA measures, or at least requires other PLFRA measures compared to a situation with groundwater flooding. PLFRA measures also require correct usage and maintenance, otherwise the damage-reducing effect can be limiting. The case study in Flanders showed how the experts emphasized the importance of correct usage and tried to tailor the PLFRA to the behavior of the homeowners. Moreover, PLFRA promotes only a limited sense of security. PLFRA reduces damage, but it cannot reduce risk to an absolute minimum. There always remains a residual risk. In contrast these measures contribute to a perception of safety among homeowners, contributing to the dike paradox (Hartmann & Spit, 2016) or escalator effect (Parker, 1995), where risk reductions invite further investments at home leading to an increase of exposure (and thus increase risk again). This escalator effect also accounts for governmental actors that feel invited to keep on investing in the flood-prone area, after embracing PLFRA in a flood-prone neighborhood. Finally, implementing PLFRA is not getting to the root of the problem of risk. Homeowners are managing and normalizing the same risk as the currentsociety is producing (Beck, Lash, & Wynne, 1992). PLFRA measures do not reduce probability and exposure but is only able to reduce vulnerability. PLFRA cannot function without a set of flood risk strategies that include protection and prevention that reduce the causes of risk. Causes of flood risk should also be solved upstream (e.g. Thaler et al., 2016), by reducing paved surfaces for green space or impermeable pavements (England & Knox, 2015), reconsidering further urbanization and other land use changes that reduce green space (Akter, Quevauviller, Eisenreich, & Vaes, 2018), or even evaluating the causes of climate change. Consequently, PLFRA measures are after all end-of-pipe solutions, being strategically promoted using the problem discourse of residual risk. However, when used in an optimal mix of protection, prevention, and other preparedness measures, PLFRA do contribute in cost-efficient ways to flood risk reductions.

Theoretical Reflections

This research has shown its relevance for society as it provides clues on how to involve homeowners in flood risk governance, by means of a floodlabel. There is only limited empirical knowledge available on the involvement of civil actors in flood risk governance. The research has been able to illustrate that, to trigger homeowners to implement PLFRA measures, a floodlabel is needed that is tailored to the local regional settings. Moreover, the relational approach has illustrated how other actors in flood risk management need to adapt, to trigger the desired adaptive behavior.

This dissertation has developed a situational approach to homeowner involvement in flood risk governance. By combining conceptualizations of risk (Klijn et al., 2015), resilience (Davoudi et al., 2012; Folke, 2006), co-evolutionary governance to flood risk management (Beunen et al., 2016; Tempels, 2016) and the actor-relational approach (Boelens, 2018, 2020), this research is able to move beyond a focus on socio-psychological mechanisms to involve homeowners in flood risk governance, using e.g. protection-motivation theory (Rogers, 1975). The situational approach includes the interplay of actors, factors, and institutions that also influence a homeowner's decision to become involved in flood risk governance and implement PLFRA measures, and are also being influenced by the homeowner's decisions. This theoretical lens is able to find structure in the complex web of interactions between actors, factors, and institutions. By taking a relational stance, this research is able to collect the conditions for a floodlabel to become operational, as well as able to question the motives and positioning of the floodlabel in relation to the actors introducing and using it.

Nevertheless, when reflecting on the theoretical frame and its elements, some critical remarks need to be faced.: in the first place, resilience. Meerow and Newell (2019) summarized three theoretical critiques based on a literature review. First, the concept remains fuzzy and ambiguous, and for this reason difficult to operationalize and materialize. This dissertation struggles todefine resilience and operationalizing as well, and we noticed how a resilient system is not necessarily a homeowner's resilience. Moreover, in the case of flood risk management it has a tendency to transfer risk instead of reducing it. This leads to, as already mentioned in the previous paragraph, undesirable inequities as side-effects of resilience transformations. A third critique points out a somewhat passive acceptance of disruptive events, instead of dealing with or solving the underlying causes of these disruptive events. This also came when discussing PLFRA as solutions for flood risk. However, by including the co-evolutionary and actor-relational approach, the critique gets somewhat countered. These relational notions in this research have illustrated that the relation of floodlabel is a reciprocal relation. The actor-relational approach is able to render actors and their (expected) roles visible (Boonstra, Boelens, Staessen, & Davids, 2020), and as such able to raise and discuss questions on whose resilience is prioritized, who defines resilience, etc. Flood risk management actors influence homeowners through the label, but the homeowners and the label also require new roles for traditional flood risk management actors. This mutual relationship illustrates that flood risk management cannot expect a transfer of risk. However, using the actor-relational approach has led to some flaws in this research. As the approach does not recognize an apex or center, it is impossible to gain an overview of a situation. Instead, the approach uses actors, factors, and intuitions to trace or clarify occurring co-evolutions, or conditions that are needed for desired directions of co-evolutions. However, this also leads to the question: when is a complex problem fully deconstructed? Or, when do we know enough to draw a conclusion? Without an overview it is hard to measure the quality of gathered knowledge. It is easy to overlook the less visible or non-active actors, factors, and institutions in the complex web of interactions. However, a relational approach is an added value to the resilience literature, as well as an added value when analyzing new instruments such as floodlabel. It makes it possible to move beyond an instrumental evaluation of a new instrument. Together these theoretical notions provide a framework to study the introduction and becoming of a floodlabel. Through the situational analysis of the interrelated practices of multiple actors from government, civic, and market this research has been able to render the functional and structural qualities of the floodlabel.

8.8 Overall Conclusions

A floodlabel is a multi-faceted instrument. It aims to inform on risk, on risk reduction, and on needs that motivate homeowners to adapt. The main question of this PhD thesis — "Does the introduction of a floodlabel contribute to flood risk governance? And if so, what contextual conditions are conducive for the implementation of a floodlabel? " — can indeed be answered with a yes, but the conducive conditions are situational, and differ from place to place, over time. This requires variations in the configurations of the label and depends on the risk and pursued forms of resilience. Some configurations of the floodlabel are more effective in certain contexts, while some of these elements function in any context. A floodlabel can be useful when the instrument is tailored to the local context of factors, actors, and institutions. The flexibility of the configuration of a floodlabel should be emphasized, as it could create a larger effect when it is tailored to the needs within the system of flood risk management for a specific country. Perhaps, we should even consider a regionally tailored label, as the context, actors, and institutions can differ within regions, provinces, and Länder. For example, in Belgium, this could mean that a label along the rivers is different in calculation and effect, as compared to a label for areas struggling with more pluvial flood risks.

When understanding floodlabel as a relational instrument, it is possible to deploy the label to evoke change at the system as well. From that point, one should focus on the dynamic actor-relational interactions between these actors in flood risk management. According to Boelens (2018), institutional innovation occurs under the influence of subsystems, through irritations and interpenetrations from the outside in. The development of floodlabel as an instrument to communicate between a diverse range of actors, as described in the previous paragraph, could be these 'irritations'. The interpenetrations however, go even further. McClymont et al. (2019) suggest that a "fluid frontier" between top-down and bottom-up flood risk management is needed to boost a co-evolutionary process. A floodlabel combines top-down technocratic suggestions with local know-how of homeowners and their flood experiences. As a consequence, this could contribute to the redistribution of responsibilities among homeowners in flood risk management. These responsibilities should be shared among e.g. 'water managers, spatial planners, emergency planners, the insurance sector and citizens' (Mees, 2017, p. 144; Mees et al., 2016b). The floodlabel could contribute to a co-evolving resilient process of becoming, contributing to a continuous and gradual transformation of existing structures and interactions among actors in flood risk management.

The question towards operationalization —*"How can a Floodlabel be implemented in flood risk governance in order to stimulate adaptive behavior among homeowners?"* —

cannot be straightforwardly answered. This research has illustrated how floodlabel as an instrument has multiple appearances that should be situationally applied, finding a fit between the resilience of flood risk management and homeowners. Implementation also requires caution, as the outcomes of the instrument are unknown. Moreover, floodlabel is just one tool out of many that is needed for resilient flood risk management. Floods need a multi-actant approach. As such, a floodlabel is just one instrument in a larger palette of instruments that complement one other. Large scale technical developments, emergency plans, adapted spatial planning, and even education, all complement each other.

Besides, governments cannot use a floodlabel to transfer responsibility to citizens without taking their own responsibility and showing these actions. The redistribution of the risk is not just a tale of government and citizens. New roles for citizens imply new roles for governments too. Floodlabel is not a tool to move responsibility towards citizens but could be an instrument to mediate on these responsibilities. Governance arrangements for floodlabel should therefore specifically search for collaborations with multiple parties. These new relations strengthen the co-evolutionary path towards flood resilience. However, current developments do not yet show examples of floodlabel as a co-evolutionary mediator. A floodlabel (e.g. the tailored advice) could provide a firmer negotiation position between homeowners and insurance companies when discussing insurance premiums for flooding. To use the flood risk advice in negotiations with insurance companies, the project should also address these market parties to find out under what conditions these parties would like to modify insurance premiums.

APPENDICES

APPENDIX 1

Questions for the Semi-Structured interviews with Homeowners Participating in VMM-pilot

Topics & Questions

1. **Experiences with high water.**
    - What is your experience with flood damage?
        - When did you last experience flooding? Does it happen often?
        - What effect did it have on you and your house? What kind of damage did you experience?
    - What did you do to limit the damage? Before, during, and afterwards?
    - What is the mental impact of the floods? How does it change your daily life?
    - Do you have flood insurance? Did the floods lead to premium increases at the insurance company?

2. **Motivation to participate in technical advice**
    - How do you know about this initiative of the VMM? Why do you participate?
    - What is the reason to participate in this advice?
    - What do you expect from this project?
    - What measures have you been advised to take?
    - What will you do with the advice/result of this project? And on what timescale?
    - What would be an extra incentive for you to take measures?
    - What are you willing & able to invest in water protection measures?

3. **Risk perception**
    - Were you aware of the flood risks when you moved into your home?
    - What do you know too little about? What information do you need regarding flood risks?
    - Have you already looked for solutions to limit flood damage?
        - What did you run into? What do you need in order to take measures against flooding yourself? Information, network, money, etc.
    - Are you considering moving? If yes, under what conditions? If not, why is this not yet an option for you?

4. **General questions residents**
    - Age of residents
    - Number of occupants
    - How long have you lived in this house?
    - Why do you live here, in this house?

APPENDIX 2

Anonymized overview of the interviewed homeowners

Anonymized Name: #1
Flood experience: 5
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Seeks confirmation in own ideas, looks for more trustworthy advice than from constructors.
Reflections on the advice: Enthusiastic about the advice. The advice was useful as a first introduction on PLFRA for the homeowner

Anonymized Name: #2
Flood experience: 3
Flood risk according to risk map (no risk / possible / at risk): no flood risk
General attitude towards expert: Seeks confirmation in own ideas, looks for more trustworthy advice than he received so far from constructors.
Reflections on the advice: Hesitating, worried about the costs. Installing PLFRA strongly depends on a personal costs-benefit analysis. Homeowner expects the expert to provide input.

Anonymized Name: #3
Flood experience: 3
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Homeowner expects some suggestions for contractors, as well as suggestions for subsidies.
Reflections on the advice: Would like to take action as soon as possible, but with help of municipality (subsidies). Homeowner is content with all new information on possible solutions. Advice forms a starting point for further action, but homeowner is also curious about subsidies.

Anonymized Name: #4
Flood experience: 3
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Homeowner uses contact with expert to discuss his ideas for PLFRA.
Reflections on the advice: Homeowner emphasizes that both municipality and homeowner can and should act. Therefore, he only implements PLFRA if the municipality takes further action in the direct surroundings of his house. Some problems cannot be solved on his land and house. Nevertheless, the homeowner appreciates the initiative of the VMM and perceives the organizations of the pilots as a first step towards a collective solution.

Anonymized Name: #5
Flood experience: 1
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Curious, open. Struggling with where to get 'the right people' for the job
Reflections on the advice: Homeowner would like to receive neutral effective advice. Construction companies never have been able to solve the flood issue.

Anonymized Name: #6
Flood experience: 1
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Homeowner is critical in the role of the government, and uses the interaction with the experts to continue the discussion between homeowner and municipality.
Reflections on the advice: Experts confirmed that the homeowner cannot reduce the flood risks, and that the municipality should act here.

Anonymized Name: #7
Flood experience: 7
Flood risk according to risk map (no risk / possible / at risk): possible flood risk
General attitude towards expert: Homeowner hoped to receive more information about the costs of PLFRA
Reflections on the advice: Homeowner looks for a cheap but successful solution, but struggles with contradicting information from 'other' parties

Anonymized Name: #8
Flood experience: 2
Flood risk according to risk map (no risk / possible / at risk): no flood risk
General attitude towards expert: Homeowner is already well-informed about possible PLFRA for the house and asks the experts for the perfect fit.
Reflections on the advice: The homeowner is disappointed in the advice, as nothing new was learned.

Anonymized Name: #9
Flood experience: 2
Flood risk according to risk map (no risk / possible / at risk): no flood risk
General attitude towards expert: Homeowner would like to receive confirmation on the PLFRA he already implemented.
Reflections on the advice: The homeowner takes flood risk seriously and is willing to adapt the house. In fact multiple PLFRA measures have been implemented already.

Anonymized Name: #10
Flood experience: 1
Flood risk according to risk map (no risk / possible / at risk): at risk
General attitude towards expert: Homeowner is critical in the role of the government and uses the interaction with the experts to continue the discussion between homeowner and municipality.
Reflections on the advice: The homeowner is curious about the advice, but also convinced that government should do better. Meanwhile the homeowner already implemented some PLFRA measures.

Anonymized Name: #11
Flood experience: 12
Flood risk according to risk map (no risk / possible / at risk): at risk
General attitude towards expert: Homeowner is an enthusiastic participant, already took action, and is now looking for the best solutions as a final piece. The homeowner also wants confirmation from an expert of actions taken
Reflections on the advice: The homeowner emphasizes how each house needs various solutions. Therefore appreciates the strategy of the VMM.

Anonymized Name: #12
Flood experience: 8
Flood risk according to risk map (no risk / possible / at risk): no risk
General attitude towards expert: Homeowner is looking for simple affordable solutions. Is willing to take action, but does not know what.
Reflections on the advice: The homeowner wants to know who to contact for the implementation of PLFRA and would like to start as soon as possible.

Anonymized Name: #13
Flood experience: 8
Flood risk according to risk map (no risk / possible / at risk): no risk
General attitude towards expert: Homeowner is already motivated, impressed by the efforts of VMM; but does not know where to start.
Reflections on the advice: The homeowner wants to know who to contact for the implementation of PLFRA and would like to start as soon as possible.

APPENDIX 3

Questionnaire for participants of tailored advice

Enquête Overstromingsrisico & Technisch Advies

Respondent-nummer:

Belangrijke Toelichting

Waarover gaat de vragenlijst?

U heeft voorafgaand aan de uitgifte van deze enquête een technisch advies ontvangen van de Vlaamse Milieu Maatschappij (VMM) i.v.m. de overstromingen in uw huis. De vragenlijst gaat over 1. het overstromingsrisico van uw huis; 2. het technisch advies dat u heeft ontvangen; en 3. over een overstromingscertificaat voor woningen, voortbouwend op advisering zoals u deze heeft ontvangen. Deze enquête is géén evaluatie van het technisch advies en niet opgesteld door de VMM, maar opgesteld door de Universiteit Gent. Het kan zijn dat enkele vragen overlappen met eerdere vragen van de VMM.
De opbouw van de vragenlijst is als volgt:

1. Algemene vragen over u en uw huis
2. Uw ervaring met overstromingen en wateroverlast
3. Over de periode voorafgaand aan het bezoek van de experts, voorjaar 2017
4. Over het technisch advies dat u heeft ontvangen
5. Over de periode ná uitgifte van het advies (winter 2018)
6. Over de ontwikkeling van een overstromingscertificaat

Wie moet deze vragenlijst invullen?

De persoon aan wie deze vragenlijst is uitgegeven en tevens het technisch advies in ontvangst heeft genomen. De vragen dient u **persoonlijk** te beantwoorden.

Hoe vult u de vragenlijst in?

- Vul bij iedere vraag **iets** in. U hebt altijd de optie om “geen mening”, “weet ik niet” of “anders” in te vullen. Een vraag zonder antwoord is ongeldig.
- Bij sommige vragen en antwoorden staat aangegeven wanneer u een vraag mag overslaan. Volg de hiervoor in ***CURSIEF*** aangegeven instructies naast de vraag of het antwoord.
- Tenzij anders aangegeven, vult u één antwoord in per vraag.
- De enquête neemt ongeveer 15-20 minuten in beslag

Retourneren van de vragenlijst

De vragenlijst kunt u direct invullen en **teruggeven aan de onderzoeker**. Vult u deze liever thuis in, dat kan. Laat u dan uw adres achter bij de onderzoeker. In dat geval wordt deze vragenlijst **thuis opgehaald op 23 óf 24 februari**, omstreeks het afgesproken tijdstip. Indien u niet thuis bent, zal de onderzoeker u enkele dagen later opnieuw bezoeken. Tenslotte kunt u de vragenlijst ook **terugsturen** naar: Peter Davids, Sint-Pietersnieuwstraat 41 B2, 9000 Gent.

Bescherming van privacy

Uw antwoorden worden volledig anoniem verwerkt. Individuele antwoorden worden niet gepubliceerd, enkel de samengevoegde antwoorden van een grote groep mensen. Voor het onderzoek zouden wij graag uw Technisch Advies, uitgegeven door de VMM inzien. Dit mag echter niet zonder uw toestemming. Daarom vragen wij hieronder om uw handtekening als u instemt met inzage voor het onderzoek.

Inzage in overstromingsrapportage:

Mag de onderzoeker, in overleg met de Vlaamse Milieu Maatschappij, uw technisch advies inzien bij de verwerking van de volgende vragenlijst? Nogmaals benadrukken wij dat al uw gegevens volledig anoniem blijven. Individuele gegevens zullen niet worden gepubliceerd, enkel de samengevoegde gegevens van een grote groep mensen.

Naam: ……………………………………………………………………………………

Adres (straat + huisnummer): ……………………………………………………………

……………………………………………………………………………………………

Dossiernummer bij VMM (vb. SPL-168) ……………………………………………

Uw Handtekening **Datum**

……………………………………………………………………………………………

Vragen?

Voor vragen in verband met deze enquête kunt u contact opnemen met Peter Davids via: peter.davids@ugent.be of 09 331 32 60

Wij danken u voor uw medewerking!

Deel 1: Algemene vragen

1.1 Wat is uw geslacht? ☐ Vrouw ☐ Man

1.2 Tot welke leeftijd groep behoort u?
☐ 18-29
☐ 30-39
☐ 40-49
☐ 50-59
☐ 60-69
☐ 70+

1.3 Wat is uw woonsituatie?
☐ Alleenstaand met kind(eren)
☐ Samenwonend zonder kind(eren) –› ga naar vraag 1.5
☐ Samenwonend met kind(eren)
☐ Alleenstaand -› ga naar vraag 1.5

1.4 Hoeveel inwonende kinderen zijn er in uw gezin in de volgende leeftijdscategorieën?
0-6 jaar: ….
7-12 jaar: …….
13-18 jaar: …….
18+:…….

1.5 Wat is uw hoogst genoten opleiding?
☐ Geen Diploma
☐ Lagere School
☐ Lager Middelbaar
☐ Hoger Middelbaar
☐ Bachelor / gradulaat / A1
☐ Master / licentiaat
☐ Anders, namelijk: ………………………………………

1.6 Welke situatie is het meest op u van toepassing?
☐ Een vaste job, voltijds (40 of meer uur per week)
☐ Een vaste job, deeltijds (39 of minder uur per week)
☐ Een tijdelijke job, voltijds (40 of meer uur per week)
☐ Een tijdelijke job, deeltijds (39 of minder uur per week)
☐ Werkloos
☐ Student
☐ Gepensioneerd
☐ Arbeidsongeschikt
☐ Werkzaam in het huishouden
1.7. Hoeveel jaar woont u in dit huis? ……………………………………………….

1.8 Welk jaar is de woning gebouwd? Als u het niet weet, vul dan een benadering in
………………………

1.9 Wat voor woning is het?

- ☐ Rijwoning
- ☐ Losstaande woning
- ☐ Half losstaande woning
- ☐ Bungalow (één verdieping)
- ☐ Appartement - Gelijkvloers
- ☐ Appartement – Bovenverdieping
- ☐ Caravan / woonwagen
- ☐ Anders, nl. ……………………………….

1.10 Bent u eigenaar of huurder? ☐ Eigenaar ☐ Huurder

1.11 Inkomen van uw gezin

Met uw gezin bedoelen we alle familieleden die onder hetzelfde dak wonen. Onder uw gezinsinkomen vallen beroepsinkomen (werknemersbezoldiging, vervangingsinkomsten, pensioen, etc.), inkomsten uit onroerende goederen (kadastraal inkomen, huur) en diverse inkomsten (kinderbijslag, alimentatie etc.).

- ☐ minder dan €1000
- ☐ tussen €1000 & €1999
- ☐ tussen €2000 & €2999
- ☐ tussen €3000 & €3999
- ☐ tussen €4000 & €4999
- ☐ tussen €5000 & €5999
- ☐ tussen €6000 & €6999
- ☐ tussen €7000 & €7999
- ☐ meer dan €8.000
- ☐ Zeg ik niet.

1.12 Welke nationaliteit heeft u op dit moment?

- ☐ Belgisch
- ☐ Anders, namelijk…..

1.13 Welke nationaliteit had u bij de geboorte?

- ☐ Belgisch
- ☐ Anders, namelijk…..

1.14 Welke taal spreekt u thuis hoofdzakelijk?

- ☐ Nederlands
- ☐ Frans
- ☐ Engels
- ☐ Duits
- ☐ Anders namelijk….

Deel 2: Ervaringen met overstromingen & wateroverlast

2.1 Hoe vaak heeft u overstromingen of wateroverlast gehad sinds u er woont? ....

2.2 Hierna volgen enkele vragen over verschillende individuele overstromingen. Vul het jaartal in. Indien u het niet precies weet, vult u het jaartal en waterstand bij benadering in. Indien uw woning meer dan drie maal overstroomde, vul dan <u>de drie zwaarste overstromingen</u> in

Jaartal	....	....	....
Welke delen van het huis zijn overstroomd geweest? Vul tevens de waterhoogte bij benadering in centimeters in bij overstroming in huis (meerdere antwoorden mogelijk)			
Woning (gelijkvloers)	☐ ………cm	☐ ………cm	☐ ………cm
Kelder	☐ ………cm	☐ ………cm	☐ ………cm
Tuin	☐	☐	☐
Anders, namelijk ……………………………………………………………	☐	☐	☐
Hoeveel materiele schade was er?			
geen	☐	☐	☐
Tussen de €1 en €999	☐	☐	☐
Tussen de €1000 en €4999	☐	☐	☐
Tussen de €5000 en €9999	☐	☐	☐
Tussen de €10.000 en €49.999	☐	☐	☐
Tussen de €50.000 en €99.999	☐	☐	☐
Meer dan €100.000	☐	☐	☐
Wie heeft de schade betaald? (Meerdere antwoorden mogelijk)			
U zelf	☐	☐	☐
brandverzekering	☐	☐	☐
Gemeentelijk fonds	☐	☐	☐
Rampenfonds	☐	☐	☐
Andere, namelijk …………………………………………	☐	☐	☐
Weet ik niet	☐	☐	☐

2.3 Kent u de oorzaak van de overstroming? Meerdere antwoorden mogelijk
- ☐ Overlopende rivier/beek/kanaal/bekken
- ☐ Hevige regenval
- ☐ Niet/slecht slikkende riolering
- ☐ grondwater
- ☐ weet ik niet

2.4 Hebt u een brandverzekering die overstromingsschade dekt?
☐ Ja ☐ Nee -> *Ga naar vraag 2.6*

2.5 Hoeveel bedraagt uw jaarlijkse brandverzekeringspremie
- ☐ Minder dan €100
- ☐ Tussen de €100 en €199
- ☐ Tussen de €200 en €299
- ☐ Tussen de €300 en €399
- ☐ Tussen de €400 en €499
- ☐ Tussen de €500 en €599
- ☐ Tussen de €600 en €699
- ☐ Tussen de €700 en €799
- ☐ Tussen de €800 en €899
- ☐ Tussen de €900 en €999
- ☐ Tussen de €1000 en €1249
- ☐ Tussen de €1250 en €1499
- ☐ Meer dan €1500
- ☐ Weet ik niet of wens ik niet te delen

2.6 Als u praat over de overstromingen met uw buren en familie, waar spreekt u dan over?
- ☐ vooral over schade en ervaringen met overstromingen
- ☐ vooral over mogelijke oplossingen om schade te voorkomen
- ☐ vooral over succesvol uitgevoerde oplossingen
- ☐vooral over gezamenlijke aankoop van beschermende maatregelen
- ☐ wij spreken niet over de overstromingen

2.7 Van wie krijgt u hulp tijdens en vlak na een overstroming? (vb: meubels tijdig versjouwen & schoonmaakwerkzaamheden) Meerdere antwoorden mogelijk
- ☐ ik krijg hulp van buren
- ☐ ik krijg van familie
- ☐ ik krijg hulp van de brandweer
- ☐ Ik krijg geen hulp
- ☐ Anders namelijk………

2.8. Hieronder volgen een aantal uitspraken. Wat is hierover uw mening? Kruis aan wat voor u van toepassing is. Duid per rij één antwoord aan

	Helemaal eens	**eens**	**neutraal**	**Oneens**	**Helemaal oneens**	**Weet niet/ geen mening**
Ik ben verantwoordelijk een oplossing te vinden voor overstromingsrisico's van mijn huis						
Bepaalde bevolkingsgroepen of buurten zijn meer verantwoordelijk voor hun overstromingsrisico's						
Mijn buurt is gezamenlijk verantwoordelijk voor de overstromingsrisico's van onze huizen						
De overheid is het best in staat om een oplossing te vinden voor de overstromingen van mijn huis						
Ik ben altijd op de hoogte geweest van het overstromingsrisico van mijn huis						
Ik ben bereid om zelf de overstromingsrisico's in mijn huis op te lossen						
Vooral de overheid is verantwoordelijk voor de overstromingsrisico's van bepaalde bevolkingsgroepen of buurten						
Bepaalde bevolkingsgroepen of buurten zijn minder belangrijk voor de overheid						

Deel 3: De periode vóór het technisch advies van de VMM

3.1 Heeft u in het verleden zelf gezocht naar oplossingen?

☐ Ja ☐ Nee -> *Ga naar 3.4*

3.2 Waar heeft u deze oplossingen gevonden? Meerdere antwoorden mogelijk

☐ Via buren omgeving met wateroverlast
☐ Via buren zonder wateroverlast
☐ Via Familie
☐ Via de gemeente
☐ Via de Vlaamse overheid
☐ Van een schade-expert via verzekeraar
☐ Aannemer (vb: Technieker, Loodgieter, Grondwerker, Klusjesman)
☐ Doe-het-zelfwinkel / Bouwbedrijf
☐ Online bronnen
☐ Andere, namelijk…………..

3.3 Welke bouwkundige oplossingen heeft u overwogen?

Meerdere antwoorden mogelijk

☐ omhoog brengen gelijkvloers bouwpeil
☐ dijkje rond woning
☐ Waterbuffer, vb. een vijver
☐ leefruimte op hogere verdieping
☐ overstroombare kelder
☐ wegneembare schotten voor ramen en deuren
☐ waterdichte buitenmuren (spouwgaten dichten, speciale coating, bepleistering etc)
☐ noodstroomgenerator
☐ Terugslagkleppen op waterafvoer, waterdichte deksel op putten
☐ afkoppeling regenwater van riolering
☐ Andere, namelijk………………………………………

3.4 Welke bouwkundige oplossingen tegen overstromingen waren al aanwezig in uw huis vóór de advisering door de VMM, zomer 2017? Links duidt u aan welke oplossingen aanwezig waren. Rechts duidt u aan wanneer deze werken zijn uitgevoerd.	**Reeds aanwezig bij koop/huur van het huis**	**Zelf uitgevoerd vóór de advisering van de VMM**
Ophoging van het gelijkvloers bouwpeil	☐	☐
dijkje rond woning	☐	☐
Waterbuffer, vb. een vijver	☐	☐
leefruimte op hogere verdieping	☐	☐
overstroombare kelder	☐	☐
wegneembare schotten voor ramen en deuren	☐	☐
waterdichte buitenmuren (spouwgaten dichten, speciale coating, bepleistering etc)	☐	☐
noodstroomgenerator	☐	☐
Terugslagkleppen op waterafvoer, waterdichte deksel op putten	☐	☐
afkoppeling regenwater van riolering	☐	☐
Andere, namelijk……………………………………	☐	☐
Geen van bovenstaande	☐	☐ -> *Ga naar Vraag 3.6*

3.5 Hoeveel hebben de maatregelen in het verleden gekost?

☐ niets
☐ tussen de €1 en €499
☐ tussen de €500 en €999
☐ tussen de €1000 en €4999
☐ tussen de €5000 en €9999
☐ meer dan €10.000
☐ weet ik niet

3.6 Welke andere maatregelen heeft u in het verleden toegepast om overstromingen te beperken? Meerdere antwoorden mogelijk.

☐ waterbestendige inrichting -> *Ga naar vraag 4.1*
☐ waardevolle zaken hoger geplaatst of makkelijk verplaatsbaar -> *Ga naar vraag 4.1*
☐ zandzakjes of pompinstallatie aangeschaft -> *Ga naar vraag 4.1*
☐ extra verzekering aangeschaft -> *Ga naar vraag 4.1*
☐ ingeschreven bij een waarschuwingsdienst -> *Ga naar vraag 4.1*
☐ aangesloten bij een buurtcomité om belangen te verdedigen -> *Ga naar vraag 4.1*
☐ Ik heb geen andere maatregelen genomen **->** *Ga naar vraag 3.7*
☐ Andere, namelijk……………………………………………………………………….-> *Ga naar vraag 4.1*

3.7 Indien u geen maatregelen heeft genomen in het verleden, waarom niet? Kruis aan wat voor u van toepassing is. Duid per rij één antwoord aan

	Helemaal waar	**waar**	**neutraal**	**Niet waar**	**Helemaal niet waar**	**Weet niet/ geen mening**
Ik twijfel aan de maatregelen die ik gevonden had						
Ik weet niet wat ik kan doen tegen de overstromingen						
de schade is gering						
het risico van een overstroming te laag is						
het is niet mijn verantwoordelijkheid						
ik voel mij te oud						
	Helemaal waar	**waar**	**neutraal**	**Niet waar**	**Helemaal niet waar**	**Weet niet/ geen mening**
de verzekering dekt alle schade						
de maatregelen kan ik niet betalen						
ik vind het een overheidstaak						
het kost me te veel tijd						

ik heb nog niet nagedacht over het mogelijke oplossingen						
de overstromings-problemen kunnen beter collectief worden aangepakt						

Deel 4: Het technisch advies van de VMM

4.1 Hoe weet u van dit project van de VMM?

☐ Via buren met wateroverlast
☐ Via buren zonder wateroverlast
☐ Via familie met wateroverlast
☐ Via familie zonder wateroverlast
☐ Via een schade-expert via verzekeraar
☐ Via de gemeente
☐ Op uitnodiging van de VMM
☐ Advertentie in de krant / online
☐ Andere, namelijk…………..

4.2 Waarom doet u mee aan dit project van de VMM? Meerdere antwoorden mogelijk

☐ hoge schade na overstroming
☐ ik wil meer informatie over overstromingsrisico
☐ ik wil meer informatie over mogelijke oplossingen
☐ reeds uitgevoerde maatregelen werken niet
☐ ik twijfel aan reeds voorgestelde maatregelen door andere partijen
☐ Overstromingen steeds gebeuren vaker

4.3 Wie adviseerde u om deel te nemen aan dit project van de VMM?

☐ op advies van buren/familie
☐ op advies van de verzekeraar
☐ op advies van de aannemer
☐ Op advies van de gemeente
☐ Geen advies, maar op eigen initiatief
☐ Andere, namelijk…………..

4.4 Welke maatregelen zijn voorgesteld in het technisch advies? Meerdere antwoorden mogelijk

☐ omhoog brengen gelijkvloers bouwpeil
☐ dijkje rond woning
☐ Waterbuffer, vb. een vijver
☐ leefruimte op hogere verdieping
☐ overstroombare kelder
☐ wegneembare schotten voor ramen en deuren
☐ waterdichte buitenmuren (spouwgaten dichten, speciale coating, bepleistering etc)
☐ noodstroomgenerator
☐ Terugslagkleppen op waterafvoer, waterdichte deksel op putten
☐ afkoppeling regenwater van riolering
☐ Andere, namelijk……………………………………

4.5 Welke aspecten van het technisch advies vindt u het belangrijkst?

Duid maximaal **2 opties** aan.

☐ Informatie over mogelijke oplossingen voor mijn huis
☐ Informatie over de overstromingsrisico's voor mijn huis
☐ Informatie over de kosten voor oplossingen
☐ luisterend oor van een expert
☐ informatie over de verkrijgbaarheid van oplossingen
☐ een advies gebaseerd op een huisbezoek door een expert
☐ het advies is gratis
☐ Ik ontvang onafhankelijk advies
☐ Andere, namelijk………………………………………

4.6 Deze stellingen gaan over de waardering van het technisch advies. Wat is hieroveruw mening? Kruis aan wat voor u van toepassing is.

Duid per rij één antwoord aan

	Helemaal waar	**waar**	**neutraal**	**Niet waar**	**Helemaal niet waar**	**Weet niet/ geen mening**
Ik ben tevreden over het technisch advies						
Ik betwijfel of de voorgestelde maatregelen een oplossing zijn voor mijn huis						
Het technisch advies heeft mij nieuwe inzichten gegeven over de mogelijke oplossingen voor mijn huis						
Het technisch advies is waardevol voor het aanpassen van mijn huis						
Het technisch advies is betrouwbaarder dan internetbronnen of andere media						
Ik doe mee aan het technisch advies omdat mijn buren/familie ook meedoen						

	Helemaal waar	**waar**	**neutraal**	**Niet waar**	**Helemaal niet waar**	**Weet niet/ geen mening**
Het technisch advies is bruikbaar omdat het informatie geeft over specifiek mijn huis						
Ik zou dit rapport delen bij de verkoop/verhuur van mijn huis						
Het technisch advies is betrouwbaarder dan eerdere adviezen van aannemers						
Ik ben bereid te betalen voor het ontvangen technisch advies						
Dit advies is ook van toepassing op het huis van mijn buren						
Dit advies is onvoldoende stimulans om mijn huis aan te passen						
Het advies geeft beter in-zicht in de overstromings-risico's voor mijn huis						

Deel 5: Na ontvangst van het technisch advies (winter 2018)

5.1 Overweegt u, na het advies van de VMM, maatregelen te nemen om uw huis aan te passen?

☐ Ja
☐ Nee -> *Ga naar vraag 5.9*

5.2 Waarom bent u bereid om naar aanleiding van het technisch advies maatregelen te nemen aan uw huis? Meerdere antwoorden mogelijk

☐ ik weet nu meer over het overstromingsrisico
☐ ik heb nieuwe passende oplossingen leren kennen
☐ Ik weet nu waar ik oplossingen kan vinden
☐ ik vertrouw de suggesties van de expert
☐ de kosten voor het aanpassen van de woning blijken niet hoog
☐ het huis aanpassen blijkt een kleine moeite
☐ De oplossingen die ik zelf gevonden had blijken juist
☐ Andere, namelijk……………………………………

5.3 Nu u het definitief technisch advies heeft ontvangen, welke bouwkundige oplossingen tegen overstromingen overweegt u uit te voeren? Meerdere antwoorden mogelijk

☐ omhoog brengen gelijkvloers bouwpeil
☐ dijkje rond woning
☐ Waterbuffer, vb. een vijver
☐ leefruimte op hogere verdieping
☐ overstroombare kelder
☐ wegneembare schotten voor ramen en deuren
☐ waterdichte buitenmuren (spouwgaten dichten, speciale coating, bepleistering etc)
☐ noodstroomgenerator
☐ Terugslagkleppen op waterafvoer, waterdichte deksel op putten
☐ afkoppeling regenwater van riolering
☐ Andere, namelijk………………………………………
☐ geen van bovenstaande

5.4 Welke <u>andere</u> maatregelen om overstromingen te beperken overweegt u nu het definitieve advies heeft ontvangen? Meerdere antwoorden mogelijk

☐ waterbestendige inrichting
☐ waardevolle zaken hoger geplaatst of makkelijk verplaatsbaar
☐ zandzakjes of pompinstallatie aangeschaft
☐ extra verzekering aangeschaft
☐ ingeschreven bij een waarschuwingsdienst
☐ aangesloten bij een buurtcomité om belangen te verdedigen
☐ Andere, namelijk………………………………………

5.5 Hoeveel bent u bereid uit te geven aan de voorgestelde maatregelen?

- ☐ niets
- ☐ tussen de €1 en €499
- ☐ tussen de €500 en €999
- ☐ tussen de €1000 en €4999
- ☐ tussen de €5000 en €9999
- ☐ meer dan €10.000

5.6 Wanneer verwacht u maatregelen te hebben uitgevoerd?

- ☐ komende 0-3 maanden
- ☐ 4-6 maanden na nu
- ☐ 7-9 maanden na nu
- ☐ 9-12 maanden na nu
- ☐ het zal langer dan 12 maanden duren.

5.7 Wie gaan wat u betreft de werkzaamheden uitvoeren?

- ☐ Een expert
- ☐ Uzelf
- ☐ Familie/vrienden/buren
- ☐ anders, namelijk………………..

5.8 Denkt u erover de maatregelen alleen uit te voeren, of samen met buren (vb: groepsaankoop, gedeelde infrastructuur etc.):

☐ Alleen
-> Ga naar vraag 6.1

☐ Collectief
-> Ga naar vraag 6.1

☐ (nog) geen idee
-> Ga naar vraag 6.1

5.9 Indien u geen van de maatregelen uit het technisch advies overweegt op te volgen, kunt u aangeven waarom niet? Meerdere antwoorden mogelijk

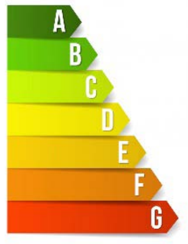
- ☐ Ik twijfel aan de maatregelen die het rapport suggereert
- ☐ Het risico weegt niet op tegen de kosten van de maatregelen
- ☐ de overstromingsproblemen kunnen beter collectief worden aangepakt
- ☐ ik voel mij te oud
- ☐ de verzekering dekt alle schade
- ☐ de maatregelen kan ik niet betalen
- ☐ Ik vind het een overheidstaak
- ☐ Het risico weegt niet op tegen de moeite
- ☐ Anders namelijk………………..

5.10 Bent u, met behulp van onderstaande stimulansen wel bereid maatregelen te nemen om de schade tegen overstromingen te beperken? Kruis per rij één antwoord aan

	Helemaal niet bereid	Eerder niet bereid	Eerder bereid	Volledig bereid
Met subsidie van de overheid				
Met praktische ondersteuning van de overheid (vb. contacten of extra informatie)				
Indien uw brandverzekeringspremie daalt				
Indien uw belastingen dalen				
Indien u alleen hoeft te betalen (en niet te organiseren / uit te voeren)				
Indien mijn buren ook maatregelen nemen				
Indien het hier vaker overstroomt.				

Deel 6. De ontwikkeling van een overstromingscertificaat

Op dit moment ontwerpt Universiteit Gent aan een certificaat voor huizen in overstromingsgebied. Het certificaat zou een persoonlijk gedetailleerd advies kunnen geven voor de oplossingen tegen overstromingen, op basis van een bezoek door een expert. Bovendien kan zo'n certificaat inzicht geven in de risico's op overstromingen voor het specifieke adres. Dit is vergelijkbaar met de labels voor huishoudelijke apparaten en energieverbruik aan huis, zoals u wellicht herkent van de afbeelding hiernaast.



De volgende vragen gaan over zo'n certificaat.

6.1 De volgende stellingen gaan over een certificaat zoals hierboven beschreven. Kruis aan wat voor u van toepassing is. Duid per rij één antwoord aan

	Helemaal waar	waar	neutraal	Niet waar	Helemaal niet waar	Weet niet/ geen mening
Alle huizen in overstromingsgebied zouden eigen certificaat moeten hebben						
Met zo'n certificaat zou ik gemotiveerder zijn mijn huis aan te passen						
Ik wil het overstromingsrisico van mijn huis vergelijken met huizen in mijn directe omgeving						
Ik zie de meerwaarde van een analyse van mijn persoonlijke overstromingsrisico						
Ik zou een dergelijk certificaat op eigen initiatief organiseren						
Het certificaat is geen toevoeging op de andere informatiebronnen over overstromingsrisico						
Als ik korting krijg op mijn verzekering, dan ben ik bereid een certificaat aan te schaffen						

6.2 Weke informatie verwacht u meer van zo'n certificaat ten opzichte van het technisch advies dat u hebt ontvangen? Meerdere antwoorden mogelijk

- ☐ meer informatie over het overstromingsrisico van mijn huis
- ☐ meer informatie over het overstromingsrisico van mijn buurt
- ☐ meer informatie over de overstromingshistorie van mijn huis
- ☐ meer details over maatregelen die ik kan nemen om mijn huis te beschermen
- ☐ meer informatie over de verkrijgbaarheid van mogelijke oplossingen
- ☐ meer informatie over de kosten van mogelijke oplossingen
- ☐ Het technisch advies heeft mij voldoende informatie verschaft om mijn risico's te verlagen
- ☐ anders, namelijk………………………………………………………….

6.3 Wanneer moet het certificaat volgens u worden uitgereikt?

- ☐ bij de verkoop / verhuur
- ☐ op verzoek van de bewoner
- ☐ na een overstroming
- ☐ met een regelmaat (vb. jaarlijks, driejaarlijks etc.)
- ☐ anders, namelijk…………………………………….

6.4 Wie moet volgens u verantwoordelijk zijn voor het uitgeven van het certificaat voor een huis?

- ☐ notaris
- ☐ verkoper / verhuurder
- ☐ koper / huurder ☐ overheid
- ☐ makelaar
- ☐ anders, namelijk……..

6.5 Moet een overstromingscertificaat verplicht zijn voor een huis?

- ☐ Ja
- ☐ Nee
- ☐ Onder bepaalde voorwaarden, namelijk……….

6.6 Zou u betalen voor een overstromingscertificaat?

- ☐ Ja *-> ga naar de volgende pagina*
- ☐ Nee
- ☐ Onder bepaalde voorwaarden, namelijk……………………………………………………………………….-> *ga naar de volgende pagina*

6.7 Wat zijn volgens u alternatieven om bewoners beter te informeren over overstromingsrisico's en oplossingen?

………
………
………
………
………

Bedankt voor uw tijd en medewerking.
Indien u nog vragen, opmerkingen of bedenkingen hebt in verband met deze enquête, dan kunt u deze hieronder kwijt.

……
……
……
……
……
…….

Bent u bereid om een aanvullend gesprek te hebben over de overstromingsproblematiek en de rol van uw gezin, of deel te nemen aan ene focusgroep op de te volgen aanpak?

Vul dan hieronder uw contactgegevens in:

Naam: ………………………………………………………………………………………………………...................
(leeg laten indien ingevuld op pagina 2)

Adres: ………………………………………………………………………………………………………...................
(*leeg laten indien ingevuld op pagina 2)*

E-mail: ..……..

Telefoonnummer: ……………………………………………………………………………………………………….

APPENDIX 4

Questions for Short Telephone Survey

This telephone survey was executed among 148 participants of the VMM pilots on tailored expert advice in Sint-Pieters-Leeuw, Lebbeke, and Geraardsbergen. Out of 209 participants in the project of the VMM, 175 homeowners picked up the phone, and 148 of these were willing to answer the questions below.

1. Were you aware of the risk of flooding before you participated?
2. How were you aware of the risk of flooding (actual event, knowledge of the area, etc.)?
3. Why did you decide to participate in this project of the VMM? (need to protect own home, awareness that floods cannot always be avoided, ...)
4. Did you receive sufficient information during the experts' visit? If no: what still needs to be improved?
5. Was the report sufficiently clear? If not, what was missing?
6. Was the contact with the experts an added value?
7. Did you follow and implement (part of) the advice?
8. What was/were the most important reason(s) to adapt your house? (advice, financial support, ...)
9. If nothing has been done yet: Do you plan to better protect your home based on this advice?
9. Following on question 8: What do you need in order to still take action (financial, additional support, ...)
10. How will you use the advice? (Just for adapting your house; share it with neighbors; use it to communicate with the authorities, etc.)
11. Can Ghent University use these answers for research? We emphasize that it concerns the answers, neither your name, address nor telephone number will be processed by them. Your answers remain anonymous.

APPENDIX 5

Semi-Structured Interview Topics and Questions for Actors (potentially) Engaged in Homeowner Participation in flood Risk Management

General:

- Who are you?

Actor & Flood Risk Management

- What is your role in flood risk management?
- What policy instruments do you have that are linked to flood risk management? What is missing / what future opportunity do you see?
- With what other actors do you cooperate in flood risk management?

Homeowner Involvement & Floodlabel

- What is, according to you, the role of homeowners and citizens in flood risk management?
- Do you know any incentive instruments to stimulate adaptive behaviour of homeowners?
- Do you involve citizens and homeowners in flood risk management? How? Do you use specific instruments or policies?
- After a small introduction on Floodlabel: Can floodlabel according to you contribute to homeowner involvement? If so, how? If not, why?
- Do you see a role for you(or your organization) to be involved in the development and/or management of floodlabel?

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