EINDRAPPORT WP2 - overstromingen

Flood resilience: a co-evolutionary approach

Residents, spatial developments and flood risk management in the Dender basin

Barbara Tempels

Promotoren Luuk Boelens en Kobe Boussauw

Steunpunt beleidsrelevant onderzoek 3de generatie Ruimte

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colofon

Verantwoordelijke uitgever: Steunpunt Ruimte
Kasteelpark Arenberg 51
bus 2429
3001 Heverlee
+32 (0)16 32 13 36
info@steunpuntruimte.be
http://www.steunpuntruimte.be

Auteur: Barbara Tempels

Met medewerking van: Luuk Boelens
Kobe Boussauw

Onderzoeksgroep: Afdeling Mobiliteit en Ruimtelijke Planning, Universiteit Gent

Foto cover:

Dit rapport bevat de onderzoeksresultaten van de onderzoekslijn klimaat uit Werkpakket 2: Veerkracht van het Steunpunt Ruimte, uitgevoerd door UGent. Deze resultaten maken deel uit van het doctoraatsonderzoek van Barbara Tempels (promotoren Luuk Boelens en Kobe Boussauw).

AMRP Afdeling Mobiliteit & Ruimtelijke Planning Universiteit Gent

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Leeswijzer

Dit rapport bevat de onderzoeksresultaten van de onderzoekslijn Klimaat uit Werkpakket 2: Veerkracht van het Steunpunt Ruimte, uitgevoerd door de Afdeling Mobiliteit en Ruimtelijke Planning van Universiteit Gent. Deze resultaten maken deel uit van het doctoraatsonderzoek van Barbara Tempels (promotoren Luuk Boelens en Kobe Boussauw). Dit eindrapport zal verder uitgewerkt worden als proefschrift.

Dit rapport vormt het overkoepelende eindrapport voor het deel klimaat. De integratie tussen de verschillende deelstudies van dit werkpakket is terug te vinden in het syntheserapport “Steunpunt Ruimte 2012-2015 : presentatie van de onderzoeksresultaten en bespreking van de beleidsrelevantie. Heverlee: Steunpunt Ruimte” (p. 20-21), waarin ook de hoofdlijnen van het onderzoek beknopt weergegeven worden.

Nederlandse samenvatting

Context

Het onderzoek vertrekt vanuit de stijgende overstromingsrisico's en gaat op zoek naar een veerkrachtige manier om hiermee om te gaan. Overstromingsrisico's ontstaan op de interactie van het watersysteem met ruimtelijke ontwikkelingen. Deze risico's stijgen enerzijds ten gevolge van veranderingen in het watersysteem. Klimaatverandering, voortgaande verharding en de aanwezigheid van sommige technische infrastructuren en kanaliseringen zorgen ervoor dat we meer en intensere overstromingen mogen verwachten. Anderzijds zorgen ook ruimtelijke ontwikkelingen, zoals de aanwezigheid van gebouwen en infrastructuren in overstromingsgevoelig gebied voor stijgende risico's.

Als we kijken naar de traditionele technische aanpak, zien we dat overstromingen doorgaans als een zuiver fysisch probleem benaderd werden. Daardoor waren oplossingen vaak ook beperkt tot het watersysteem. Ruimtelijke ontwikkelingen vormen daarbij vaak een sluitstuk.

Met de invoering van het decreet Integraal Waterbeleid in 2005 en na de overstromingen van 2010 zien we dat die discussie enigszins verschuift. Ondanks de investeringen in technische infrastructuren, blijkt de schade zeer hoog te zijn door de aanwezigheid van stedelijke ontwikkelingen in overstromingsgevoelig gebied. Meer en meer wordt er dus ook gekeken naar complementaire maatregelen vanuit het ruimtelijk systeem.

Onderzoek rond het beheersen van overstromingsrisico's heeft zich echter gefocust op de geïsoleerde studie van (hoofdzakelijk technische) maatregelen, waarbij voorbijgegaan werd aan de complexe maatschappelijke context. Daarom ligt de nadruk van dit onderzoek op het maatschappelijke aspect van overstromingsbeheer.

Opzet

Het onderzoek vertrekt vanuit de hypothese dat de co-evolutie of wederzijdse interactie tussen overstromingsbeheer en maatschappij bepalend is voor de veerkracht van een bepaald gebied tegenover overstromingen. Maatschappelijke actoren dragen bij tot de ruimtelijke ontwikkeling van overstromingsrisico's, zowel positief als negatief, actief als passief en direct als indirect. Daarbij heeft iedere actor zijn eigen 'strategie' om met het overstromingsrisico om te gaan. Deze wordt ook beïnvloed door de context, waaronder het momentum, de plaats, maar ook de acties van de andere stake- en shareholders behoren. Op deze manier bestaan er verschillende strategieën om met overstromingsbeheer om te gaan. Veerkracht ontstaat wanneer gegeven de voortdurend veranderende omstandigheden deze ook steeds in co-evolutie met elkaar zijn.

Het onderzoek wil inzicht krijgen in de ruimtelijke ontwikkeling van overstromingsrisico's en de rol van maatschappelijke actoren hierin, en om van daaruit na te denken over hoe het ruimtelijk beleid beter kan omgaan met overstromingsrisico's. Door in te gaan op de relatie tussen overstromingsbeheer en zijn maatschappelijk-ruimtelijke context wordt getracht een meer veerkrachtig perspectief te ontwikkelen voor toekomstig beleid terzake.

Dit werd onderzocht aan de hand van een beleidsanalyse op Vlaams niveau, enquêtes bij bewoners van overstromingsgevoelige gebieden in het Denderbekken, interviews met maatschappelijke stakeholders in Geraardsbergen en Vlaanderen, en een focusgroep met beleidsmedewerkers en stakeholders.

Conclusies

Uit de beleidsanalyse bleek dat het huidige planningssysteem met zijn vaste, gezoneerde bestemmingen niet voldoende kan inspelen op nieuwe of veranderende kennis over het overstromingsrisico en onzekere omstandigheden. Bovendien lijkt de rol van ruimtelijke planning en vooral maatschappelijke actoren binnen het integraal waterbeheer beperkt, niettegenstaande het voornoemde, op zijn minst evenredige belang van ruimtelijke ontwikkelingen in de overstromingsproblematiek.

In de enquête zien we een overwegend passieve houding van bewoners. Ze leggen vaak alle verantwoordelijkheid bij de overheid en hebben in hun locatiekeuze weinig aandacht voor de overstromingskwestie. Ook andere actoren, zoals de verzekerings- en vastgoedsector, beperken zich tot het nakomen van hun door de overheid opgelegde wettelijke verplichtingen.

Niettemin zijn er ook tekenen van de opkomst van een zeker sociaal kapitaal, i.e. capaciteiten die in een gemeenschap aanwezig zijn om met overstromingen en overstromingsrisico's om te gaan. Burgers spelen bijvoorbeeld een belangrijke rol in kennisverspreiding rond overstromingsrisico's. Bovendien weten burgers met overstromingservaring ook meer over de maatregelen die ze zelf kunnen nemen en nemen deze wel degelijk ook meer maatregelen. Dit sociaal kapitaal wordt echter nog niet ten volle benut.

Gezien de institutionele context is het immers feitelijk niet zo verwonderlijk dat er thans nog zo weinig maatschappelijke (zelf)verantwoordelijkheid genomen wordt. Overstromingsbeheer was lang de exclusieve verantwoordelijkheid van waterbeheerders, die de afgelopen eeuwen vooral door overheden wordt aangestuurd. Daarnaast zijn er ook weinig incentives en structuren om zelf je risico's te minimaliseren, zoals blijkt uit het zo goed als volledig ontbreken van een zekere individuele verantwoordelijkheid voor het beheersen van overstromingsrisico's of de financiële schade ten gevolge van overstromingen, of een open discussie hierrond. Momenteel lijkt de wijze waarop het formeel overstromingsbeheer georganiseerd wordt globaal genomen dan ook eerder contraproductief voor de sociale veerkracht tegenover overstromingen. Zo kunnen bewoners achter hoge dijken het misleidende gevoel krijgen voor altijd veilig te zijn. Gegeven het feit dat steeds meer beleidsmakers en -voorbereiders tot de overtuiging komen dat de overheid het niet meer alleen kan en enkel technische maatregelen niet voldoende zijn, wordt die veerkracht en medewerking van betrokken maatschappelijke actoren wel steeds belangrijker geacht. Enkele recente beleidsinstrumenten proberen derhalve het slapend kapitaal te activeren, maar tot dusver zijn er nog weinig effecten zichtbaar.

Uit de analyse komt naar voor komen dat de interacties tussen enerzijds land- en wateractoren, en anderzijds beleids- en maatschappelijke actoren de twee kernspeerpunten voor een veerkrachtig overstromingsbeleid zijn.

Enerzijds betreft dit het participatieluik (interactie tussen beleids- en maatschappelijke actoren). Momenteel zijn de participatiemogelijkheden eerder beperkt. De sterke technische benadering en de gesloten communicatie rond overstromingsrisico's zorgt ervoor dat burgers de indruk krijgen dat de overheid de problematiek onder controle heeft, of toch zou moeten hebben, en dat er derhalve niets van hun verwacht wordt.

Anderzijds wordt de overstromingsproblematiek nog steeds vooral gezien als een 'watervraagstuk', meer dan als een 'landvraagstuk' (integratie tussen land en water). Het bewustzijn rond overstromingsrisico's onder maatschappelijke actoren is dan ook laag. Hoewel het integraal waterbeleid hierin eerste verbeteringen heeft aangebracht, blijft dit nog steeds een belangrijk aandachtspunt. Zo blijkt uit dit onderzoek dat men in droge perioden en ondanks verplichte

waarschuwingen bij verkoop die risico's nog steeds niet goed begrijpt of inschat, dan wel minimaliseert. Daarnaast hebben zich in de laatste decennia ook veel ruimtelijke ontwikkelingen in overstromingsgebieden voorgedaan, die niet zomaar zijn terug te draaien.

Beleidsaanbevelingen

De beleidsvragen die uit deze bevindingen voortvloeien, zijn dan ook hoe we die twee interacties meer vruchtbaar en zichtbaar kunnen maken. Hoe kan het beleid stimuleren dat maatschappelijke actoren meer betrokken zijn en actief en constructief gaan bijdragen aan het beheren van overstromingsrisico's? Wellicht moeten we ook erkennen dat we niet alle risico's op voorhand kunnen uitsluiten, maar mogelijk wel die veerkracht van maatschappelijke actoren om daarmee om te gaan kunnen bevorderen. Vanuit het onderzoek worden twee simultane en complementaire beleidssporen voorgesteld waarmee het beleid kan navigeren doorheen de co-evoluties tussen land en water, en overheid en maatschappij, om tot een veerkrachtig overstromingsbeheer te komen: adaptieve conditieplanning en co-evolutionaire interventies. De eerste beleidsactie is daarbij meer conditionerend, de tweede meer actiegericht.

Bij de adaptieve conditieplanning worden niet-beleidsactoren indirect, via generieke randvoorwaarden, gestimuleerd om verantwoordelijkheid op te nemen. Dit kan bijvoorbeeld via economische mechanismen zoals het systeem voor schadecompensatie aanpassen en bepaalde subsidies of praktische ondersteuning voor individuele landschappelijke of bouwtechnische maatregelen, of via informatieverspreiding, het ondersteunen van marktonwikkelingen, enzovoort.

De co-evolutionaire interventies daarentegen zijn veel meer gericht. Er worden voorposten gecreëerd op hotspots van overstromingsrisico's, waarbij de overheid op voet van gelijkwaardigheid samen met burgers, het maatschappelijk middenveld en actoren uit het bedrijfsleven naar veerkrachtige oplossingen te zoeken, afhankelijk van de omstandigheden naar tijd en plaats (situationeel).

Daarbij zijn er echter enkele uitdagingen. De vraag kan gesteld worden wat de maatschappelijke rol van ruimtelijke planning en waterhuishouding hierbij nu precies is. Vooral als we zien dat momenteel de energie vooral gestoken wordt in het oplossen van problemen die gecreëerd zijn in het verleden. Gezien de inherente onzekerheid en veranderingen moeten we er rekening mee houden dat het waarschijnlijk is dat dergelijke problemen in de toekomst opnieuw zullen gecreëerd worden. Daarom is het belangrijk om goed voor te sorteren op de te verwachten korte, hevige en extreme omstandigheden als gevolg van klimaatverandering, en rekening te houden met veranderingen hierin.

Daarnaast ontbreekt er inzicht in de situatie en het standpunt van landgebruikers om als overheid de verantwoordelijkheid te kunnen delen met hen. Hierbij is het van belang om de effecten van dergelijke beleidskeuzes en de implicaties ervan op lange termijn te monitoren en evalueren, om zo tot een lerend, adaptief beleid te kunnen komen. Bijsturingen moeten steeds mogelijk zijn op basis van nieuwe kennis.

Om een open discussie mogelijk te maken over wie welke verantwoordelijkheden kan en zou moeten opnemen, is het belangrijk dat de overheid niet enkel informatie verspreidt over het risico, maar ook over welk niveau van bescherming ze biedt en wat bewoners zelf derhalve ook kunnen, dan wel moeten doen.

List of acronyms

CIW	Flemish Coordination Committee on Integrated Water Policy *(Coördinatiecommissie Integraal Waterbeleid)*
DIWP	Decree Integrated Water Policy *(Decreet Integraal Waterbeleid)*
FD	European Floods Directive
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan *(Overstromingsrisicobeheerplan)*
RBMP	River Basin Management Plan *(Stroomgebiedbeheerplan)*
RCMP	River Catchment Management Plan *(Bekkenbeheerplan)*
VMM	Flemish Environmental Agency *(Vlaamse Milieumaatschappij)*
W&Z	Waterways and sea canal *(Waterwegen en Zeekanaal)*

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1 Introduction

Dealing with flood risks is one of the main environmental issues in spatial planning following climate change and urbanization. The European Floods Directive defines a flood as "*the temporary covering by water of land not normally covered by water*" (Directive 2007/60/EC, Article 2). River floods are among the most prominent, urgent and devastating consequences of climate change that one can experience in Europe. Climate change will increase both their intensity and likelihood in the future (IPCC, 2014). This will affect urban areas in particular, because they are often located close to rivers or coastlines, thereby exposing valuable and vulnerable land uses to floods.

1.1 Flood risk management in Western European countries

Under influence of increasing flood risks and uncertainty, many Western European governments have recently adopted a risk-based approach to flood management (Kellens et al., 2013; Klijn et al., 2008). While the earlier flood protection paradigm considered the socio-spatial context to be a prerequisite and tried to find solutions within the confines of the water system itself by avoiding flooding altogether, the risk-based approach incorporates the socio-spatial aspect of flooding, such as urbanization in floodplains and increases in sealed land. Subsequently this risk-based approach puts emphasis on avoiding damage due to flooding (Johnson and Priest, 2008). Therefore, human dimensions of natural hazards are becoming more and more important (Raschky, 2008).

Consequently, there is a growing awareness that spatial planning should play an important role in flood risk management (FRM) (De Smedt, 2014; Jong and van den Brink, 2013; Pattison and Lane, 2012; White, 2013). Flood management is no longer reactive to changes in spatial developments, but becomes an integral part of spatial planning and the conception of spatial developments (Woltjer and Al, 2007). In line with the tendency in spatial planning theory towards actor involvement (Boelens, 2010; Boelens and de Roo, 2016), societal actors should play an increasingly important role in flood risk management (Fleischhauer et al., 2012; Löschner et al., 2014; Penning-Rowsell and Pardoe, 2012). Taking into account the limited resources of governments, climate change and inherent limitations of flood protection, involving residents in flood risk management can become an important part of the solution (Kreibich et al., 2011).

However, until now flood management research has mainly focused on the isolated study of (mostly technical) systems (Pahl-Wostl, 2002; Pahl-Wostl et al., 2007b). As a result, flooding frequencies and technical solutions have been well studied (de Moel et al., 2009), while knowledge on spatial developments in flood-prone areas and the societal mechanisms behind is lacking. In the Western European context, the role of residents and societal actors in dealing with flood risks is new to the debate. It is gaining interest due to the inherent limitations of the traditionally high degree of government responsibility in the light of climate change. An integrated understanding of how flood risks and societies interact, and how this affects spatial planning and flood risk management is still lacking. Therefore, the overall aim of this research is to gain insight into the societal dimension of the flooding issue, and look at how society interacts with formal flood risks and how they could contribute to managing flood risks.

1.2 Changing flood risks as a challenge

Flood risk management is facing some major challenges leading to increased flood risks. First of all, the frequency and intensity of flooding is expected to increase due to climate change (IPCC, 2014). Although most systems are able to

adapt to gradual changes in average conditions, they are particularly vulnerable to changes in the occurrence and intensity of extreme events (De Groof et al., 2006).

This climatological trend is exacerbated by morphological changes due to spatial developments, such as the increase in sealed area, preventing the infiltration of rainwater and causing a larger surface runoff and therefore an even higher probability of flooding. This not only leads to higher losses in flood-prone areas, but also the creation of additional, new flood-prone areas.

Floods are often conceptualized as an external threat to human systems, a disturbance that needs to be minimized and if possible even eliminated. However, the analysis of the flooding issue indicates that reality is more complex. Human agency also contributes to the flood frequency, and more importantly determines the extent of the flood losses and the appropriateness of flood management actions. For example the potential losses due to flooding are increasing due to spatial developments. Urban developments in floodplains contribute to the problem in two ways. Firstly, space for the rivers diminishes and water levels increase downstream. Secondly, most settlements are not adapted to inundations, exposing people and assets to floods (Hartmann, 2011b; Petrow et al., 2006).

All these changes are associated with a great deal of uncertainty (Dessai and van der Sluijs, 2007). Although there is a relatively large consensus on the effects of climate change in Western European regions, the actual extent and distribution of potential impacts, especially on the local scale, are unknown. In addition, climate extremes are quite unpredictable in the long term. But also the societal changes described above, such as urbanization, are subject to uncertainty. Furthermore, also decision-making is characterized by uncertainty as to the outcome of decision (Tompkins and Adger, 2004). So while most of these changes are gradual and continued existing trends, the consequences are difficult to predict due to the interactions among the different driving forces. This range of uncertainties cannot be mitigated through modeling or further research, as they are inherent to complex systems, and therefore inherently unpredictable. Therefore, flood management strategies can no longer be based on conventional methods of risk assessment, development and evaluation of alternative measures, and implementation of the optimal measure.

These changes and the associated uncertainty give rise to an array of questions on how we as a society deal with flood risks.

1.3 Tendencies in flood risk management: from flood protection to flood risk management

These challenges have induced a shift in framing floods and the approach towards how floods should be managed. In recent decades, new approaches in dealing with floods have been discussed in the literature and in practice (Folke, 2003; Hutter, 2006; Klijn et al., 2004; Liao, 2012; Pahl-Wostl et al., 2007a). Flood policy is shifting from the rather robust defence against floods towards a more flexible and adaptive flood risk management (Hartmann and Juepner, 2014; Klijn et al., 2015; Vinet, 2008).

In principle, floods can be approached with two different concepts: increasing the robustness, or accepting the risk and adapting to it (flexibility). The first usually requires modeling and prediction, technical flood protection measures such as dikes, and strong water management institutions with technical skills. The latter depends on comprehensive and integrative concepts, encompassing many stakeholders and asking for collaboration at various levels. Adaptability does

not mean just amending the city, thus enabling the existing urban structure to remain the same. Rather, adaptive cities will become transformed by (the threat of) flood events.

1.3.1 Flood protection

Since the beginning of industrialization, flood protection has been the dominant approach in most European countries. It is based on the predict-and-control paradigm (Pahl-Wostl, 2007), or the assumption that flooding can be modeled and predicted, with a calculable return period and degree of safety. Subsequently they may be constrained through engineered solutions (dikes, dams, etc.) (Fleming, 2002; Johnson and Priest, 2008; Patt and Juepner, 2013). In this way, a high degree of protection is provided by governmental interventions in the water system and floodplains can be made available for all kinds of land uses (Hartmann, 2011b; Loucks, 2000). In this approach, emphasis is on absorbing shocks, limiting short-time damages, performing a speedy recovery back to the same functions (Liao, 2012). The goal is to preserve existing developments by defending against the water and enforcing a strong boundary between land and water (Hartmann, 2009).

The advantage of flood protection is that it enables constant conditions for settlements behind the dikes, and therefore facilitates using (protected) land efficiently without making compromises because of a flood risk. Resistance is easier to live with in everyday life. It enables easier decision-making for land-use planners and clear division of responsibilities between water management and spatial planning (Hartmann and Driessen, 2014).

Despite major investments in such flood protection measures (Loucks et al., 2008), the annual damage increased over the past decades (Munich Re, 2010), suggesting that this approach might no longer effectively reduce flood risks. Flood protection projects have allowed flood-prone areas to develop from a cost-efficiency perspective, assuming them to be flood free due to the technical interventions. However, this causes more people and capital to be exposed in case of a flood (Burby et al., 2000). So although the probability of flooding is lowered, a potential flood will increasingly cause an unacceptable damage.

The increasing probability of flooding challenges the assumption of predictable and therefore constrainable floods. The ability to control extremes by technical means has its limitations, since any technical system can fail. Due to the inherent variability, occurring climate extremes can always be more intense than its safety level. Furthermore, technical systems are associated with high costs borne by the whole community, such as infrastructure works and maintenance.

Also, the tolerance of flood risk is decreasing due to improvements in the control of flood risk, prompting the need for a higher degree of safety (Brilly and Polic, 2005). At the same time, the awareness is also decreasing. Residents generally perceive the government to be responsible for flood protection (Wardekker et al., 2010), causing a low autonomous adaptive capacity for extreme shocks.

In the light of increasing flood frequencies, maintaining safety levels is no longer economically or technically viable due to the inherent limits and side effects of a flood management system that is based on the outdated paradigm of controlling nature and neglects the inherent uncertainty arising from complex systems (Liao, 2012). If no other approach to flood risk management is chosen, this entrenches a lock-in situation in technical flood protection approaches because existing settlements can hardly be removed (Hartmann, 2011a).

1.3.2 Flood risk management

In contrast to flood protection, flood risk management does not mean the quest for fail-safe options to prevent flooding. It rather assumes that flood risks vary and calamities will happen. Flood risk management asks for adaptations of vulnerable objects in order to minimize the consequences of floods, but at the same time it allows some flooding (Vis et al., 2003). This vulnerability encompasses not only (infra)structural aspects, but also social aspects such as adaptive capacities, which determine communities' ability to cope with flooding. Examples for physically resilient structures include floating homes (Pierdolla, 2008) and adapted interiors for houses (e.g. not putting electrical installations in the basement), but also escape routes for evacuations or calamity polders (Roth and Warner, 2007), and even, in some cases, abandoning certain areas (McLeman and Smit, 2006).

In addition to adjustments and restructuring of physical structures, also the socio-economic and political setting of flooding needs to be examined. Adaptive capacities are a result of several social, economic, technological, knowledge-related, institutional and cultural mechanisms (Brouwer et al., 2007). However, these mechanisms and their interactions are very complex, making increasing adaptive capacities less straightforward. It involves financial recovery capacity, insurance schemes (Berke and Campanella, 2006; Clark, 1998), liability issues, availability of information, etc.

These examples show that resilience comes with costs for adaptation and compromises for land uses. In addition, it challenges existing institutions and well-entrenched modes of governance (van den Brink, 2009).

The list of examples also reveals that centralized governmental institutions such as water management agencies can hardly implement flood risk management on their own. Flood risk management asks for the compliance and cooperation of not only many different institutions, but also of public and private stakeholders (Loucks et al., 2008). So, not only does flood risk management require a fundamental rethinking of existing working paradigms within water management agencies, but also this shift of paradigms needs to be supported and sustained by various stakeholders with sometimes competing interests: public and private actors, comprehensive and sector planning, central and decentralized structures. A new mode of governance that balances these issues of flexibility and robustness is needed.

1.4 Flood risk management in Flanders

Historically, flood management started as a private affair, and became the exclusive responsibility of the government over the centuries (Crabbé, 2008). In several steps, responsibilities shifted from private to public, and from local to regional. Following a major flood in 1976, the government has embarked on a mission to provide protection against flooding. This resulted in the 1980's in the Sigma plan, a water engineering protection program based on technical infrastructures, as in most Western-European countries, which marks the beginning of a comprehensive governmental flood protection program.

However, the last decade, water managers are shifting in their discourses towards shared responsibility for water management following the developments discussed above. Accordingly they intend to share these responsibilities with spatial planners, residents, etc. However, due to the historical evolution described above, these societal actors have lost their affinity with water management, making this a hard and highly contested issue.

Within this technical approach, spatial planning was not considered to be an important instrument to reduce flood consequences. Solutions for the problems within the water system were restricted to engineering this water system.

This has led to some major issues, the most important being the presence of unadapted spatial developments in flood-prone areas, due to the lack of building restrictions, and the high degree of soil sealing due to urbanization.

Figure 1. Pictures of the consequences of the 1953 flooding of the Scheldt river. This flood was caused by a levee break due to high tidal waves.

However, in recent years, flood risks have increasingly been regarded as a spatial issue (Neuvel and van den Brink, 2009). The shift from flood protection to flood risk management questions established physical and governance boundaries between land and water.

It is remarkable that in the discussions around the Decree on Integrated Water Policy (DIWP) of 2003 and debate following the 2010 flooding, peripheral developments, sprawl and poor urban planning are pointed out as one of the main causes for the extent of the flooding damages. For the first time, the presence of buildings and infrastructure in flood-prone areas was questioned. This is quite remarkable, as managing flood risks was never the explicit responsibility of spatial planning. Although the spatial structure plan of the 1990s mentions the importance of the physical system for spatial structures, and the DIWP from 2003 aims to bring spatial planners and water managers together, the main the land use allocation plan, dating back to the 1970s, does not really take flood risks into account.

Figure 2. Pictures from the 2010 flooding in the Dender basin. Intense rainfall caused unprecedented flooding.

In the public debate, people are looking more and more at spatial planning, both as being partly responsible for the extent of the damages, but also as a potential part of the solution. At the same time, water managers are experiencing the financial and technical limitations of providing flood protection, and want to share responsibilities with citizens and other both governmental and non-governmental actors.

HET NIEUWSBLAD VRIJDAG 29 APRIL 2011

Kans op overstromingen stijgt, maar Vlaanderen blijft bouwen

Het risico op overstromingen is nu 20 procent groter dan 15 jaar geleden. En toch blijft Vlaanderen maar woningen bouwen, parkings aanleggen en industrie neerpoten in gebieden die bij hevige regen meteen blank staan. Ze zijn te duur om te onteigenen, luidt de verklaring.

VINCENT DOUCHY

De Watercommissie in het Vlaams Parlement presenteert volgende week een eindrapport over de oorzaken van de watersnood van november 2010. Hevige neerslag zette toen 20.000 hectare Vlaams grondgebied blank.

De conclusies zijn alarmerend. Ondanks investeringen in dijken en wachtbekkens werd het risico op overstromingen sinds 1996 een vijfde groter. 'Vlaanderen is immers in snel tempo aan het *verharden*', zegt commissievoorzitter Bart Martens (SP.A). Tussen 1976 en 2000 verdrievoudigde de bebouwde oppervlakte met huizen, wegen, industrieterreinen en parkings tot 18,3 procent. Zonder ingrijpen wordt dat in 2050 42 procent.

Waar beton en asfalt ligt, kan water niet insijpelen. 'Men plaatst dikke rioolbuizen om water snel weg te krijgen', zegt Martens. 'Maar door die rechtstreekse afvoer zitten de beekens snel vol. Water krijgt geen ruimte meer om in landbouwgrond of beddingen in te sijpelen.'

13 overstromingsgebieden

Sinds 2003 realiseerde Vlaanderen amper 13 overstromingsgebieden, goed voor slechts 616 hectare. Oorzaak van die magere balans is meestal lokaal burgerprotest. 'De potpolder van Kruibeke-Bazel-Rupelmonde ligt sinds 1977 op tafel. Nu pas wordt hij aangelegd', zegt Martens. 'De talloze administratieve procedures moeten we dringend stroomlijnen.' Dat in Vlaanderen talloze organen bevoegd zijn voor water – Vlaamse overheid, provincies, gemeenten, talloze experteinstanties... – maakt het niet efficienter. 'Iedereen betrokken, niemand verantwoordelijk', zegt Martens.

Ander pijnpunt is dat de Vlaming blijft bouwen in risicogebied. Vandaag ligt 11.000 hectare grond – 23.700 percelen – op terrein dat ooit bebouwbaar is verklaard maar risicovol blijkt. Een bouwverbod zou door het recht op schadevergoeding miljarden kosten. En dus blijven steden en gemeenten vergunningen toekennen. Al gelden er vandaag wel voorwaarden. Notarissen krijgen de plicht om bij verkoop van onroerend goed in de akte aan te geven dat het terrein overstromingsgevoelig is. En een watertoets gebiedt gemeenten sinds 2006 om het watersnoodrisico na te gaan. Maar die toets echt bindend maken, blijkt voor de overheden een stap te ver. De Watercommissie zal zich daarover nog buigen.

Intussen moet Vlaanderen alternatieven zoeken om het water zo efficiënt mogelijk op te vangen, zegt voorzitter Martens. 'Via aangepast bouwen, met constructies op poten of waarin het gelijkvloers een open parkeerruimte is.' En door bestaande woonwijken in overstromingsgebied te beveiligen. 'Verhoog dáár de dijken, en compenseer elders langs de waterloop met extra overstromingsruimte.'

TUSSEN 1976 EN 2000 VERDRIEVOUDIGDE DE BEBOUWDE OPPERVLAKTE MET HUIZEN, WEGEN, INDUSTRIETERREINEN EN PARKINGS TOT 18,3 PROCENT

Bart Martens (SP.A)

"

DUIZENDEN PERCELEN IN RISICOGEBIED OVERSTROMING

Bouwverbod is onbetaalbaar

356.699

De overstromingsgevoelige gebieden in Vlaanderen totaliseren een oppervlakte van 356.699 hectare.

71.556

Van die oppervlakte is 71.556 hectare effectief overstromingsgevoelig, de rest is mogelijk overstromingsgevoelig. De effectieve zones beslaan 5,26 procent van Vlaanderen.

23.700

Er staan op die 71.556 hectare tussen de 36.000 en 56.000 gebouwen.
Ter grootte van 11.000 hectare liggen er nog 23.700 onbebouwde percelen met 'harde' bestemming (woningbouw, bedrijven, openbaar nut).

Deze woonwijk in Geraardsbergen werd afgelopen winter overspoeld. © Kurt Desplenter

Schadevergoeding, grondenruil of paalwoningen bouwen. Aan Vlaanderen de keuze om het overstromingsgevaar te lijf te gaan.

De toets werkt nog niet naar behoren. Het advies wordt niet altijd gevolgd, de kwaliteit ervan laat te wensen over, de betrokken partijen schuiven de verantwoordelijkheid door. Gemeentebe- le betrokken overheidsdiensten en de waterloopbeheerders zitten) bestaat geen consensus om de watertoets dwingend te maken. Het ligt wel in de bedoeling de vraag om wateradvies ver-

Figure 3. Societal debate following the 2010 flooding. "Probability of flooding increases, but Flanders keeps on building" (left) and "Ban on construction is too expensive" (right).

1.5 Outlook: research scope

This research aims to gain insight into the spatial component of the flooding issue, and the relationships between formal flood risk management and spatial developments. The central question is 'what is the role of societal actors in the spatial development of flood risks?' It starts from the observation that the predict-and-control flood management system often does not effectively reduce risk and will not suffice in the light of societal and climate change. Through the resilience lense, a co-evolutionary hypothesis is drawn: the lack of acknowledgement of the interactions between land and water in producing and managing flood risks is leading to a lock in, where governments are solely responsible for the technocratic management of flood risks. To gain insight into these interactions, the points of view of different actors involved in the spatial development of flood risks in Flanders (Belgium) are explored. Based on these insights, conclusions can be drawn on how these relationships can become more constructive in the future.

This research on the one hand advances both the theoretical and practical development of the resilience principle in spatial planning. It adds the co-evolutionary perspective, which is then applied to flood risk management.

On the other hand, it contributes to the discussion on the inclusion of non-governmental actor in flood risk management. It does not assume flood risk management to be an exclusive governmental responsibility or activity, and abandons the idea that governments control the management of flood risks. This focus on multi-actor perspectives is not new. However, this research develops a flat ontology of flood risk management, focusing on the interactions between formalized policy actors, and the informal actions of residents and other societal actors in a co-evolutionary perspective.

This report is structured as follows. The second chapter presents the theoretical framework of resilience, translating it to spatial systems and flood risks management. This leads to the co-evolutionary perspective, stating that flood risks emerge in the interaction between land and water. Based on this theoretical framework, the research question is broken down into sub-questions. The third presents a policy analysis of managing flood risks in Flanders. The Flemish flood risk management approach is confronted with resilience theory. In the fourth chapter, the results of a survey among residents of flood-prone areas in the Dender basin are discussed. The fifth chapter discusses the points of view

of civil society actors based on interviews. In the sixth chapter, the points of view of policy makers, residents and civil society are brought together, based on a focus group on policy options. The seventh and final chapter draws conclusions on a co-evolutionary approach to flood risk management.

2 Resilience, flooding and flood risk management

Within the debate on new forms of flood risk management, resilience has recently gained a lot of interest. A vast literature that theorizes the resilience concept and translates it into practice has been developed. Also in practice, it has become a guiding principle for managing floods and other hazards in different policies (e.g. Defra, UK), programs (e.g. Making Cities Resilient (UNISDR), Climate Resilient Cities (ICLEI), City Resilience Profiling Programme (UN-Habitat)), research programs (e.g. SMARTeST, StarFlood – EC 7th framework program), educational programs (e.g. Institute for Water Education – UNESCO-IHE), etc.

However, there are divergent interpretations as to what flood resilience – and other related terms – actually encompasses. In academic literature, there is a vast body of literature discussing and reviewing the definitions resilience, its sub concepts and its relation to other concepts. In practice, we observe different interpretations by different agencies. For example in the UK, flood resilience on the building scale is used as often a synonym for wet-proofing, allowing water into buildings but minimizing damage through adapted design, and an antonym for resistance or dry-proofing, stopping water from entering a building. In Flanders however, architects use the term 'water robust or resilient building' to indicate all types of adapted building techniques to minimize flood damages on the building scale, including both wet- and dry-proofing.

This chapter explores the resilience concept as a theoretical framework for managing flood risks in the face of future challenges, in order to discern the contribution of resilience to flood risk management. First, its definition and application within planning and flood risk management is discussed. Then resilience is translated into a flood risk management strategy. This application reveals that co-evolution, one of the underlying concepts of recent interpretations of resilience, forms a relatively new theoretical lens to analyze the role of spatial developments in flood risk management. The idea that actors, technical systems, flood risks and other societal interests co-evolve through time and thus shape the way flood risks are managed, provides the starting point for the hypothesis and research methodology of this research, discussed at the end of this chapter.

2.1 The resilience concept: evolution and conceptual interpretations

The resilience concept originates in studies from the 1960s and 1970s on the way ecological systems deal with stresses and shocks caused by external factors. Since its introduction in the influential paper on stability of ecosystems by Holling (1973), the concept has been picked up by different research fields, such as psychology, anthropology, environmental psychology, cultural studies and social geography (Folke, 2006). It has an increasing popularity in scientific research and a number of policy domains as a framework to understand dynamics in socio-ecological systems (Folke, 2006; Turner, 2010).

Under the influence of new insights and beliefs, it also has undergone a number of substantive conceptual reorientations that are founded in different worldviews and scientific traditions (Davoudi et al., 2012). An evolution can be noted from engineering, to ecological and finally to socio-ecological resilience (Folke, 2006; Holling, 1996). This conceptual evolution thus reflects a paradigm shift in how scientists think about the world towards complex adaptive systems. These systems are conceived as "complex, non-linear and selforganizing, permeated by uncertainty and discontinuity" (Berkes and Folke, 1998: 12). The fundamental differences between these interpretations are of major importance, as they lead to different problem definitions, focuses and approaches.

Although the relevance and potential of the concept is widely recognized, resilience is often used inconsistently and regularly not explained (Fünfgeld and McEvoy, 2012), causing the concept to become vague, an umbrella for a seemingly infinite number of new ideas and desirable system attributes (Klein et al., 2003). Therefore, the conceptual evolution and application within spatial planning is discussed in what follows.

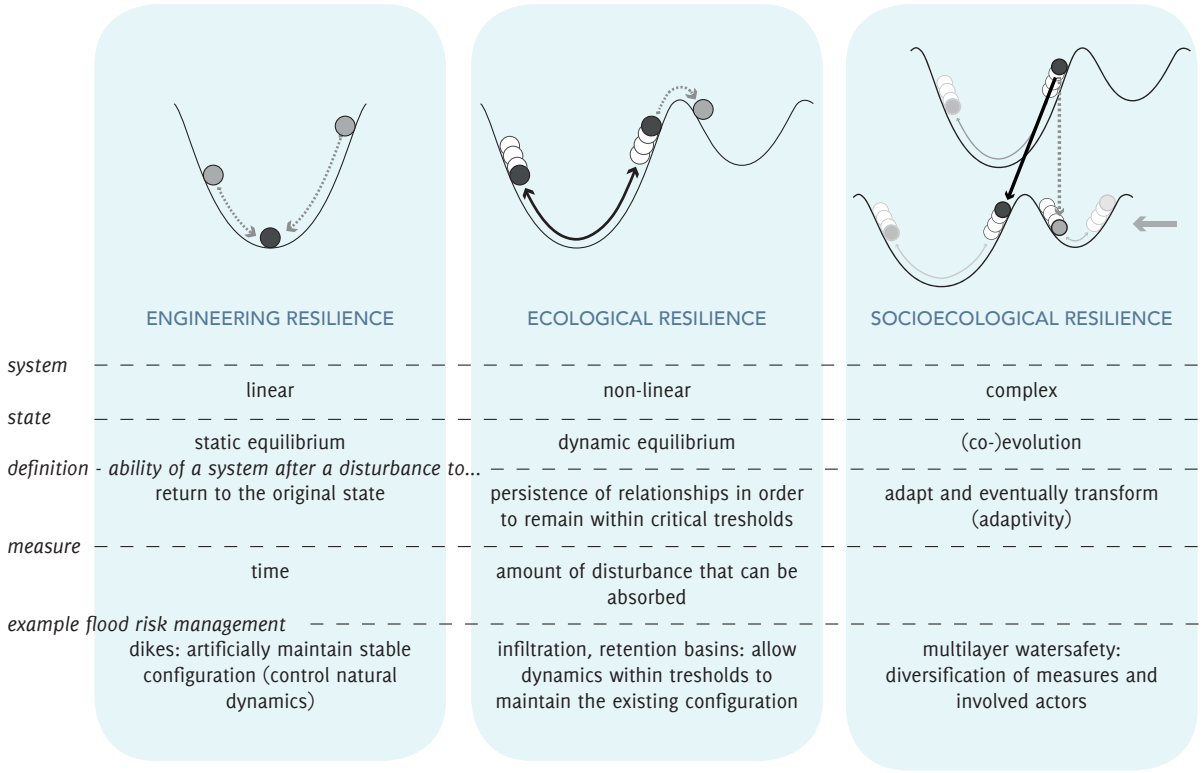

Figure 4. Schematic representation of (a) engineering, (b) ecological en (c) socio-ecological resilience. Resilience is illustrated by a ball in a basin (system). Disturbances cause the ball to move. In (a), a resilient system is a ball that returns quickly to its stationary position. In (b), a resilient system encompasses a ball moving within the thresholds of its basin. In the third interpretation (c), the basin shape is changing (disturbance), and the system needs to co-evolve with this change in order to be resilient.

2.1.1 Introduction of resilience by Holling (1973)

The paper from 1973 on the behavior of ecological systems exposed to external changes by Holling is widely accepted as the origin for the development of the resilience concept. In this paper, he discerns two kinds of behavior or system properties: stability, which "is the ability of a system to return to an equilibrium state after a temporary disturbance" and resilience, "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973: 17). Based on these restricted definitions of stability and resilience, a system can have very low stability (i.e. fluctuate greatly), but be very resilient, or be very stable, but have a low degree of resilience (i.e. vulnerable to for example climatic extremes).

He makes this distinction to refine and restrict the notion of stability, which in his view was inadequate to describe certain systems behavior, since it assumes conditions very near equilibrium points. This analytical conceptualization however does not comply with the nonlinear behavior observed in some ecological systems, and is according to Holling only a convenience considering the difficulties in analyzing the behavior of nonlinear systems at some distance from equilibrium. To date, this challenging of the dominant stable equilibrium view is an important contribution of the resilience concept to different strands of academia (Folke, 2006).

The stability view emphasizes equilibrium, little fluctuation and a predictable world. Resilience on the other hand emphasizes domains of attraction and persistence (as the opposite of extinction). Extinction is in this view not purely a random event; it results from the interaction of random events with those forces that define the shape, size, and characteristics of the domain of attraction. In his later work, Holling (1996) makes a distinction between engineering resilience, in line with his 1973 restricted definition of stability, and ecological resilience.

2.1.2 Three conceptualizations: engineering, ecological and socio-ecological resilience

2.1.2.1 Engineering resilience

Engineering resilience (Figure 4a) is based on the single equilibrium view and only applies to the behavior of linear systems, or non-linear systems in the immediate vicinity of a stable equilibrium where a linear approximation is valid (Folke, 2006). It assumes a pre-determined stable state, to which a system eventually returns after a disturbance (recovery). In this definition, resilience is determined by the time it takes for a system to return to the equilibrium after a perturbation.

As discussed, this linear approach is insufficient to describe time and spatial scales in which a system is intrinsically dynamic.

2.1.2.2 Ecological resilience

The ecological interpretation (Figure 4b) rejects the existence of one single stable equilibrium state, and acknowledges the inherent dynamism of systems and the existence of multiple equilibrium states, and therefore the possibility that a system flips into an alternative stability domain after a disturbance (Holling, 1973, 1996). This alternative stability domain is characterized by other structures and processes, making a return to a previous equilibrium extremely difficult, if not impossible (Holling, 1973). Tipping points or thresholds mark the transition between stability domains. If a systems passes such as tipping point, it will reorganize.

Resilience can then be measured as "the magnitude of the disturbance that can be absorbed before the system changes its structure" (Holling, 1996: 33). Focus here is on staying within critical thresholds and staying within the same regime, that is defined by the same processes, structures, feedbacks and therefore identity (Walker et al., 2004).

2.1.2.3 Socio-ecological resilience

The growing interest in linked social and ecological systems has led to the socio-ecological interpretation of resilience (Figure 4c). While engineering and ecological resilience are fundamentally different, both assume that equilibria in systems exist, whether as a pre-existing equilibrium to which a resilient system can bounce back (engineering) or a new one to which it can bounce forward (ecological). Socio-ecological resilience challenges the idea of equilibria and assumes that systems can change through time (Scheffer, 2009 in Davoudi et al., 2012). Changes and regime shifts are not necessarily the consequence of external disturbances, but can occur due to internal dynamics with no clear or linear cause-effect-relationship (Davoudi et al., 2012).

Resilience is from this perspective not a return to a 'normal' condition, but rather the capacity of complex socio-ecological systems to change, adapt and eventually transform as a reaction to strains and stresses (Carpenter et al., 2001). While earlier conceptualizations of resilience are mainly concerned with preventing irreversible change, socio-

ecological resilience also encompasses the possibility of reorganization. In this interpretation, the ideas of adaptation, learning and self-organization become much more the center of focus (Carpenter et al., 2001; Folke, 2006).

2.1.3 (Co-)evolutionary aspects

Resilience encompasses both being persistent or robust to disturbance, while at the same time renew, regenerate and re-organize following a disturbance. However, in practice focus has been more on absorbing shocks and maintaining function (bouncing back), and less on the capacity for reorganization and development (Davoudi et al., 2012; Folke, 2006). To overcome this, Davoudi et al. (2012) propose an evolutionary approach where long-term change is necessary in the face of changing conditions. They contest the equilibristic view proposed by the engineering and ecological interpretations. She questions the strong emphasis on bouncing back and short-term damage reduction, and advocate instead long-term adaptive capacity building. Resilience is then "not conceived of as a return to normality, but rather as the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains" (Davoudi et al., 2012: 302). Resilience from this perspective is closely related to adaptation, which is "not about returning to some prior state, because all social and natural systems evolve and, in some senses, co-evolve with each other over time" (Tompkins and Adger, 2004: 5).

2.1.4 Relation between the three types of resilience

This conceptual evolution does not replace older conceptualizations, but can be seen as gradual extensions of the concept. In each new concept, the scope is broadened by new knowledge on system behavior. For example, the single equilibrium (engineering resilience) is a good approximation of the state of a non-linear system (ecological resilience) in the immediate vicinity of a stable equilibrium. Complex adaptive systems do not return to their 'original state', but evolve (socio-ecologicgal resilience), but if disturbances and therefore reorganization is small, returning to an equilibrium (ecological resilience) might be an acceptable approximation. This means that engineering and ecological resilience are in a way part of socio-ecological resilience, as an approximation that is correct only under certain circumstances. For example a resilient system will change under the influence of disturbances (evolution), but this change may not always be fundamentally reorganizational (stable equilibrium as an approximation).

This is also evident from the fact that operationalization's of socio-ecological resilience generally encompass three aspects, persistency, adaptability and transformability, corresponding to the emphases of the consecutive conceptualizations of resilience.

2.2 Resilience and spatial planning

Also within spatial planning, the concept of resilience is gaining interest in the context of increasing risks, both in terms of frequency and intensity. Through related fields, dealing with external shocks such as environmental sciences, ecosystem services, natural hazards and risk mitigation, climate change adaptation, etc., the concept has been introduced in spatial planning.

The resilience concept is in line with recent theoretical developments in spatial planning, which has led to a swift adoption of the concept. In the 1960s and 1970s, it was acknowledge that a worldview based on technical rationality was not sufficient for the societal challenges that planners were facing, as spatial developments had proven to be not as controllable and unambiquous as expected. Therefore, the understanding of spatial systems has shifted over the

last decades, from structuralist to post-structuralist and complex, with aspects such as non-linearity, uncertainty, adaptation and co-evolution (de Roo, 2012; De Roo and Silva, 2012). This has resulted in co-evolutionary and actor-relational approaches within planning, focusing on conditions that open up, on navigation, and on creating consistency between a redundancy of spatial initiatives, rather than controlling spatial developments (Boelens, 2010; Boonstra, 2015). Since resilience focuses on the persistence of relations in a inherent dynamic and uncertain system and environment (Holling, 1973), the resilience concept fits well into this ontology of space.

In what follows, a number of elements of the translation of resilience and its foundations to spatial systems and planning is discussed. What does the resilience principle imply for spatial planning? It draws on the premise that in order to implement a resilience approach in spatial planning, the theoretical foundations of the resilience principle, such as complexity and non-linearity, should also be part of the spatial planning paradigm, which is not (yet) the case. This part aims to embed resilience within spatial planning theory. This part will provide some insights in what the adoption of the resilience concept within spatial planning implies for planning practice, leading to a theoretical framework on resilience and co-evolution within spatial planning and development.

2.2.1 Challenges in translating resilience to spatial systems

Since resilience originates from natural sciences, it runs the risk of being translated too literally into other fields, thereby denying the specificities of other systems, problems and domains. While in some research fields, the adoptions of the resilience principle has led to a new creative view on existing practices, it has led to confusion, ambiguity and criticism in other fields (see for example Swanstrom, 2008). Especially in social sciences, the adoption of the resilience concept has received much criticism.

This is related to the similarities and the differences between the considered system and ecological systems, which form the original base for the theoretical framework of resilience. Social systems and their relation with space differ fundamentally from ecological systems. These differences are situated both on the level of the system itself (natural species versus society) as on the level of the shock (environmental external shocks versus external and internal change).

Since resilience originates from ecological sciences, it often disregards issues of human agency and power. While species undergo change and respond to it reactively, people often undertake conscious, proactive and purposeful action, based on knowledge, predictions and assessment of potential effects. These action strategies are charged with values and norms, and are influenced by emotional and political aspects (see for example Prater and Lindell, 2000). While ecological adaptation is aimed at the persistence of genetic properties within a species, social systems aim for much more than merely survival. A broader array of issues is at stake, such as social justice, emotional aspects, individual and often conflicting interests, minimizing economic damage, etc. Furthermore, strategies are strongly influenced by the prevailing political and institutional framework and the actors and factors involved. In addition, the question can be raised how a stability domain or regime can be defined and delineated in the social context. However, not all human actions are purposeful and values are not supported by all groups of society, leading to an emergent complexity that is similar to that of ecological systems.

With regard to the disturbance, a major difference is that ecological systems only deal with environmental disturbances. In engineering resilience, these disturbances were conceptualized as being external, although later conceptualizations recognize the possibility that shocks are internal to the system. However, in spatial systems, changes are not always fully external to that system. Often, society itself is partly responsible for these changes. For

example, disturbances such as floods are not fully external to the system; changes in the system itself, such as urbanization, increase in sealed soil and even to a certain extent climate change, are also responsible for these shocks. Furthermore, spatial systems do not only deal with environmental disturbance, but also with political, social and economic disturbances, which are very much internal to a social system.

2.2.2 Implications for spatial planning

Although resilience has proven to be a strong analytical framework for empirically observed change, the question is how it translates to planning practice, which deals more with questions of foresight and intervention. Resilience is an analytical framework and therefore holds no normative connotation or judgment on the desirability of the state of the system under study; it merely describes the persistence of system. When actively pursuing resilience in systems, as is the case when it is applied in spatial planning and flood risk management, it assumes a normative position, as the question arises what state of a system is desirable and what state we therefore want to make more resilient. However, this question is often not explicitly addressed. This leads to a conservative attitude, because purposefully increasing resilience implies that the current condition is assumed to be the most optimal one (Davoudi et al., 2012). This is especially the case for engineering and ecological resilience. The evolutionary perspective transcends this normative question as no the emphasis is less on one ideal state, but rather on long-term adaptability and flexibility, allowing for uncertainty and surprise.

Furthermore, much of the confusion about the resilience concept arises from the lack of explicitation of which type of resilience is referred to. Analyses have shown that in practice, the interpretation of resilience is at best ecological, and at worst engineering (Davoudi et al., 2013; Davoudi et al., 2012). This has led to a frustration among resilience scholars, arguing that conceptual clarity is needed and resulting in a huge production of theoretical works on the definition of resilience and its operationalization.

However, the implementation issues might run deeper than a lack of definition. Another difficulty in the adoption of the resilience principle in planning practice is that it is not really consistent with the prevailing planning discourse and paradigm. Linear thinking is still deeply rooted in existing practices, while the insights and views socio-ecological resilience is based on (i.e. complex adaptive systems) are often not a part of it dominant planning practices. Non-linearity, uncertainty and complexity are actually just the opposite of what spatial planning originally pursued. This means that a thorough application of the resilience concept within spatial planning implies a paradigm shift, based on the acknowledgement of uncertainty and complexity in spatial developments (Shaw, 2012). Figure 5 clarifies these differences between resilience planning and rational and communicative planning.

This paradigm shift is based on some recent insights in spatial systems. Governments are not the only actors that shape space; civil society, citizens, businesses and other societal actors shape space, sometimes in relation to governments. Furthermore, spatial developments are not always purposeful of conscious, but sometimes a side effect of other societal processes (Boelens, 1990; Boelens, 2006). Spatial developments are a result of the interactions between many actors and actions at different scales (Boelens, 2009; Boelens, 2010; Boonstra and Boelens, 2011). Choices from the past influence future development options, since evolutions and transitions are affected by path dependencies (Martin and Simmie, 2008). These path dependencies include both physical (e.g. structures) and socio-cultural (e.g. identity, institutions) region-specific characteristics. Furthermore, developments elsewhere and global trends also affect spatial developments. When trying to control spatial evolutions and transitions, these elements can

influence the outcome in an unexpected where. Therefore, spatial developments can no longer be seen as controllable processes.

The planning focus thus shifts from managing and controlling spatial developments through direct intervention and strong central coordination, to a more adaptive planning approach, that 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. As, the central government is than rather a process mediator, supporting the development of the self-organizational capacity of regions. Governments can thus take up multiple roles, ranging from inspiring and informing, to initiating and facilitating. It is important to seize opportunities from autonomous developments, so that planning becomes the outcome of self-organizing processes (Boonstra and Boelens, 2011).

	Rational comprehensive planning	Communicative/ collaborative planning	Resilience planning
Rationality	Instrumental rationality	Communicative rationality	Integrative rationality A framework that combines instrumental and communicative rationality
Actors	Individuals/ technicians	Individuals in interactive groups	Interdisciplinary groups with technical expertise Social groups as learning agents of change
Relations between actors/issue of power	Defining goals for all	Consensus generation	Commitment
Time perspective	Medium to long term	Short term	Long-term perspective, systems approach and immediate action
Concern	Problem solving	Collective agreement/ decision	Issues raised under the instrumental rationality act as constraints
Aim	Defining the most effective actions/to achieve goals	Consensus, mutual understanding	Defining priorities for a no-regret situation Preparedness for both slow and major disturbances
Output	Decisions: based on technical knowledge	Collective decision based on socially constructed values	Flexible solutions depending upon spatial heterogeneity, function and temporal change
Context/substance	Comprehensive decisions	Context as an outcome of process	Red tape and priorities
Value systems	Individual values	Socially constructed values	Universal values for common benefits
Bases of evaluation of outputs	Efficiency	Consensus-based values	Resilience attributes

Figure 5. The resilience planning paradigm and its major characteristics in comparison to rational and communicative planning paradigms (Eraydin and Tasan-Kok, 2013b: 30)

Although these ideas recently received a lot of attention, the transfer of complex adaptive systems thinking within spatial planning practice is still in an early stage, because linear thinking is deeply rooted in planning practice (Wilkinson, 2012a; Wilkinson, 2012b). While resilience is in line with recent developments in planning theory (e.g. complexity and complex adaptive systems, self-organization, adaptive planning), it seems that the lack of integration of this worldview into the prevailing paradigm is leading to an implementation gap. For example, many authors have

tried to distill the attributes of urban resilience in order to measure resilience (Albers and Deppisch, 2012; Godschalk, 2003). However, no agreement on such indicators has been reached. While there is some consensus on the resilience attributes, it might however be impossible to model for the emergent uncertainty and complexity in complex adaptive systems, as modeling assumes some degree of predictability, and therefore is more in line with linear thinking.

The main paradigm shift towards resilience thus lies in the consideration of urban areas and spatial developments as complex adaptive systems (Eraydin and Tasan-Kok, 2013b). The systematic approach by contemplating the interaction between the components of spatial systems as proposed by resilience thinking is not new. Systems thinking focuses on the whole, not the parts, of a complex urban system. However, the novelty lies in the understanding that change can result in different outcomes, depending on these interactions. It is important to understand the interactive relations, interfaces and arrangements among the components of the urban system and their impacts. As Eraydin and Tasan-Kok (2013a: 238) put it: "*understanding the co-evolutionary dynamics of urban systems and defining the substance of planning accordingly are vital for resilience planning*".

2.3 Resilience and flood risk management

Resilience is often discussed as a new flood management approach (Begum et al., 2007; de Bruijn, 2005; Petrow et al., 2006; Roth and Warner, 2007), as it is believed to be able to deal with uncertainty and surprise inherent in flood risks and spatial developments. In this paragraph, we discuss what a resilience approach to flooding exactly encompasses and how it differs from other flood management approaches. This part aims to elaborate and operationalize a resilience approach, by translating the theoretical aspects of the resilience approach to the context of flood management.

In this paragraph, we first look at how the resilience concept can contribute to the conceptualization of flood risks. Then it is discussed what the analytical framework of resilience implies for flood risk management strategies, and what the main elements and characteristics of a resilience approach for flood management strategies are following the flood management strategy framework of Hutter (2006). Based on literature, it reviews resilience aspects of process, content and context. This application of the resilience concept on flooding and flood risk management shows the potential of the concept, with regard to both framing the issues, as well as inspiring innovative approaches for responses.

2.3.1 Implications for the conceptualization of flood risks

Some lessons on the conceptualization of flood risks can be drawn from the resilience perspective. Traditionally, floods are framed as purely natural-physical disturbances in the water system. As such, they are external threats to human systems. By framing floods like this, solutions are usually confined within the boundaries of the water system and water management, and intended to minimize and, if possible, even eliminate floods. However, as indicated above, socio-spatial aspects (e.g. vulnerable urban developments in flood-prone areas, settlements in potential retention areas upstream) also substantially contribute to flood risks, i.e. both the probability of flooding and potential flood losses. From a socio-ecological resilience stance, floods are no longer a merely biophysical problem, but emerge from the co-evolutionary process between land and water. Taking this into account, on the one hand, charges flood risks with additional complexity, but also implies that potential solutions can also be found in socio-spatial interventions, e.g. by lowering vulnerabilities. So the issue of flooding rests at the intersection of the water system (water flows,

engineering infrastructures etc.) and the socio-spatial system (settlements and spatial development). Consequently, integrating socio-spatial systems in flood risk management can lead to a more comprehensive view on the issue.

Furthermore, emphasis in practice is mostly on absorbing shocks, minimizing short-term damages a speedy recovery to the existing condition and functions, corresponding with engineering resilience, or ecological resilience at best. This leaves little space for reorganization and development. The socio-ecological resilience concept questions this attitude. Controlling nature and other conservative mechanisms limits the dynamic that is needed to allow a system to adapt to a changing context in order to be more suited. In a long-term perspective, focus is more on dynamics and renewal than (technically) embedding stability.

2.3.2 Resilience and the three dimensions of flood risk management strategies

> *"A management approach based on resilience, on the other hand, would emphasize the need to keep **options open**, the need to view events in a regional rather than a local context, and the need to emphasize **heterogeneity**. Flowing from this would be not the presumption of sufficient knowledge, but the **recognition of our ignorance**; not the assumption that future events are expected, but that they will be **unexpected**. The resilience framework can accommodate this shift of perspective, for it does not require a precise capacity to predict the future, but only a qualitative capacity to devise systems that can **absorb and accommodate future events in whatever unexpected form they may take**."*
>
> (Holling, 1973: 21)

Flood risk management is traditionally focused on minimizing disturbance and reducing risks and the negative effects of potential disturbances. However, a resilience approach would encompass including disturbance as an integral part of the planning process. "The idea is to accept the fact that changes are going to take place, and while taking steps to reduce the risks, urban systems should be prepared to absorb these changes, reorganize themselves and develop new adaptive strategies to manage and cope with the change while improving their capacities" (Eraydin and Tasan-Kok, 2013b: 231). Priorities then shift from controlling change to increasing the capacity of the spatial system to cope with, adapt to and shape change (Eraydin and Tasan-Kok, 2013b).

The question is now to what kind of strategies the resilience principle leads. To answer this question, the principles of resilience are applied flood risk management. Resilience as a concept embraces two characteristics: the robustness or strength of a system when subjected to stress, achieved through diversification (heterogeneity), and the adaptability or flexibility of a system in response to changing conditions and objectives (keeping options open). The resilience concept can be applied both to governance systems and to the many elements and features of the built environment (Holling, 1973). From this perspective, floods should not be managed through a one-sided protection by technical measures approach, but through diversification (e.g. technical measures ànd behavioral change, government ànd private initiative) and flexibility (e.g. taking into account changes in flood risks).

Based on literature review, the implications for flood risk management are discussed based on the framework on strategies by Hutter (2006). Hutter (2006) defines three dimensions of flood management strategies: content, process and context (Figure 6). The content includes the objectives, measures and (policy) instruments of flood management. The process considers the way in which content is conceived. The context comprises the internal and external context within which floods are managed. The content and the process thus constitute an actor's flood management strategy, in relation to the context it takes place in. Within this framework, the resilience principle can be applied to each of

these three dimensions, leading to the following questions: (a) what measures and instruments contribute to flood resilience, (b) which processes lead to flood resilience, and (c) what context allows flood resilience? In what follows, we discuss how the concept of resilience translates to each of these three aspects of flood risk management strategies.

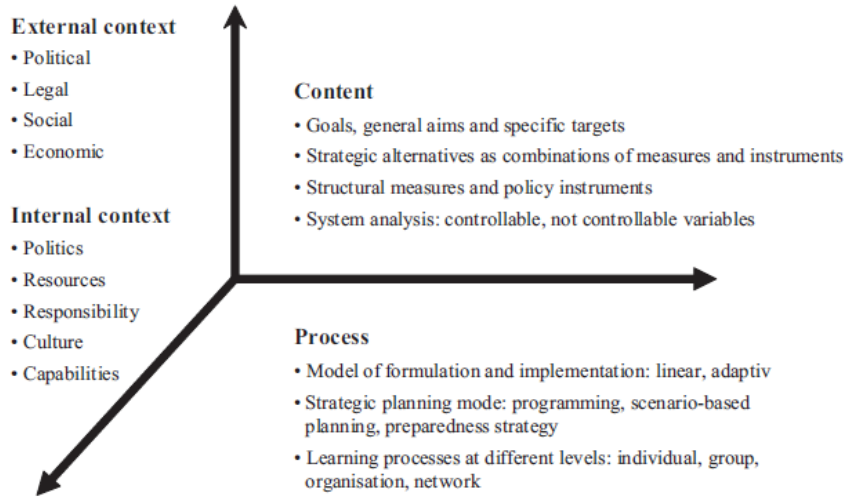

Figure 6. Dimensions of strategies for the management of flood risks (Hutter, 2006)

2.3.2.1 Content: from protection to multilayered approaches

A resilience approach encompasses a diversification of measures to deal with flood risk, providing a degree of redundancy in the face of surprise. Although current practice is often quite one-sided, strongly focused on technical protection measures, there is a large diversity in options on how to reduce impacts of extreme weather-related events such as floods. In fact, it is not the quantity, but the function and structure of elements that is important for resilience. Measures that are little considered and applied in current practice might contribute to a more diversified approach to flood risk. However, diversity also comes at a cost (inefficiencies, additional investments of obsolete capital).

In addition to diversity in aims and measures, measures that contribute to resilience should be flexible, allowing for further adjustment to unforeseeable circumstances. This means that physical structures should not be planned for one future, but for a large range of potential futures. This not only has technical, but also economical and organizational implications. For example a diversification in initiative and responsibility could also contribute to more flexibility in face of change by allowing for a quicker detection of and response to change.

Within flood risk management, a common classification of measures is structural measures, non-structural measures and instruments. Structural measures are permanent engineering works, intended to reduce the frequency of flooding, such as flood storage reservoirs, flood walls, embankments, tidal barriers, etc. Non-structural measures are physical interventions which are not permanent or do not necessarily involve traditional engineering works, such as catchment management to enhance water retention, erosion control by reforestation, river rehabilitation, temporary defenses, flood resistant construction techniques, flood proofing. Lastly, instruments are non-structural interventions aimed at changing the social, financial and institutional context of flood risk systems, such as regulation, financial instruments and communication. From the hazard risk reduction field, three generic strategies to reduce risks are defined: choose change, reduce losses or accept losses (Table 1). A resilience approach would thus encompass measures from all of these different types. However, currently the focus is mainly on risk reduction and sharing losses (Bouwer et al., 2007); choosing change on the other hand has not extensively been applied as a measure.

Strategy	Option	Examples for flood risk management
Choose change	Change location Change use	Delocalization, not build in flood-prone areas Flood-proof construction, floodable functions
Reduce losses	Prevent effects Modify event	Warning systems, emergency relief Dikes
Accept losses	Share loss Bear loss	Compensation, insurance

Table 1. Generic options for hazard risk reduction and measures for flood risk management (based on Klein et al. (2003))

However, a wider range of diversified measures is possible, as shown by the framework on adaptive responses by (Smithers and Smit, 1997). They distinguish seven dimensions of adaptive responses to climate extremes: intent, role of government, scale, timing, duration, form and effect (Table 2). Currently focus is mainly on technical buffering measures, but as stated before, this is no longer viable. Strategic, autonomous responses, both on the individual as on the community scale, are lacking. Also behavioral responses, i.e. the modification of practices of individuals, groups or institutions, have not been properly considered. For example, relocation is believed to increase the physical, social, environmental and economic resilience of flood-threatened communities, while allowing them to maintain their essential economic function, social ties, and community identity with only modest federal investment (Cummings et al., 2012; Godschalk et al., 2009). Nevertheless, this measure is rarely considered and only seen as a last resort. As a last element, current flood management mainly enhances stability by buffering - both physically as financially - and often does not facilitate (societal) change.

intent	- incidental - result of purposeful decisions
role of government	- autonomous /private (voluntary) - government/public agency (regulatory) o direct (implement actions) o indirect (supporting functions)
scale	- spatial (local, regional or national) - social (actor) (individual or societal/community scale)
timing (relative to time of climatic disturbance)	- planning (proactive or reactive) - operation (before, during or after)
duration	- tactic (short term) - strategic (long term)
form	- technological, engineered - behavioural
effect	- buffer from perturbation (enhance stability) - facilitate change to meet altered conditions (enhancing resilience or flexibility)

Table 2. Dimensions of adaptive responses to climatic variability (based on Smithers and Smit (1997))

This framework shows gaps in our current flood risk management practice from a diversity and flexibility point of view. However, the fact that some dimensions of adaptive responses to flood risk are being overlooked might be not so much related to a lack of knowledge, since a call for such alternative measures exists in scientific literature (Cummings et al., 2012; Grothmann and Patt, 2005; Montz and Gruntfest, 1986), but rather with a prolonged discrepancy between recommendations and practice, and the difficulties of applying such measures within the existing processes and context (Hutter, 2006).

	Prediction and control regime	**Integrated, adaptive regime**
Management paradigm	Prediction and control based on a mechanistic system's approach	Learning and self-organization base don a complex systems approach
Governance	Centralized, hierarchical, narrow stakeholder participation	Polycentric, horizontal, broad stakeholder participation
Sectoral integration	Sectors separately analyzed resulting in policy conflicts and emergent chronic problems	Cross-sectoral analysis identifies emergent problems and integrates policy implementation
Scale of analysis and operation	Transboundary problems emerge when river sub-basins are the exclusive scale of analysis and management	Transboundary issues addressed by multiple scales of analysis and management
Information management	Understanding fragmented by gaps and lack of integration of information sources that are proprietary	Comprehensive understanding achieved by open, shared information sources that fill gaps and facilitate integration
Infrastructure	Massive, centralized infrastructure, single sources of design, power delivery	Appropriate scale, decentralized, diverse sources of design, power delivery
Finances and risk	Financial resources concentrated in structural protection (sunk costs)	Financial resources diversified using a broad set of private and public financial instruments
Environmental factors	Quantifiable variables such as BOD or nitrate concentrations that can be measured easily	Qualitative and quantitative indicators of whole ecosystem states and ecosystem services

Table 3. Comparison between the 'predict and control'-regime and the integrated adaptive regime in water management (Pahl-Wostl, 2007)

2.3.2.2 Process: from linear to adaptive management

The adaptive character of flood management strategies not only depends on the diversity and flexibility of measures and aims, but also on the way they are conceived and embedded in communities' practices (Hutter, 2006), i.e. the processes (internal dynamic) in relation to their specific context (external challenges). Measures with essentially the same aim (e.g. flood prevention) can imply different degrees of adaptation to flooding, depending on the process, e.g. community support, contribution to a learning process, embedding in a cycle of constant reassessment and evaluation, etc. Resilience is not merely considered to be an outcome, but also a process (Djalante and Thomalla, 2010). As both the external challenges as the internal dynamics are constantly changing, not only the measures, but also the management process must be diverse, flexible and adaptive (Pahl-Wostl et al., 2007a; Tompkins and Adger, 2004). Resiliency implies responsive governance systems - decision-making processes that can quickly identify and respond to new priorities or new threats. The process of constantly incorporating change leads to resilience (Holling, 1986 in

Liao 2012), while the loss of resilience is a consequence of imposing stability through generic evaluations and solutions on a part of a system that is dynamic in nature (Holling, 1996).

Adaptive management is defined as a learning-by-doing process in which specific objectives are open and are adjusted after each flood (Liao, 2012; Pahl-Wostl, 2007; Tompkins and Adger, 2004) (Table 3). It is an iterative process, based on feedbacks and knowledge building, where management strategies are continually being evaluated and improved by learning from experiences (Lessard, 1998), and aimed at increasing the adaptive capacity of the system. Therefore, focus is more on the process (development, evolution, etc.), than on the product. It tries to deal with unpredictable interactions between people and ecosystems while they co-evolve (Berkes and Folke, 1998).

It is based on social and institutional learning: the idea that organizations and institutions, just like individuals, can learn from policy choices through feedbacks from the environment. However, knowledge is not only built in a select group of water managers, but within a broader community, and different types of knowledge are combined, so that the community can adapt to changes in the physical water system through autonomous development (Pahl-Wostl et al., 2007b). The process is co-evolutionary in the sense that feedback takes place in two directions between the management policy and the broader community on the one hand and the condition of the resource on the other (Berkes et al., 2001).

2.3.2.3 Context: community resilience

Within flood management, the context is often seen as being external and unalterable, as "*it enables and restricts human agency*" (Hutter, 2006). Therefore, this aspect has not really been subject of research. Nevertheless, the context has a large influence on flood risk management, because it sets the conditions for the flood risk management regime (content and process).

A useful perspective for applying the resilience principle to the context of flood management is community resilience. Norris et al. (2008: 130) define community resilience as "*a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance*". This set of networked adaptive capacities comprises both the resources themselves, as its dynamic properties (robustness, redundancy and rapidity).

Resilience calls for building adaptive capacities (i.e. learning capacities of institutions and networks, responsible power structures, etc.). Increasing the political, economic and social adaptive capacities enables a society to adapt to changing conditions, and thus increase resilience to flooding on the long term. Economic resources (such as economic growth, stability and equitable distribution of income and wealth, and access to housing, health care, schools and employment) are seen as the essential base for a resilient community (Adger, 2000; Godschalk, 2003). In line with what is mentioned under "process", the ability of not only formal institutions, but also the entire community to gather knowledge by learning from experiences is an important factor. In addition, responsive power structures are needed that consider the interests of all stakeholders (Berkes and Ross, 2013). Collective action and decision-making are central themes. Governments can offer an integrated framework for institutions at different levels, to encourage multi-stakeholder participation and commitment, and even to support self-organization (Djalante and Thomalla, 2010). A last aspect is social capital. Individuals invest in, access or use resources that are embedded in social networks. Therefore, social capital can be defined as the total effective or potential resources that are linked to possessing a durable network of relations.

2.4 Extending flood risk management: the co-evolutionary perspective

2.4.1 Framing the flooding issue: socio-physical interactions and co-evolution

While it is true that most societal aspects cannot be altered directly from a flood risk management perspective, it is not necessarily so that the context unilaterally determines the boundaries and constraints for flood risk management. This conceptualization of the context of flood risk management is too deterministic, and ignores interactions between flood risk managers and other actors that contribute to flood risks but not to flood risk management.

Rather, flood risk management (e.g. technical infrastructure, governmental rules, engineering rules, technology, etc.) and communities (behavior and habits of citizens) have co-evolved over long periods of time (Pahl-Wostl, 2002). This reciprocal interaction extends beyond merely public support for management choices. Formal FRM itself also shapes the perceptions, expectations, behavior, practices and habits of the broader society (Pahl-Wostl, 2002, 2007). The way governments deal with, and have dealt with floods en flood losses in the past has an impact on the adaptability of their societies (Bouwer et al., 2007). This means that path-dependencies arising from previous management choices influence transitions to new management modes. Buffering a system from environmental perturbations (e.g. through dikes) and their adverse effects (e.g. through insurance and compensation systems) can for example reduce or even remove the impetus for other types of adaptation (Botzen et al., 2010; Smithers and Smit, 1997). The strong reliance on public flood management may hamper individual responsibility (Grothmann and Reusswig, 2006). The current flood management regime itself thus appears to be quite self-preserving, as some mechanisms maintain it from within (Liao, 2012).

Considering floods as a result of the interaction of social and physical systems sheds a new light on flood management (Gerrits, 2008). Kallis (2007: 4) states that 'a co-evolutionary explanation [...] entails two or more evolving systems whose interaction affects their evolution'. Co-evolution expresses the idea that evolutionary adaptation in system A changes the conditions for all other systems to which system A is (part of) the environment (Stalder, 1997). As Holling (1996: 31) puts it, "both the biota and the physical environment interact such that not only does the environment shape the biota but the biota transforms the environment".

Floods are inextricably results of co-evolving land (socio-spatial) and water (natural-physical) systems (Folke et al., 2002; Tompkins and Adger, 2004). This means that flood risks influence land-use options, and socio-spatial developments on land in turn have an impact on flood risks (e.g. increased run-off) (Gerrits, 2011; Hartmann, 2010; Mitleton-Kelly, 2003). The mechanisms behind spatial developments respond to (changes in) flood risks (Hartmann, 2011a; Pahl-Wostl, 2007). These include spatial demands, real estate markets, insurance systems (Botzen et al., 2009), knowledge of flood risks (Bubeck et al., 2012), perceptions and attitudes towards floods, and the behavior and practices of the broader society. The presence of valuable spatial developments in flood-prone areas, on the other hand, causes a need for protection through technical infrastructure, governmental rules, engineering rules and technology.

2.4.2 The lack of spatial planning in flood risk management: a co-evolutionary explanation

In the traditional robustness-based approach to managing floods, this co-evolution is not sufficiently acknowledged. Also natural hazards risk reduction research has focused too long on the isolated study of (mostly technical) systems and responses (Pahl-Wostl, 2002, 2007), disregarding complexity and the human dimension. Co-evolution however is a natural process. Interactions across systems are emergent, but not always acknowledged. In these traditional views,

systems are conceptually closed, which might well be less a meaningful reality than a perceptual convenience (Holling, 1973).

When framing the flooding issue as a purely physical problem (as discussed above), solutions are restricted to the water system (technical assessments and solutions). The societal context (including spatial developments) is then seen as being external and unalterable, enabling and restricting flood management options (Hutter, 2006). The interaction between land and water is then one-directional: what happens on the land has consequences for the management of the water system, but land uses rarely respond to changes in the water system (Figure 7). This has contributed to a generic, mechanistic and often technocratic interpretation of the adaptation principle towards a preventive approach through technical measures.

However, this traditional static conceptualization of the societal context does not reflect the dynamic and reciprocal co-evolution of both systems (Boisot and Child, 1999). The lack of acknowledgement of this reciprocal relation between flood management and its societal context has led to some unwanted (side) effects. The strong focus on protecting against and preventing flooding makes that risks are less and less tolerated, inducing the need for an even higher degree of safety. An example of this is the 'levee effect' (Baan and Klijn, 2004; Bubeck et al., 2013b), whereby investments in defense infrastructures enabled citizens to build in floodplains, which results into a need for continuous investment in flood defense. On the one hand, this excludes a more natural approach, such as making room for the river, and on the other, potential losses in case of flooding increase. Hartmann (2008: 8) discusses a technological lock-in: "*embankments pretend security, which justifies value accumulation behind them. (…). The social arrangement in the floodplain sustains this effect. Finally, a threshold based flood-protection based on embankments is a technological lock-in. Due to time, this lock-in tightens, because more embankments will have been build, more values will have to be protected.*" The strong emphasis and dependence on government intervention causes a low sense of responsibility amongst residents, and therefore low autonomous adaptive and self-organizational capacities. Consequently, residents not only adopt a passive attitude, but their individual choices of interventions sometimes also increase risks.

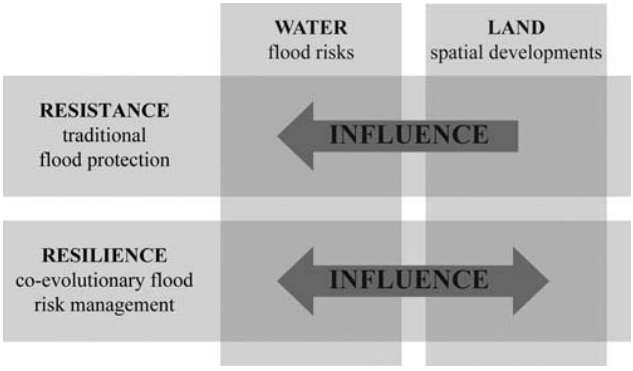

Figure 7. Interactions between land and water in flood protection and resilience approaches

It is often argued that spatial planning can reduce vulnerability by discouraging development in flood-prone areas (Burby et al., 2000). In practice, however, spatial planning has not succeeded in this (Hutter, 2006), as proven by the ongoing development of floodplains (Montz and Gruntfest, 1986). Spatial planners are faced with a lack of societal support to enforce land use restrictions in flood-prone areas. Essentially, this failure is not so much related to a lack of knowledge or a problem of uncertainty, but rather to the strong focus on the water system in flood risk management. Through the co-evolutionary relation between land and water, this causes a negligence of flood risk in the land system

and a lack of support to manage flood risks through spatial planning. The interactions between the land and water system are thus not fruitful. The broader land mechanisms (such as real estate markets) induce maladaptations, serving short-term human goals, but often with attendant costs on individuals, communities and society, which are accepted to be 'the cost of business'. However, these may become unbearable in light of a heightened exposure to extreme climatic events (Smithers and Smit, 1997). As the need for managing flood risks in spatial planning is growing due to increasing damages, spatial planners are confronted with their limited effectiveness. To overcome this, insights in these interactions and how they can become more fruitful is keystone.

2.4.3 Towards a better understanding of co-evolutionary mechanisms

In this context, (Pahl-Wostl, 2007: 50) argues that "one needs to better understand the interdependence and co-evolutionary development of management objectives and paradigms, environmental characteristics, technologies and social routines". A resilient system encompasses the dynamics to accommodate trends and co-evolve (Wardekker et al., 2010). The relationship and interaction between society and flood risk management is thus keystone for resilience.

In literature, two types of co-evolution are defined in literature in relation to flood risk management. The first is the coevolution of between social and ecological systems, in line with resilience theories. Social and ecological systems are inherently linked through what Norgaard (1994 in Gunderson, 2010) calls an synergistic and co-evolutionary relationship. According to Eraydin and Tasan-Kok (2013b: 6) "*resilience thinking facilitates the understanding of the co-evolution of socio-economic and ecological systems*".

In relation to flood risk, this would translate to the co-evolution between the ecological water system and the social land system. However, in this approach, it is not clear on which side engineering systems fall; on the one side it is part of the ecological water system, on the other hand, it is conceived and structured by the social system.

This is addressed by the socio-technical system view. Socio-technical systems link physical (and non-structural) systems with actors (e.g. flood management organizations) and rules (e.g. acceptable standards) performing a particular function (e.g. flood risk management) (Geels, 2004). By using the socio-technical system concept, the co-evolution of the technical system and socio-economic system, of structure and function, becomes the focus of attention. From this viewpoint, the interactions within the flooding system should be considered as a dynamic process of mutual adaptations and feedbacks between the physical flooding system and the actors being impacted upon by flooding or responding to flood risk (Ashley et al., 2012).

2.4.4 The multi-actor perspective: polyrationality and multistrategy

Based on recent theoretical developments in spatial planning, a third type of co-evolutionary interactions is added: the co-evolution between actors. The content-process-context framework used in section 2.3.2 starts from the perspective of water managers, solely performing formal flood risk management. However, this view is a one-sided perceptual convenience, as water managers are not the only actors involved in the (spatial) development of flood risks. Flood risk management (FRM) is often described as a purposeful activity to mitigate flood risks. It should however be taken into account that all actors that somehow shape the water-land system contribute to flood risks and therefore indirectly manage them. In this view, flood risk management is not only performed by water managers or governments, but by a whole lot of actors that contribute to flood risks such as residents, businesses, etc. Furthermore, not all actions that contribute to flood risks are purposeful. In fact, these contributions to flood risks might be formal or informal, direct or indirect, positive or negative, and purposeful or unconscious. The different involved actors have different rationalities

about flood risks (Hartmann, 2010), and therefore each has different strategies to deal with them. The interrelations between these actors cause the subsystems they belong to to co-evolve.

This relates to actor network theories and the flat ontology of planning, in which there are no *a priori* differences between the intentions and performed behavior of planning actors, such as citizens, entrepreneurs, governments, and others (Boonstra, 2015). These actors are thus not hierarchically structured, but are on equal footing. This ontological theory follows the observation that spatial developments have proven to be not as controllable and unambiguous, but much more complex than expected. Governments are not the only actors that shape space, but other actors have their autonomous spatial development processes.

The flood risk management framework can thus be extended with a fourth element: actors. Each of these actors has an individual strategy (content and process in Figure 6) to deal with flood risks. The result of these individual strategies forms part of the context for other actors. The context thus includes the actions of other actors and factors, adding a co-evolutionary actor-centered perspective to flood risk management strategies. This means that actions by one actor can change the environment for other actors, destabilizing and putting adaptive pressure on their flood risk management strategy. From an actor perspective, the environment thus constantly changes under influence of what other actors do.

However, for most actors other than water managers (e.g. residents, civil society, etc.), their strategies are unintentional, implicit or a side effect of other objectives, and therefore often counteracts formal flood risk management objectives. Therefore, the immediate challenge for flood resilience is not restricted to innovative measures or processes that lead to resilience, but also a more fruitful co-evolution between water managers and other actors, so that flood risk management can be expanded to a encompass multiple co-evolving actors. In such a multi-actor approach, responsibilities are shared between governmental and non-governmental actors. The question however is how spatial planners and land users can responsibilized, convincing them to contribute positively to managing flood risks, if they themselves don't feel the need to do so.

2.5 Conclusion

The theoretical framework for this research started from the resilience concept and resilience thinking. The increasing recognition of the interdepence of biophysical and socioeconomic systems has led to efforts to adopt resilience in spatial planning and flood risk management. In this chapter, we discussed the definition and some issues in the adoption of resilience in spatial planning, such as the lack of clear denotion of the used conceptualization, differences between social and ecological systems, the use of resilience as a (policy) goal and the discrepancies between the theoretical foundations of the resilience concept and the prevailing planning paradigm. It argues that a resilience approach is only useful if it is embedded in a planning paradigm that is in line with the theoretical assumptions of the resilience concept.

The application to flood risk management however shows that resilience nevertheless makes a valuable contribution. What the resilience approach offers to flood risk management is not completely new, as diversifying measures and including more actors is a general trend in this field. What can be considered new in flood risk management is the co-evolutionary framing of changes in socio-ecological systems; the idea that interactions between the components of the spatial system can influence outcomes in an unexpected way. From this perspective, flooding is not a purely

physical problem. Flood risks emerge form the interaction between societal and natural processes. This means that societal actors play an important role in the spatial development of flood risks, both positive (managing flood risks) and negative (developing flood risks). However, little is known about the interaction between the water system and broad spatial developments.

Co-evolution provides an analytical framework to understand this interdependent evolution of social and environmental subsystems. This sheds a different perspective on floods, i.e. the conceptualization of flood risks as the result of interaction between the water and land systems, and the associated range of possible management options, leaving room for uncertainty, change and surprise.

2.6 Research design

2.6.1 Research question

The key question thus is how the relations and interactions between the social and ecological system, between the social and the technical system, and between actors contributing to flood risks influence the overall resilience to flooding. This research analyzes these co-evolutionary interactions in flood risk management. It focuses on the role of different actors within (formal and informal) flood risk management from the public, civic and business society, i.e. governments, residents, civil society organizations, and market actors, and the interactions between their strategies to deal with flood risks.

The hypothesis is that currently in Flanders, co-evolutionary interactions between these three groups undermine future resilience to flooding. It is expected that the development of flood resiliency in Flanders is obstructed by formal flood management, due to the dominance of technical protection measures and the high dependence on government intervention. The idea that social and natural systems co-evolve through time forms an explanatory framework for the existing condition and the historical evolutions that have led to this condition, but also gives rise to questions concerning future developments. Therefore, this research also explores how we can make these co-evolutions more resilient.

The framework developed in this chapter will structure the empirical research on flood management in Flanders (Figure 8). Depending on the actor group, a different research methodology is used. The actions of these different groups are confronted with the resilience framework, based on the basic principles of adaptability and diversification.

2.6.2 Methodology

Due to the focus on actors in this research, it uses a case study based mixed methods approach. Four actor groups were questioned in three case study scales, through four different data collection methodologies.

2.6.2.1 Four actor groups

This research looks at the interactions between the four main actor groups from the public, civic and business society involved in FRM. These are:

- Water managers: The water managers are primarily responsible for formal flood risk management. The competences are distributed among different governmental actors (i.e. W&Z, VMM, provinces, municipalities

and polders and wateringues) according to the hierarchy in the water system (i.e. respectively the navigable waterways and unnavigable waterways 1st, 2nd and 3rd category).

- Spatial planning: Through integrated water management policies, spatial planning is also a major actor in formals FRM. Three levels of spatial planning in Flanders are the region, the province and the municipality.

- Land users: Land users outside and in of flood-prone areas affect the flood risks though their spatial developments in terms of increased surface run-off on the one hand, and exposure of buildings in flood-prone areas on the other. Land users located in flood-prone areas are directly confronted with the consequences of floods and undergo the effects of formal flood risk management measures and policies. These include residents, businesses, nature and agriculture.

- Market actors: This group indirectly contributes to the spatial development of flood risks, as they are involved in the market mechanisms that support and influence spatial developments in flood-prone areas, and the way land users manage their flood risks. These include insurers, banks, architects, notaries, contractors, real estate agents, engineering consultancies,

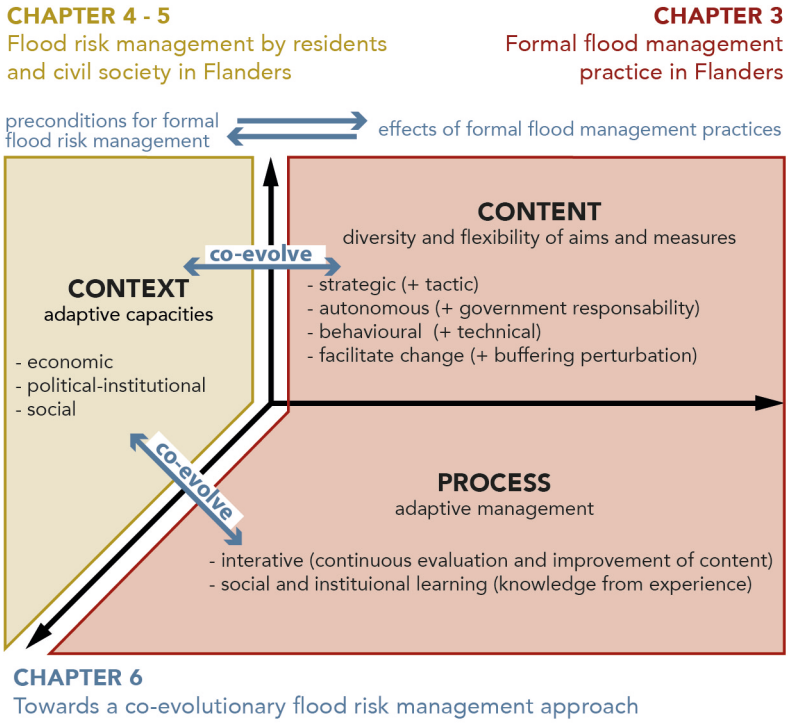

Figure 8. Research design

2.6.2.2 Case studies: three scales

Because of the different scales these actors operate at, the research takes a multi-scalar case study approach. In this way, regional, catchment and local actors are included in the research.

a. Flanders

Flanders, the low-lying northern part of Belgium, is densely built (more than 460 inhabitants / km^2) and has a dense river network, causing it to be sensitive to flooding. According to the most recent water assessment maps 71,556 ha or 5.3 % of Flanders have recently been flooded or have a flood return period of 100 years with a flood depth of 30 cm.

According to the Flemish Environmental Agency[1] 36,000 to 56,000 buildings and 23,000 building parcels or 9% of the available building parcels are located within flood-prone areas. The damage compensations due to flooding amount to 40 to 75 (even 100) million € per year, or approximately 0,05% of the gross national product. This is a relatively high monetary risk in comparison with neighboring countries. By 2050 (under an average climate scenario) an increase in flood risk of 50% is expected.

b. Dender catchment

The Dender region is one of the areas with the most frequent flooding within Flanders. The most recent floods took place in 1995, 1999, 2001, 2002-2003, 2010, 2011 and 2014 (Coninx and El Kahloun, s.d.). The Dender catchment is part of the Scheldt basin. The upstream part of the catchment (675 km^2) is located in the Walloon Region, where the Dender has its source, and the downstream part (709 km^2) is located in Flanders and managed by the Flemish government. As water management in Belgium falls under the responsibility of the regional authorities, this means that the Dender is managed by the Walloon government for the upstream half of the chatchment, and by the Flemish government for the downstream part.

The flooding issue in the Dender catchment is often debated in the media and there is a social and political debate going on about what needs to be done to reduce floods and flood-related damage. Known problems are the (relatively) high density of buildings and sealed land in the floodplains (as already reported in the 1960s by Van Nuffel (1969)), the outdated infrastructure and the lack of coordination with the Walloon Region, both during floods as in general (CIW, 2011).

c. Geraardsbergen

The community of Geraardsbergen (Belgium) is located in the Dender catchment (part of the Scheldt catchment). It is located in Flanders and borders on the Walloon Region. Geraardsbergen experienced the most devastating consequences within Flanders during the November 2010 flooding. Not only were frequently flooded areas affected; also a lot of buildings were inundated for the first time. There is a social and political debate going on about what needs to be done to reduce floods and flood-related damage. Known problems are the (relatively) high density of buildings and sealed land in the floodplains, the outdated infrastructure and the lack of coordination with the Walloon Region, both during floods as in general.

2.6.2.3 Data collection

In accordance with the type and the size of the different actor groups, different methods for data collection were used. These methods were both quantitative and qualitative. These different data collection methods produced rich and complementary data.

- Document analysis: In order to understand how current FRM policies support the development of flood resilience, a policy document analysis was used. This allowed us to gain a comprehensive overview of the different policy fields active in FRM and to reconstruct the recent developments in these policies.
- Survey: To understand to viewpoint of residents, a survey was chosen. This allows for a comprehensive overview of the different opinions amongst a large population. A restriction of this methodology is that the

[1] presentation on 22/10/2013

questions are fixed and often close. To overcome this, feedback from interviews with residents and input from scholars and policy makers was taken into account in the preparation of the questionnaire.

- Bilateral interviews: Interviews were used for in a number of ways.
    - Interviews with policy makers were used to complement the policy analysis (chapter 3), in order to gain more in-depth insight in aspects of policy that might not be included in official policy documents (yet). They were focused on knowledge rather than viewpoints.
    - Interviews with residents were used to support the development of the questionnaire for the survey (chapter 4). These interviews were open-ended.
    - In-depth interviews were used as a main data collection method for land users and market actors, both on the regional and the local scale (chapter 5), because this group is smaller and more difficult to reach in a general sense (for example through surveys). Furthermore, these bilateral interviews allowed us to explore their experiences with flood risks and FRM in depth. These interviews were semi-structured.
- Focus group: Because of the highly divergent discourses found in the various actor groups, a focus group was organized. This methodology allowed us to bring these actors together and to confront their discourses and discuss different perspectives and aspects of the issue in depth.

2.6.3 Structure of the report

The third chapter discusses the current state of formal flood risk management by governmental actors in Flanders. The main question is whether current flood management efforts and practices contribute to resilience and adaptability. This question is answered by mapping and analyzing the different dimensions of flood management strategies (content, process and context) in Flanders mainly through (policy) document analysis, supplemented with some interviews.

The fourth and fifth chapters discuss how non-governmental actors operate within this institutional context, and how this contributes or counteracts with formal, governmental flood risk management strategies. In the fourth chapter, the point of view of residents of flood-prone areas in the Dender basin is explored based on a survey. It addresses the topics of awareness and knowledge on flood risks, risk perception, location choice, sense of responsibility and protective behavior.

The fifth chapter discusses the points of view of civil society actors based on interviews and policy options based on a focus group that brought together the different points of view of policy makers, residents and civil society.

Therefore, the sixth chapter addresses how we can achieve more flood resilience through flood risk management, taking into account these co-evolutionary interactions. It addresses the question how co-evolutionary processes can become more fruitful, and in particular how policy makers can navigate these processes to attain this.

3 Formal flood risk management in Flanders

This chapter addresses formal flood risk management (FRM) and policy in Flanders, as performed by governmental actors such as water managers and spatial planning. It aims to provide on the one hand an analysis of how resilient formal flood risk management in Flanders currently is, and on the other hand a background for the analysis of how non-governmental actors operate within this institutional context in the following chapters.

It first looks at how the content and process of the existing formal FRM strategies within water management and spatial planning relate to the flood resilience strategy discussed in the theoretical framework presented in chapter two. It focuses on the instruments related to land use and spatial planning. From a co-evolutionary resilience perspective, it is equally important how elements of formal FRM influence the flood risk management behavior and strategies of other (non-governmental) actors. Therefore, the third part of this chapter addresses the policies and participation possibilities for non-governmental actors such as residents and land-users. It focuses on the rules and instruments stipulated in formal FRM that form the institutional and regulatory context for the way non-governmental actors (e.g. residents) deal with flood risks.

These questions are answered by mapping and analyzing the content and process dimensions of formal flood management strategies in Flanders through policy document analysis, supplemented with some interviews with policy makers. Considering the existing research, this chapter does not aim to provide an exhaustive overview of FRM in Flanders. For example Nolf (2013) gives a historical overview of the history of flood management in Flanders, Crabbé (2008) provides a detailed analysis in the formation of integrated water management in Flanders, and Mees et al. (2016) gives an extensive overview of the governance arrangements active in flood risk management in Belgium. Instead, it discusses the main elements in relation to the flood resilience strategy discussed in the theoretical framework (see Chapter 0), i.e. actors, content, process and context.

3.1 Formal flood risk management

3.1.1 Actors

Water management in Flanders is organized according to the hierarchy of the water system (see Figure 4). These governmental actors are charged with implementation of water management, i.e. the management of the watercourses.

watercourses	competent actor
navigable	department of Mobility and Public Works (MOW)
non-navigable 1st category	Flemish Environmental Agency (VMM)
non-navigable 2nd (and 3rd) category	Provinces
non-navigable 3rd category	Municipalities
non-navigable 2nd and 3rd category under their charge	Polders and Wateringues

Table 4. Governmental water management actors (based on Mees et al. (2016))

Following the 2003 Decree on Integrated Water Policy (DIWP), two platforms that ensure coordination and integration within this highly fragmented field of actors have been established: the Coordination Commission on Integrated Water Policy (CIW) on the regional scale, and the sub-basin authorities at the sub-basin scale.

The CIW is a consultation platform that assembles all relevant policy domains and levels involved in water policy. It includes the regional departments on mobility and public works, spatial planning, agriculture, economy and environment, representatives of the sub-basin boards, and umbrella organizations for the water companies, provinces, cities and municipalities, and polders and wateringues. It is staffed by representatives of the different and is the principal actor for waterrelated policy-making in Flanders. This institution is responsible for policy-making and the development of plans and strategies. The different water managers individually provide input for this by contributing expertise, relevant information and analytical results such as modeling of flood risks.

At the sub-basin level, coordination between the different authorities is organized in the sub-basin boards. The daily operation at the sub-basin level is provided by the sub-basin secretariat, consisting of representatives of the Flemish and provincial water managers and the department of spatial planning. The sub-basin council includes representatives of societal stakeholders and sectors involved in water policy: agriculture, nature and environment, mining and energy, fishing, tourism and recreation, housing and mobility. It gives advice to the sub-basin board.

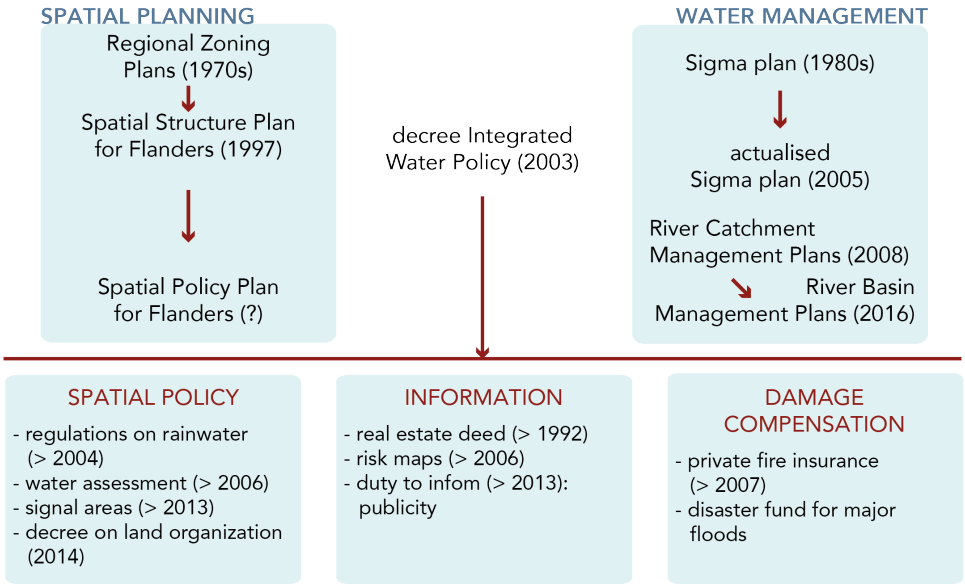

Figure 9. Overview of the main formal FRM plans and instruments

3.1.2 Content and process

3.1.2.1 Sigma plan (1977 and 2005)

The Sigma plan is the first comprehensive plan to manage flood risks in Flanders. The Sigma plan was originally drawn up after the heavy 1976 floods. This plan for the tidal Scheldt river focused on flood protection. Based on a cost-benefit analysis, a T1000 protection level for rural areas and T4000 for cities was considered to be most effective. This was to be achieved through dike elevations, a storm surge barrier and flood control areas. The storm surge barrier was never executed because it was considered not too be cost-efficient enough.

Under influence of the discourse on integrated water management that emerged in Flanders in the late 1990s, early 2000s, the Sigma plan was actualized. This actualization shifted the aim of the Sigma plan from merely flood protection towards improving flood safety, accessibility, recreation and natural values. Based on the experience from the implementation of the original plan, it also included a decision-making structure with discussion opportunities at general plan and at project level. This included a soundboard group and thematic working groups, including representatives of different stakeholder groups, such as nature, farmers, hunting and fishing, etc.

The Sigma plan is still being implemented today, and has proven to be a valuable experience and example of collaboration between W&Z and other stakeholders such as environmental NGO's, farmers, the government's nature administration, the governmental research institute on nature conservation, etc. The design and structure of this plan has evolved under influence of internal experiences and external social developments.

3.1.2.2 Decree on Integrated Water Policy (2003 and 2013)

The DIWP (2003 and 2013) is the main legal framework for the management of flood risks in Flanders. It forms the start and legal anchoring for integrated water management, which brings the spatial planning domain into flood risk management. The original decree from 2003 establishes the aims, instruments and organizational structure of integrated water management. This includes among others the establishment such as the CIW, the water assessment and the RCMPs, but also less often used instruments such as expropriation, right of pre-emption and duty to buy. It also consolidates several existing legal water management instruments in one comprehensive framework. Different consecutive implementation orders have brought these instruments into practice.

In 2013 the decree was substantially reformed. The main reason was the (procedural) simplification of the levels of planning in water management through the integration of the different water management plans into one RBMP. Also the duty to inform was included. The sections of these individual plans or instruments go deeper into the content of these reforms.

3.1.2.3 River Basin Management Plans 2016-2021

The River Basin Management Plans 2016-2021 (RBMP) for the Scheldt and Meuse basin are the main plans for flood risks. They are the first generation of Flood Risk Management Plans and as such form the implementation of the European Flood Directive (FD). They were published in March 2016 and contain sub-basin specific parts, listing per sub-basin all the actions to implement the plan. These actions are based on a comprehensive cost efficiency calculation.

The RBMPs are the second generation of water management plans, succeeding the first generation of RBMPs, River Catchment Management Plans (RCMP) and Sub-River Catchment Plans (SRCMP) of 2008-2015. The RBMP on the level of the river basin was drawn up by the CIW, while the catchment and sub-catchment level plans were drawn up by the eleven different sub-basin authorities. They have been approved and adopted through a process of public consultation. Over a period of 6 months in 2006-2007, stakeholders could comment on the draft plans. This was the first time that participation in governmental water management was possible. The RBMPs were subject to a yearly evaluation, which monitors the progress of the implementation of the action plan.

In the second and current generation of RBMPs, it was chosen to integrate the different levels in order to simplify the planning process. All levels are now integrated on the level of the river basin, with different sub-basin specific parts, in the comprehensive RBMPs. This is an important scaling up of the level of plans. According to the FD, the FRMPs should be drawn up based on first a preliminary flood risk assessment, followed by the development of flood risk and flood hazard maps. Since data on flood risk assessment were already available, the first phase was skipped. In 2013 the flood risk and flood hazard maps were developed, based on which a comprehensive analysis weighing costs and benefits was performed. The resulting FRMPs were integrated in the RMBPs, which then went into public consultation in 2014, just like the first generation of RMBPs, and were published in 2016.

3.1.2.4 Evaluations of flood events

After the flooding of November 2010, a global evaluation on the flooding issue was made. On the one hand, the CIW drafted a report (CIW, 2011) including an inventory of the flood event and important points of attention, and an action plan on the regional level. On the other hand, a series of parliamentary discussions was organized in January to March 2011. A wide array of stakeholders and representatives of various organizations presented their findings, considerations and recommendations for flood risk management. This led to the resolution on flooding (July 2011). The CIW reported on a yearly basis on the progress of the action plans, with the last report concluding the implementation of the resolution in July 2014.

3.2 Spatial planning

3.2.1 Actors

Within spatial planning, the subsidiarity principle applies. This means that the issues that are relevant for the regional scale are included in regional plans drafted by the Department Space Flanders, the regional spatial planning authorities. Lower authorities, i.e. the provinces and municipalities can draft their own plans within the constraints of these regional plans. Building permits for projects of local relevance are issued by the municipality, while large-scale projects are licensed by the regional spatial planning authorities.

3.2.2 Content and process

The regulative framework for regional planning in Flanders is the regional zoning plans, dating back to the 1970s. Despite several land use plan changes, these zoning plans still constitute the blue print for spatial developments in areas were no new planning processes were started. The plans from the 1970s have enabled suburbanization and lead to an enormous increase of the share of built-up land (Poelmans and Van Rompaey, 2009), and still provide a more than sufficient stock of residential areas and zones for residential expansion to meet demographic demands for housing.

However, residential parcels developed under the zoning plans are often poorly located in remote areas, including flood-prone areas. Although the first flood risk maps were drawn up in the 1970s, flood risks were not systematically included in the conception of the regional zoning plans until the 1990s. Reasons for this include the limited knowledge on flood risks at that time, a lack of political prioritization of flood-related issues in planning, and even fraudulent manipulation (Boussauw and Boelens, 2015). In addition, the impact of the enormous increase of the share of built-up land and the subsequent increase in flood frequency was not anticipated in the 1970s (Poelmans & Van

Rompaey, 2009). Moreover there was a strong belief in an engineering approach to flood prevention, as exemplified by the Dutch Delta Works and materialized in the Sigma plan after the 1976 flooding. Within this plan, a remarkably strong divide between water managers and spatial planners was maintained as it focused only on flood protection. Controlling flooding through engineered solutions was considered to be the main or even sole responsibility of water managers, while dealing with flood risks was still not a core issue for spatial planning. Therefore, little effort was done to prevent or control development in flood-prone areas. It was only in the revision of the Sigma plan in 2005 that a risk-based approach was adopted, in which spatial planning for the first time played a role, although limited to providing space for retention basins.

Since the Spatial Structure Plan for Flanders (*Ruimtelijk Structuurplan Vlaanderen*) of 1997 and the adoption of the principles of integrated water management in 2003, the issue of flooding is receiving more attention in planning practice. Nevertheless, the integration of flooding issues in spatial planning is difficult since water management (especially for larger rivers) occurs on a regional scale, while spatial planning is practiced - to a large extent - on a local level (subsidiarity principle). This complex actor network makes integration, responsiveness and decisiveness hard. It is also extremely difficult to change 'hard' zoning codes such as residential area into 'soft' ones that might produce less damage in case of flooding, such as nature and recreation, due to the rigid planning system and the emphasis on property rights.

Land use and spatial planning are often mentioned as a shortcoming in the flooding issue (Vlaams Parlement, 2011). Over time, knowledge on flood risks has increased through new experiences and modeling techniques, but as stipulated above, zoning plans have only to a very limited extent co-evolved with this knowledge. There is a call for a better integration between different governmental levels and institutions active in water management (Flemish Parliament, 2011).

Since 2003, different policies and tools have been developed under the DIWP to improve this situation. Examples include the so-called 'water assessment', which is now a mandatory part of the approval procedure for buildings or spatial plans, and the selection of a number of 'signal areas' where rezoning is considered because of imminent water issues (De Smedt, 2014). The goal is to have a more steering role through regulation, especially for new constructions. However, decision-making remains the responsibility of the individual planning institutions.

3.2.2.1 Water assessment

Firstly, there are a number of instruments to integrate water issues better in spatial policy. Since 2006, licensing authorities need to perform a water assessment (in Dutch 'watertoets') in the context of building permit requests or spatial plans approvals. This is similar to the Dutch Water Assessment introduced in 2003. The water assessment examines whether a plan, a building permit or a program has a harmful effect on the water system. According to the extent of the harmful effects, the government can impose conditions to limit or prevent damage, or measures to restore or compensate the harmful effect can be imposed, or even deny the permit. The decision of the licensing authorities is supported by an advice by the water managers.

The water assessment maps support the assessment process by providing information on flood risks in a user friendly way. The most important map indicates actual and potential flood-prone areas. Actual flood-prone areas have recently flooded or have a flood return period of 100 years with a flood depth of 30 cm. In potential flood-prone areas, flooding is possible under extreme weather conditions or failure of flood defenses.

Although the instrument was included in the DIWP of 2003, its implementation only started with the implementation decree of 1 November 2006, following some discussion (Grietens, 2005). Since then, it has been optimized and changed several times. In 2010, the CIW performed an evaluation of the process based on a survey of advising and licensing authorities (CIW, 2010). In May 2011, an evaluation of the Water Assessment was part of the general evaluation of the November 2010 flooding (CIW, 2011). In July 2011, the two main advisory boards, i.e. the environmental council and the socio-economic council, issued an advice on own initiative. These evaluations led to decree amendments to simplify the water assessment both content-wise as formally in 14 October 2011 and its implementation on 1 March 2012. The main changes were that the advice of the water manager became obligatory, the list of plans and building permits to which the water assessment applied was elaborated, and the motivation requirements of the water paragraph and advice in the building permit became stricter. A new web application and updated maps supported licensing and advising authorities to execute the water test. Also citizens can used the web application to gain information on his project and the water assessment.

The renewed Water Assessment was again evaluated in 2013 by the CIW, again based on a survey of advising and licensing authorities (CIW, 2013). Based on this evaluation, some technical adjustments were made in the decree of 12 December 2014 and implemented on 22 January 2015. Also the maps underwent a second modeling update in September 2014.

In practice however, it remains difficult to stop or limit development of flood-prone areas. Permits are rarely denied (CIW, 2010, 2013). This is a result from the passive or reactive nature of the water assessment; only when plans are drawn up, a decision is made on the development of the area. At that point, refusal is difficult. This situation creates legal uncertainty and provides insufficient protection for the space needed for water storage. Other reasons are according to De Smedt (2014: 108) are 'the fear of compensation claims, the lack of knowledge about the vulnerabilities of the water system among the authorities and civil servants and the lack of political courage to take stringent but necessary measures.' Also the lack of clear water retention policy leads to varying (sometimes free) interpretations and the advice of the water manager in the water assessment is not binding. Moreover there is no supervision on the compliance with the conditions or building regulations of the water assessment.

3.2.2.2 Signal areas

A policy framework was established to pro-actively preserve water storage capacity in so-called signal areas. Signal areas are plots in flood-prone areas that have hard destination (e.g. residential and industry) within the regional zoning plans, but have not yet been developed. These areas comprise 11,000 ha or about 0.83% of the Flemish territory. The 'signal areas' instrument is aimed at controlling the development of these areas, to avoid a substantial increase of potential risks

Under the decree on land use of 25 August 2014, a comprehensive toolbox is available to implement the spatial development perspective, such as public utility servitude, statutorily required reparcelling, if necessary combined with infrastructure or construction works or a zoning swap, and the application of a sharpened Water Test (De Smedt, 2014). To the knowledge of the authors, this toolbox has not yet been applied in the context of the signal areas.

Another important accompanying measure concerns the financing of potential planning blights due to zoning changes in the signal areas. The Flemish government foresees a 60% subsidy of the planning blight fees in the context of a spatial implementation plan (*ruimtelijk uitvoeringsplan*) that implements approved initial agreements; the remainder is paid by the provinces and municipalities. The subsidy of the Flemish government is paid by the Rubicon fund. This

fund was established in 2003 after the 2002 floods to support investments in flood control by the Flemish region and local governments. It currently receives incomes from the plan income taxes of zoning changes towards business activities, its own revenues and potential grants from the general expenditure budget of the Flemish Community.

As established in the DIWP of 2003, the signal areas were defined and spatially delineated in the first generation of RCMPs of 2009. Three types were defined:

(1) natural water conservation areas: areas where precipitation is naturally retained for a long time
(2) current water storage areas: areas suitable for water retention (without causing flooding to existing buildings) that are currently used by the water system for water retention
(3) potential water storage areas: areas that are physically suitable to store water, but do not flood anymore due to human interventions

Within the Green Paper for the new spatial policy plan (*Beleidsplan Ruimte Vlaanderen*) from 2012, a short-term action is included to take measures with respect to areas with a hard destination with high flood risks or essential infiltration function. This was an important impetus to further develop the signal areas instrument.

For all signal areas, additional development restrictions apply since March 2013 (Concept Note). This includes signal areas that are not selected for systematical review or follow-up trajectory, or waiting for the results of this trajectory (see further).

For the main signal areas, an additional follow-up trajectory was started. For this, the main signal areas were selected, based on the impact of potential development of the area. This impact is assessed based on three criteria:

- location in current water storage area
- size of the (cluster of) signal area(s)
- location in an area with significant known problems and/or opportunities.

Three series of signal areas were processed, within a different timeline (see Table 5). The sub-basin authorities systematically reviewed the exact risk for these areas. This review suggests a development perspective that is not contradictory with the interests of the water system.

series	number	review	initial agreement
1	66	before February 2013	March and May 2014
2	17	between February and December 2013	May 2015
3	151	2014	currently in process[2]

Table 5. Process timing of the three series of signal areas

Based on this analysis and deliberation with the involved governmental bodies (municipal, provincial and regional) within the so-called follow-up trajectory, an initial agreement is drawn up, containing an area-specific spatial development perspective, the initiating administration (appointed by the provincial governor if no consensus was

[2] The third series does not only include problems within the watersystem, but for this series it is also possible to expand the areas based on the spatial vision of the municipality. If for example 90% of an natural area is flood-prone, it is possible to include the remaining but not flood-prone 10% in order to include a coherent area in the reallocation. This integration however causes some issues; can the preservative policy also be applied to the non-flood-prone part? If development is refused in this part, policy makers expect that the council of state will grant a permit nevertheless, since there are no compelling reasons to refuse permits in this part.

reached) and the instruments to be used for implementation. There are three options for the spatial development perspective:

(1) no action: The existing zoning is compatible with the need for water retention.
(2) additional measures through the Water Assessment while maintaining the zoning: The existing zoning is negative for the water system, but there is no high flood risk.
(3) zoning change: The existing zoning is not compatible with the need for water retention and has a high flood risk.

3.2.2.3 Spatial planning regulations on rainwater (2004, 2013)

The regulations play an important role in the discharge of rainwater in a heavy storm. These regulations apply to wells for rainwater, infiltration installations, buffer installations and separated discharge of wastewater and rainwater. The general starting point is that as much rainwater as possible is re-used locally. In second instance, the remainder must be infiltrated or buffered, so that only in the last instance a limited amount of water is discharged in delay. According to the paved area of the building project, certain volumes of water need to be infiltrated or buffered. This regulation applies to the whole Flemish regions, but provincial and municipal governments are free to implement additional, stricter regulations. The 2013 reform of the regulations significantly tightens the rules.

3.3 Complementing real estate policies towards land users in flood-prone areas

Apart from water management and spatial planning policies, there are also some relevant complementing policies from related fields that influence the way societal actors deal with flood risks. They might stimulate (e.g. providing information on flood risks) or discourage (e.g. relatively low insurance premiums) homeowners to take initiatives.

3.3.1 Insurance and damage compensation

Regulations on insurance and damage compensation are relevant for spatial developments in flood-prone areas, since these influence attitudes and actions of residents. Federal legislation from 2007 stipulates that flood damages are a compulsory part of the private fire insurance. Through this legislation, citizens become responsible for flood damages through private insurance, although the system is highly regulated. Even though fire insurance itself is not obligatory, about 95% of Flemish households buy such insurance, as it is often a condition for obtaining a mortgage.

The federal flood risk maps (2007) indicate where residents' pay a higher premium, as determined by the insurer based on its own risk assessment. There is a legal limit of a 90% surplus premium related to natural disasters. On average, this is about 4% of the whole fire insurance premium extra (Vanneuville et al., 2006). Households that pay this legal limit are insured by the tariffication office. This is a common pool in which all insurers partake. In case of damages, all insurers bear the costs together, proportional to their relative share of policies. For houses built after September 2008, insurers are free to decide whether they want to provide insurance and against what premium. The maximum tariffs of the tariffication office no longer apply. This approach thus accommodates a certain, but limited solidarity principle between all citizens, at risk or not at risk.

Before 2007, flood damages were compensated by the national disaster relief fund if the flood was recognized as a natural disaster. The Act of 21 May 2003 introduced a mandatory insurance coverage against flood through an extension of the fire insurance policy. However, this act was never implemented, because the insurance coverage under the 2003 act was limited to buildings located in flood-prone areas. The fact that flood damages would be

covered by the premiums of a small group of households with a real risk of flooding would lead to an uninsurable concentration of risks. This was contrary to the basic principle of solidarity of insurance systems.

3.3.2 Duty to inform

The law on the land insurance contract of 25 June 1992 stipulates that notaries, architects, etc. can consult the location of real estate in a flood risk zone (following the federal flood risk maps) through the municipal administration.

In October 2013 this was extended to a duty to inform, an instrument that was included in the amendments to the DIWP of 2013 and was implemented on 10 October 2013. The duty to inform applies to all stages of real estate transactions (both rent and sale), i.e. from promotion and publicity, for all real estate (both buildings and land) in flood-prone areas. People that sell or rent real estate in effective or potential flood-prone areas on the water assessment maps need to disclose this location in all publicity, in the form of a logo or an explicit verbal indication, depending on the type of publicity. Notaries also need to include a water paragraph in the real estate deed.

3.3.3 Availability of information

Information on flood risks and possible measures residents of flood-prone areas can take is freely available online, but not actively disseminated. Different websites inform on flood risks. www.waterinfo.be is a joint project of the regional water managers. It provides information on current and predicted water levels, but also historical maps and hydrological reports on flood events. The website of the CIW also includes a geoportal with the maps supporting the RBMPs, the water assessment and the signal areas.

Different maps on flood risks are available. The regional water assessment maps clusters a number of maps. The effective flood-prone areas consist of recently flooded areas and modeled flood-prone areas. Potential flood-prone areas include naturally flood-prone areas (both alluvial and colluvial), potential flood-prone areas delineated within the Sigma plan and mine subsidence areas. The federal maps with risk areas for flooding are based on slightly stricter criteria than the regional water assessment maps and applies for regulations on damage compensation.

3.4 Conclusion and discussion

This part focuses on to what extent the policies discussed above contributes to resilience to flooding, as conceptualized in the theoretical framework of this research (Chapter 2). It discusses the adaptability and flexibility of the content, process and context of spatial developments in flood-prone areas.

It is clear that both the integration of flood risk concerns within spatial planning, as the development of instruments aimed at the involvement of land users in flood risk management are still relatively young. These policies are still in development and implementation has sometimes not yet taken place.

3.4.1.1 Actors

Throughout the last decades, competences regarding to the management of the watercourses have been gradually scaled-up (Crabbé, 2008). The most recent step in this process is that since 2014, municipalities have the option to transfer the management of their watercourses to the provinces, which most municipalities have accepted. This is related to an increasing degree of specialization within water management.

On the other hand, spatial planning decisions for example on building permits for housing are taken on the local level. Furthermore, also residents and other societal actors that might in the future have to contribute to FFRM under the 'shared responsibilities' discourse operate at a local level. The question is how their local knowledge, involvement and participation can be brought together with the expert knowledge and higher scale operating levels of water management.

3.4.1.2 Content: from protection to multilayered safety?

When coping with flood risks, spatial planning has to deal with a rigid built and regulatory legacy. Due to the relatively late conception of the regional zoning plans in the 1970s, some flood-prone areas had already been developed. Moreover, the regional zoning plans inadequately took flood risks into account, resulting not only in further development in flood-prone areas, but also in a rigid regulatory framework that allowed developments to take place in these areas without taking into account the water system. These zoning plans have proven to be extremely influential, and are still an important part of spatial planning policy in Flanders. In the early states of the Sigma plan (1977), the role of spatial planning was limited to providing space for controlled flood areas. Measures related to spatial developments in flood-prone areas thus were not included in flood risk management.

However, from the 1990s and especially the 2000s onwards, developments within spatial planning have supported diversity in potential measures for new spatial developments in flood-prone areas. While the water assessment in the first place aims at neutralizing potential impacts on the water system, it also imposes adaptive building techniques if required. By assessing each plan individually, tailor-made advices are possible.

The signal areas allow reevaluating land-use allocations, enabling the introduction of building prohibitions in the most critical areas. Again, area specific considerations and deliberation is taken into account, to decide on the most desirable development perspective in relation to the current and expected future flood risk. However, the optimalisations in the signal areas process stay within the logic of the zoning plans by merely altering them. Therefore, this approach further strengthens the entrenchment in a strong regulatory framework, limiting adaptability in the face of changing flood risks even further.

Furthermore, spatial planning has little to no control over existing buildings. Only substantial renovations require a permit, and thus are subject to the water test. For these existing spatial developments, measures depend on the initiative and willingness of homeowners (see also paragraph 3.3.).

The different flood risk maps (federal and regional) cause inconsistent communication towards citizens and therefore ambiguity on flood risks.

3.4.1.3 Process: from linear to adaptive management?

Within flood risk management, there is a strong emphasis on content, more specifically the measures that are chosen. For example calculation for the prioritization of flood risk management actions within the RBMPs was based on a cost-efficiency model. However, this approach does not take into account other aspects such as who pays for these measures and who benefits from them. Furthermore, it also does not take into account who is involved, if there is local social support for these actions and who has the power to implement these measures. These elements are expected to be included in a later phase (currently ongoing). However, the outline of the plan is at that point already established.

Evaluation of plans and instruments is performed often and systematically, and results in changes in these regulations and plans. This enables adaptability and allows for the development of learning capacities. However, the development of these learning capacities is mainly aimed at expert knowledge.

As for spatial planning, both the process of the water assessment and the signal areas are charged with some rigidity. Granting a building permit is a linear, one-off process. In that sense, permits are not adaptable at all: it is not possible to change or withdraw a building permit, and in reality, virtually no follow-up or monitoring takes place. Nevertheless this rigidity, linking the water assessment to the building permit allows policy makers and water managers to base their advices on current knowledge and insights. The reactivity allows for a certain degree of adaptivity, which is not possible within the rigid land use allocations of the regional zoning plans.

The Water Assessment instrument is subject to frequent evaluations and successive adjustments. These evaluations are mainly focused on managerial optimalization: making the information more accessible for the different actors involved, simplifying the performance of the Water Assessment, making the process more transparent and uniform. Also the content of the Water Assessment has shifted from merely compensating lost buffer capacity of the water systems towards also including regulations to reduce potential flood damages such as adaptive building techniques. However, the more strategic questions underlying this instrument are less prominent.

The signal areas on the other hand are more pro-actively aimed at preventing harmful spatial developments in flood-prone areas. However, changes to the land use plans of the 1970s are subject to slow and lengthy procedures, which limits the ability to quickly identify and respond to new priorities or new threats. Also for the Signal areas instruments, evaluation is foreseen, but has not yet been performed as the process is still going on.

This approach is relatively slow and requires long processes with different stages of approval. Although the signal areas for example take into account projections for climate change, this attests to little capacity to deal with changes.

3.4.1.4 Context

While the aim is to include multiple actors and share responsibilities in flood risk management, participation for non-governmental actors is very limited and relationships are mainly built between different governmental actors. Due to the high diversity of actors and governance levels involved, integration of the different actors is a complicated task. The CIW aims to bring together different actors, but this integrations is limited to public administrations. Within the sub-basin council, organized societal actors are represented and can draft advices for the RBMPs and the Water Implementation Program, or on their own initiative. For the RMBPs, participation of the broad public and societal stakeholders is organized through a public consultation procedure. However, this excludes participation in the earliest conception of the plans, and the formal procedure forms a barrier.

This is especially remarkable taking into account that the measures modeled in the FRMPs include adaptive building. This means that it is possible that adaptive building techniques are more efficient than collective protection. However, it is very unlikely that the government will pay for these measures.

The way governments deal with flood-risks is quite top-down. Both the Water Assessment and Signal areas take a restrictive approach towards limiting damages in flood-prone areas to avoid land-uses that are expected to aggravate flood risks. However, under uncertainty and a lack of information, restrictions to for example private property rights might not be justified (Fleischhauer et al., 2012).

The weak spot of both the water assessment and the signal areas is the legal status and enforceability of measures (De Smedt, 2014). The advice of the water manager in the water assessment is not binding. Moreover there is no supervision on the compliance with the conditions or building regulations of the water assessment. Also the decision by the Flemish government on the development perspective of the signal areas is not binding on the government that approves or establishes the spatial development plan (De Smedt, 2014). So there is little guarantee that the conditions in the water assessment and the development perspective for the signal areas will be implemented.

4 Residents in flood-prone areas

Within Flanders, governmental and institutional aspects (Crabbé, 2008; Mees et al., 2016) and technical aspects (Kellens, 2011) of flood risk management are relatively well known. Several doctoral theses have focused on institutionalized approaches to flood risk management. A large gap however is the societal side. Actions taken by other actors than governments can contribute to or mitigate flood risks.

However, little research has been dedicated to how non-governmental actors operate within this institutional context, and how this contributes or counteracts with formal, governmental flood risk management strategies.

This chapter analyzes a wide array of interactions of residents with flood risks in the Dender basin (Flanders, Belgium), based on a survey amongst residents in flood-prone areas. These interactions include (1) the availability and use of knowledge, (2) the way risks are experienced, (3) how residents chose their location and the extent to which they are willing to move, (4) who they deem responsible for different aspects of the issue and (5) what they do to protect themselves. This chapter discusses how these interactions contribute to flood risk management, and how they could become more fruitful for flood risk management in the future.

As such, this part contributes to the existing knowledge in two ways. On the one hand, the focus is specifically on residents and spatial planning, since the debate on flood risk management is often conducted from the perspective of water managers. On the other hand, it discusses a large array of topics – from psychosocial aspects such as awareness and knowledge, to behavioral aspects and eventually the translation to policy.

4.1 Interaction between residents and flood risks

In what follows, we will discuss some aspects that influence residents' experience of flood risks, and how they deal with them accordingly, based on literature review. Most of the topics addressed in this chapter have been described individually within different fields and geographical or political contexts (see further). However, the survey provides an integrated view on these issues.

4.1.1 Knowledge

Knowledge on flood risks is a prerequisite for taking action. As memories of flood experiences fade trough time, risks are disregarded. Therefore, risk communication is an important element of any strategy to activate residents. However, the rigid institutionalization of risks through modeling and risk maps can give rise to a biased and oversimplified perception of complex conceptualization of risks (e.g. return period). Accordingly, local knowledge is often undervalued.

4.1.2 Risk perception and experience

Since knowledge of risks does not always translate into personal worry, merely providing information about risk is not enough (Parker et al., 2009; Willis et al., 2011). Risk perception generally depends on personal characteristics, situational factors and risk characteristics (Lindell and Hwang, 2008). Explicitly dealing with risk perceptions in risk communication can make flood risk management more effective (Baan and Klijn, 2004; Buchecker et al., 2013; Grothmann and Reusswig, 2006; Kellens et al., 2011). Flood forecasting and warning play a central role in this (Brilly and Polic, 2005).

4.1.3 Location choice and willingness to move

Filatova et al. (2011) state that low individual flood risk awareness leads to inefficient spatial developments and increased flood risks. They argue that by increasing individual risk awareness, it is likely that flood risks are integrated in the individual economic decisions at the housing market, since housing prices are often lower in flood-prone areas (Eves, 2004; Montz and Tobin, 1988).

Individual decisions on private risk mitigation measures and location choice are also influenced by the extent to which insurance premiums internalize actual variations in risk and damages are cross-subsidized by the whole population (Bouwer et al., 2007). Possible incentives for individual risk reduction might include lower premiums, higher coverage and lower deductibles (Botzen et al., 2010). However, in practice, premiums generally do not fall as risk is reduced (Penning-Rowsell and Pardoe, 2012).

4.1.4 Sense of responsibility

The limits of the capacity of the state to manage flood risk are widely recognized, and therefore, there is an overall plea towards more individual responsibility in flood risk management (Johnson and Priest, 2008). However, the division of responsibility between state, public organizations and citizens in the management of flood risk is often not clearly established. Lalwani and Duval (2000) have shown that personal responsibility is not assumed when there is no clear information indicating that they are personally responsible for threat management, even under conditions of high risks and sufficient resources to deal with the risk. When governments are assumed to provide protection, there may be a reluctance to accept responsibility. However, in many European countries, the government is perceived to be responsible for protecting private persons against flood losses (Vari et al., 2003). The strong reliance on and confidence in public flood protection hampers the private sense of responsibility (Grothmann and Reusswig, 2006). Even if personal responsibility is clear, it is mostly accepted if individual resources or instruments to act upon risks are available (Filatova et al., 2011).

4.1.5 Protective behavior

Risk perception and awareness are often analyzed in the light of understanding why people take precautionary action against flooding (Bubeck et al., 2013a; Grothmann and Reusswig, 2006; Waterstone, 1978). However, perceived risk does not contribute directly to taking protective responses (Parker et al., 2009). Several studies have shown that there are wider socio-psychological mechanisms at play. These include risk appraisal elements (e.g. risk perception, awareness, potential damage, previous exposure) and coping appraisal (e.g. self-efficacy, resources and outcome expectation, cost-benefit ratio), within an institutional context (e.g. political focus and reliance on public protection) (Grothmann and Reusswig, 2006; Kreibich et al., 2011; Waterstone, 1978; Zhai et al., 2006).

On the other hand, the impetus for individual adaptation can be reduced or even removed by technological or financial assurances (Smithers and Smit, 1997). The confidence in flood prevention and centrally led, engineered solutions implicitly triggers a low risk awareness and disbelief in the efficacy and practicability of private damage prevention, which may contribute to an inactive attitude towards autonomous adaptation measures (Grothmann and Reusswig, 2006).

The above shows that the interaction between residents and flood risk management is influenced by complex economic, psychological and social mechanisms. Therefore, the transition towards more residents' involvement and a

more active role for spatial planning in flood management, as advocated in literature and policy plans alike, is difficult to realize. Existing flood management paradigms are in a way self-preserving as they reproduce themselves through feedback mechanisms (Jong and van den Brink, 2013). The path dependencies following the high expenditures for flood protection induce low responsibility awareness among the involved citizens.

4.2 Methodology

We conducted a survey amongst residents of flood-prone areas in the Dender basin in order to measure attitude and behavior of residents in relation to riverine flood risks – for the first time in Flanders. The questionnaire comprised 66 questions and resulted in a database with 317 unique variables. It discussed the respondents' experience with flooding, their knowledge on the risk and possible private measures, their housing location choice and flood protection behavior, and their views on flood risk management. It was the explicit choice of the authors, in line with the research design, to conceive a broad and comprehensive questionnaire, addressing a wide range of flood-related themes relevant in relation to the role of spatial planning in flood risk management, as illustrated by the state of the art given above.

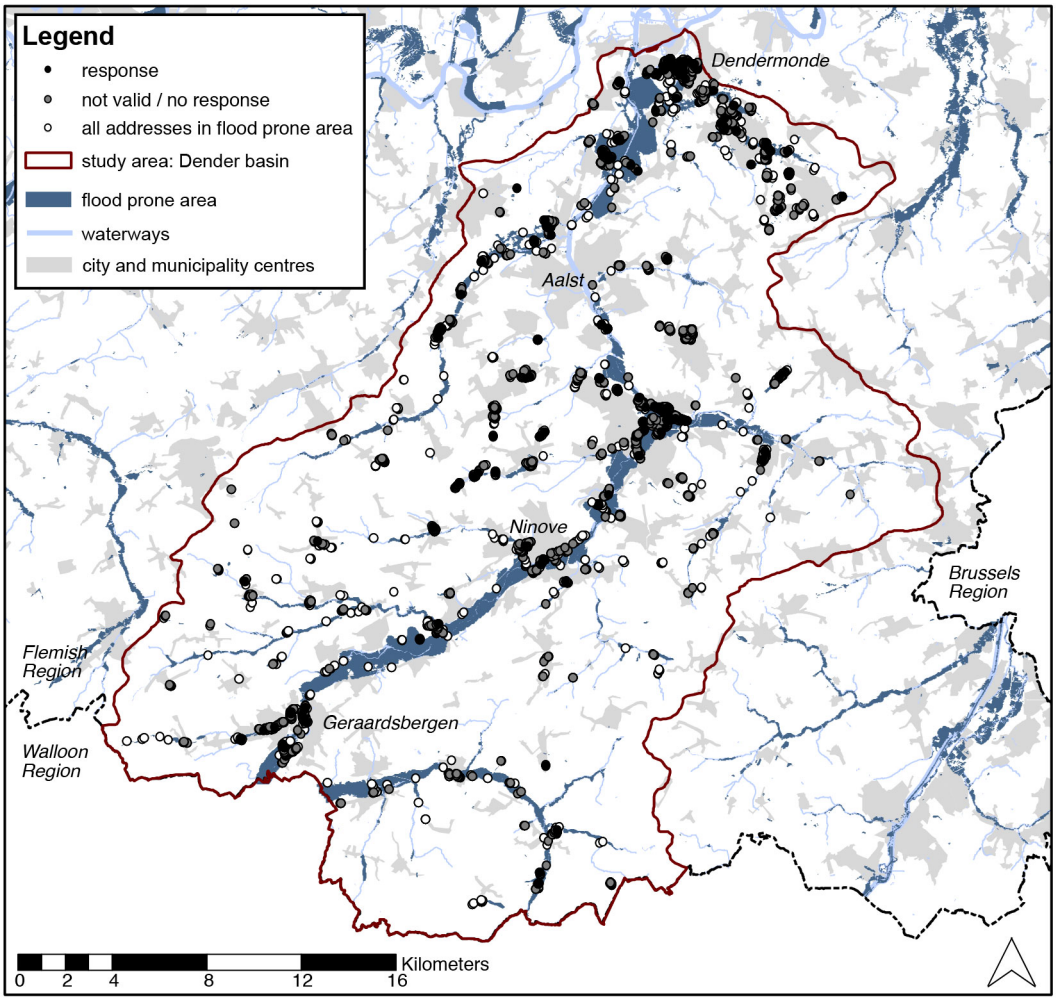

Figure 10. Map of the case study area: the Flemish part of the Dender basin, with indication of flood-prone areas according to the water assessment maps and the sample of the survey.

In September 2014 the survey was distributed amongst residents of actual flood-prone areas following the effective flood-prone areas of the Water Assessment maps (version 1 September 2014). These areas have recently flooded or

have a flood return period of 100 years with a flood depth of 30 cm. From the 4,732 addresses in this area, 1,100 were sampled. Businesses and public institutions, vacant homes and incorrect addresses were omitted, based on onsite assessment. This led to a sample of 916 active private households. Based on this, the population can be proportionally estimated at 3,940 active households. A relatively small sample was chosen in order to use the available resources to obtain an as high as possible response rate and therefore better representativeness. In order to maximize the response rate, the questionnaire was personally delivered and could be returned on paper and online.

We used different explorative methods, including bar charts, chi square tests and linear regression. Subsequently, we analyzed the pairwise relation between variables from the survey by means of Spearman's bivariate rank tests for non-parametric variables (such as Likert scale questions) and Mann-Whitney tests for dichotomous variables (such as yes/no question). For Spearman's test the correlation coefficient (r_s) and significance level (* = $0.01 < p < 0.05$; ** = $p < 0.01$) are reported. For the Mann-Whitney test, the significance level is reported. Some socio-economic variables from the survey that did not yield significant correlations were left out. A full overview of the statistical analysis results can be found in Annex 2 (Table 7 for the Mann-Whitney tests, and Table 8 and Table 9 for the Spearman's rank tests).

4.3 Results

We received 184 completed questionnaires. One response was excluded because it was a double entry, resulting in 183 valid responses (response rate 18.8%). Considering the length of the questionnaire and the relatively small population, this was considered to be sufficient. Descriptive statistics on the sample can be found in Table 6.Representativeness of the sample could not be tested because socio-economic data of the population (residents of actual flood-prone areas) are not available for privacy reasons.

Following the research design, the results are discussed in five themes: (1) awareness and knowledge, (2) risk perception, (3) location choice and willingness to move, (4) sense of responsibility and (5) protective behavior and seeds of self-initiative.

		total
N		183
age, mean (standard deviation)		57.0 (15.5)
gender	male	61.2 %
	female	38.3 %
occupation	retired	39.3 %
	non-active	7.1 %
	active	53.0 %
flood experience	none	41.2 %
	without damage	25.3 %
	with damage	33.5 %

Table 6. Descriptive statistics of the survey sample

4.3.1 Awareness and knowledge

About two thirds of the respondents are aware that they live in a flood-prone area, while a quarter of the respondents think their residence is not situated in a flood-prone area. This awareness is associated with flood experience ($p<0.01$, Mann-Whitney). This is confirmed by the fact that only a third of all respondents indicate they were aware of the flood risk when they moved there. This is not correlated to the length of residency: respondents that have recently moved were at that time not necessarily more aware of the flood risk. However, younger respondents are better aware of flood risks when moving ($0.01<p<0.05$, Mann-Whitney).

However, the knowledge on the flooding issue is rather limited. A bit more than half of respondents (57.5%) say they know little or very little about the flood risk. Here again, the number of floods experienced is of significant relevance ($r_s=0.16^*$), but also length of residency ($r_s=0.16^*$) and ownership ($r_s=0.25^{**}$). Respondents that were aware of the flood risk at the time of moving also feel that they know more about the flood risk ($p<0.01$, Mann-Whitney). Respondents that are aware that they are living in a flood-prone area however do not necessarily feel that they know more about the flood risk ($p>0.1$, Mann-Whitney).

About 80% of the respondents say they know little about measures they can take themselves. As with the knowledge on flood risks, the respondents who have experienced more floods ($r_s=0.26^{**}$) and have lived longer in the same house ($r_s=0.16^*$) indicate that they know more about possible measures. Respondents that know more about flood risks ($r_s=0.51^{**}$) and were aware of the flood risk at the time of housing choice ($p<0.01$, Mann-Whitney) know more about measures. However risk awareness does not yield a significant correlation ($p>0.1$, Mann-Whitney).

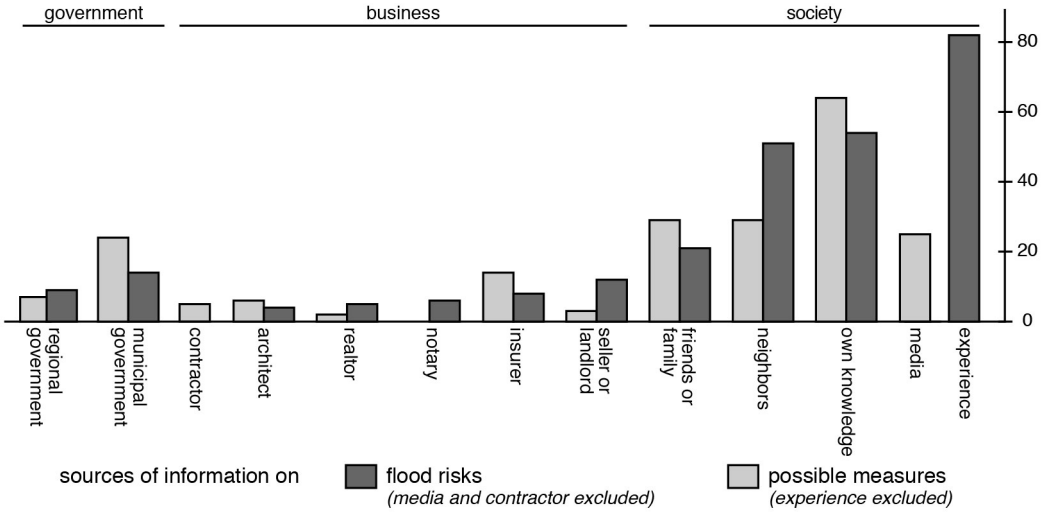

Figure 11. Sources of information on flood risks (a) and measures (b), measured in number of respondents that have accessed these sources.

The above suggests that knowledge on flood risks and measures is for a large part experience-based. This is confirmed by looking into where this knowledge is coming from (Figure 11). Beside flood experience, the most important actors that provide information on flood risks are in the first place civil parties, followed by governmental bodies (especially local governments) and business actors. The relative importance of these actors in information dissemination is generally the same for flood risks and possible measures, with the exception of the differences between civil parties and the rest being smaller for information on measures.

Although over half of the respondents (59.2%) know the official water assessment maps, only a third of these respondents (36.9%) know the correct classification. Only 18.7% of the respondents have consulted the water assessment maps, which is nevertheless most of all information sources (e.g. websites, informal conversation, brochure or newsletter). Also the governmental website with information on flood risks reaches 13.7% of the respondents, which is similar to informal conversation as a source for information.

4.3.2 Risk perception and experience

Around half of respondents (55.6%) indicate not knowing when the next flood will take place. A fifth (21.3%) think it will be in less than 5 years, and another fifth (19.1%) between 5 and 25 years. As all respondents live in areas that have a modeled return period of 100 years (or less) with a flood depth of at least 30 cm, these answers might indicate that there is no real underestimation of flood frequencies, but rather that there is a great uncertainty or lack of knowledge on the flood risk. There is no significant difference between the estimation of the current expected flood frequency and the expected flood frequency in 2050 ($p>0.05$, Wilcoxon Signed Ranks test). This indicates that respondents do not expect a substantial increase in flood frequency.

The emotional impact from the flood risk is analyzed for three different aspects: suffering, fear and worrying. About 40% indicate that they suffer from these emotional impacts. The most important emotional impact is fearing floods (m=3.02 on a 5-point Likert scale, s.d.=1.47) and worrying about the flood risk (m=3.00, s.d.=1.41), while suffering from the flood risk is perceived as the least important emotional impact (m=2.64, s.d.=1.45). All three emotional impacts (suffering, fear and worrying) show similar patterns of association with other variables. Significant correlations were found with the age of the residence (resp. $r_s=0.28^{**}$, $r_s=0.22^{**}$ and $r_s= 0.20^{**}$), flood experience (resp. $r_s=0.61^{**}$, $r_s=0.45^{**}$ and $r_s=0.43^{**}$) and risk awareness ($p<0.00$ for all three variables). However, only for suffering correlations were found with knowledge on the flood risk ($r_s=0.25^{**}$). For suffering and fear also associations were found with length of residency (resp. $r_s=0.22^{**}$ and $r_s=0.20^{**}$) and state of residence (resp. $r_s=-0.26^{**}$ and $r_s=-0.19^{**}$).

Subsequently, the impact of flooding in terms of the way different types of damage are experienced by respondents (with flood experience) was examined (Figure 12). Emotional impacts such as the dirt and effort to clean, and the uncertainty, fear, shock and helplessness appear to be the most disruptive and frequent impacts. More temporal effects, such as the difficult accessibility and disruption of everyday life are frequent, but less disruptive. However, more long-term effects such as administration and negotiation with insurance companies and contractors, and financial and material loss are considered to be less frequent, but very disruptive. These findings largely correspond to what Siegrist and Gutscher (2008) have observed. However, it is remarkable that in this case financial loss is perceived as quite hindering, which is not in line with Siegrist and Gutscher's observation that emotional impacts are greater than material and financial ones.

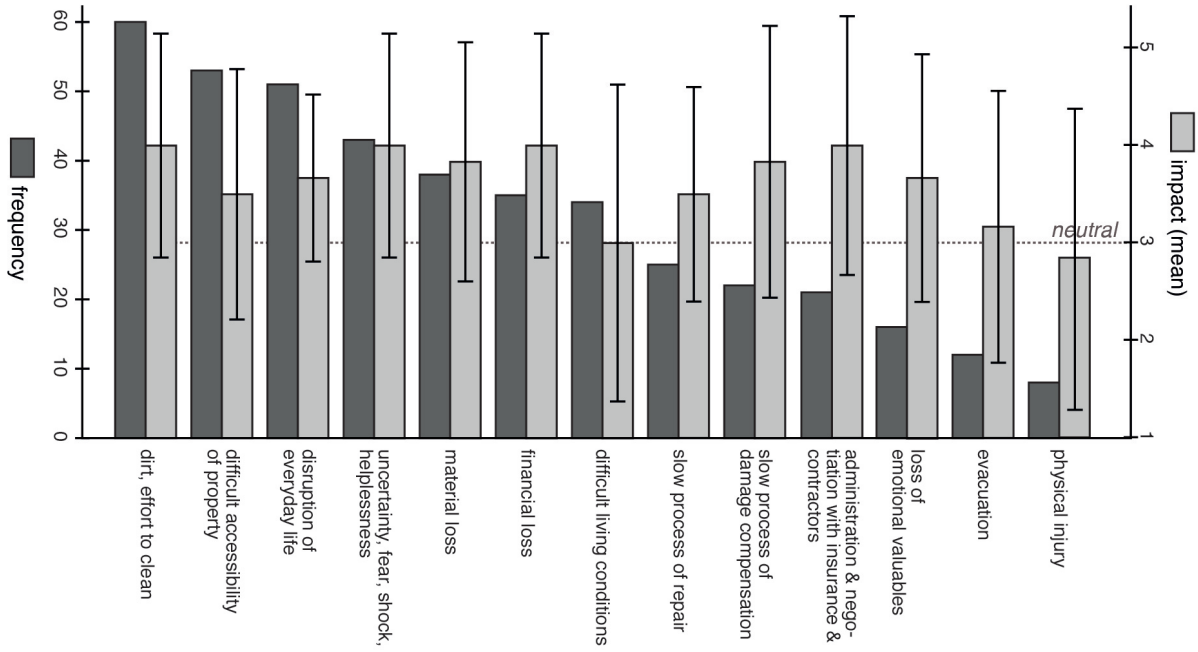

Figure 12. Frequency of different damage aspects (a) and perceived impact of different damage aspects (b). The response categories for this question inspired by the findings from Siegrist and Gutscher (2008).

4.3.3 Location choice and willingness to move

The respondents like living where they reside: more than three quarter of respondents are happy with their home and 60.7% are planning to spend the rest of their life there, while only 11.4% want to move away within five years. Respondents who know more about flood risks more often like to live where they live (r_s=0.18*) and plan on staying there longer (r_s=0.24**). Besides that, mainly non-flood related variables play a significant role. The pleasure of living is associated with the state of the residence (r_s=0.22**) and income (r_s=0.20*). On the other hand, desired future length of residency is correlated with ownership (r_s=0.32**), how long respondents have lived there (r_s=0.33**) and age (r_s=0.33**). It is remarkable that respondents with experience of flooding do not necessarily dislike the idea of staying, as no significant correlation for these variables was found.

The overall satisfaction with their home is confirmed by the fact that only 14% of respondents regret their choice of location. There is a strong correlation with flood experience (r_s=0.49**), as all respondents that regret their location choice have experienced floods. However, it is remarkable that having regrets correlates with the pleasure of living (r_s=-0.38**) and the state of the residence (r_s=0.22**), but not with the intended length of residency: respondents that regret their location choice are not planning to move away faster. Respondents that were not aware of the flood risk at the moment of their location choice, also regret having decided to live there more often (0.01<p<0.05).

The question comes up why respondents live in flood-prone areas. The main motivations for housing choice are non-water related factors, such as accessibility, proximity of facilities, characteristics of the residence and social ties with the area (Figure 13a). These are far more important than amenities related to the location in the flood-prone area, such as proximity of water or possibly lower real estate prices. So there is no clear link between location choice and flood risks. On the other hand, a green and quiet environment is an important attractor as well, but it is unclear whether this is specifically related to the flood-prone area, or rather to the broader (rural or suburban) environment.

For respondents that were aware of the flood risk at the moment of location choice, the main considerations for their location choice are that the risk is low on the one hand, and that the location and characteristics of the residence are favorable on the other (Figure 13b). Motives that are less desirable from a flood management perspective, such as misjudgment of flood risk, reliance on insurance and financial deprivation are of less importance. This might indicate that the location choice for respondents aware of the flood risk is well informed. However, it is possible that risks turn out to be higher than expected and issues could emerge in the near future.

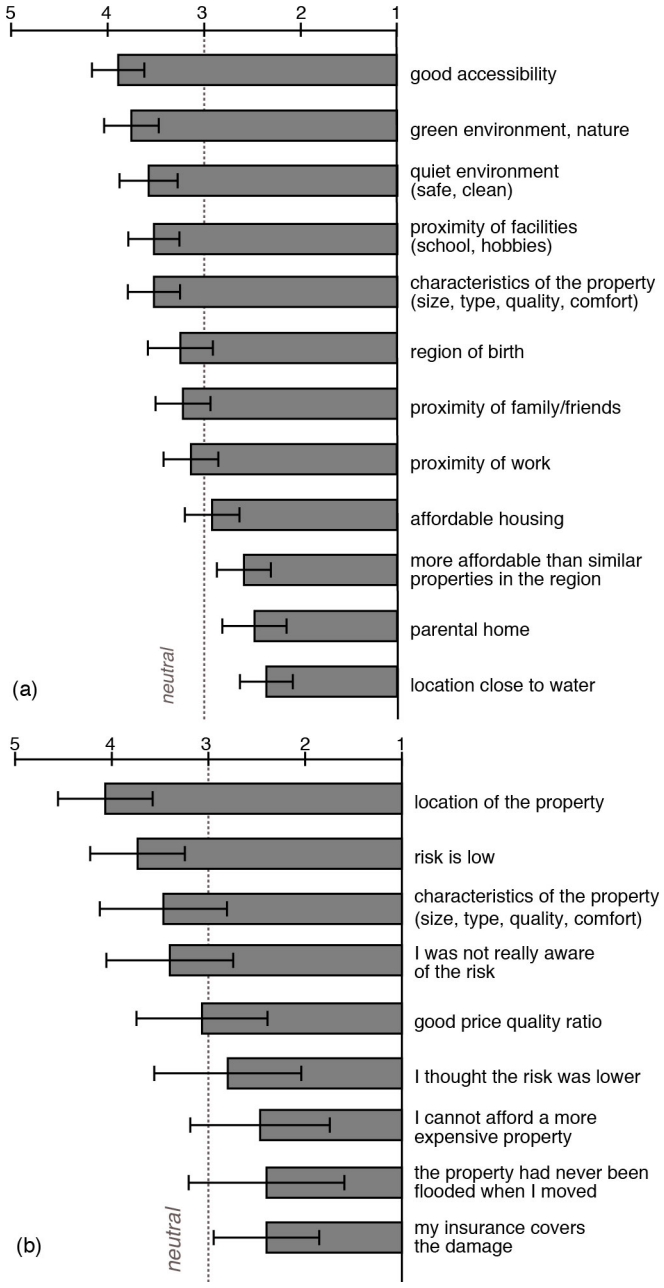

Figure 13. Reasons for housing choice in general (a) and for respondents aware of flood risks at the moment of housing choice (b), measured in mean score on a 5 point Likert scale, error bars indicate 95% CI

In line with the finding that respondents like to live where they live, the desire to move away is very low: 5.4% want to move, while 85.5% do not want to move. The desire to move is correlated with flood experience (r_s=0.27**) and risk awareness at the moment of location choice (0.01<p<0.05), next to the state of the residence (r_s=-0.17*). Also the

willingness to move (as a flood protection measure) is low: only 10.8% are willing to move, while 89.2 % are not willing to move. This however does not correlate with risk-related variables such as knowledge or flood experience, but rather with non-flood related variables such as age (r_s=-0.21*) and length of residency (r_s=-0.19*): the younger the respondents and the shorter they live there, the more willing they are to move. Nevertheless, the desire and willingness to move away is associated with high emotional impacts: respectively r_s=0.22** for suffering (only desiring to move), r_s=0.37** and r_s=0.29** for fear, r_s=0.37** and r_s=0.29** for worrying, and r_s=0.59** and r_s=0.38** for regretting their location choice.

When asked after how many floods respondents might want to move, 40.5% of respondents indicate that they would never move due to flooding. Surprisingly this persistence correlates positively with flood experience (r_s=0.25**). This means that respondents with flood experience are more persistent in wanting to stay there than respondents without flood experience. These are also the respondents with the highest knowledge on risks (r_s=0.22**) and measures (r_s=0.31**), and the respondents that have lived there longest (r_s=0.28**).

Parallel to the considerations of respondents aware of flood risks at the moment of housing choice, the main reason why respondents do not want to move is that the risk is low (Figure 14). Remarkably, the second most important reason is that the respondents can live with the flood risk, which might indicate a certain acceptation of the flood risk, although again, it is possible that risks are underestimated. Notwithstanding the low desire to move, 20.1% of respondents indicate that if they would move, it would be at least partly because of the flood risks, and a third of the respondents (29.7%) state that they would move to a similar residence outside of the flood prone area if it would not cost any money.

Thus, the attachment of respondents to their homes is rather associated with non-flood related variables, such as socio-economic and real estate characteristics, while flood risks and experience do not necessarily reduce this attachment. Also the willingness to move seems to be related to socio-economic variables, rather than flood risks.

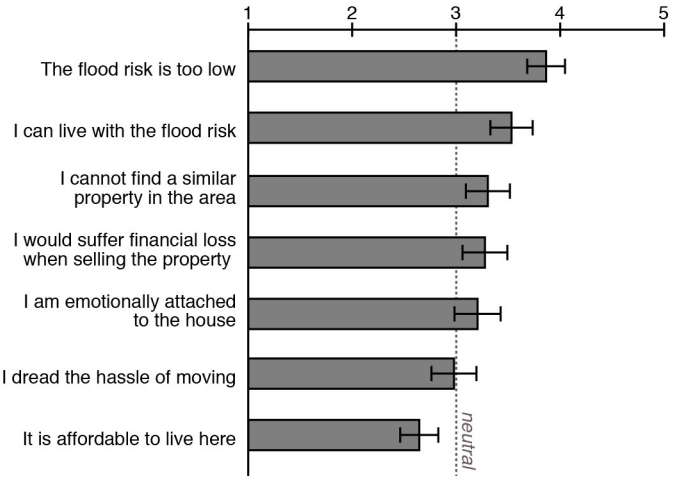

Figure 14. Reasons not (willing) to move, measured in mean score on a 5 point Likert scale, error bars indicate 95% CI

4.3.4 Sense of responsibility

The respondents consider the government (both local and regional) to be the main responsible for the existing flooding issue, while they perceive the residents to be least responsible (Figure 15a). It is remarkable that there is a large consensus on this: the vast majority of respondents (about 80%) agree with the statement that the government is

responsible for the existing problems, while only 10% agree with the statement on residents being responsible for the existing problems.

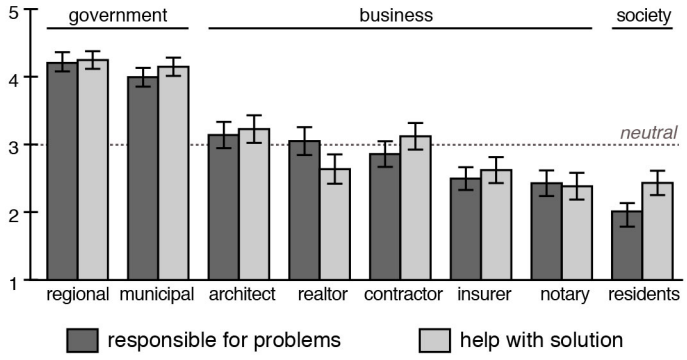

Figure 15. The extent to which different actors are responsible for the existing problems (a) and can help solving problems (b), measured in mean score on a 5 point Likert scale, error bars indicate 95% CI

The extent to which different actors are expected to be able to help in resolving the issue (Figure 15b) shows a similar pattern: 89% of respondents also deem the government to be responsible for resolving the issues, while only 19% believe that residents can help resolving the issues. Nevertheless, 42.1% of respondents wish to be involved in finding solutions to the flooding issue.

In relation to location choice and flood risks, 70.6% of respondents agree with the statement "As the authorities have allowed me to come and live here, they are responsible to protect me against flooding", while only 19.5% of respondents agree with the statement "I have moved here, so I am responsible to protect myself against flooding". This is quite remarkable considering the fact that regional zoning plans originally did not sufficiently take flood risks into account.

So the government is perceived as the leading actor in both causing and solving the flood issue, while respondents see only a limited role for themselves. However, the extent to which residents consider themselves to be responsible for the existing problems and can help in resolving them is associated with knowledge on flood risks (resp. r_s=0.23** and r_s=0.18*) and knowledge on measures (resp. r_s=0.19* and r_s=0.30**). High levels of knowledge are thus associated with a higher sense of responsibility. Also risk awareness at the moment of location choice is of relevance: respondents that were aware of the flood risk at the moment of location choice put less responsibility for the existing problems on the government ($0.01<p<0.05$) and more on residents ($p<0.01$), while they also believe more often that residents can help in resolving the issue ($p<0.01$). This indicates the importance of knowledge on risks and measures, and risk awareness at the moment of location choice in assuming responsibility.

When asked to what extent governments and residents take sufficient action, about 44% of respondents indicate that they themselves take sufficient action while only 30% think the government does so. This is associated with flood experience: respondents with flood experience feel more often that the government is not taking sufficient action (r_s=-0.19*) while they themselves do so (r_s=0.26**).

4.3.5 Protective behavior and seeds of self-initiative

About a third of respondents indicate they have taken initiative to inform themselves about the flood risk and the measures they can take. These respondents indicate that they know more about the flood risk ($p<0.01$) and the

possible measures they can take (p<0.01). Information-seeking behavior on flood risks seems to be inspired by risk awareness at the moment of location choice (0.01<p<0.05), while information-seeking behavior on measures is related to flood experience (p<0.01).

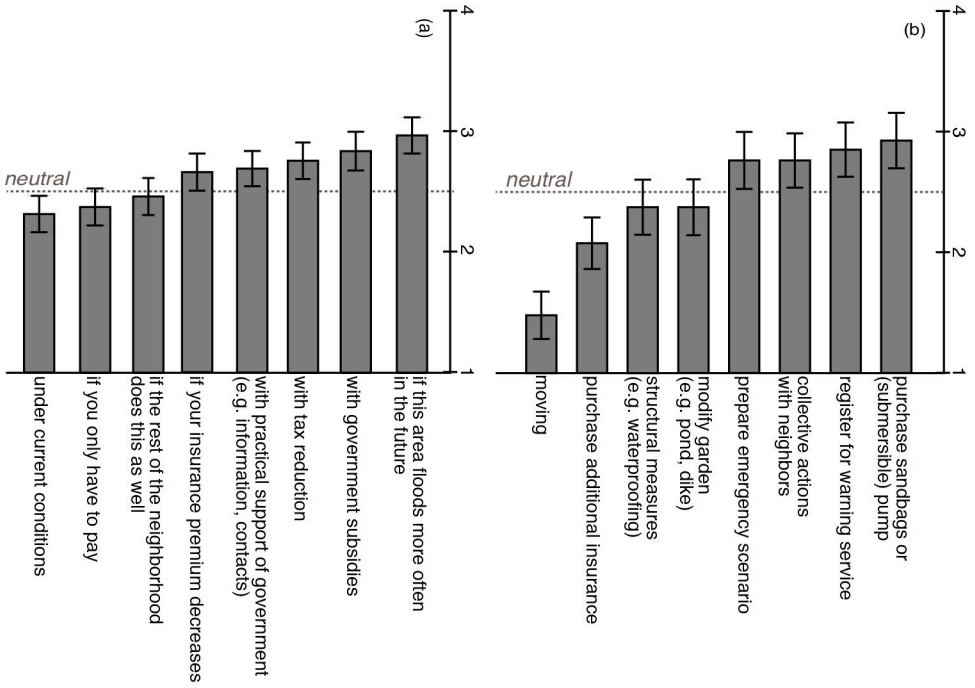

Figure 16. Willingness to take measures to reduce flood damage under different conditions (a) and by type of measures (b), measured in mean score on a 4 point Likert scale, error bars indicate 95% CI

A bit less than half of respondents (43.4%) are willing to take measures against flooding. Respondents that are willing to take measures have more often sought information on risks (0.01<p<0.05) and possible measures (p<0.01). The willingness to take measures is also associated with flood experience (r_s=0.33**) and knowledge on measures (r_s=0.27**). Considering under which conditions respondents would be willing to take measures, we see that an increased flood frequency and government incentives such as subsidies, tax reduction and practical support are most preferred (Figure 16a). The low score for the option 'if the rest of the neighborhood does this as well' indicates a lack of sense for collective action.

If we look at what type of measures the respondents are willing to take, it is no surprise that mainly low-cost and low-key measures are preferred (Figure 16b). However, it is remarkable that collective action scores high, especially since the previous results showed little belief in the respondents' own capacities in dealing with flood risks.

Nevertheless, half of all respondents have already taken action to reduce the consequences of flooding. Taking action is mainly associated with flood experience (r_s=0.63**): 16.4% of respondents without flood experience, 47,6% of respondents with flood experience without damage and 89.5% of respondents with flood experience and damage have taken measures. This indicates that taking action is mainly reactive to flooding. Other significant flood-related variables are knowledge on risks (r_s=0.22**) and measures (r_s=0.31**), information-seeking behavior on risks (0.01<p<0.05) and measures (p<0.01), but also non-flood related variables such as condition of the property (r_s=-0.21**) and age of residence (r_s=0.27**), and length of residency (r_s=0.34**) play a significant role.

However, the investment in these measures is rather limited: 60% of the respondents that have taken action, invested less than € 500 in these measures. The invested amount is associated with flood experience (r_s=0.31**), knowledge on measures (r_s=0.29**) and the extent to which respondents like to live there (r_s=0.30**). The most frequent measure is purchasing sand bags or a pump(ing installation) (73%), followed by storing valuables on an elevated spot in the house, and structural measures (around 30%), while only a small fraction (around 5%) joined a neighborhood committee, waterproofed their interior, registered for a warning service or purchased an additional insurance. Here again, low-cost and low-key measures are preferred above structural measures. Furthermore, we observe very little collective action, although the findings above have indicated a relatively high willingness to take collective action. About half of the respondents that have taken action, are satisfied with the measures they have taken. Nevertheless, only about a third of respondents think these measures protect them sufficiently against flooding and feel more at ease since these measures.

The motives to take action (Figure 17a) are mainly flood-event related. We notice a tendency towards more ad-hoc decisions in the context of a specific flood event, rather than pro-active or reactive reasoning. In addition new information appears to be quite unimportant as a motive for taking action. So even though our survey has showed strong correlations between knowledge levels and sense of responsibility on the one hand, and willingness to take action on the other, it seems that knowledge in itself is not sufficient as an incentive to take action. However, if we look at the reasons why respondents do not take action (Figure 17b), we see that the main reasons are the strong belief in collective action and government responsibility, followed by the consideration that risks are low and the distrust in individual actions. Personal circumstances were mentioned least. Here, proclaimed trust in collective action again conflicts with observed protective behavior.

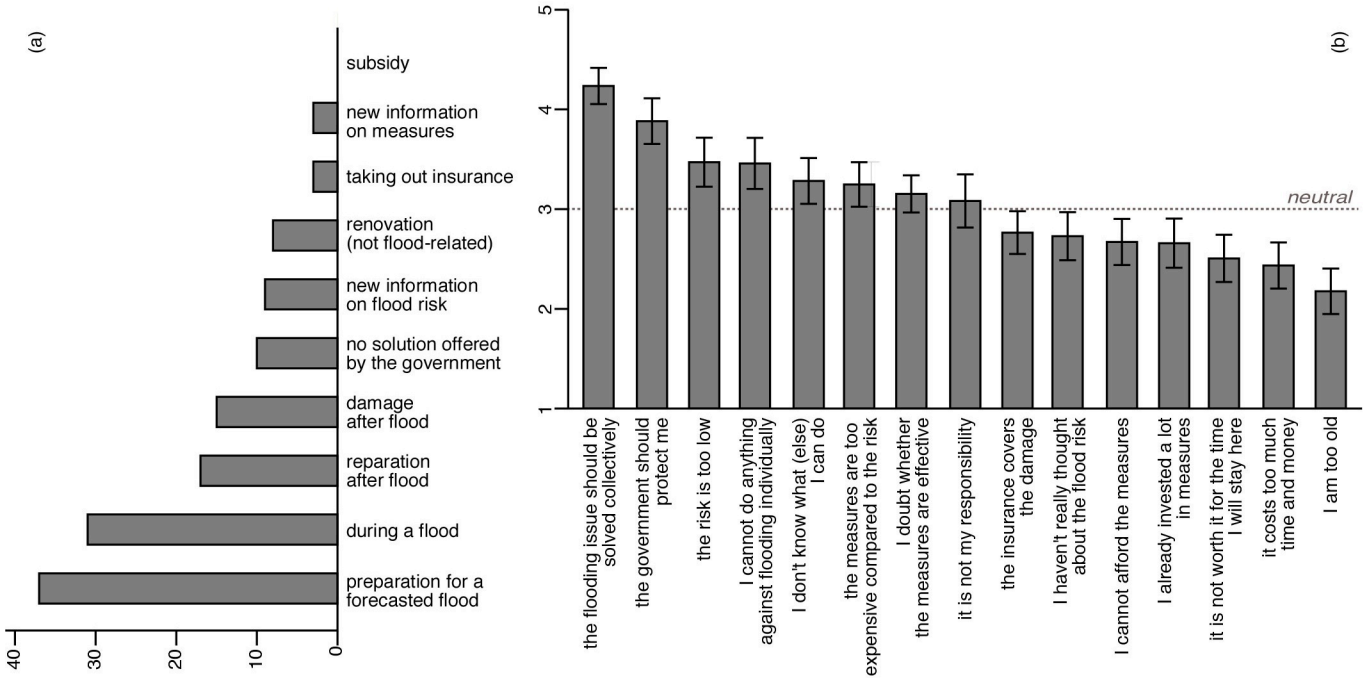

Figure 17. Motives to take action (a), measured in number of respondents, and motives not to take action (b), measured in mean score on a 5 point Likert scale, error bars indicate 95% CI

4.4 Conclusion and discussion

Research in water management and planning often presents the flooding issue as a rather technical matter, while the interrelationship with broader social dynamics and institutional issues is not always discussed thoroughly. We have therefore conducted a survey that assesses how residents of flood-prone areas in the Dender basin (in Flanders, Belgium) deal with the risk to which they are exposed. Our survey has probed for the residents' knowledge of the flood problem, their perception of the associated risks, the measures they take, the satisfaction with their home and their sense of responsibility. We started from a sample of households whose residence is designated as a flood-prone area in official maps. This research base is interesting since Belgium is known for a rather weak position in steering development (Boussauw and Boelens, 2015; Verbeek et al., 2014), unlike many neighboring countries such as the Netherlands. This context would suggest that residents play an active role in flood risk management. However, very little efforts have been made to include or activate residents in flood risk management, as opposed to for example the United Kingdom. This would suggest that residents included in our research would show a relatively low degree of risk awareness and responsibility, and would not be inclined toward self-initiative.

This hypothesis has largely been confirmed. A large majority of residents have low risk awareness, are badly informed, have little or no intention to relocate, and strikingly often impose all responsibility for the risk they run on the authorities. Residents do not really see themselves as being responsible, and also do not believe they can actively contribute to managing flood risks. They deem a very limited role for themselves, and expect solutions from the government. Nevertheless, they do take some action, but these actions are low-key, individual and ad hoc. So far, recent government initiatives such as publishing and regularly updating flood risk maps, adjusting insurance policies, and introducing a mandatory notification on flooding issues when a house is sold, seem to bring little change.

These findings represent a clear connection with the Belgian institution of regional zoning plans, an area-wide set of land use plans that are in force since the seventies and distinguish between zones which in principle could be developed, and zones that are intended for agriculture, nature and forest (and where construction is, in principle, not allowed). Although these plans have their merit in having managed to keep some open space areas free of any construction, they also implied a de facto right to build on land that was actually never thoroughly evaluated as being appropriate construction land. Therefore, today a number of flood-prone areas are still considered to be construction land, certainly by owners, developers and residents, while the responsibility to keep the lot dry (and in many cases, the house on it as well) is placed on the government.

A number of measures that are currently being taken by the government, aim at increasing knowledge and raising awareness and sharing responsibility between governments and citizens. It is expected that in the future these will contribute to improved control of the flooding issue. However, although information made available by the government reaches a relatively wide group of residents, only a fraction of this group fully comprehends and retains this information. Residents still rely more on neighbors, friends and family to acquire knowledge on flood risks. This proves the importance of civil society and non-governmental actors for the way residents manage their flood risks. White et al. (2001) state that increased knowledge does not necessarily lead to declining damage figures. Residents of flood-prone areas may be in denial about the flood risks, and expect to be protected.

Therefore, recent developments in policy-making are looking into the possibilities to loosen somehow the link between a particular land use designation in the zoning plan and the actual right to build, and in some cases to cancel such existing, although inappropriately awarded development rights. However, it is still unclear what how these

policies will be implemented. Moreover, a strong emphasis on governmental technical protection has proven to be counterproductive in terms of a passive community refusing responsibility. Therefore, we should also look at the unintentional effects of common protective policies. In the context of budget cuts and uncertain climate change, there is a growing need to rethink this position.

This research contributes to this discussion. On the one hand policy-making should be informed by what residents think and do. On the other hand, individual action is framed by governmental actions, even if this is not addressed explicitly. The way residents look at their own and other's roles and responsibilities in managing flood risks, is to a certain extent the result of a flood paradigm that focuses on a technical, centralized approach based on flood prevention. Flood risk management choices generate feedback mechanisms towards civil society and the way they deal with flood risks through experience and expectation. For a long time, flood protection was a governmental activity and flood risks were not formally taken into account in spatial plans and developments. Dissemination of information has only very recently taken form and there is very little experience in private flood protection measures. However, the intended transition towards citizen responsibilization does not comply with the public opinion on responsibilities in flood risk management, and therefore, this discussion needs to be openly addressed.

The results of the survey bear testimony of the old flood risk management paradigm. One cannot expect that residents are spontaneously self-reliant if the way they deal with flood risks has co-evolved with a flood risk management paradigm that attaches much importance to a technical, top-down approach. While some changes are taking place, these are still small. Therefore, the shift towards more resident involvement therefore needs to be openly addressed and supported in all aspects of the interactions of residents with flood risks. In this light, the survey provides some promising leads. Respondents like to live in flood-prone areas and are mostly satisfied with their current homes. Civil parties play an important role in knowledge dissemination. Furthermore, there is quite some confidence in the power of collective action, although currently, social capital seems to be lacking to put this into practice. These elements can be interpreted as opportunities that could lead to more resident involvement and active contribution in flood risk management, under conditions of appropriate support.

5 Societal actors: interactions and conflicts with formal flood risk management

This chapter aims to gain insights into the societal dimension of the flooding issue. How do societal attitudes and actions affect flood management options, and what are these attitudes and actions based on? Through interviews with different types of societal actors (residents, real estate agents, etc.) on the local (Geraardsbergen) and regional scale (Flanders), their points of view are analyzed. Some insights are formulated, which can help to overcome the difficulties in the transition towards new forms of flood management and governance, and to put more effective flood management strategies into practice.

5.1 The role of societal actors

As described in the theoretical framework, different actors from public, civic and business societies are involved in the spatial development of flood risks. In this chapter we focus on land users on the one hand, and market actors on the other. In what follows, a brief overview of these groups and their roles in and contributions to flood risk management is discussed.

5.1.1 Land users

Land users in flood-prone areas affect the flood risks through their spatial developments in these areas. They are directly confronted with the consequences of floods, and undergo the effects of FRM policies. Land users outside of flood-prone areas contribute to flood risks in terms of surface run-off.

- Residents in flood-prone areas
- Businesses in flood-prone areas: Apart from material damage, companies also experience financial damage because activities are interrupted. On the other hand, companies have more resources and are more organized in (risk) planning.
- Nature: Environmental organizations give voice to nature as an important land user in flood-prone valley areas.
- Farmers: Agricultural businesses are affected by flooding, but also play a role in water management through cultivation methods and water use.

Water managers in Flanders are exploring possibilities to share responsibilities with these groups. 'Shared responsibility' is an important and explicit aspect of their policies.

5.1.2 Market actors

Market actors indirectly contribute to the spatial development of flood risks. They are involved in the market mechanisms that support and influence spatial developments in flood-prone areas and the way land users manage their flood risks.

- Housing market actors: Since October 2013, real estate agents are legally required to inform potential buyers on flood sensitivity. Therefore, they play a role in the consideration of flood risks of (potential) homeowners at the moment of their location choice.

– Insurance market actors: Flood risks are by law a mandatory part of the fire insurance. Although this fire insurance is not compulsory, about 95% of Flemish households has one. Therefore, flood risks are cross-subsidized across almost the entire Flemish population. For houses built before 23 September 2008, there is a statutory ceiling for the premiums. For houses built after, insurers are not required to offer insurance.

– Building industry actors: Architects and contractors are responsible for the conception and construction of built developments both inside as outside of flood-prone areas. In flood-prone areas, the construction techniques can play a decisive role in the (potential) damage in case of flooding, for example through flood proofing. Outside of flood-prone areas, limiting and reducing soil sealing improves infiltration and buffering of water, and thus lowers flood risks. As such, they respectively play an important role in the development and implementation of flood-proof and water conscious building techniques.

5.2 Methodology

The point of view of the societal actors (both land users and market actors) is examined in three consecutive stages that each time builds upon the findings of the preceding phase. First, actors directly involved with flood risks at the local level (Geraardsbergen) were interviewed. Consequently, professional associations and organizations at the regional level (Flanders) that are indirectly involved with flood risks, but are familiar with policy-making were interviewed. Both series of interviews were transcribed and analyzed through open coding. These points of view were confronted with those of policy makers in a focus group. In this focus group, policy implementation and options for more stakeholder involvement were discussed.

5.2.1 Geraardsbergen

17 societal (non-governmental) actors were interviewed in April 2014 on their experience, their role, their own and other's responsibilities and future management options in the flooding issue. The questionnaire was semi-structured. The respondents were:

– six residents:
    a. four residents in the flood-prone area, with flood experience and involved in citizen groups
    b. two residents close to the flood-prone area without flood experience
– three businesses in the flood-prone area (industrial company, retailer and tavern)
– two farmers in the flood-prone area (hobby farmer with flood experience and dairy and arable farm without flood experience)
– one insurance broker (located in Geraardsbergen)
– three real estate agents (two offering real estate in Geraardsbergen, and one with particular experience with real estate in flood-prone areas)
– two environmental organizations active in Geraardsbergen

For a list of the respondents, see annex 3.

5.2.2 Flanders

During the period of May-July 2015, six representatives of non-governmental stakeholders at the Flemish level were interviewed. In an in depth interview of at least an hour, they were asked about the societal role of their profession in FRM, any issues they encounter in performing this role, and how they see future developments. In the questions it was explored how these different actor could contribute more to FRM, in line with the policy discourse of shared responsibility. See Annex 3 and 4 for respectively the respondents and the questionnaire. The questioned associations were:

- Boerenbond, an agricultural professional association
- Assuralia, a professional association for insurers
- Natuurpunt, an independent voluntary association for nature protection
- NAV, a professional association for architects
- VCB, a professional association for the construction sector
- CIB, a professional association for the real estate sector

5.2.3 Focus group

In November 2015 a focus group on flood risk management in the Dender basin and Flanders took place. This focus group started from the question 'how can a greater involvement of residents be created'. The participants comprised 19 actors: 12 policymakers and 7 stakeholders. The policymakers included people from the regional, provincial and municipal spatial planning departments, regional water managers and a mayor. First the results of the survey were presented. Then, three themes related to role of societal actors in FRM were discussed: (1) the way responsibilities are distributed, (2) the way the financial burdens of measures and damages is distributed and (3) how non-governmental actors participate in FRM. The participants discussed three statements on one of these topics, and then jointly discussed the outcomes. See Annex 5 for the participants and discussion statements. The report of this focus group can be obtained on request from the author.

5.3 The local scale: land users and market actors in Geraardsbergen

The results for the local actors in Geraardsbergen are discussed in two ways. First, a short overview of the results per actor group is given. Then, an overarching thematic discussion follows on conflicting needs, different interpretations and different framings of the problem.

5.3.1 Land users

The land users are generally aware of flood risks, although the frequency and intensity of flooding, and especially the gradual expansion of the flood-prone area surprises them. Most actors mention that the government has made mistakes in the past by assigning residential land uses in flood-prone areas.

5.3.1.1 Residents

All residents agree that they have limited responsibility in the flooding issue. They feel the government has created the existing situation by allowing developments in the floodplain.

Some residents in the flood-prone areas knew about the flood-risks when they moved there, but were not fully aware of the extent and consequences. Others have seen the risks increase over the years. Residents often feel helpless and left out in the cold. They feel that they cannot take sufficient or effective measures themselves. Nevertheless, some residents have invested heavily in individual engineering solutions. They feel that the government should take responsibility and provide safety to residents, but that it does not realize the structural solutions it promises. They also believe that there is not enough communication towards residents.

Respondents in the worst affected areas have set up a committee. The main objective is to put pressure on policy makers and to keep the debate alive, in order to obtain structural measures. They also disseminate information and advice amongst residents on how to deal with flooding.

Although the residents outside of flood-prone areas have some fear of flooding, they do not actively inform themselves. They agree to the government investing heavily in protecting residents and damages, and cross-subsidization of damage through insurances. They generally feel that the government does not take enough action.

5.3.1.2 Businesses

In contrast to residents, managers are not emotionally attached to their property and experience little emotional impact. Decisions to take precautionary measures are mainly based on economic motives. In terms of damage and taking action, there are large differences between the businesses. The retailer has little expensive fixed elements in his store, causing the damage to be rather limited. As all damage was reimbursed by the insurance, the retailer and the tavern feel no need to take precautionary measures other than moving their merchandise when a flood is expected. The industrial company on the other hand has experienced extensive damage (both material as operational), which was mostly not reimbursed by his insurance. Therefore he is willing to take precautionary measures. However, the municipality does not authorize building a dike, as it would reduce the water storage capacity. The manager does not see any other effective precautionary measure that he can take. Relocalization is not an option for any of the businesses, as the retailer and tavern are bound to their location in the shopping district and municipality center, and it would to expensive for the industrial company.

5.3.1.3 Farmers

The farmers feel that agricultural lands are less protected against flooding than for instance residential areas and their damages are less compensated[3]. They think that the government does not protect them to the extent possible. They feel that farmers should have the same rights as residents, although they understand that the need for protection is higher in residential areas as damages are higher.

They don't feel like their activities contribute to the problem[4]. They believe that urbanization and the increase in sealed land are mainly responsible for increasing flood risks. They also feel that farmers cannot take any measures against flooding, at least not on an individual level. At most, they can purchase pumps.

[3] In case of damage they can obtain tax reductions, while inhabitants have private insurances and disaster relief funding by the government.

[4] Although other sources point out certain cultivation methods as part of the problem.

5.3.1.4 Environmental organizations

One organization is very committed to the flooding issue and strives for a full restoration of the natural floodplain of the Dender. They state that it is not financially viable to protect all buildings in light of increasing flood risks. They feel that no new buildings should be built in known flood-prone areas, existing buildings in the floodplains should be (in the long term) demolished and nature should be able to take its course. To achieve this, they contest building permits, advocate a stricter application of existing water policies (especially locally) and inform local media on malpractices. Although they are very active in the societal debate, they are not formally involved in policy-making. The other organization agrees in general terms with the first one, but does not take any action to pursue this.

5.3.2 Market actors

5.3.2.1 Insurance broker

Residents in known flood-prone areas pay a higher premium. Premiums are calculated based on flooding history and location within known flood-prone areas. Additional precautionary measures by residents do not lead to a lower premium. The broker feels that he can provide advice on precautionary measures, but cannot impose them. He indicated that he probably would not insure a house built after 23 September 2008, as the principle of solidarity has its limits. He is not prepared to use the insurance premiums to invest in flood measures, as he considers that to be a governmental responsibility.

5.3.2.2 Real estate agents

The real estate agents indicate that they provide accurate information on flood risks to potential buyers (although they claim that this is not the case for all real estate agents). They state that it is government responsibility to provide them with objective information on the flood sensitivity. This was not the case in the past, but this is no longer a problem. However knowledge on flood risks remains a bottleneck. They do not see an active role for themselves in flood risk management (for example by investing in flood measures to increase the value of flood-prone land). They do not see any problems in selling properties in flood-prone areas, as long as the client is correctly informed. They have a strong belief in technical measures on the building scale (e.g. flood-proofing) to prevent damage. One agent saw an additional role for himself in providing expertise and advice on precautionary measures and building techniques. Although prices are lower (about equal to the additional cost of flood-proofing the building), they state that selling properties in flood-prone areas is difficult, as flood risks put off a lot of potential buyers. According to one agent, the lower price does not outweigh the disadvantages of living in flood-prone areas. Another agent emphasizes the advantages of an attractive location in a natural environment close to the city.

5.4 The Flemish scale: contributions of societal actors to FRM

5.4.1 The current role of different societal actors

Nature and agriculture are two of the most important land users in flood-prone areas.

- Nature: The flooding issue is for the environmental organization an opportunity to realize win-wins for their biodiversity objectives. They have become an important landowner in valley areas through systematic voluntary procurement on the market, and also manage natural (valley) areas owned by others. To do so, they

are partly subsidized by the government, but also use their own resources. They are an important project partner for governments for natural restoration in valleys and flood-prone areas. They believe that they could contribute more to FRM in terms of active land purchaser, but this would require more resources.

- Agriculture: The agricultural association stresses that farmers are very well aware of their land and the water system, and that they often have adjusted their activities accordingly. The environmental organization however states that there is much to gain in terms of management in agricultural areas, both within and outside of flood-prone areas. This includes erosion measures, water conservation and adapted land-use in flood-prone areas (i.e. grassland). However, they argue that implies a major mind switch, as the thinking about water in agriculture has been focused on draining for a very long time.

The different market actors all stress the boundaries of their professional activities. They feel that any contributions to FRM should stay within the social role of their profession.

- Real estate agents: Through the duty to inform, the role of real estate agents in the communication of flood risks towards potential buyers is legally established. According to the association, this law is merely a codification of their general duties as real estate agents. They believe that advice on potential individual flood-protection measures is not strictly within their scope. Although it might be possible that some real estate agents specialize and profile themselves by providing technical advice on flood-proof building techniques, they believe that this is only a niche market.

- Insurers: They indicate that it is possible that insurers give a discount on the premium if residents take measures. However, under the current conditions, this is unlikely, as the market for this is too small. However, they don't feel that it is their duty to pro-actively inform residents on flood risks or the measures, since they are only consulted after a house has been built or acquired.

  They have questions about the effects of the modeling updates of the flood risks maps. This creates some uncertainty, as a changing classification has implications towards insurability. However, in most cases, this change in classification is not even noticed, as the insurance policy is drawn up once and not updated afterwards.

- Architects and contractors: The architects' association indicates that architects play an important role in prevention. It is the task of the architect to advise the building owner on potential measures to prevent damage. However, the initiative for flood-proof building comes primarily from the building owner. Both the contractors' and the architects' associations state that if the demand grows, techniques for flood-proof construction will develop. However, at the moment, this is a niche market.

They all face relatively few problems carrying out the duties included in the legal framework for their respective professions. Issues are mainly concentrated around optimalizations of the practical implementation and the need for good information on flood risks from the government.

However, their role in FRM generally seems to be restricted within the mandatory legal framework. Outside of the legal requirements, the role of these market actors is limited and little initiative is taken. Thus, their still is some room to take up more FRM-related tasks within their professional activities.

5.4.2 Relation with formal FRM

5.4.2.1 Involvement of societal actors in FRM policy making

The open space land users, i.e. environmental and agricultural organization are most familiar with developments in formal FRM, as they were involved in the Sigma plan and then the turn towards integrated water management from the early 2000s. They are familiar with the organizational structures and responsibilities of the different governmental actors involved in FRM. They are also locally represented in the sub-basin council that issues advices towards the sub-basin board. They are however less familiar with the more recent developments towards shared responsibility.

Nevertheless, both environmental and agricultural organizations criticize the relation of policymakers with local stakeholders. The agricultural organization feels that they are not involved in the conceptual phases, but only in the later stages of the process. They argue that a public inquiry is not the most efficient way to communicate with local stakeholders. Farmers often have knowledge on not only the local water system, but also on the suitability of certain measures within the operation of their businesses. Taking this into account is keystone for the public support of this group, as this allows tailor-made location-specific solutions. In fact, they argue that it should be easy for governments to create public support for FRM from farmers, as they are also concerned with the water system, but due to the lack of deliberation, this is often not the case. The environmental organization on the other hand is under the impression that so much effort goes into internal deliberation between the different governmental departments that by the time stakeholders are consulted, the process has progressed so far that the options for deliberation are limited.

The market actors on the other hand were not involved in the earlier stages, but are becoming more involved in the more recent developments towards shared responsibility. The different professional associations were involved in the development of the relevant policies. For example, the architects' association was involved in the development of the spatial planning regulations on rainwater, and the insurance industry was involved in the development of the legal framework for the fire insurance of 2005.

While water managers have since invited the insurance industry to FRM seminars to think about the role of damage compensation in the discourse of share responsibility and in the light of climate change, the insurance industry was not very avid to play an active role in this discussion, as they encounter little to no problems in the implementation of the existing legal framework. The professional association for architects on the other hand is subsidized by the Department of Environment, Nature and Energy of the Flemish government to appoint a water consultant. This consultant informs architects on water related building regulations and technical aspects of structural measures against flooding on the building level. He plays an intermediary function between the construction industry and policy makers in water management. On the one hand, input for policy issues based on practical experience is provided to policy makers, while on the other hand the government indicates on which topics communication towards the construction industry is needed.

5.4.2.2 Interaction between formal FRM and societal actors

All actors indicate that they consider the government to be the leading actor for FRM. As they encounter no major flood risk related problems in their daily activities, they take a reactive attitude towards government initiatives, instead of pro-actively raising issues about their role in FRM.

In relation to building in flood-prone areas, the architects' association indicated that they consider the government to be the most important partner, as they determine where building permits can be issued and under which conditions

(through the water assessment). The construction sector association has a similar point of view, stating that technical expertise is not the main issue that is lacking. They believe that building techniques will develop if there is a sufficient demand for this type of solutions, but that the government is responsible for bring about this demand. For example for water infiltration, they believe the government should set the example in the design public space.

However, as shown by the following quote, this reactive attitude does not necessarily imply a passive one:

> *"It was communicated by the government that a total ban on building could not be imposed en that building in flood-prone areas would be permitted. So from within the construction sector, the question rose "how should we then build?" And from this question, an IWT project proposal (ed. research proposal on flood-resistant building techniques) grew."*
>
> - representative of NAV (architects' association)

This proposal was refused, but the government subsequently funded the water consultant project of the architect's association.

5.4.3 Views on governmental FRM

5.4.3.1 Levels of governing

The environmental organization believes that the scaling up of responsibilities in FRM, for example from municipalities towards provinces, is a good evolution, because it leads to a more professional and integrated water management, which was needed in many places. The farmers' association on the other hand stresses the importance of the local level in the communication and deliberation with the individual farmers. They indicate that projects by local authorities have more public support, because municipal authorities are better placed to discuss potential solutions with farmers.

The architects' association indicates that the different regulations from the regional, provincial and municipal level should be integrated and easily consultable. Otherwise, it is hard for architects to keep an overview of the regulations they should take into account, since for example the spatial planning regulations on rainwater can be specified on every level.

5.4.3.2 Spatial planning

The environmental organization feels that FRM is still more performed by water managers than by spatial planners:

> *"Integrated water management is actually not about water, it is about land. All the problems that need to be solved in integrated water management are caused on land, and not in the streams. So water managers often cannot solve this. Because they don't have the instruments and the power to do so. And within the instruments and powers they have, they often do what they can."*
>
> - representative of Natuurpunt (environmental organization)

They argue that water managers sometimes chose suboptimal solutions, because spatial planners and land users do not take up their responsibilities. They propose two main roles for spatial planning. On the one hand, the negative effects of further built developments needs to be limited. On the other hand, they plea for an active recovery policy to make up for mistakes from the past.

5.4.3.3 Water management

The environmental and agricultural organizations consider the Sigma plan to be very successful. An important element in this success that there were sufficient supporting policies and resources. Within the Sigma plan, there is a frequent project-based collaboration between W&Z and both Natuurpunt and Boerenbond.

In the implementation of the FD through the RBMPs by both the main regional water managers (VMM and W&Z) such collaborations are lacking. The process is perceived to be very closed, and at the moment, supporting policies are still conceptual and available resources seem to be much more limited. While it is true that this approach is still relatively young, the plans have nevertheless already been established. These are now being further developed in local pilots, where more participation is intended.

5.4.4 Towards more involvement of societal actors

How can societal actors be stimulated to contribute to managing flood risks? In what follows, the essential elements for an improved contribution to FRM according to the participants is discussed.

a. Knowledge on flood risk

For the market actors, knowledge is an essential element for their contribution to FRM. They expect the government to deliver this knowledge. Therefore, three important elements are the availability, accessibility and comprehensibility of this information. Especially comprehensibility is of major importance, as these market actors are no experts in FRM. A lack of comprehensibility leads to oversimplification, and therefore misjudgment of the flood risk. The current conceptualization of flood risks seems to be insufficient to communicate the inherent uncertainties related to flood risks, which leads to a very black-and-white view on flood risks and a limited capacity to deal with changes in these risks.

b. Societal awareness

The interviewees indicate that their current limited role is related to the lack of demand for societal solutions, such as private structural protection measures, additional insurance, technical advice from real estate agents). Potential real estate buyers do not really worried about flooding, and therefore also not ask for information on possible solutions. Therefore, specialization in flooding creates little added value for their businesses. They will only take up these additional roles if this would give them some kind of competitive advantage, but this is currently rarely the case. However, they are convinced that if this demand would emerge in the future, the market will respond to this and these arrangements will develop spontaneously.

c. Specialization

An important condition for more involvement of market actors in FRM is the development of specialized knowledge on their (potential) contributions to FRM. However, the architects, real estate agents and insurers all currently show no real specialization towards FRM within their fields. The architect's association stresses the importance of involving more actors in the building industry, such as engineers, building contractors and research labs for technical certification. Currently, technical knowledge is still limited. The role of the water consultant is limited to disseminating and exchanging information and raising awareness, while the production of technical knowledge is still lacking behind. Infiltration and flood-proof building are still abstract concepts for many architects, and the application of these

techniques raises a lot of questions and uncertainties. However, the development of a technical framework requires better collaborations and resources for research. All market actors argue that this will develop, once there is sufficient demand for such arrangements.

d. Social project management

The environmental organization stressed the need for social project management skills. Most water managers were schooled as hydrological engineers, while the newly developing discourse on shared responsibilities requires social project management. This requires a cultural switch for water managers, which is a slow process.

5.5 Policy-making for shared responsibilities in FRM

5.5.1 Responsibility

All participants agreed that the government is responsible to create a global vision that also sets conditions for residents of flood-prone areas. This means that it should be deliberated with citizens what can be solved collectively and what should be solved individually. This requires that it be stated clearly that the government cannot protect all buildings against flooding and that building permits are not a guarantee for protection. Through the new FRMPs and the accompanying cost-efficiency models, it is relatively easily to list the buildings that in the future cannot be protected from this cost-efficiency perspective. If residents need to protect themselves, the governments need to inform them properly on the measures that have been taken in the past, what measures residents can take and in which time frame this should happen. The participants think that if the full responsibility is placed on residents, actions will only be taken after a new flood occurs. Although floods have a catalyzing force, they consider this to be too late. Furthermore, the government could also support residents through group purchases.

However, in addition to this supportive, deliberative role, the participants felt that public authorities also need to react more strictly in order to responsibilize residents. For example if residents do not comply with the conditions in the building permit (that were imposed based on the water assessment), they feel that all responsibility should be placed on these residents. Opinions differ on the proposal to make the flood damage compensation conditional on taking private measures on the building scale. On the one hand, such a system could set good examples. On the other hand, in the current system insurers are consulted too late in the process (often when building is completely finished) to impose such measures. However, a diversification of risk profiles in classes could provide a framework to communicate on flood risks and might incentivize residents to improve their house. It could also be used to capitalize risks better in insurance premiums, although insurers are not in favor if this and policy-makers are also cautious. It is important that the insurance system stays affordable in order to prevent a social deprivation due to the concentration of socially vulnerable groups that cannot afford insurance in the possibly cheaper housing stock in flood-prone areas.

5.5.2 Financing

There was agreement that the lack of differentiation of the fire insurance premiums in accordance to the flood risks creates a very inert system. At the time of the law on the inclusion of natural hazards in the fire insurance policy, not as much information on the flood risks was available as today. Now, a differentiation of premiums is practically feasible due to better knowledge. The participants are in favor of a more differentiated premium system, and thus higher premiums in flood-prone zones, as they believe that this could be an incentive for private mitigation behavior.

The government actors indicate that the mentality has changed from 'the government can solve this' towards 'everyone needs to contribute'. Therefore, the rules on damage compensation should be altered. Societal actors to a certain extent agree this with. However, all agree that flood risks should absolutely not be fully capitalized in the insurance premium, as to maintain a certain degree of solidarity. Also, too much differentiation might induce social problems for vulnerable groups. Therefore, a certain upper limit is necessary, to maintain affordability and therefore avoid social deprivation. Especially for new developments, higher insurance premiums are considered to be justified. The participants argue that it is impossible to prevent new constructions in flood-prone areas. Therefore, higher premiums could discourage building in flood-prone areas and make residents bear their own risks.

As to the zoning issues, the participants question the fairness of changing land use allocations and development rights without compensation. They argue that if the government changes the rules, it should compensate the affected citizens. On the other hand, it is argued that the government cannot be held responsible for information on flood risks that was not available at the time when the zoning plans were established. This should be taken into account when determining planning blight and compensation.

Traditionally, this compensation can be settled through a planning blight, but this requires large funds. Therefore, they argue that this compensation can take the form of zoning swap, tradable development rights, etc. However, strictly speaking, land use allocations do not equal building rights. If land is technically unsuited for construction, building permits can be refused. However, if adaptive building techniques develop further, it becomes harder to refuse building licenses, as the argument that residential plots in flood-prone areas are not technically suitable for construction is no longer valid. This might also increase the right to compensation if zoning is changes. As to the development of flood-prone areas pending a zoning decision, there is some disagreement. Some believe that the government should ban building activities in the meantime, as this forms a stronger basis for negotiating. Others argue that building should be possible under conditions, and these conditions can be negotiated.

The participants agree that the government (i.e. the whole population, through taxes etc.) should pay for FRM measures such as reparcelling with a zoning swap. If residents are expected to financially contribute to FRM measures directly, they believe that this is only possible on the individual residence scale. However, some participants believe that financial contributions towards the FRM could also play an important role in raising awareness.

The participants agree that the government is not responsible for the consequences in terms of legal uncertainty from flood risk map updates. These consequences include for example that insurers are entitled to charge higher premiums or that potential buyers suddenly need to be informed on flood-risks - with potential implication for the real estate value - if a residence suddenly falls under effective flood-prone area in the water assessment maps. They believe that the government is not responsible for the changes in the flood risks and the incremental knowledge on them, and can never provide legal certainty for this. They also indicate the limits of flood risk maps and modeling, and the need to be cautious with the knowledge that they generate. There should also be a possibility to adjust to the maps based on local knowledge, as the models are not always accurate. However, the question then remains who bears the burden of these changes, and should there be some kind of redistribution of the burden for this.

5.5.3 Participation

The participants acknowledge citizens' local, area-specific knowledge and indicate that it is important to take this knowledge better into account when making plans. Land users know the terrain and therefore might suggest better

solutions. Citizens groups also keep policy-makers awake. However, it was questioned whether citizens should have decision-making powers. FRM is a complicated matter, due to the interplay between the individual risks and the wider water system. Therefore, FRM also requires technical knowledge that citizens' might be lacking. The participants believe that it is important that the government maintains its role as a regulator, to safeguard the overall perspective. Letting citizens' decide is also believed to imply that policy-makers shun their responsibilities.

Nevertheless, policy-makers and societal stakeholders both stress the need for participation and the current lack of it. They believe that decision-making processes with intensive, early participation will result in higher public support. The current public consultation procedures in contrast only take place after decisions are more or less made.

Nevertheless, policy-makers are not eager to give real powers to citizens' and societal stakeholders are not always interested in these real powers. The water managers are perceived to be very inaccessible, even for the organized societal stakeholders such as the farmers' association. The policy-makers involved in FRM however indicate that these groups hardly make use of the existing structures to participate in FRM decision-making. Also citizens are reluctant to take budgetary decisions, because they are aware of the different interests at play. Other problems include the challenge of thinking from the individual versus the collective interest, the difficulties to include less vocal or interested groups.

The policy makers indicate that the results from the Flood Risk Management Plans (FRMP's, which modeled the costs and benefits of different combinations of protective, preparedness and prevention measures) will be used for participatory deliberation. Policy makers argue that funds should be used as optimal as possible. A uniform basic degree of protection is considered to be undesirable, because this might not be cost-effective. However, differentiated levels of protection might be a difficult message to communicate towards land users. Nevertheless, policy makers are in favor of this.

Information plays an important role in this. Therefore, univocal communication towards citizens is important, especially considering the fragmented nature of governmental responsibilities in water policy.

5.6 Conclusion and discussion

5.6.1 Local scale

On the local scale, there is quite some controversy on what good measures are. For example dredging the Dender is the most mentioned solution, but is not believed to be effective by water engineers. Also, people feel abandoned because they cannot see any tangible solutions, and therefore feel like nothing is happening. Nevertheless, policy processes are in motion (although slow) to develop effective solutions (e.g. preparatory studies). There seems to be a need for communication and information dissemination, not only on the risks and potential measures by land users, but also on what the government is planning and implementing and which solutions are effective and feasible.

There is a discrepancy between the type of measures and the time span for action that the land users expect. One the one hand, they want long-term, fail-safe solutions, but expect actions to be quick and reactive in the aftermath of the flood. However, long-term solutions are achieved through long-term processes (from study to implementation). Because of the difficult reconcilability of these two aspects, they feel like they are not heard and their needs are not met.

There is a large reliance on government, especially by residents, but also by farmers. Out of the three types of land users, businesses seem to be the most proactive in dealing with potential flood damages. Farmers and businesses also worry the least about damages. The land users often do not mention source-oriented solutions (e.g. removing sealed land, expropriation), as these are more space consuming and difficult to implement. They want the water problem to be resolved outside of their property, even though this might not be the most efficient. Also the non-land users actors feel like managing flood risks in a governmental responsibility, and therefore have limited willingness to actively contribute to it. Local environmental organizations do however contribute to managing flood risks, although rather by counteracting governmental actions than by active collaboration.

Everyone interviewed explicitly or implicitly agrees that if the government grants building permissions, they must also be responsible for protecting these buildings from water. There also seems to be a general consensus that errors were made in the past when assigning land uses to the floodplains in the 1970s. Although this is probably true to some extent, some problems may also arise from increasing and shifting flood risks. In this context, it is not possible to guarantee that all authorized buildings will be flood-free in the long term and protection is neither technically feasible nor economically sound. The societal actors (except for environmental organization) do not take the increasing risk into account when formulating the problem and potential solutions, although they themselves often experience increasing risks. Also providing information on flood risks is seen as a governmental task. This is contrasted by quite a passive attitude: information-seeking behavior could only be observed in the worst affected areas, and only after floods (reactive), but not when buying a property (proactive).

As can be expected, in the worst affected areas of Geraardsbergen, people are best informed on the risks and most people have taken precautionary measures. Nevertheless, they state that they feel that the government is responsible for protecting them. Their action taking is inspired by frustration and disappointment in the government, rather then the belief in the effectiveness of the measures themselves. Also they don't perceive themselves as being well informed (although they have the most knowledge on flood risks), possibly for the same reason.

5.6.2 Regional scale

The market actors consider the government to be the leading actor in FRM, both directly and indirectly. On the one hand, they decide where and under what conditions permits can be issued, how damages should be compensated and what information should be provided to potential buyers. On the other hand, FRM markets (e.g. individual flood protection) are not developing due to a lack of demand. The respondents believe that governments are the key actor in generating this demand. For example, currently technical knowledge and frameworks for individual flood protection are lacking, impeding its implementation. However, the architects' association believes that the government plays a more crucial role in this than engineers, because the governments set out the conditions for this market.

5.6.3 Policy implications

Changes in policies that affect citizens living in flood-prone areas are a subject to heavy discussion and disagreement. Societal actors often argue that if the government changes its rules, it should also bear the consequences. For example an often-heard argument is that as residents have built in these areas in a legitimate way, they should not pay for any changes in policies. Policy-makers on the other hand stress that changing these rules is necessary under the current conditions. They are thus in favor of more adaptable policy-making, while this might not be accepted by the societal actors. This static view conflicts with the inherently uncertain nature of flood risks.

In this respect, there is often a stark contrast in discourse on the existing developments and new developments. Generally, actors agree that new developments are easier to control through regulations such as the water assessment, the signal areas, etc. It is also more justified to place more responsibility on citizens in terms of for example private protection, insurance premiums, etc. because they are assumed to be properly informed and therefore make well-informed, conscious choices in relation to the flood risk. Therefore, they expect that future flood risks will be easier to manage through better zoning and building restrictions and shared responsibilities. Existing developments on the other hand are harder or even impossible to manage. It is generally believed that they earn more protection, compensation, etc., because they were not informed on the risk and have complied with all regulations.

However, the presumed knowledge that is at the base of this discursive distinction between new and existing developments is always circumstancial and temporarily. Flood risks their selves, but also technical restrictions and cultural conditions that influence the conceptualization of risks, evolve over time. Therefore knowledge is always relative, uncertain and incomplete (Scott et al., 2013; White et al., 2001). Therefore, stark contrast in the reasoning above might in reality not be that stark. Our current knowledge might in the long term also prove to be faulty, and current policies and decisions in the long term just as well run the risk of being considered 'mistakes from the past', much like it is now generally accepted by the majority of stakeholders in FRM that the zoning plans from the 1970s do not sufficiently take flood risks into account.

Furthermore, there is a remarkable tension between the acknowledgement of incremental knowledge on the one side, for which the government cannot be held accountable, and changing the rules - often according to this incremental knowledge -, for which societal actors expect compensation from the government.

In the tendency towards participation, there seems to be a friction between the operating levels of formal and informal FRM. Decision-making in formal FRM is aimed at making comprehensive, integrated decisions based on the global perspective of the water system. Over the last decades, powers in water management have been scaled up, which is believed to be more effective due to the need for expert knowledge on the one hand, and a global perspective on the other. Citizens' and stakeholders' involvement on the other hand takes place at the local level. This is evidenced by the fact that it turns out to be difficult to keep societal actors interested and involved in current participation options within the sub-basin councils and on the regional level. Within the hierarchical policy-making in FRM, there seems to be little room for early, local participation.

6 Towards fruitful co-evolution

6.1 General conclusions from the empirical research

Considering the uncertain and variable nature of the impact of climate change, the limited power for solutions of governments in the current financial and social context and the limits of existing technical protection systems, the government in itself cannot guaranty sufficient resilience. Multiple parties are needed for this and therefore, we need to develop co-evolutionary resilience.

However, the survey and interviews with land users and market actors show that these civic and business actors do not really take flood risks into account and consider the mitigation of flood risks as a governmental task. In the survey, we see a predominantly passive attitude of residents. Also the market actors limit their role to fulfilling their legal obligations, as they currently encounter few problems. Considering the institutional context, it is not surprising that these actors take little initiative. FRM has become an exclusive responsibility of water managers. There are also few incentives and structures to minimize flood risks themselves.

Nevertheless, there are signs of a certain social capital. Citizens play an important role in the dissemination of knowledge on flood risks. Furthermore, residents with flood experience often take measures individually and within their own capacities to manage their risks. So to a certain extent, civic and business actors do take up responsibilities in FRM.

There is thus a certain 'dormant' social capital present that can be addressed to develop more social resilience. The prevailing policy however does not sufficiently appeal to this capital. The current planning system with its rigid land use allocations cannot respond adequately to new or changing knowledge on flood risks and uncertain conditions. Furthermore, the role of spatial planning and civic and business actors within integrated water management seems to be limited, notwithstanding the relative importance of spatial developments in the flooding issue. Currently, FRM generally seems even to be counterproductive for the development of social resilience. Some recent policy initiatives try to active this dormant capital, but so far, few effects are visible.

The main interactions between public actors and civic and business actors are one-way, distorted and incomplete. There is a need for more coordination and dialogue between the societal actors and policy makers. In a co-evolutionary process, policy makers inform societal actors on their knowledge and actions, but societal actors also share their insights and actively collaborate or contribute by taking private measures. Of course, there will always be conflicting interests and opinions on how to solve the problem, but it seems that at the moment the essence of the debate is overshadowed by misconceptions and passive attitudes. From a co-evolutionary perspective, the observed gap between society and flood risk management and the lack of fruitful co-evolution can be overcome by a dynamic, two-way interaction between government and society. In what follows, this co-evolutionary perspective is further elaborated in policy recommendations.

6.2 Key policy issues

The interactions that emerged from the analysis, between land and water actors on the one hand, and between policy actors and civic and business actors on the other, form the two key policy issues for the development of flood resilience.

The interaction between land and water raise questions on the integration of these two systems. The flood issue is still seen as a water problem rather than a land problem. The awareness on flood risks among societal actors therefore is low. The question can also be asked what the function of spatial planning precisely is, especially if we consider that currently, a lot of effort is going into solving problems that have been created in the past, and inevitably will be created again in the future given the changing and uncertain conditions. Although integrated water management has brought important improvements, this remains an important concern. This issue of balancing water and land use demands and the dilemma of flexibility vs. robustness that arises from these interactions is further discussed in the article in Annex 6.

The interaction between governments and societal actors on the other hand raises questions on participation. Currently, participation options are limited. The strong technical approach and the closed communication on flood risks create the impression amongst residents that the government has the flooding under control, or at least it should have, or that citizens are not expected to contribute. This issue of the public-private dived in FRM is further discussed in the article in Annex 7.

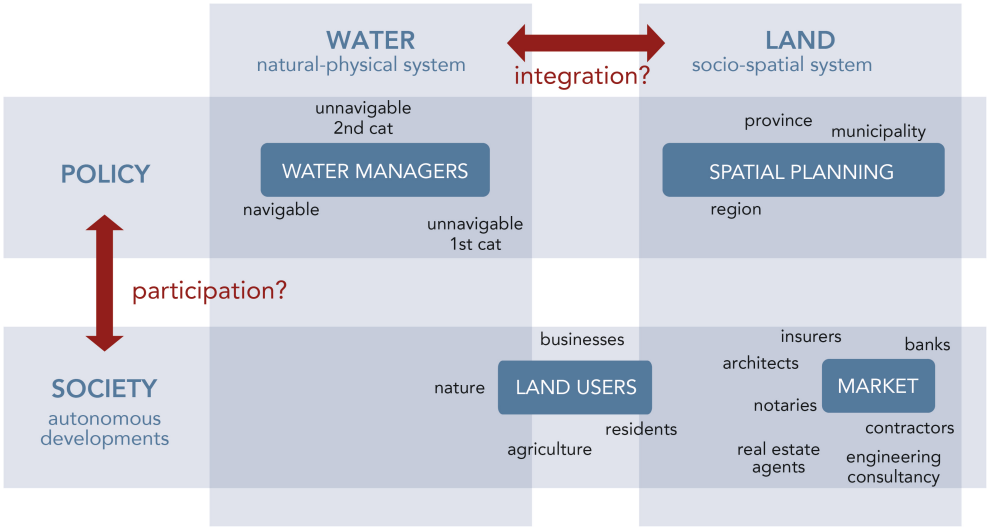

Figure 18. Interactions between different actors in the different sub-systems of FRM and the related policy questions

Addressing these issues requires some fundamental changes in knowledge development and communication. The lack of insights into the situation and position of land users impedes the government to share responsibilities with them. The incorporation of this kind of knowledge is new to formal FRM, and its development will require some time and adjustment. Furthermore, it is important to monitor and evaluate the societal effects and implications of policy choices, both in the short and long run, in order to develop a learning, adaptive system. This requires a more elaborate consideration of the spatial development of flood risks and the effects instruments have on them.

To enable an open discussion on who could and should take up which responsibilities, it is important that the government sufficiently informs societal actors on different aspects of FRM. Although knowledge on the flood risks is

an important condition for citizen involvement, merely informing them on these risks is not sufficient. Also information with regard to the level of protection the government provides, is important to enable an open discussion on responsibilities. Finally, also information is necessary on the actions residents need or can take to protect themselves and what the options enables residents to act on the flood risks.

This communication towards citizens and land users needs to be clear and univocal. Currently, the high degree of fragmentation of powers leads to confusion. An example of this is the variety of available flood risk maps. The differences between the various maps may cause confusion on the flood risks, thus not only questioning the credibility of the content of these maps, but also the need and necessity to take (self-organized) action.

6.2.1 Towards co-evolutionary planning: two complementary, simultaneous strategies

As concluded above, different actors produce FRM, parallel to and in co-evolution with each other. However, under the current conditions, the actions by societal actors are often not concerned with flood risks, and therefore rarely contribute to the overall goals of minimizing flood damages, and in the worst cases even counteract these goals. If we look at policy-making from this co-evolutionary perspective, the role of governments needs to adapt to these changing circumstances too. The policy question that arises from this research, is how we can make the two key interactions mentioned above fruitful and effective, so that the outcomes are not only complementary, but also reinforce each other too towards a greater socio-technical resilience. How can policy enable societal actors to actively and constructively contribute to the management of flood risks? This section discusses two simultaneous and complementary strategies for policy-makers to navigate the interactions between land and water, and between government and society, in order to make them more fruitful and achieve flood resilience through its FRM. This approach is fundamentally different from the existing flood risk management approach, where governmental actors are considered to be the only one performing FRM.

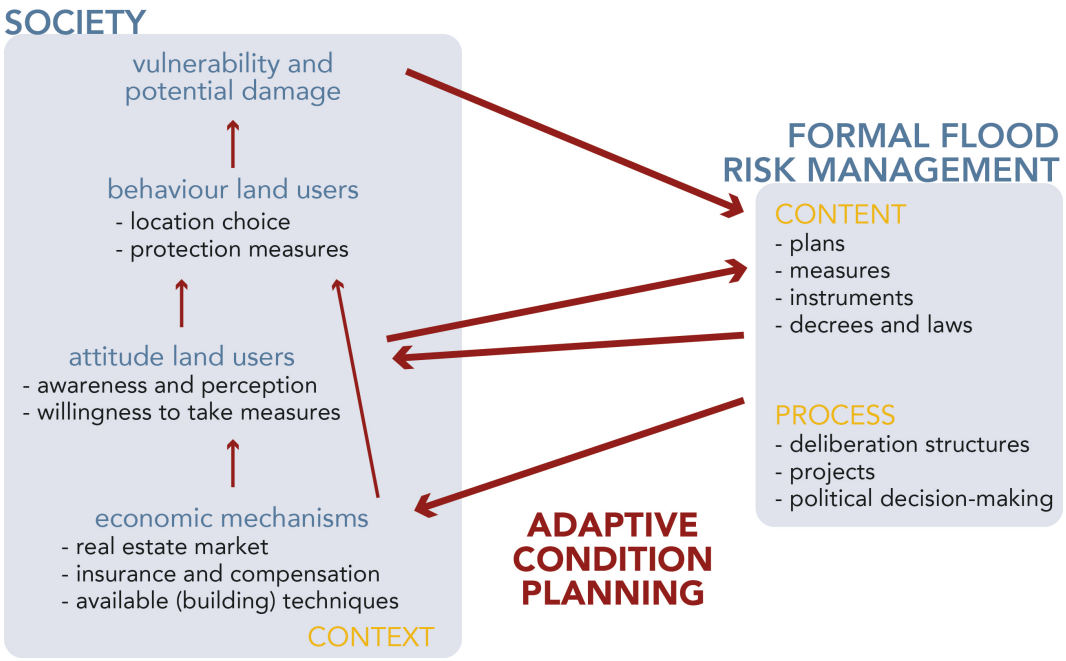

Figure 19. Schematic representation of adaptive condition planning

The first is adaptive condition planning (Figure 19). This strategy is about creating conditions under which societal actors are enabled to take up responsibilities. Through this strategy, non-governmental actors are indirectly

encouraged to contribute to managing flood risks. Currently, a lot of the societal mechanisms that contribute indirectly to the development of flood risks, such as insurance and real estate markets, do not contribute to a diversification of responsibilities. This means moving away from an exclusive restrictive permission-oriented planning, with fixed standards of what can and what cannot be allowed, towards a planning policy that sets sharper conditions under which certain developments are allowed. Furthermore, it also needs to communicate cleary what can and cannot be expected from the government, in order not to give false expectations in relation to the expected increase of flood risks due to for instance climate change. To create these conditions, different (policy) frameworks, such as spatial, environmental, civil engineering, legal and welfare policies, need to mutually reinforce each other. These integrated conditions in spatial planning should be complemented with conditions regarding for example economic mechanisms such as the abolishment of excessive damage compensation regulations and/or the provision of subsidies, information dissemination, the support of the technical development of adaptive building techniques, etc. in order to improve water-space resilience.

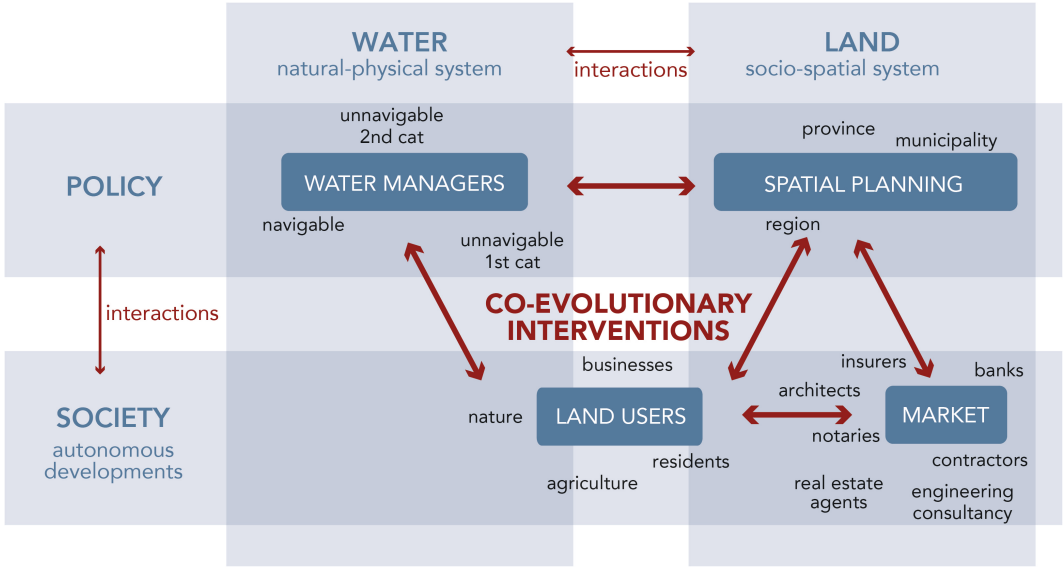

Figure 20. Schematic representation of co-evolutionary interventions

The co-evolutionary interventions are more specifically targeted (Figure 20). This strategy aims to create outposts at hotspots of flood risk areas, where the government situationally in time and place takes up the role of an equal partner with the present civic and business actors, in order to jointly sitmulate improved social resillience through time- and location-specific solutions. Again, it is important to address these various fields of policy and social (self-)organization simultaneously, in order to use the resources (time, money, expertise, social support, etc.) in a mutually reinforcing way. In this situational and circumstantial area-based approach, it is important to start from the local (perception of the) flooding issue and the role and positions that the actors assume. Area-specific knowledge development (such as this research) can be a starting point to bring local actors together, in order to gain attention for the existing and future flood risks in specific situations and start a discussion on more effective en resilient solutions or levels of acceptance in the near future.

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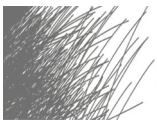
8 Annexes

8.1 Annex 1: Questionnaire survey



Afdeling
Mobiliteit & Ruimtelijke Planning
Universiteit Gent

Enquête **Y5T46**

Bewoners overstromingsgevoelige gebieden

Bedankt voor uw interesse in deze enquête!

De opbouw van de vragenlijst is als volgt:

1. Woning
2. Kennis overstromingsrisico
3. Ervaring met overstromingen
4. Individuele maatregelen
5. Bereidheid om maatregelen te nemen
6. Visie
7. Algemene gegevens

We herinneren u er graag aan dat u de vragenlijst ook kunt invullen via de link http://edison.ugent.be/amrp. De vragenlijst dient uiterlijk tegen **dinsdag 30 september 2014** online ingevuld of per post teruggestuurd te worden.

Instructies:

- Lees de vragen en bijgevoegde commentaren goed.
- Geef één antwoord per vraag, tenzij anders vermeld.
- Bij sommige vragen en antwoorden staat aangeduid dat u vragen mag overslaan. Volg hiervoor de in **rood** aangegeven instructies naast de vraag of het antwoord, bijvoorbeeld **(➔2.5)**. Indien er niets vermeld staat, gaat u gewoon naar de volgende vraag.
- Vul bij elke vraag *iets* in. U hebt altijd de optie om “niet van toepassing”, “geen mening”, “ik weet het niet”, “geen van bovenstaande” of “andere” in te vullen. Een vraag waar niets bij aangeduid is, is ongeldig.

Voor vragen in verband met deze enquête kunt u contact opnemen met Barbara Tempels via barbara.tempels@UGent.be of 09/331 32 60. Ook indien u hulp nodig hebt bij het invullen van de vragenlijst kunt u hier terecht.

Alvast bedankt voor uw medewerking!

1 Woning

1.1 **In welk jaar werd uw woning gebouwd?** _____
Vul een jaartal bij benadering in indien u het niet precies weet.

1.2 **In welk jaar bent u hier komen wonen?** _____
Vul een jaartal bij benadering in indien u het niet precies weet.

1.3 **In wat voor woning woont u?**
- O eengezinswoning (huis) open bebouwing
- O eengezinswoning (huis) halfopen bebouwing
- O eengezinswoning (rijhuis) gesloten bebouwing
- O bungalow (één verdieping)
- O appartement, studio, kamer, loft op gelijkvloers
- O appartement, studio, kamer, loft op bovenverdieping
- O woonwagen, caravan
- O andere: _____

1.4 **Hoeveel slaapkamers heeft uw woning?** _____

1.5 **In welke staat is uw woning?**
- O grondige renovatie nodig
- O lichte renovatie nodig
- O licht verouderd, maar niet direct renovatie nodig
- O modern, woonklaar

1.6 **Bent u eigenaar of huurder?**
O eigenaar.....OF.....O huurder

↓

1.7 **Hebt u een bestaande woning gekocht?**
O ja O nee

1.8 **Hoeveel heeft de aankoop of bouw van uw woning gekost?**
Indien u het niet precies weet, vult u een bedrag bij benadering in.
€ _____
of BEF _____
- O ik heb niet betaald (vb. schenking, erfenis)
- O ik weet het niet of ik wens dit niet mee te delen

↓

1.9 **Wie is de eigenaar van uw woning?**
- O particulier
- O sociale huisvestingsmaatschappij
- O gemeente of OCMW
- O privévennootschap
- O ik weet het niet
- O andere: _____

1.10 **Hoeveel huur betaalt u maandelijks (zonder bijkomende kosten)?**
€ _____
- O ik betaal geen huur
- O ik weet het niet of ik wens dit niet mee te delen

1.11 **Hebt u een brandverzekering die overstromingsschade dekt?**
O ja O nee (➔1.13)

1.12 **Hoeveel bedraagt uw jaarlijkse brandverzekeringspremie?**
- O minder dan € 100
- O tussen € 100 en € 199
- O tussen € 200 en € 299
- O tussen € 300 en € 399
- O tussen € 400 en € 499
- O tussen € 500 en € 599
- O tussen € 600 en € 699
- O tussen € 700 en € 799
- O tussen € 800 en € 899
- O tussen € 900 en € 999
- O tussen € 1000 en € 1249
- O tussen € 1250 en € 1499
- O meer dan € 1500
- O ik weet het niet of ik wens dit niet mee te delen

1.13 **Hoe graag woont u hier?**

helemaal niet graag	eerder niet graag	neutraal	eerder graag	erg graag
O	O	O	O	O

1.14 **Hoe lang bent u van plan hier nog te blijven wonen?**
- O minder dan 1 jaar
- O 1 à 5 jaar
- O 5 à 15 jaar
- O meer dan 15 jaar
- O de rest van mijn leven
- O ik weet het niet

1.15 **In welke mate waren de volgende redenen belangrijk om hier te komen wonen?**
Vul één antwoord per regel in. Indien bepaalde aspecten niet van toepassing zijn (bv. indien uw woning niet in uw geboortestreek gelegen is, niet uw ouderlijke woonst is of niet nabij het water ligt), duidt u voor die regel 'n.v.t.' aan.

	helemaal niet	eerder niet	neutraal	eerder wel	heel erg	n.v.t
vlotte bereikbaarheid	○	○	○	○	○	○
nabijheid van werk	○	○	○	○	○	○
nabijheid van familie/vrienden	○	○	○	○	○	○
nabijheid van voorzieningen (school, hobby's)	○	○	○	○	○	○
geboortestreek	○	○	○	○	○	○
ouderlijke woonst	○	○	○	○	○	○
groene omgeving, natuur	○	○	○	○	○	○
ligging nabij het water	○	○	○	○	○	○
rustige omgeving (geen hinder, veilig, net)	○	○	○	○	○	○
kenmerken van de woning (omvang, type, kwaliteit, comfort)	○	○	○	○	○	○
goedkope grond/woning	○	○	○	○	○	○
goedkoper dan gelijkaardige grond/woningen in de omgeving	○	○	○	○	○	○
andere: _____	○	○	○	○	○	○

1.16 **Duid aan hoe uw woning bouwtechnisch uitgerust is (in relatie tot overstromingen).**
Meerdere antwoorden mogelijk.

- ☐ woning opgehoogd of dijkje/muurtje rond woning
- ☐ waterbuffer voorzien (vb. vijver)
- ☐ vloerniveau woonruimtes op veilige hoogte
- ☐ geen ondergrondse constructies (vb. kelder, tank)
- ☐ fundering op kolommen
- ☐ overstroombare kelder
- ☐ wegneembare schotten voor deuren of ramen
- ☐ buitenmuren waterdicht (vb. waterwerende stenen of bepleistering, coating, voegen en barsten afgedicht)
- ☐ noodstroomgenerator aanwezig
- ☐ terugslagkleppen op waterafvoer, waterdichte en verankerde deksels op putten, stookolietank verankerd
- ☐ geen van bovenstaande
- ☐ andere: _____

2 Kennis overstromingsrisico

In dit deel wordt eerst het huidige overstromingsrisico en uw kennis ervan besproken. Vervolgens komt de kennis van het overstromingsrisico op het moment dat u hier kwam wonen aan bod.

2.1 **Is uw woning volgens u gelegen in overstromingsgevoelig gebied?**
○ ja ○ nee ○ ik weet het niet

2.2 **Hoeveel weet u over het overstromingsrisico van uw woning?**

erg weinig	weinig	veel	heel veel
○	○	○	○

2.3 **Hebt u zelf initiatief genomen om u te informeren over het overstromingsrisico?**
○ ja ○ nee

2.4 **Van wie hebt u informatie verkregen over het overstromingsrisico?**
Meerdere antwoorden mogelijk.

- ☐ verkoper of verhuurder
- ☐ buren
- ☐ vrienden of familie
- ☐ notaris
- ☐ vastgoedmakelaar
- ☐ verzekeraar
- ☐ gemeente (vb. bouwaanvraag)
- ☐ Vlaamse overheid (vb. website)
- ☐ eigen kennis
- ☐ ondervinding of ervaring
- ☐ architect
- ☐ andere: _____

2.5 **Welke van de volgende bronnen hebt u reeds geraadpleegd in verband met overstromingsrisico's?**
Meerdere antwoorden mogelijk.

- ☐ Watertoetskaarten
- ☐ website www.waterinfo.be
- ☐ andere website overheid (VMM, CIW, Vlaams Gewest, gemeente)
- ☐ andere website (geen overheid)
- ☐ bouwaanvraag
- ☐ nieuwsbrief of brochure
- ☐ informeel gesprek
- ☐ infodag
- ☐ geen van bovenstaande
- ☐ andere: _____

2.6 **In welke zone ligt uw woning volgens de Watertoetskaart?**

- ○ ik ken de Watertoetskaart niet
- ○ ik weet het niet
- ○ niet overstromingsgevoelig
- ○ mogelijk overstromingsgevoelig
- ○ effectief overstromingsgevoelig

2.7 **Wanneer denkt u dat de volgende overstroming hier zal plaatsvinden** *(bovenste regel)***, en om de hoeveel jaar denkt u dat overstromingen hier over 40 jaar zullen voorkomen** *(onderste regel)***?**

	< 5 jaar	5 jaar	10 jaar	25 jaar	50 jaar	100 jaar	>100 jaar	ik weet het niet
volgende overstroming	○	○	○	○	○	○	○	○
over 40 jaar	○	○	○	○	○	○	○	○

2.8 **Hoe hoog ten opzichte van het vloerniveau (gelijkvloers) komt het water hier momenteel maximaal bij een overstroming** *(bovenste regel)***, en hoe hoog denkt u dat het water hier over 40 jaar maximaal zal komen** *(onderste regel)***?**

	< 25 cm	25 à 49 cm	50 à 74 cm	75 à 99 cm	100 à 150 cm	> 150 cm	ik weet het niet
momenteel	○	○	○	○	○	○	○
over 40 jaar	○	○	○	○	○	○	○

2.9 **Was u op de hoogte van het overstromingsrisico toen u hier kwam wonen?**

- ○ ja
- ○ nee **(➔2.11)**

2.10 **In welke mate waren de volgende aspecten bepalend om toch voor een woning in overstromingsgevoelig gebied te kiezen?**
Indien bepaalde aspecten niet van toepassing zijn, duidt u 'n.v.t.' aan.

	helemaal niet	eerder niet	neutraal	eerder wel	heel erg	n.v.t.
het risico is laag	○	○	○	○	○	○
ik was me niet echt bewust van het risico	○	○	○	○	○	○
ik dacht dat het risico lager was	○	○	○	○	○	○
de verzekering dekt de schade	○	○	○	○	○	○
goede prijs-kwaliteitverhouding	○	○	○	○	○	○
toen ik hier kwam wonen was het hier nog nooit overstroomd	○	○	○	○	○	○
kenmerken van de woning (omvang, type, kwaliteit, comfort)	○	○	○	○	○	○
ligging van de woning	○	○	○	○	○	○
ik kan geen duurdere grond/woning betalen	○	○	○	○	○	○
andere: _____	○	○	○	○	○	○

(na deze vraag ➔2.12)

2.11 **Wat had u anders gedaan indien u wel op de hoogte was van het overstromingsrisico?**
Meerdere antwoorden mogelijk.

- ☐ aanvullende maatregelen treffen
- ☐ een lagere koop-/huurprijs onderhandelen
- ☐ hier niet komen wonen
- ☐ ik zou niets anders gedaan hebben
- ☐ ik weet het niet
- ☐ andere: _____

2.12 **Denkt u dat uw brandverzekeringspremie hoger is ten gevolge van het overstromingsrisico?**

- ○ ja
- ○ nee
- ○ ik weet het niet

2.13 **Denkt u dat uw woning minder waard is ten gevolge van het overstromingsrisico?**

- ○ ja
- ○ nee **(➔3.1)**
- ○ ik weet het niet **(➔3.1)**

2.14 **Hoeveel minder waard?**

- ○ minder dan 5 % minder
- ○ tussen 5 en 10 % minder
- ○ tussen 10 en 15 % minder
- ○ tussen 15 en 20 % minder
- ○ tussen 20 en 25 % minder
- ○ meer dan 25 % minder
- ○ ik weet het niet

3 Ervaring met overstromingen

3.1 **Hoeveel keer is uw woning, kelder of tuin sinds u hier woont overstroomd?** _____ **('0' ➔ 3.4)**

3.2 **Hierna volgen enkele vragen over de verschillende individuele overstromingen. Vul bovenaan het jaartal in.**
Indien u het jaartal niet precies weet, vult u een jaartal bij benadering in. Indien uw woning meer dan drie maal overstroomde, vult u de drie zwaarste overstromingen in.

jaartal:	_____	_____	_____
Welke delen zijn overstroomd geweest? *Meerdere antwoorden mogelijk.*			
woning (gelijkvloers)	☐	☐	☐
kelder	☐	☐	☐
tuin	☐	☐	☐
water uit de woning gehouden dankzij zandzakjes, dompelpomp enz.	☐	☐	☐
Hoeveel materiële schade was er? (zowel gebouw als inboedel en tuin)			
geen	○	○	○
tussen € 1 en € 999	○	○	○
tussen € 1000 en € 4999	○	○	○
tussen € 5000 en € 9999	○	○	○
tussen € 10.000 en € 49.999	○	○	○
tussen € 50.000 en € 99.999	○	○	○
meer dan € 100.000	○	○	○
ik weet het niet	○	○	○
Wie heeft de schade betaald? *Meerdere antwoorden mogelijk.*			
zelf	☐	☐	☐
brandverzekering	☐	☐	☐
gemeentelijk fonds	☐	☐	☐
Rampenfonds	☐	☐	☐
andere: _____	☐	☐	☐
ik weet het niet	☐	☐	☐

3.3 **In welke mate vond u de volgende aspecten erg bij deze overstroming(en)?**
Indien u bepaalde soorten hinder niet ondergaan hebt, duidt u 'n.v.t.' (niet van toepassing) aan.

	helemaal niet erg	eerder niet erg	neutraal	eerder erg	heel erg	n.v.t.
lichamelijke letsels	○	○	○	○	○	○
evacuatie	○	○	○	○	○	○
ontregeling dagelijks leven	○	○	○	○	○	○
moeilijke bereikbaarheid woning	○	○	○	○	○	○
moeilijke bewoonbaarheid woning	○	○	○	○	○	○
vuil, moeite om op te ruimen	○	○	○	○	○	○
traag verloop herstelling	○	○	○	○	○	○
traag verloop terugbetaling	○	○	○	○	○	○
administratie en onderhandelen met verzekeraars / aannemers	○	○	○	○	○	○
onzekerheid, angst, schok, hulpeloosheid	○	○	○	○	○	○
materieel verlies	○	○	○	○	○	○
financieel verlies	○	○	○	○	○	○
verlies emotioneel waardevolle voorwerpen	○	○	○	○	○	○

3.4 **In welke mate…**	helemaal niet	eerder niet	neutraal	eerder wel	heel erg
hebt u reeds last ondervonden van het overstromingsrisico?	○	○	○	○	○
hebt u angst voor overstromingen?	○	○	○	○	○
maakt u zich zorgen over het overstromingsrisico?	○	○	○	○	○
hebt u spijt van uw keuze om hier te komen wonen?	○	○	○	○	○
voelt u zich in de steek gelaten?	○	○	○	○	○

3.5 **Welke delen van uw woning/perceel zijn voor u er woonde overstroomd geweest?**
Meerdere antwoorden mogelijk.

☐ geen ☐ woning (gelijkvloers) ☐ tuin
☐ ik weet het niet ☐ kelder ☐ onbebouwd perceel

4 Individuele maatregelen

4.1 **Welke maatregelen hebt u genomen om de schade of hinder in geval van overstroming te beperken?**
Meerdere antwoorden mogelijk.

☐ bouwtechnische maatregelen (zoals in vraag 1.16)
☐ waterbestendige inrichting (vb. meubels, vloeren, schrijnwerk, muurbekleding of isolatie)
☐ waardevolle zaken hoger geplaatst of makkelijk verplaatsbaar (vb. elektrische infrastructuur of toestellen, meubels)
☐ zandzakjes of pomp(installatie) aangeschaft
☐ extra verzekering aangeschaft
☐ ingeschreven op een waarschuwingsdienst
☐ aangesloten bij buurtcomité om belangen te verdedigen
☐ ik heb geen maatregelen genomen (➔4.7)
☐ andere: _____

4.2 **Hebt u deze maatregelen individueel of samen met anderen genomen? (vb. groepsaankoop, gemeenschappelijke infrastructuur)**
Indien u zowel individuele als collectieve maatregelen hebt genomen, duidt u beide aan.

☐ individueel ☐ collectief

4.3 **Hoeveel hebben deze maatregelen samen gekost?**

○ niets ○ tussen € 500 en € 999 ○ tussen € 5000 en € 9999
○ tussen € 1 en € 499 ○ tussen € 1000 en € 4999 ○ meer dan € 10.000

4.4 **Wat was/waren de aanleiding(en) om deze maatregel(en) te nemen?**
Meerdere antwoorden mogelijk.

☐ voorbereiding voor een voorspelde overstroming
☐ tijdens een overstroming
☐ hoge schade na overstroming
☐ herstellingswerken na overstroming
☐ nieuwe informatie over overstromingsrisico
☐ nieuwe informatie over maatregelen
☐ subsidie
☐ afsluiten verzekering
☐ verbouwingen (niet gerelateerd aan overstroming)
☐ geen oplossing geboden door de overheid
☐ andere: _____

4.5 **Hebt u sinds deze maatregel(en) reeds een overstroming meegemaakt?**

○ ja ○ nee

4.6 **In welke mate gaat u akkoord met de volgende uitspraken?**

	helemaal niet akkoord	eerder niet akkoord	neutraal	eerder akkoord	volledig akkoord
Ik ben tevreden over de genomen maatregelen.	○	○	○	○	○
Deze maatregelen beschermen mij voldoende tegen overstromingen.	○	○	○	○	○
Ik voel mij sinds deze maatregelen meer op mijn gemak.	○	○	○	○	○

4.7 **Hoeveel weet u over maatregelen die u zelf kunt nemen tegen overstromingsschade?**

erg weinig ○ weinig ○ veel ○ heel veel ○

4.8 **Hebt u zelf initiatief genomen om u te informeren over maatregelen die u zelf kunt nemen tegen overstromingsschade?** ○ ja ○ nee

4.9 **Van wie hebt u informatie verkregen over de maatregelen die u zelf kunt nemen tegen overstromingsschade?**
Meerdere antwoorden mogelijk.

☐ verkoper of verhuurder ☐ notaris ☐ gemeente ☐ aannemer
☐ buren ☐ vastgoedmakelaar ☐ Vlaamse overheid ☐ eigen kennis
☐ vrienden of familie ☐ verzekeraar ☐ architect ☐ media
☐ andere: _____

4.10 **Welke van de volgende bronnen hebt u reeds geraadpleegd in verband met de maatregelen die u zelf kunt nemen tegen overstromingsschade?**
Meerdere antwoorden mogelijk.

☐ brochure 'Overstromingsveilig bouwen en wonen' van de Coördinatiecommissie Integraal Waterbeleid (CIW)
☐ andere brochure of nieuwsbrief
☐ website overheid (VMM, CIW, Vlaamse gewest, gemeente)
☐ andere website (geen overheid)
☐ informeel gesprek
☐ infodag
☐ andere: _____

4.11 **In welke mate zijn de volgende uitspraken voor u van toepassing?**

	helemaal niet	eerder niet	neutraal	eerder wel	heel erg
Ik durf mijn woning niet voor lange tijd te verlaten.	O	O	O	O	O
Ik zou graag per sms geïnformeerd worden over aankomende overstromingen.	O	O	O	O	O
Ik spreek geregeld met mijn buren over de overstromingsproblematiek.	O	O	O	O	O
Ik ben bang voor diefstal tijdens een overstroming.	O	O	O	O	O
Ik wil graag verhuizen.	O	O	O	O	O
Ik verplaats spullen naar boven bij een overstroming.	O	O	O	O	O
Ik controleer geregeld de waterstanden.	O	O	O	O	O

5 Bereidheid om maatregelen te nemen

5.1 **In welke mate bent u bereid om maatregelen te nemen om de schade door overstromingen te beperken onder de volgende voorwaarden?**

	helemaal niet bereid	eerder niet bereid	eerder bereid	volledig bereid
in de huidige situatie	O	O	O	O
mits subsidies van de overheid	O	O	O	O
mits praktische ondersteuning van de overheid (vb. informatie, contacten)	O	O	O	O
indien uw brandverzekeringspremie daalt	O	O	O	O
indien uw belastingen dalen	O	O	O	O
indien u enkel hoeft te betalen (niet zelf uitvoeren)	O	O	O	O
indien de rest van de buurt dat ook doet	O	O	O	O
indien het hier in de toekomst vaker overstroomt	O	O	O	O

5.2 **In welke mate bent u bereid om de volgende maatregelen te nemen?**
Indien bepaalde maatregelen in uw geval niet mogelijk zijn, duidt u 'n.v.t.' (niet van toepassing) aan voor die regel.

	helemaal niet bereid	eerder niet bereid	eerder bereid	volledig bereid	n.v.t.
bouwtechnische maatregelen (zoals in vraag 1.16)	O	O	O	O	O
tuin aanpassen (vb. vijver of dijkje aanleggen)	O	O	O	O	O
extra verzekering aanschaffen	O	O	O	O	O
noodscenario voorbereiden (vb. waardevolle zaken hoger plaatsen, makkelijk verplaatsbare meubels)	O	O	O	O	O
zandzakjes of (dompel)pomp aanschaffen	O	O	O	O	O
inschrijven voor waarschuwingsdienst	O	O	O	O	O
collectieve maatregelen met buurtbewoners	O	O	O	O	O
verhuizen	O	O	O	O	O

5.3 **Hoeveel bent u bereid te betalen voor maatregelen om de schade door overstromingen te beperken?**
Duid één antwoord aan.

O niets
O eenmalig tussen € 1 en € 99
O eenmalig tussen € 100 en € 449
O eenmalig tussen € 500 en € 999
O eenmalig tussen € 1000 en € 4999
O eenmalig meer dan € 5000
O jaarlijks tussen € 1 en € 99
O jaarlijks tussen € 100 en € 249
O jaarlijks tussen € 250 en € 499
O jaarlijks tussen € 500 en € 999
O jaarlijks meer dan € 1000

5.4 **Waaraan zou u dit geld besteden?** _____

_____

_____

5.5 **In welke mate gaat u akkoord met de volgende uitspraken?**

Ik wil niet verhuizen of ben nog niet verhuisd omdat…	helemaal niet akkoord	eerder niet akkoord	neutraal	eerder akkoord	volledig akkoord
ik met het overstromingsrisico kan leven	O	O	O	O	O
het overstromingsrisico te laag is	O	O	O	O	O
ik een emotionele band heb met het huis	O	O	O	O	O
ik opzie tegen de rompslomp van een verhuis	O	O	O	O	O
ik geen gelijkaardige woning in de omgeving vind	O	O	O	O	O
ik financieel verlies zou lijden bij verkoop van de woning	O	O	O	O	O
het hier goedkoop wonen is	O	O	O	O	O
andere: _____	O	O	O	O	O

5.6 **Na hoeveel ernstige overstromingen denkt u dat u zou verhuizen?**

O 1 O 3 O ik zou niet verhuizen omwille van overstromingen
O 2 O meer dan 3

5.7 **In welke mate gaat u akkoord met de volgende uitspraken?**

Ik neem geen maatregelen omdat…	helemaal niet akkoord	eerder niet akkoord	neutraal	eerder akkoord	volledig akkoord	geen mening
ik niet weet wat ik (nog meer) kan doen.	O	O	O	O	O	O
ik betwijfel of de maatregelen goed werken.	O	O	O	O	O	O
ik individueel niets kan doen tegen overstromingen.	O	O	O	O	O	O
het risico te laag is.	O	O	O	O	O	O
ik al veel geïnvesteerd heb in maatregelen.	O	O	O	O	O	O
het mijn verantwoordelijkheid niet is.	O	O	O	O	O	O
de verzekering de schade dekt.	O	O	O	O	O	O
de overstromingsproblematiek beter collectief opgelost kan worden.	O	O	O	O	O	O
de overheid mij moet beschermen.	O	O	O	O	O	O
het de moeite niet is voor zolang ik hier nog ga wonen.	O	O	O	O	O	O
ik te oud ben.	O	O	O	O	O	O
het te veel tijd en moeite kost.	O	O	O	O	O	O
de maatregelen te duur zijn in verhouding met het risico.	O	O	O	O	O	O
ik de maatregelen niet kan betalen.	O	O	O	O	O	O
ik nog niet echt stilgestaan heb bij het overstromingsrisico.	O	O	O	O	O	O

5.8 **In welke mate gaat u akkoord met de volgende uitspraken?**

	helemaal niet akkoord	eerder niet akkoord	neutraal	eerder akkoord	volledig akkoord
Ik ben hier komen wonen, dus ben ik verantwoordelijk om mij te beschermen tegen overstromingen.	O	O	O	O	O
Aangezien de overheid mij de toelating gegeven heeft om hier te komen wonen, moet zij mij beschermen tegen overstromingen.	O	O	O	O	O
Het is mogelijk om zelf maatregelen te treffen om zich te beschermen tegen overstromingen.	O	O	O	O	O
Ik zou verhuizen naar een gelijkaardige woning buiten overstromingsgevoelig gebied mocht het mij geen geld kosten.	O	O	O	O	O
Ik wil graag betrokken zijn bij het zoeken naar oplossingen voor de overstromingsproblematiek.	O	O	O	O	O
Als ik verhuis, zal dat ten minste gedeeltelijk omwille van het overstromingsrisico zijn.	O	O	O	O	O

6 Visie

6.1 **Stel dat de overheid of anderen zouden investeren in overstromingsbeheer in uw wijk, waarin zou dat volgens u moeten gebeuren? Kies maximaal 5 antwoorden.**

- ☐ overstromingsvoorspellingen (korte termijn) communiceren
- ☐ overstromingsrisico (algemeen) communiceren
- ☐ financiële compensatie van schade
- ☐ noodhulp (vb. verhuizen van goederen en personen)
- ☐ financiële ondersteuning van private maatregelen (vb. subsidies)
- ☐ zandzakjes en mobiele dijkjes voorzien
- ☐ woonwijk indijken
- ☐ dijken en stuwen bouwen langs de waterlopen
- ☐ lokaal netwerk van natuurlijke grachten en vijvers aanleggen
- ☐ lokale verharding verminderen
- ☐ verharding bovenstrooms verminderen
- ☐ bestaande infrastructuren overstroombaar maken
- ☐ herlokaliseren (verhuizen en afbreken) van gevoelige infrastructuren (gebouwen enz.)
- ☐ bufferbekkens bovenstrooms aanleggen
- ☐ andere: _____
- ☐ ik weet het niet

6.2 **Op welke manier moeten volgens u overstromingsgevoelige gebieden verder ontwikkelen? Kies maximaal 2 antwoorden.**

- ☐ niet meer bouwen
- ☐ overstromingsbestendig bouwen (vb. op palen, overstroombare woningen)
- ☐ normale ontwikkelingen toelaten mits de ontwikkelaar of bouwheer geïnformeerd wordt en de volledige verantwoordelijkheid voor schade neemt
- ☐ enkel functies toelaten die compatibel zijn met overstromingen (vb. watergebonden landbouw)
- ☐ normale ontwikkelingen toelaten en die beschermen tegen het water
- ☐ andere: _____
- ☐ ik weet het niet

6.3 **Vindt u dat de volgende partijen voldoende doen in de overstromingskwestie?**

	helemaal niet	eerder niet	neutraal	eerder wel	zeker wel	ik weet het niet
uzelf	O	O	O	O	O	O
verkoper/verhuurder	O	O	O	O	O	O
buren	O	O	O	O	O	O
notaris	O	O	O	O	O	O
vastgoedmakelaar	O	O	O	O	O	O
verzekeraar	O	O	O	O	O	O
gemeente	O	O	O	O	O	O
Vlaamse overheid	O	O	O	O	O	O
architect	O	O	O	O	O	O
aannemer	O	O	O	O	O	O

6.4 **Wat zouden ze volgens u moeten doen of gedaan hebben?** _____

_____

_____

6.5 **In welke mate denkt u dat de volgende partijen…**

	verantwoordelijk zijn voor de bestaande overstromingsproblematiek?					**u kunnen helpen bij het oplossen van de overstromingsproblematiek?**				
	helemaal niet	eerder niet	neutraal	eerder wel	heel erg	helemaal niet	eerder niet	neutraal	eerder wel	heel erg
bewoners	O	O	O	O	O	O	O	O	O	O
notarissen	O	O	O	O	O	O	O	O	O	O
vastgoedmakelaars	O	O	O	O	O	O	O	O	O	O
verzekeraars	O	O	O	O	O	O	O	O	O	O
gemeente	O	O	O	O	O	O	O	O	O	O
Vlaamse overheid	O	O	O	O	O	O	O	O	O	O
architecten	O	O	O	O	O	O	O	O	O	O
aannemers	O	O	O	O	O	O	O	O	O	O

7 Algemene gegevens

7.1 **U bent een…** ○ man ○ vrouw

7.2 **In welk jaar bent u geboren?** _____

7.3 **Hoeveel personen (buiten uzelf) wonen er op dit adres?**

_____ partner
_____ kind(eren)
_____ ouder(s)
_____ ander(e) familielid/-leden
_____ andere(n)

	ja	nee
7.4 **Hebt u een niet-Belgische nationaliteit?**	○	○
Hebt u ooit een niet-Belgische nationaliteit gehad?	○	○
Heeft een van uw ouders ooit een niet-Belgische nationaliteit gehad?	○	○

7.5 **Wat is uw hoogst behaalde diploma?**

○ geen diploma
○ lagere school
○ middelbare school
○ bachelor / graduaat / A1
○ master / licentiaat
○ doctoraat

7.6 **Wat is het totale maandelijkse netto-inkomen van uw huishouden?**

Hieronder vallen beroepsinkomsten (werknemersbezoldiging, vervangingsinkomsten, pensioen enz.), inkomsten uit onroerende goeden (kadastraal inkomen, huur) en diverse inkomsten (kinderbijslag, alimentatie enz.).

○ minder dan € 1000
○ tussen € 1000 en € 1999
○ tussen € 2000 en € 2999
○ tussen € 3000 en € 3999
○ tussen € 4000 en € 4999
○ tussen € 5000 en € 7499
○ tussen € 7500 en € 9999
○ meer dan € 10.000
○ ik weet het niet of wens dit niet mee te delen

7.7 **Wat is uw beroep?**

○ zelfstandige
○ arbeider
○ bediende
○ ambtenaar
○ huisman/-vrouw
○ student
○ werkzoekende
○ gepensioneerd
○ beroepsonbekwaam

Bedankt voor uw tijd en medewerking!

Indien u nog opmerkingen, bedenkingen of andere ideeën hebt in verband met deze enquête of de overstromingsproblematiek, kunt u deze hieronder kwijt.

_____
_____
_____
_____
_____
_____

Bent u bereid om een aanvullend gesprek te hebben over de overstromingsproblematiek? Vul dan hier uw contactgegevens in! Het gesprek zal tussen de 30 en 60 minuten duren.

naam: _____
adres: _____
e-mailadres: _____
telefoonnummer: _____

8.2 Annex 2: Statistical analysis of the survey results

p	knowledge			
	risk awareness (2.1)	initiative knowledge flood risk (2.3)	risk awareness at location choice (2.9)	initiative knowledge measures (4.8)
age of the residence (1.1)	0,084	0,152	0,419	0,312
length of residence (1.2)	0,647	0,336	0,184	0,005**
state of the residence (1.5)	0,522	0,427	0,652	0,132
ownerships (1.6)	0,864	0,521	0,097	0,242
age (7.2)	0,620	0,457	0,046*	0,090
income (7.6)	0,406	0,151	0,893	0,274
number of floods experienced (3.1)	0,001**	0,941	0,385	0,000**
flood experience (3.1-2)	0,007**	0,799	0,368	0,000**
risk awareness (2.1)	/	0,029*	0,430	0,162
knowledge risk (2.2)	0,190	0,000**	0,000**	0,000**
risk awareness at location choice (2.9)	0,430	0,028*	/	0,835
knowledge measures (4.7)	0,243	0,000**	0,007**	0,000**
suffering (3.4a)	0,000**	0,046*	0,529	0,000**
fear (3.4b)	0,000**	0,725	0,031*	0,003**
worrying (3.4c)	0,000**	0,321	0,227	0,000**
pleasure of living (1.13)	0,710	0,007**	0,321	0,889
intended length of residence (1.14)	0,696	0,340	0,561	0,314
regret (3.4d)	0,002**	0,617	0,016*	0,001**
desire to move (4.11e)	0,121	0,390	0,033*	0,018*
responsible: residents (6.5a1)	0,201	0,052	0,006**	0,996
responsible: government (6.5a6)	0,325	0,472	0,023*	0,594
solution: residents (6.5b1)	0,932	0,005**	0,007**	0,527
solution: Flemish government (6.5b6)	0,001**	0,086	0,766	0,775
taking measures (4.1)	0,000**	0,039*	0,300	0,000**
willingness to take measures (5.1a)	0,106	0,010*	0,145	0,002**

Table 7. Mann-Whitney tests for dichotomuous variables

r_S	knowledge		perceptions and experience			location choice and willingness to move					
	knowledge risk (2.2)	knowledge measures (4.7)	suffering (3.4a)	fear (3.4b)	worrying (3.4c)	pleasure of living (1.13)	intended length of residence (1.14)	regret (3.4d)	desire to move (4.11e)	willingness to move (5.2h)	number of floods before moving (5.6)
age of the residence (1.1)	0,019	0,091	0,283**	0,223**	0,199**	-0,045	0,116	0,130	0,115	-0,082	0,207**
length of residence (1.2)	0,161*	0,163*	0,219**	0,199**	0,117	-0,070	0,333**	0,082	-0,025	-0,188*	0,276**
state of the residence (1.5)	-0,025	-0,110	-0,257**	-0,191*	-0,137	0,217**	-0,059	-0,224**	-0,168*	-0,081	-0,062
ownership (1.6)	0,249**	0,233**	0,094	0,094	0,031	0,062	0,320**	0,115	-0,077	-0,210*	-0,021
age (7.2)	0,093	0,110	0,034	0,104	-0,021	-0,125	0,328**	-0,006	-0,060	-0,211*	0,237**
income (7.6)	0,094	0,036	0,090	-0,016	0,064	0,203*	-0,115	0,042	-0,077	-0,163	-0,116
number of flood experienced (3.1)	0,157*	0,255**	0,591**	0,423**	0,396**	-0,131	0,084	0,424**	0,206**	0,054	0,310**
flood experience (3.1-2)	0,125	0,253**	0,612**	0,446**	0,434**	-0,142	0,057	0,494**	0,271**	0,060	0,248**
risk awareness (2.1)	0,107	0,098	0,433**	0,298**	0,306**	0,030	-0,034	0,259**	0,130	0,103	0,037
knowledge risk (2.2)	/	0,508**	0,253**	0,048	0,072	0,175*	0,239**	0,024	-0,067	-0,156	0,220**
knowledge measures (4.7)		/	0,324**	0,089	0,131	0,105	0,168*	0,050	0,050	-0,131	0,306**
suffering (3.4a)			/	0,370**	0,682**	-0,030	0,049	0,547**	0,224**	0,097	0,266**
fear (3.4b)				/	0,864**	-0,199**	0,027	0,658**	0,374**	0,285**	-0,042
worrying (3.4c)					/	-0,160*	-0,034	0,664*	0,367**	0,294**	0,002
pleasure of living (1.13)						/	0,370**	-0,382**	-0,390**	-0,353**	0,188*
intended length of residence (1.14)							/	-0,113	-0,355**	-0,501**	0,217*
regret (3.4d)								/	0,558**	0,375**	-0,140

Table 8. Spearman's rank tests for two variables, for the topics knowledge, perception and experience, location choice and willingness to move

r_S	sense of responsibility					protective measures		
	responsible: residents (6.5a1)	solution: residents (6.5b1)	voldoende doen: uzelf (6.3a)	doing enough: neighbors (6.3c)	doing enough: Flemish govern-ment (6.3h)	willingness to take measures (5.1a)	maatregelen nemen (4.1)	investering in maatregelen (4.3)
age of the residence (1.1)	-0,032	-0,025	0,161	0,090	-0,048	0,151	0,268**	-0,052
length of residence (1.2)	0,087	-0,089	0,237**	-0,002	0,088	0,087	0,341**	-0,040
state of the residence (1.5)	-0,055	-0,079	0,128	-0,004	0,081	-0,070	-0,211**	-0,040
ownership (1.6)	0,030	0,021	-0,185*	-0,114	0,018	0,065	0,273**	0,147
age (7.2)	0,080	-0,150	0,154	-0,025	0,066	0,065	0,075	0,035
income (7.6)	-0,043	0,106	-0,054	-0,050	0,047	0,105	0,704	0,210
number of floods experienced (3.1)	-0,142	-0,016	0,407**	0,294**	-0,113	0,289**	0,542**	0,101
flood experience (3.1-2)	-0,107	0,038	0,444**	0,258**	-0,188*	0,330**	0,627**	0,308**
risk awareness (2.1)	-0,144	-0,008	0,056	0,148	-0,039	0,142	0,356**	-0,117
knowledge risk (2.2)	0,229**	0,175*	0,212*	0,061	0,047	0,031	0,216**	0,126
knowledge measures (4.7)	0,190*	0,299**	0,311**	0,245**	0,130	0,268**	0,310**	0,288**
suffering (3.4a)	-0,019	0,095	0,332**	0,343**	-0,156	0,381**	0,574**	0,133
fear (3.4b)	-0,047	0,044	0,205*	0,182	-0,254**	0,325**	0,504**	0,004
worrying (3.4c)	-0,005	0,118	0,218**	0,263**	-0,237**	0,385**	0,520**	-0,043
pleasure of living (1.13)	0,149	0,109	0,045	0,170	0,104	-0,023	0,157*	0,297**
intended length of residence (1.14)	0,111	0,043	0,234**	0,079	0,205*	0,152	0,093	0,152
regret (3.4d)	0,165*	0,052	0,190*	0,108	-0,294**	0,263**	0,434**	-0,058

Table 9. Spearman's rank tests for two variables, for the topics sense of responsibility and protective measures

8.3 Annex 3: Overview of interviews

a. Chapter 3: governmental actors (6)

organization	interviewee	date
Ruimte Vlaanderen	Robin De Smedt	30/10/2012, 06/05/2015
VMM	John Emery	27/09/2013
province of Oost-Vlaanderen	Patrick Wohlmutter en Reinout Debergh	11/09/2013
Aquafin	Kristoff Derveaux	21/11/2014
municipality of Geraardsbergen, sustainability official	Liesbet Van de Casteele	06/02/2014
municipality of Geraardsbergen, major	Guido De Padt	11/05/2015

b. Chapter 5: societal actors Geraardsbergen (16)

organization	interviewee	date
Natuurpunt	Johan Vander Heyden	04/2014
Jippy's (clothing store)	Serge Van Der Poorten	04/2014
Coessens NV	Luc Coessens	04/2014
tavern Loeist	P. De Grauwe	04/2014
farmer	Herman van Melckebeke	04/2014
farmer	Roland Vekeman	04/2014
citizens committee Majoor van Lierdelaan	Debby Hulshoff	04/2014
citizens committee Majoor van Lierdelaan	Julien Van Den Bremt	04/2014
citizens committee Majoor van Lierdelaan	Rurik Van Landuyt	16/04/2014
village council Zandbergen	Hans Desmet	04/2014
resident near flood-prone area	familie Van Wichelen	29/04/2014
resident near flood-prone area	Kirst Van der Mijnsbrugge en Tine Ongenaede	04/2014
foundation Omer Wattez	Lode De Beck	04/2014
KBC insurance	Filip Arents	04/2014
CasaVista real estate & insurnaces	Cedric Vanden Bossche	04/2014
Leiegoed real estate	Luc Peerlinck	04/2014

c. Chapter 5: societal actors Flanders (6)

organization	interviewee	date
Boerenbond	Saartje Degelin en Leen Franchois	13/05/2015
Assuralia	Bernard Desmet	18/05/2015
Natuurpunt	Wim Van Gils	1/07/2015
NAV (water consultant)	Julie Alboort	30/07/2015
Vlaamse Confederatie Bouw	Nicola Loxham en Marc Dillen	05/08/2015
CIB Vlaanderen	Pieter Decelle	1/12/2015

8.4 Annex 4: Questionaire for the semi-structured interviews with Flemish stakeholders

a. Role of the organization

1. What is the role of your organisation in FRM?
2. With which actors does your organisation have most contact about flood risks?
3. Who is for your organization the most important partner in FRM?
4. Are you involved in policy processes in FRM? Or non-governmental FRM processes?
5. Do you take initiatives in FRM?
6. What are for your organization the main challenges in FRM?

b. Role of their profession

7. Which responsibility does your profession have in relation to flood risks and damages? How do you see this evolve in the future?
8. Did your profession ever encounter problems related to flood risks and damages? (i.r.t. liability, etc.)

c. Future developments

9. If you could change one thing in the flooding issue, what would it be?
10. Can your profession or assication help to find a solution for FRM? Under which conditions? How can this be stimulated?
11. Do you think that your organization should do more in FRM? Why?

8.5 Annex 5: Participants and discussion statements used for the focus group

8.5.1 Participants

institution	name	discussion group
Ruimte Vlaanderen	Robin Desmet	2. participation - Geraardsbergen
	Bien Weytens	1. responsibility - Liedekerke/Denderleeuw
VMM	Sven Verbeke	2. participation - Geraardsbergen
	Bram Vogels	1. responsibility - Liedekerke/Denderleeuw
	Annelies Huyck	3. financing - Aalst
	Johan Schuermans	2. participation - Geraardsbergen
	Kris Cauwenberghs	3. financing - Aalst
	Kristof Decoene	1. responsibility - Liedekerke/Denderleeuw
W&Z	Micheline Gruwé	2. participation - Geraardsbergen
stad Geraardsbergen	Guido De Padt	2. participation - Geraardsbergen
Liedekerke	Pascal De Geijnst	1. responsibility - Liedekerke/Denderleeuw
provincie Oost-Vlaanderen	Boris Snauwaert	3. financing - Aalst
Boerenbond	Leen Franchois	2. participation - Geraardsbergen
	Johan Sanders	3. financing - Aalst
Vlaamse Confederatie Bouw	Gert Huybrechts	3. financing - Aalst
Natuurpunt	Wim Van Gils	1. responsibility - Liedekerke/Denderleeuw
Waterbouwkundig Labo	Fernando Pereira	3. financing - Aalst
NAV	Julie Alboort	1. responsibility - Liedekerke/Denderleeuw
Uniiversiteit Antwerpen	Hannelore Mees	2. participation - Geraardsbergen

8.5.2 Statements for discussion

a. Responsibility

1. Users of flood-prone areas should protect themselves against flooding,
   a. both implementing and funding measures
   b. irrespective of whether they are/were aware of the flood risk

2. Protection measures (such as the construction of dikes or FCAs) should only be made possible if has been proved that there is a sufficient water buffering and infiltration.

3. The compensation of flood damages (by the firue insurance and the disaster fund) should depend on the compliance with the conditions of the water assessment.

b. Participation

4. If users of flood-prone areas are expected to take up more responsibilities in FRM, they should also be more closely involved in both the decision-making and implementation in formal FRM.

5. It should be decided on a local level how funds for FRM are used. (partiicpatory budgetting)
   a. by residents/land users
   b. by local governments

6. Users should not only be actively informed on the precise level of protection the government offers them; this level of protection should be established in deliberation with these users.

c. Financing

7. The fire insurance should take into account the effective risk in the calculation of the premium,
   a. taking into account the individual measures taken.

8. In areas that flood frequently, the land use allocation 'residental zone' should be deleted from the zoning plans. Land oners in flood-prone areas have no right to compensation if the land use allocation of their land changes.

9. The government is not responsible for the legal uncertainty due to the updates of the Water Assessment and federal risk maps.
   a. houses that suddenly are located in a flood-prone area
   b. houses that are no longer located in a flood-prone areas

8.6 Annex 6: article "A co-evolving frontier between land and water: dilemmas of flexibility versus robustness in flood risk management"

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A co-evolving frontier between land and water: dilemmas of flexibility versus robustness in flood risk management

Barbara Tempels[a]* and Thomas Hartmann[b]

[a]*Centre for Mobility and Spatial Planning, Ghent University, Ghent, Belgium;* [b]*Department of Human Geography & Regional Planning, Utrecht University, Utrecht, the Netherlands*

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Floods cause enormous damage on land and thus question the boundary between land and water in an extreme way. As floods increase in frequency and intensity, flood risk management must change from a resistance-based approach to a resilience approach. Whereas land uses require robust boundaries between land and water, the changing water system demands more flexible boundaries. This contribution discusses this tension from a theoretical perspective of resilience and co-evolution, using a socio-ecological systems approach. This offers a new perspective on the co-evolving frontier between land and water.

Keywords: flood management; flexibility; robustness; resilience; co-evolution

Introduction

River floods are among the most prominent, urgent and devastating consequences of climate change that one can experience in Europe. Climate change will increase both their intensity and likelihood in future (IPCC, 2014). This will affect urban areas in particular, because they are often located close to rivers or coastlines, thereby exposing valuable and vulnerable land uses to floods.

Traditionally, floods have been controlled with technical infrastructures (i.e. dikes and dams) (Patt & Juepner, 2013). Despite major investments in such flood protection measures (Loucks et al., 2008), the annual damage increased over the past decades (Munich Re, 2010), suggesting that this approach might no longer effectively reduce flood risks. Urban developments in floodplains contribute to the problem in two ways: first, space for the rivers shrinks and water levels increase downstream; and second, most settlements are not adapted to inundations, exposing people and assets to floods (Hartmann, 2011b; Patt & Juepner, 2013; Petrow et al., 2006). If no other approach to flood risk management is chosen, this entrenches a lock-in situation in technical flood protection approaches because existing settlements can hardly be removed (Hartmann, 2011a).

In fact, in recent decades, new approaches in dealing with floods have been discussed in the literature and in practice. Flood policy is shifting from the rather robust defence against floods towards a more flexible and adaptive flood risk management (Hartmann & Juepner, 2014; Patt & Juepner, 2013). This shift questions established physical and governance boundaries between land and water. Whereas traditional approaches promote

*Corresponding author. Email: barbara.tempels@ugent.be

robust boundaries between dry and wet land, adaptive approaches introduce a fluid frontier between the two.

The more flexible flood risk management approach conflicts with the robustness of existing spatial structures and land-use rights. This tension is an important reason why more flexible and adaptive approaches are not yet standard practice. However, insights are lacking on how to balance the simultaneous but conflicting needs for flexibility and robustness of this boundary.

This paper identifies key questions of the dilemma of flexibility versus robustness in flood risk management. It therefore sets an agenda for future research. The tension between flexibility and robustness is discussed from a theoretical perspective. This discussion is supported by general observations and examples from flood risk management practice, derived from previous work by the authors and the literature (Hartmann, 2011a; Tempels, 2013). Using a socio-ecological systems approach, a new perspective on the frontier between land and water is developed, based on resilience and co-evolutions between land and water. By reframing the issue in a complex adaptive systems approach of co-evolution between water and land, the governance of flood risks can become more effective.

From flood protection to flood risk management

In principle, floods can be approached with two different concepts: increasing the robustness, or accepting the risk and adapting to it (flexibility). The first usually requires modelling and prediction, technical flood protection measures such as dikes, and strong water management institutions with technical skills. The latter depends on comprehensive and integrative concepts, encompassing many stakeholders and asking for collaboration at various levels. Adaptability does not mean just amending the city, thus enabling the existing urban structure to remain the same. Rather, adaptive cities will become transformed by (the threat of) flood events.

Flood protection

Since the beginning of industrialization, flood protection has been the dominant approach in most European countries. It is based on the assumption that floods are predictable, with a more or less constant trend in the flooding frequency. Subsequently they may be constrained through engineered solutions (Fleming, 2002; Johnson & Priest, 2008; Patt & Juepner, 2013) and floodplains can be made available for all kinds of land uses (Hartmann, 2011b; Loucks, 2000). In this approach, emphasis is on absorbing shocks, limiting short-time damage, performing a speedy recovery back to the same functions. The goal is to preserve existing developments by defending against the water and enforcing a strong boundary between land and water (Hartmann, 2009).

The advantage of flood protection is that it enables constant conditions for settlements behind the dikes, and therefore facilitates using (protected) land efficiently without making compromises because of a flood risk. Resistance is easier to live with in everyday life. It enables easier decision-making for land-use planners and clear division of responsibilities between water management and spatial planning (Hartmann & Driessen, 2014).

Flood risk management

In contrast to flood protection, flood risk management does not mean the quest for fail-safe options to prevent flooding. It rather assumes that flood risks vary and calamities will

happen. Flood risk management asks for adaptations of vulnerable objects in order to minimize the consequences of floods, but at the same time it allows some flooding (Vis et al., 2003). This vulnerability encompasses not only (infra)structural aspects, but also social aspects such as adaptive capacities, which determine communities' ability to cope with flooding. Examples for physically resilient structures include floating homes (Pierdolla, 2008) and adapted interiors for houses (e.g. not putting electrical installations in the basement), but also escape routes for evacuations or calamity polders (Internationale Kommission zum Schutz des Rheins (IKSR), 2002), and even, in some cases, abandoning certain areas (McLeman & Smit, 2006).

In addition to adjustments and restructuring of physical structures, also the socio-economic and political setting of flooding needs to be examined. Adaptive capacities are a result of several social, economic, technological, knowledge-related, institutional and cultural mechanisms (Brouwer et al., 2007). However, these mechanisms and their interactions are very complex, making increasing adaptive capacities less straightforward. It involves financial recovery capacity, insurance schemes (Berke & Campanella, 2006; Clark, 1998), liability issues, availability of information, etc.

These examples show that resilience comes with costs for adaptation and compromises for land uses. In addition, it challenges existing institutions and well-entrenched modes of governance (van den Brink, 2009).

The list of examples also reveals that centralized governmental institutions such as water management agencies can hardly implement flood risk management on their own. Flood risk management asks for the compliance and cooperation of not only many different institutions, but also of public and private stakeholders (Loucks et al., 2008). So, not only does flood risk management require a fundamental rethinking of existing working paradigms within water management agencies, but also this shift of paradigms needs to be supported and sustained by various stakeholders with sometimes competing interests: public and private actors, comprehensive and sectoral planning, central and decentralized structures. A new mode of governance that balances these issues of flexibility and robustness is needed. Before discussing the relevant questions, we need to elaborate where the needs for flexibility and robustness are coming from.

Flexibility versus robustness

The turn from flood protection to flood risk management is triggered by a need for flexibility due to changing conditions. But where does this need for flexibility and robustness come from? In what follows, the context that shapes these simultaneous but contrasting needs is drawn.

The need for flexibility

The water system is influenced by complex natural–physical components (Patt & Juepner, 2013). For example, the exact occurrence and intensity of climate extremes is unpredictable in the long-term, as the climate is inherently variable. Moreover, the climate seems to be changing towards an increasing intensity and frequency of flooding (IPCC, 2014).

Additionally, human interventions induce (intentional or unintentional) alterations to the water system. Technical infrastructures such as dikes and dams, upstream activities, and also land uses in the catchment have considerable impacts on the water system. Particularly in urban areas of developed countries, the multiple and intense land-use activities in catchments make the prediction and management of the water system more

challenging and complex. For example, the urbanization of floodplains takes up space for the rivers and also increases discharge of rainwater due to sealed surfaces. Urbanization also creates local heat islands with their own microclimate, making the flood forecast more difficult.

But also social aspects of flood management are subject to long-term change. Considering multiple actors (water managers, politicians, residents, etc.) leads to relational uncertainty (Brugnach et al., 2008). This type of uncertainty emerges from the parallel and equivalent existence of multiple knowledge frames. Different actors understand the issue differently, hold different values and beliefs and therefore have different judgments about the potential actions or interventions. Therefore, decision-making is characterized by uncertainty regarding the outcome of the decision (Tompkins & Adger, 2004).

All these elements are associated with a range of uncertainties (Dessai & van der Sluijs, 2007) and complexities that cannot be mitigated through modelling or further research, as they are inherently unpredictable. Therefore, 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 risk require more flexible schemes to be incorporated into decision processes and management choices.

However, there are some clear disadvantages and discomforts to more adaptable approaches, such as physical constraints to remove built structures or high costs (monetary compensations) and social difficulties (issues of justice, legal certainty and liability) when changing land-use allocations. Nevertheless, there is no adequate alternative: facing increasing floods and continuing urban developments in flood-prone areas, traditional approaches to floods fail, and flexibility is becoming an essential component of future flood risk management.

The demand for robustness

An important argument for traditional flood protection is that it provides a robust setting for all kinds of activities behind dikes. This goes back to the pioneers of water engineering (Nisipeanu, 2008). Building a dike along a river essentially increases the value of property rights behind the dike, because the land becomes attractive for building activities. Spatial planning decisions in those areas are based on the assumption that a certain piece of land remains physically consistent over a long period of time. Changing such a designation is rather difficult (as discussed above). Needham and Hartmann (2012) conclude that property rights are inevitable but also desirable: they are inevitable because whenever a spatial plan or a planning measure specifies how a particular plot of land may or may not be used, it is socially constructing and assigning property rights through the law; they are desirable because property rights make planning decisions robust. So, robust planning decisions are essential for the functioning of society – the whole system of property rights, and thus economic investment, builds on reliable and robust spatial planning decisions.

However, contemporary planning theory often criticizes such property-oriented spatial planning as being too inflexible to cope with uncertainties and wicked situations (Bertolini, 2010; Hartmann et al., 2012a). Planning thus creates lock-in situations. A spatial allocation and distribution of goods that might have been desirable at one time can become inconvenient or even dangerous, as seen in the case of riparian urban development and increasing floods. Moreover, planning theory asserts that ‘in the everyday world of spatial planning practice, planners are more likely to rely on intuition or practical

wisdom' (Hillier, 2010, p. 11). To some extent, planners guess (Paterson, 2007) and experiment (Bertolini, 2010; Hillier, 2010) with space. However, abandoning robust spatial planning decisions and changing towards a system based entirely on flexibility is also not an option. The robustness of spatial planning decisions is and remains an essential element for the functioning of our society.

The concept of resilience: balancing flexibility and robustness

So on the one hand there is a need for robustness within planning, while on the other hand there is also a need for flexibility emanating from changing flood risks. Both claims are legitimate (Needham & Hartmann, 2012), and both the approaches have advantages and disadvantages (Table 1). Therefore, it is not a question of choosing one above the other; rather, the question is how to accommodate both needs. Therefore, a new balance between flexibility and robustness needs to be found to govern land and water effectively in urban areas. The rest of this paper addresses this balance by discussing the resilience approach and the co-evolutionary interactions between flood risk management and society.

Resilience is often discussed as a new flood management approach (Begum et al., 2007; Bruijn, 2005; Petrow et al., 2006; Roth & Warner, 2007). Although resilience is best known as an advocate for more flexible approaches, the concept also stresses the

Table 1. Flood protection and flood risk management.

	Flood protection (robustness)	Flood risk management (flexibility)
Perception of flooding	Floods are predictable, with a more or less constant trend in flooding frequency	Flood risks vary and are unpredictable
Perception of damage	Quest for fail-safe options	Calamities will happen
Goal	Preservation oriented	Allow for reorganization and development, enable the system to adapt to changing conditions
Means	Defending against the water and enforcing a strong boundary between land and water	Adaptation of vulnerable objects to minimize the consequences of floods, but also allows some flooding
Advantages	Constant conditions: • Facilitates using (protected) land efficiently without compromises • Easier decision-making for land-use planners • Clear division of responsibilities between water management and spatial planning	Deals better with uncertainty and associated complexity with respect to changes in the physical and social components of flood risk
Disadvantages	Too inflexible to cope with uncertainties and change May create lock-in	Costs for adaptation and compensation Compromises for land uses Issues of justice, legal certainty and liability Challenges existing institutions and well-entrenched modes of governance Compliance and cooperation of not only many different institutions, but also of public and private stakeholders

need to balance robustness and flexibility. On a very basic level, resilience describes the ability of a system to absorb disturbances (shocks); so it means that cities are, one way or another, able to absorb the negative consequences of flooding. In this view, it advocates a more flexible approach as a response to the changing conditions in flood risks (e.g. climate change and socio-economic developments), while retaining some robustness. In fact, earlier conceptualizations of resilience (i.e. engineering and ecological resilience) mainly focused on maintaining stability and being persistent or robust within certain boundaries against disturbances. However, more recent interpretations challenge this equilibristic view (Davoudi et al., 2012). Based on coupled socio-ecological systems, the importance of renewing, regenerating, and reorganizing following a disturbance is emphasised. In other words, the resilience concept encompasses both being persistent or robust (robustness), and at the same time being able to renew, regenerate and reorganize (flexibility).

Nevertheless, focus in practice has been more on bouncing back and short-term damage reduction (robustness), and less on the capacity for reorganization and development (flexibility) (Folke, 2006). To overcome this, Davoudi et al. (2012) propose an evolutionary approach where long-term change is necessary in the face of changing conditions. Resilience is then 'not conceived of as a return to normality, but rather as the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains' (p. 302).

But how does the concept of resilience add understanding to how to deal with the tension between flexibility and robustness in flood risk management? The theory of resilience is based on socio-ecological systems. The idea that social and ecological systems develop in co-evolution with each other can add some perspective.

Co-evolution between social and natural systems

Traditionally, floods are framed as purely natural–physical disturbances in the water system. As such, they are external threats to human systems. By framing floods like this, solutions are usually confined within the boundaries of the water system and water management, and intended to minimize and, if possible, even eliminate floods. However, as indicted above, socio-spatial aspects (e.g. vulnerable urban developments in flood-prone areas or settlements in potential retention areas upstream) also substantially contribute to flood risks, i.e. both the probability of flooding and potential flood losses. Taking this into account, on the one hand, charges flood risks with additional complexity, but also implies that potential solutions can also be found in socio-spatial interventions, e.g. by lowering vulnerabilities. So the issue of flooding rests at the intersection of the water system (water flows, engineering infrastructures etc.) and the socio-spatial system (settlements and spatial development). Consequently, integrating socio-spatial systems in flood risk management can lead to more comprehensive view on the issue.

Considering floods as a result of the interaction of social and physical systems sheds a new light on flood management (Gerrits, 2008). This perspective is called 'co-evolution'. Kallis (2007, p. 4) states that 'a co-evolutionary explanation [...] entails two or more evolving systems whose interaction affects their evolution'. Floods are inextricably results of co-evolving land (socio-spatial) and water (natural–physical) systems (Folke et al., 2002; Tompkins & Adger, 2004). This means that flood risks influence land-use options, and socio-spatial developments on land in turn have an impact on flood risks (e.g. increased run-off) (Gerrits, 2011; Hartmann, 2010; Mitleton-

Kelly, 2003). The mechanisms behind spatial developments respond to (changes in) flood risks (Hartmann, 2011a; Pahl-Wostl, 2006). These include spatial demands, real estate markets, insurance systems (Botzen et al., 2009), knowledge of flood risks (Bubeck et al., 2012), perceptions and attitudes towards floods, and the behaviour and practices of the broader society. The presence of valuable spatial developments in flood-prone areas, on the other hand, causes a need for protection through technical infrastructure, governmental rules, engineering rules and technology. Finally, co-evolution provides an analytical framework to understand the interdependent evolution of social and environmental subsystems.

An example for such co-evolution of boundaries between land and water can be found in Nijmegen in the Netherlands. The 'Waalsprong' is a huge urban expansion project north of the centre of Nijmegen, across the River Waal. The project is part of the 'Room for the River' programme initiated by the Dutch government, which combines water safety targets with spatial planning goals (Coninx & Cuppen, 2010). At the point where the development is occurring, the Waal bends sharply and also becomes narrower. In 1993 and 1995 this location was subject to flooding. The extension plans already existed before the Room for the River programme. However, the programme added that the urban development and flood protection support each other. The chosen solution is to move the existing Waal dike in Lent a few hundred metres inland to restore the river's floodplain and to construct an ancillary channel there. This enables the hinterland to develop while at the same time preparing a sufficient buffer for flood risks. This provides both robustness (the dike) and flexibility (the creation of a floodplain and an ancillary channel), enabling the frontier between land and water to co-evolve.

Also in the urban regeneration project HafenCity in the centre of Hamburg, Germany, similar considerations were taken into account. This site is located outside of Hamburg's main dike line, and is hence prone to flooding. All roads and bridges were elevated to the minimum height corresponding to the flood walls protecting the inner city, while the bases of the buildings were constructed so that they are flood secure. Instead of altering the water system, adjustments in the spatial system were implemented to allow flooding. Although this approach is still quite technical and engineered, it reflects a shift towards accommodating more flexibility.

The lack of co-evolution in flood risk management

In the traditional robustness-based approach to floods, this co-evolution is not acknowledged. When framing the flooding issue as a purely physical problem (as discussed above), the societal context (including spatial developments) is seen as being external and unalterable, enabling and restricting flood management options (Hutter, 2006). The interaction between land and water is then one-directional: what happens on the land has consequences for the management of the water system, but land uses rarely respond to changes in the water system (Figure 1). This traditional static conceptualization of the societal context does not reflect the dynamic and reciprocal co-evolution of both systems (Boisot & Child, 1999).

Co-evolution and flexibility versus robustness

The examples illustrate how a co-evolutionary perspective to the two systems of land and water can help in finding a new balance between robustness and flexibility in flood risk management. Co-evolution is more than the mutual influence between both systems

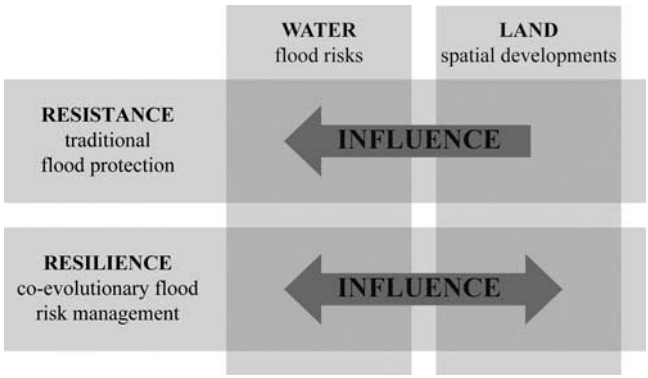

Figure 1. Interactions between land and water in flood protection and resilience approaches.

(Gerrits, 2011). In order for co-evolution to be fruitful, it is important that both systems are dynamic.

A co-evolving system tries to adapt to the environment when necessary, and it tries to influence its environment when possible (Edelenbos & van Buuren, 2006). The discussion of flexibility versus robustness thus comes down to accommodating both changing flood risks (when necessary) and stable social development by influencing the water system (when possible) in a co-evolutionary process. In the case of flood management, this means that spatial planning and water management need to be adapted to each other. Currently, in practice, there is a tendency towards this approach due to the increasing importance of spatial planning within the flooding issue (e.g. Coninx & Cuppen, 2010) and the growing interest in co-evolutionary planning (Boelens & De Roo, forthcoming).

Discussion and conclusions: co-evolution as a perspective that bridges the socio-spatial and the natural–physical system

So, on the one hand, we have a social system that is asking for robustness, while, on the other hand, changes in the water system demand flexibility. To understand this tension between flexibility and robustness, the concept of co-evolution between land (socio-spatial systems) and water (as a natural–physical system) is proposed. Actions on land affect the water system, while flood risks emanating from the water system affect spatial development options. This can help in framing the flooding issue more realistically, as far as interactions between flood management choices and society are considered. For example, flood risks are generally defined as the probability of flooding weighed against the potential damage. These two variables are often treated as independent variables; flood management strategies lower either the probability of flooding or the damage in case of flooding. However these two variables are dependent, arising from the mutual influences between the water and land system. Measures to lower the probability of flooding (e.g. building dikes) influence the development of potential damage (e.g. construction of new buildings). Vice versa, the presence of vulnerable groups or structures heightens the need for protection from flooding.

Currently, there are few insights into these interactions. On the one hand, social research describes issues of vulnerability (Grothmann & Reusswig, 2006; Siegrist & Gutscher, 2008), while hydrological models estimate the effects of infrastructural

interventions on the probability of flooding. Therefore, the interactions between flood management choices and society need to be analysed and monitored.

The concept of co-evolution does not per se provide a solution to the dilemma of flexibility versus robustness, but it offers another perspective that that bridges the socio-spatial demand for robustness and the natural–physical constraint and need for flexibility in the interplay of land and water at its fluid frontier. By understanding the mutual influence (the co-evolutionary character) of the two systems, the perspective on flood risk management measures changes. When drafting measures in one system, the effects on the other system should be considered so as to obtain a more realistic estimate of the resulting flood risks. When areas are protected from flood risks, what does this imply in terms of spatial development perspectives? What are the effects on flood risks of urban development, locally and also downstream? And what does this mean in the long term? By considering the interactions and co-evolutionary nature of 'water' and 'land' systems, more comprehensive and effective results can be expected.

Although this seems to be obvious, this is not yet standard practice. Often, the focus in flood risk management is more on the water system and less on the effects of the land system and how they influence water issues. Flood risk management measures are generally restricted within the boundaries of the water system, while within spatial planning, a remedial approach to managing flood risks is used.

Finally, this contribution offers not more and not less than a perspective on the dilemma of balancing robustness and flexibility in flood risk management. The co-evolutionary perspective, discussed above, raises a couple of essential and important research questions. One of the issues has to do with the costs of flexibility (adaptation measures, but also compensation claims for disturbing the robust system 'land'). Also, questions of justice and equity need to be dealt with: if flood risk management requires a more flexible approach to floods, who will get what kind of protection? This requires new discourses on the risk absorption capacities of land uses; but it also raises a couple of legal issues related to liabilities or responsibilities. Further attention needs to be paid to these questions. The perspective of co-evolution helps understanding the interdependencies of the social and environmental subsystems land and water – thus helping understanding the fluid frontier between the two.

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8.7 Annex 7: article "Shifting public-private responsibilities in Flemish flood risk management. Towards a co-evolutionary approach"

Mees, H., Tempels, B., Crabbé, A., Boelens, L., under review, Shifting public-private responsibilities in Flemish flood risk management. Towards a co-evolutionary approach

Shifting public-private responsibilities in Flemish flood risk management. Towards a co-evolutionary approach.

Abstract
Similar to several other countries in Europe, a policy debate emerged in Flanders (Belgium) stating that flood risks should no longer be tackled by water managers alone but should become a shared responsibility between water managers, other governmental actors and citizens. Hence, a form of "co-production" is advocated, whereby both governmental and non-governmental actors participate in bringing flood risk management into practice. This new approach represents a remarkable break with the past, since flood management in Flanders is traditionally based on flood probability reduction through engineering practices. The intended shift in private/public responsibilities can thus be expected to challenge the existing flood policy arrangement. Based on quantitative and qualitative research, this paper compares the attitudes towards individual responsibilities in flood protection among public officials and residents of flood-affected areas in the flood-prone basin of the Dender river. We find that whereas most public officials are in favour of sharing flood risk responsibilities between authorities and citizens, the majority of residents consider flood protection as an almost exclusive government responsibility. We discuss the challenges this discourse gap presents for the pursuit of a co-produced flood risk management and how these can be addressed. It is argued that a policy of co-production should embrace a co-evolutionary approach in which input, output and throughput legitimacy become intertwined.

Key words: flood risk management; public-private responsibilities; co-evolution; co-production

Introduction

In the last decade, various authors have described a shift from a flood management based on resistance towards a risk-based approach (Meijerink and Dicke, 2008; Johnson & Priest, 2008; Hildén et al., 2012; Bubeck et al., 2013). According to the latter perspective, flood risks do not only result from a natural hazard itself but also from the societal processes and responses to it. Flood risk management (FRM) assumes that interactions between water and land influence the risk of flooding (Tempels & Hartmann, 2014). Whereas traditional flood management aims to prevent flooding by interventions in the water system only, FRM recognises that these do not sufficiently prevent flood damage and that complementary measures to reduce the vulnerability of land uses in flood-prone areas are needed. By addressing the water and the socio-spatial system simultaneously, water and land use policy thus become intertwined. In this paper, the term flood risk management refers to the actions taken by governmental and non-governmental actors, with the purpose of preventing and mitigating flood damage.

With the Floods Directive of 2007, the European Union endorsed the FRM approach by mandating each EU member state to draft a Flood Risk Management Plan (FRMP), which takes into account measures of prevention (i.e. spatial planning), protection (i.e. structural defence) and preparedness (i.e. emergency planning). In Flanders (Belgium), this has recently been anchored in the concept of

multi-layer water safety (MLWS) (Flemish Government, 2013). MLWS implies that flood risks are no longer an exclusive task of the water management sector, but should become a shared responsibility between water managers, spatial planners, emergency planners, the insurance sector, the building sector and citizens. This new approach represents a remarkable break with the past, because flood management in Flanders is traditionally considered to be the exclusive responsibility of governmental water managers (Mees et al., 2016). Experience of flood events and the expected increase of flood risks in the future, however, has led these managers to conclude that they cannot deal with floods alone any longer. In a first step to bring MLWS into practice, the Flemish government commissioned a so-called 'Flood Risk Management Plan (FRMP) Study'. The FRMP-study determined for the majority of Flemish watercourses an optimal set of prevention, protection and preparation measures, based on cost-benefit analysis (VMM, 2014). The study compared measures' costs and benefits, regardless whether they are to be financed by public or private actors. As a result, some of the recommended actions belong to the private investment sphere, e.g. flood-proof building. By whom these measures should be implemented and financed has not been determined yet, but considering the MLWS discourse of the Flemish government administration, one can expect that a larger involvement will be requested from citizens in the future. Hence, a form of "co-production" will need to be introduced, whereby both governmental and non-governmental actors participate in bringing FRM into practice.

What form this intended co-production will take precisely, is not clear at this stage yet but it does nonetheless raise questions on the feasibility of the new approach. Although preventing flood events is not a state responsibility by law in Flanders, the development of governmental water management organisations has created expectations among the public that the government will protect them from flooding (Mees et al., 2016). Through time, state-society relationships have co-evolved towards a situation in which FRM has been put entirely in hands of governmental institutions. Public flood awareness and citizen involvement in FRM are low, both in its decision-making and implementation (Van Rossen, 2003; Mees et al., 2016). But in a changing environment of flood risks, due to climate change and urbanisation, this co-evolution has resulted in a suboptimal lock-in of the current flood risk policy. A so-called 'levee effect' (Baan & Klijn, 2004; Bubeck et al., 2013) can be witnessed, whereby investments in defence infrastructures have enabled citizens to build in floodplains, which requires a continuous further investment in flood defence. Policymakers acknowledge that a redistribution of flood risk responsibilities and competences is needed in order to face the challenges ahead, but it is questionable whether this is possible in the current governance context. In this paper, it is investigated to what extent flood-prone residents in Flanders are open to adopt larger private responsibilities in FRM and which changes in the current state-society relationships are needed to allow a shift of public-private responsibilities in FRM.

Hereto, the current discourses prevailing among public officials and citizens in the basin of the Dender river are analysed. The Dender basin is highly flood susceptible, due to its hydro-morphological characteristics and the urbanisation of its flood plains. Based on semi-structured interviews among public officials and a survey among residents of the Dender basin, we analyse how these actors perceive private and public responsibilities towards FRM and to what extent citizens in flood-prone areas are willing to contribute to FRM and are already doing so. In the discussion, we will reflect on the following questions: (1) are discourses of public officials and residents in compliance, (2) if not, which challenges does this put on the government's pursuit of FRM co-production and (3) which change in governance is needed in order to enable this co-production?
By answering these research questions, the paper contributes both to the scientific and societal debate on public-private flood risk responsibilities. The pursuit of a risk-based flood management has induced policymakers in many countries to advocate a greater involvement of citizens and communities in FRM (Bubeck et al., 2013; Kievik & Gutteling, 2015; Walters, 2015). Since this trend is in most countries relatively new, it remains understudied what are the barriers to and opportunities of

citizen co-production in FRM. This article gives insight into the barriers towards enhancing co-production and proposes a co-evolutionary approach in order to overcome them.

The public-private divide in flood risk management, theories and concepts

For a long time, flood management has been considered a prime example of a pure collective good (Meijerink & Dicke, 2008). In several countries in Western Europe and in the United States, however, a trend can be observed towards increasing individual responsibilities in FRM, turning it partially into a club or private good (e.g. Meijerink & Dicke, 2008; Bubeck et al., 2013; Geaves & Penning-Rowsell, 2016).

Mees et al. (2012) stress that a particular set of public-private responsibilities is driven by a certain rationale, held by its stakeholders. These rationales can take a juridical, economic and/or political perspective, which leads respectively to considerations of fairness, effectiveness, efficiency and legitimacy. First, the distribution of responsibilities should be well-defined and lead to a reasonable share of risks, costs and benefits between and among generations (fairness). Secondly, the distribution should lead to an effective and efficient adaptation policy. Last, the policy needs to be approved by those directly involved or affected (legitimacy). Often, the different criteria are conflicting, depending on the specific context. Individual flood risk protection in rural areas is in some cases most efficient, but poses questions of fairness in comparison to others living in collectively protected areas, if these measures are to be financed and implemented by households themselves (Leichenko & O'Brien, 2006; Johnson & Priest, 2008; Walker & Burningham, 2011). This problem could be solved through governmental subsidies, which might in turn lead to the question why tax-money should be spent on citizens who have chosen to live in floodplains. In these cases, issues of water management and land use become entangled. Distributing public and private responsibilities in FRM is consequently not a technical matter of calculating efficiency and effectiveness, but requires a political debate and broad social support.

Co-production and its limitations

In the rising debate on flood risk responsibilities, citizens are expected to co-produce FRM. Co-production is defined as 'the involvement of citizens, clients, consumers, volunteers and/or community organisations in producing public services as well as consuming or otherwise benefiting from them' (Alford, 1998). The concept has been employed within divergent disciplines. In planning theory, it is used to describe the participation of citizens in the strategic planning process (Albrechts, 2012), whereas scholars of public administration and services management link it to the involvement of citizens and civil society actors in the delivery of public services (Osborne & Strokosch, 2013). Analogue to Osborne and Strokosch (2013) and Bovaird and Löffler (2013), we employ co-production here as an umbrella term, which contains several sub-concepts to describe citizen involvement in decision-making and delivery (Figure 1), among which

- *co-planning*, which entails forms of public participation in the decision-making phase, i.e. in the formulation of opinions, adoption of decisions and in rare cases in the agenda-setting;
- *co-delivery*, i.e. the involvement of citizens in the implementation of policy measures, and,
- *comprehensive co-production*, when citizens are involved in the entire policy cycle (i.e. both a policy's agenda-setting, decision-making and implementation).

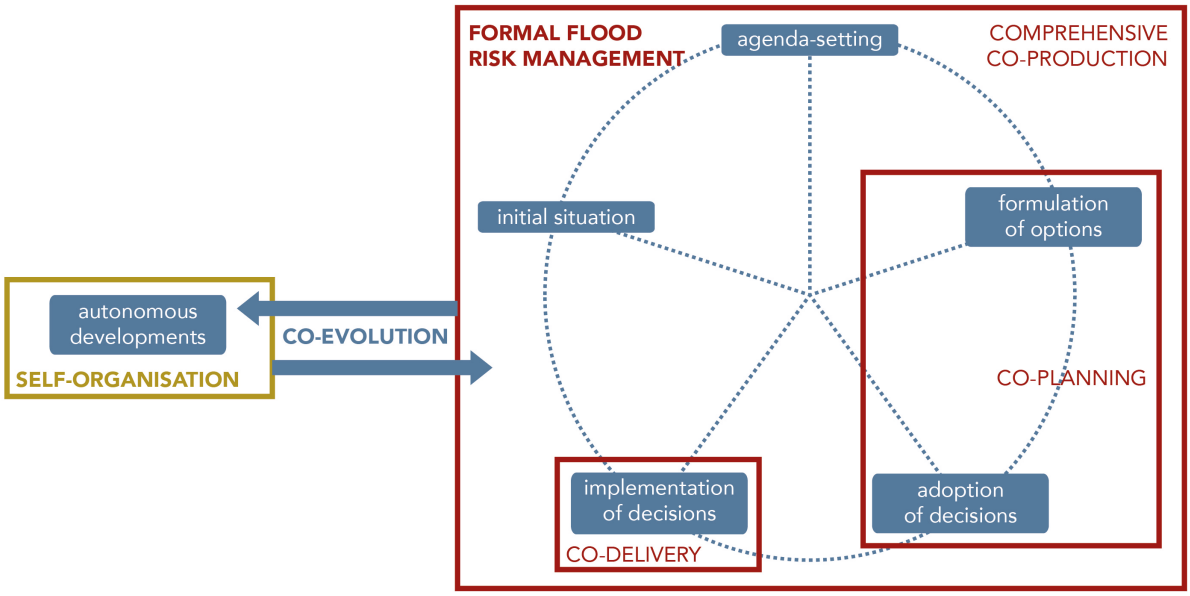

Figure 1. Overview of the different forms of co-production, based on the stages of the policy cycle (Werner & Wegrich, 2007; Crabbé & Leroy, 2008). The red boxes indicate which phases of policy-making are included in participatory processes.

Although its definition does not explicitly prescribe it, most scholars consider co-production to be initiated by governmental actors (Watson, 2014). This implies that citizens are either little or not involved in defining the issue at stake (i.e. agenda-setting phase), which is criticized by others for being counter-productive (Pierre, 2000; Purcell, 2008; Boelens, 2010; De Roo, 2012). Indeed, in practice it has proven difficult to engage non-governmental actors successfully in a later stage of governance, due to the lack of mutually understood governmental and societal goals (Rees et al., 2005; Reed, 2008). Co-produced planning processes are criticised for being too time consuming, reproducing existing power relations (Currie-Alder, 2007; Huitema et al., 2009), too focussed on process and not on content (Wigmans, 1982; van der Cammen & Bakker, 2006), not genuinely improving the quality of its output (Innes & Booher 2000), just resulting in a 'public support machine' (Hendriks & Tops, 2001; Woltjer, 2002). Boonstra and Boelens (2011) claim that this kind of traditional participatory processes are cause of new *restrictive inclusionary processes*; thematically, procedurally and even geographically.

Several authors have also critically addressed co-delivery. Nye et al. (2011), for example, attribute the trend of co-delivery observed in English flood risk governance to 'the environmental rhetoric of individuals becoming the repository of environmental responsibility' (Eden, 1996 in Nye et al., 2011). This way, it fits into a neo-liberal conceptualization of resilience, stressing the need of individual self-reliance (Davoudi et al., 2012).

A co-evolutionary perspective

To meet the challenges of co-production, this paper adopts a co-evolutionary approach to FRM. While many forms of co-production focus on the mutual implementation of fixed targets (set by governments), co-evolutionary approaches are based on the mutual interactions between different subsystems. As Kallis (2007, p. 4) states, 'a co-evolutionary explanation (…) entails two or more evolving systems whose interaction affects their evolution'. This approach is therefore more open and adaptive, making it more suitable for dealing with complex and changing conditions.

If we apply this to co-production in FRM, two relevant subsystems are the state and society. The first exists of water managers and spatial planners on different levels, the latter of residents, insurers,

architects, contractors, etc. Within these subsystems, different (groups of) actors are directly or indirectly, actively or passively, and deliberately or unintentionally involved in the development of flood risks and ways to deal with them (Tempels & Hartmann, 2014). They interact with each other through real estate markets, building activity, spatial developments, insurance systems, the behaviour and practices of individuals and public protection measures. This means that decisions and actions taken by the state influence what societal actors think and do, and opposite. All actors involved in the development and management of flood risks thus have their own cycles of agenda setting, decision-making and implementation, which are being influenced by those of others.
Throughout time, this co-evolutionary process has shaped the state of FRM today (Pahl-Wostl et al., 2007b). Co-evolution is thus an inherent part of FRM. This is different from co-production, which is part of formal FRM strategies and thus requires a conscious and active relationship between the two subsystems. While co-production is rooted in policy development and is thus a goal-oriented process, co-evolution is undefined in its result. The resulting co-evolution can be fruitful for preventing and mitigating flood damage, or it leads to a suboptimal lock-in of state-society relationships. In order to stimulate a fruitful co-evolution, policymakers can purposefully engage in the existing co-evolutionary processes. By doing so, authorities take into account the existing co-evolutions to attain common goals of security and preparedness. Boelens and De Roo (2016) call this 'planning of undefined becoming'. It means that the living micro-scale is taken as a departing point to explore a variety of options within the specific institutional setting, without pre-defining management goals. Through mutual understandings of the subsystems, anticipating on their feedback and adapting own strategies, constructive co-evolutions between state and society can be built (Boonstra, 2015).

In the remainder of this article, we explore how the public-private divide is constructed in Flemish FRM today and which opportunities and barriers it offers to new forms of co-production. Reflections are made on whether a co-evolutionary approach could help to overturn the current lock-in of Flemish flood risk policy, in which citizens are little involved in any flood risk policy phase, which leads to low flood awareness and responsibility.

Methodology

Case selection and description

This paper bases itself on case study research, which is a fruitful method for applying a co-evolutionary approach. Indeed, a co-evolutionary perspective requires attention for local circumstances and conditions. Hereto, analysing FRM in depth at local scale offers an optimal basis to investigate how a co-evolutionary approach can work in practice.

We selected the Flemish part of the Dender basin as our unit for research because it is one of the most frequently flooded areas within Flanders (Figure 2). This is particularly the case for Geraardsbergen, the city in which the qualitative part of this research was conducted. The Dender has its source in Wallonia and mouths into the Scheldt river in Flanders. Recent flooding occurred in 2002, 2003, 2010 and 2014. The most severe flood took place in 2010, when damage was caused to 1466 households (Assuralia, 2011). The Dender basin forms a fruitful case for investigating attitudes towards personal responsibilities in flood-prone areas. As a result of its recent flood history and following debates, this area forms a pilot case for the implementation of the multi-layered water safety. Furthermore, the issue of flooding continues to receive widespread attention in the area, which has facilitated the cooperation of residents and officials in the data collection.

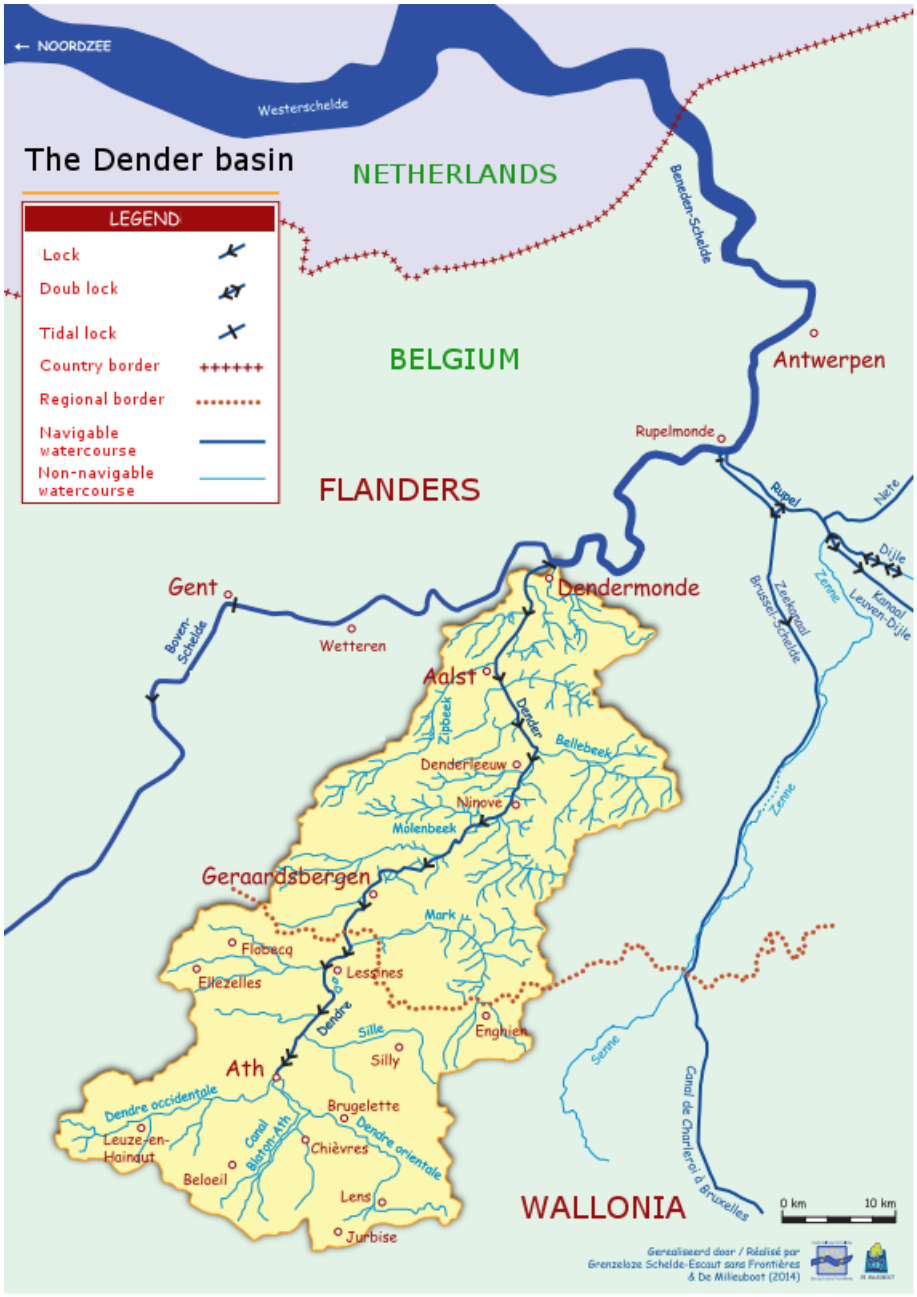

Figure 2: Map of the Dender basin. *Source: Grenzeloze Schelde (2014).*

Data collection and analysis

The paper brings together the results from two studies focused on FRM in the Flemish Dender basin. The first is a survey among the population of the basin, which has been conducted within the Policy Research Centre for Spatial Planning commissioned by the Flemish government in September 2014. Next to that, the city of Geraardsbergen has been examined between August 2014 and January 2015 as a case of the STAR-FLOOD project, which makes part of the EU FP7-programme. While the first study investigated the position of non-governmental actors, the second focused primarily on public officials. To obtain a comprehensive understanding of how the different stakeholders look at the issues of citizen involvement, these results were brought together and compared against the shared theoretical framework described above.

Three different techniques were applied, namely document analysis, interviews and survey.

First, existing policies and plans relevant for the Dender basin have been analysed, to understand to what extent citizen involvement in FRM has been pursued already and what kind of co-production these plans intend.
Second, we conducted interviews with 17 stakeholders, involved in FRM as public officials (i.e. water managers, spatial planners and emergency managers at the regional, provincial and municipal level) and representatives of civil society. Herewith, we gained insight into the actors' view on the desired division of private and public responsibilities and forms of co-production. In order to illustrate the findings of our results section, we have extracted representative quotes from the interviews. These quotes have been anonymised to protect our respondents.
Last, a survey was conducted among residents of flood-prone areas in the Dender basin. Due to the size and diversity of this group, a survey was chosen to make overall statements possible. The survey measured attitudes and behavior of residents in relation to flood risks, more specifically to what extent residents are willing and able to become involved or contribute in FRM. For more information on the survey methodology, see Tempels et al. (submitted). Considering the catalysing importance of flood experience for the issues of responsibility and individual protection, we focus here only on the respondents with flood experience (n=108).

Because they result from two research projects, the different methods have been applied simultaneously but independently. In a later stage, the quantitative and qualitative data were put together to enrich each other mutually (Bergman, 2010). The survey results demonstrated the response frequency of the investigated attitudes among the population and allowed to make solid statements about the discourse prevalence. The in-depth interviews with public officials and residents gave insight into the underlying rationales of discourses present in the survey and document analysis.

In the result section discourses and practices of citizen co-production in FRM are discussed and compared. According to some authors (e.g. Laclau & Mouffe, 1985) "no object can be outside discourse" (in Behagel, 2012) but this article employs the analytical frame of Behagel (2012), which presents discourse and practice as two positions on different ends of a spectrum. Discourse constitutes social reality through articulation, whereas 'practice' does so by activity. In Behagel's framework, articulation describes the constitution of discourse in political action, while a logic of practice shows how activity unfolds over time in specific local conditions. Consequently, both offer useful insights in how social reality develops.

Co-production in discourse and practice in the Flemish Dender basin

Discourses prevalent among public officials

Among governmental actors, a distinction can be made between public officials at regional level (Flemish government), provincial level (Province of East-Flanders) and local level (City of Geraardsbergen).
Within the Flemish government, several officials are in favour of sharing more responsibilities with non-governmental actors in the context of the MLWS, i.e. with the insurance sector and citizens.

> *"Multi-layer water safety is about the awareness as a water manager that you are not the only one responsible. Before the French revolution it was the private owner who was responsible so he did not build in flood-prone areas. But due to several legislative acts we came to a situation in which the governmental water managers became the only responsible, not spatial planning, not the citizens. If it was allowed to build somewhere, nobody cared about water, the government would take care so the land would remain dry. Now, we are in a process of*

bringing these actors back into the management, but that is something that cannot be changed of course with 1 act of legislation or 1 flood."
(Translated excerpt from an interview with an official from Flemish Environment Agency)

In their view, the involvement of spatial planners, citizens and other private actors has become indispensable due to two developments external to flood management. The first is the increasing degree of urbanisation in floodplains. With the creation of the Regional Zoning Plans in the 1970s, a significant number of flood-prone areas have been assigned as 'residential area'. In the following decades, these zones were gradually built up, which reduced their water storage capacity and increased the demand for ever more flood defence infrastructure. Also urbanisation outside the floodplains contributed to the flood problem, due to increased surface run-off. Secondly, projections of climate change predict an increase of winter flooding and intense weather conditions (Flemish Government, 2012). As a result, the Flemish water managers consider the involvement of additional actors necessary to maintain and increase the effectiveness of FRM in the future.

Apart from increasing effectiveness, the discourse to involve new actors in FRM results from cost-efficiency considerations. Cost-benefit analyses in preparation of the FRMPs have shown that in some cases property-level measures are preferable over collective protection. Hence, following the framework of Mees et al. (2012), the discourse is dominated by an economic perspective. To the officials interviewed, it remains unclear how considerations of 'fairness' should be dealt with, i.e. who should be responsible to implement and pay for these measures. According to some, a subsidy system would be recommendable but this had not yet been debated within the government administration or at political level.

Also among officials from the municipal and provincial government, a discourse is prevalent that preventing flood damage should be a shared responsibility between citizens and the government. The government should take the actions needed to protect citizens but there are measures citizens can and should take in addition.

"Since 2010, the city tries to promote the self-reliance of the citizens. Because there is always someone who pays and now that is the community. I think it is just normal that if there is a problem you first try to solve it yourself."
(Translated excerpt from an interview with an official from City Geraardsbergen)

"There was a house where the water reached up to 2,10 meters. There you need real infrastructural measures, which are not affordable for citizens, so it should be the community who provides them. But people can take measures to resist to small flooding problems, e.g. water barriers, etc."
(Translated excerpt from an interview with an official from City Geraardsbergen)

However, local actors claim to also understand the general view among the population that if they have been allowed to build, they should also be protected against flooding. In addition, city officials consider it unjust to refuse property owners to build in residential zones. Here again, the present discourses offer no clear viewpoint from a fairness and legitimacy perspective. This creates a self-reinforcing situation, with the government neither being able to prohibit citizens to build in flood-prone zones or to demand self-protection.

"These people have been permitted to live there. So is it the mistake of the citizens, the permitting authorities or the Regional Zoning Plan? The city has allowed them a permit but

only in conformity with the Regional Zoning Plan. The real mistake is that these areas have been designed as building area about 30 years ago."
(Translated excerpt from an interview with an official from City Geraardsbergen)

Within the province and city, officials react reluctantly on the FRMP-study. In contrast to the Flemish government, cost-efficiency concerns hold at local level a less prominent place in decision-making. The respondents point out that the assumptions underlying CBA inherently contain certain biases and preferences, therefore it should be used as a guiding but not a determining tool.

"Interviewer: Do you use them within the city as well, the concept of prevention, protection and preparation?
Respondent: Yes, in future we'll have to. We actually do not apply them for measures for which we are fully responsible. Our administration departs from the rule that if we can take a certain measure, we should take it. But for more complex and thus expensive projects we order a study and there might be aspects for which we don't have the required resources."
(Translated excerpt from an interview with an official from City Geraardsbergen)

The fact that the FRMP-study prescribes individual instead of collective protection measures in a number of cases, leads to concern among local actors from a legitimacy perspective.

"Recently, the VMM offered us the 3Ps, which states not all responsibility should be passed on to the government, also from the citizens is expected… But with communicating this message to the citizen, we still stand at the start. Is this politically feasible? […] Citizens won't take this, when there is flood damage they always think it's the water manager who did it."
(Translated excerpt from an interview with an official from Province East-Flanders)

Indeed, a clear statement from politicians at Flemish level on the responsibility of citizens is also missing. The discourse is prevalent among the administration in charge of policy preparation, and also the Flemish Minister of Environment stated in public that "*water security should be a shared responsibility of water managers, spatial planners, citizens and emergency services"* (Schauvliege, 2013). But what this means in practice remains unclear.

Most interviewed public officials are in favour of enhanced co-delivery in FRM but few statements are made on co-planning or comprehensive co-production. All water managers at Flemish and provincial level recommend that citizens should be informed rather than to include them more actively in the decision-making process. It is stated by water managers at the different governmental echelons that it is important to first have a well-developed plan before presenting it to the public. In most cases, society is represented in decision-making by two types of actors belonging to the governmental structure; citizens by municipalities and NGOs by different government departments.

Discourse prevalent among the population

The discourse dominating among the population is primarily fed by fairness and legitimacy considerations. Our interviews with members from the citizen committees of Overboelare and Zandbergen, two sub-municipalities in Geraardsbergen, revealed a wide-spread frustration about the fact that housing and building plots in the neighbourhood lost their value due to the flooding issue, which became only problematic in the end of the 1990s. This frustration is translated into passing on responsibility for the problem and its solutions to the government. Also, the vast majority of respondents of the survey (86.4 %) beliefs that the Flemish government is responsible for the existing

problems, while only 10.7 % agrees that residents are (also) responsible. Consequently, the residents consider their personal responsibility as limited to non-existent.

> *"If I buy a building plot, I also expect the government to protect me from flooding, otherwise it should not be a residential area."*
> (Translated excerpt from an interview with the citizen committee of Overboelare)

75.5% of the respondents indicate that they deem the government responsible to protect them against flooding, as they have allowed them to settle there. Only 15.5% follows the argument that citizens who have chosen to live there, are responsible to protect themselves against flooding. The survey indicates that people affected by floods attribute even more responsibility to the government than the general population in flood-prone areas. The perceived link between building permits and the obligation to provide protection is quite remarkable, as building permits do not make statements about the suitability for construction nor include a legal obligation for the government to provide protection.

The population of affected areas is very sceptical of individual adaptive measures for existing buildings. According to the survey, only 17.9 % believe that residents can help resolving the issues. The main reasons given for not taking individual measures primarily result from fairness/legitimacy considerations and only in second order from an effectiveness perspective, namely (1) they believe the flooding issue should be solved collectively (84.9%), (2) the government should provide protection (76.8%) and (3) they cannot do anything against flooding individually (62.6%) (Figure 3). Interview respondents from Overboelare stated that only when the government has taken all possible steps to protect them, they could consider what to do on top of that. Only in second order, the survey respondents indicate that they don't know what (else) they can do (52.6%) or that they doubt whether the measures are effective (48.0%), that it is not their responsibility (42.9%), that the measures are too expensive in comparison to the risk (42.1%) or that the risk is too low (40.3%). However, several interviewed citizens have visited the information market the city organised on individual protection measures and considered applying them. Most actions appeared however relatively costly and their effectiveness not guaranteed. As a result, the citizens turned back to the conclusion that it should actually be the government's responsibility to protect them.

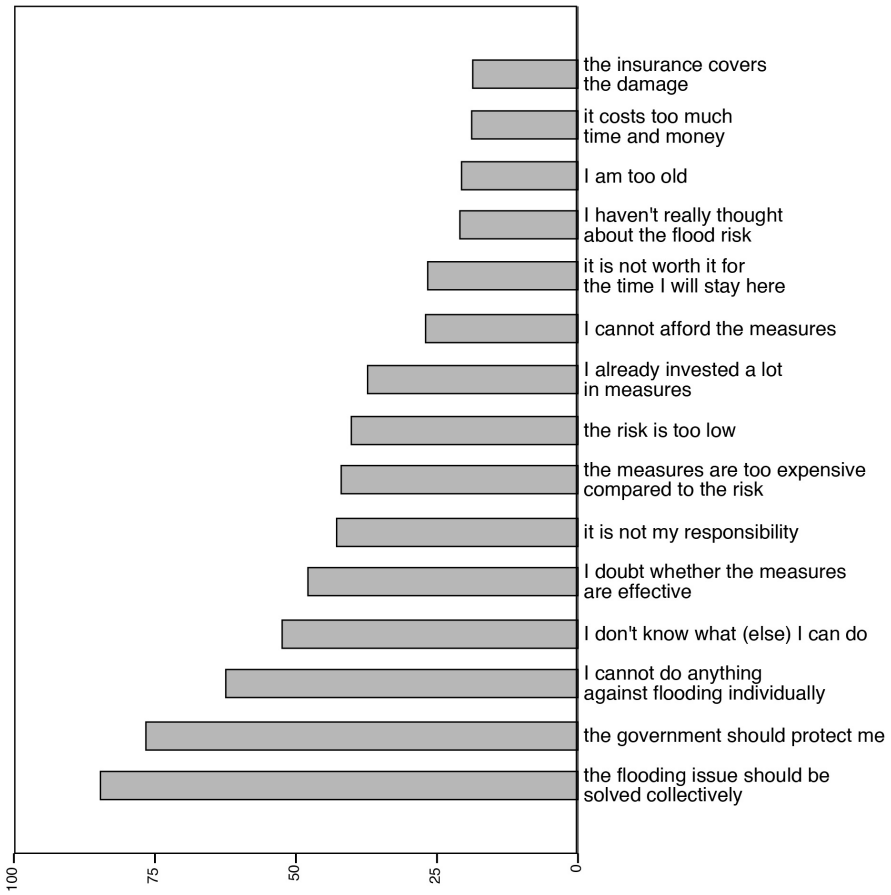

Figure 3. Reasons why respondents do not take measures, measured in percentage of respondents. (n=108)

Governmental actions towards co-production

Although the Flemish government refrains from making a clear political statement for enhanced private responsibilities in FRM for the moment, it has taken some first steps to bring co-delivery into practice. In 2011, a brochure and an interactive website were published with guidelines on 'water-resistant building'. In cooperation with the Flemish architects' association (NAV), the government organises training sessions for professionals on the topic. Because there is a considerable lack of knowledge on the potential and costs of adaptive building measures, the government conducted a pilot study on flood resilient building in 2013-2015. In this study, 85 existing buildings have been investigated on their potential to implement damage reducing measures and the costs thereof. Based on these investigations, general information files have been drafted per type of measure, which provide information on technical details, possible applications and pricing (VMM, 2015).

In addition, a number of pilot projects have been set up in 2014 and 2015 to bring the FRMP-study into practice. In the catchment of the Maarkebeek for instance, the set of measures presented by the FRMP-study has been discussed among all involved governmental parties and a 'river contract' has been signed (CIW, 2015). This river contract includes among others the adaptation of a small number of houses located in flood-prone area. Among the water managers involved, discussion exists on whether these measures should be financed by governmental or private funding.

Apart from knowledge development and dissemination, the first legislative steps have been taken to increase individual flood risk responsibility. Starting from the idea that only an informed resident can be held responsible for his own actions, the Flemish government introduced the *Duty to Inform* in

2013.[5] According to this legal prescription, the vulnerability of properties to flooding needs to be declared in real estate advertisements.

Also at local level, governmental actors have taken action to stimulate the implementation of protective measures by private households. After the flood of 2010, the City of Geraardsbergen organised an information market where several flood resilient building products were presented to the public. Moreover, the City provides a small subsidy of 250 euro for households who take adaptive measures. This has been awarded 26 times in 2011, 11 times in 2012, once in 2013 and once in 2014. The majority of requests concerned the installation of pumps and some floodgates.

Although they form important building blocks in shifting the public-private divide of flood risk responsibilities, the impact of the measures mentioned above has been limited. At the moment, stimulating private action forms only a marginal part of the FRM measures pursued by government. This is even less the case when it comes to establishing co-planning and comprehensive co-production. (Organised) citizen involvement in the decision-making is generally limited to more passive information and consultation forms in later stages of the planning process (i.e., public hearings, info markets). After the 2010 flood, however, more direct citizen participation has been organised by Geraardsbergen City, whereby citizens in the different districts could articulate their concerns and suggestions. In the meantime, a system of neighbourhood councils has been set up to allow for a more structured and permanent participation.

Private actions towards co-production

According to the residents of Overboelare and Zandbergen, very few households adapted their houses after the 2010 flood. The information market could not convince them of the effectiveness and affordability of this type of measures, and the subsidy provided by the municipality was too small to compensate. However, 72% of the respondents of the survey indicate to have taken precautionary actions, of which 75.3% purchased sand bags or a pumping installation and 32.5% took structural measures (e.g. waterproofing of outer walls). Of the people that have taken measures, 11.7% has not spent any money, 65% invested less than €1000, 15.6% between € 1000 and € 5000 and 7.8% has invested more than € 5000. In addition, 54% of respondents with flood experience indicate to be in principal willing to take structural measures to limit damages due to flooding under the current conditions. Under conditions of increased frequency of flooding and governmental subsidies, respectively 83.9% and 81.9% would be willing to take measures.

After the 2010 flood, residents of Overboelare and Zandbergen collected themselves in neighbourhood groups in order to deal with the consequences of flooding collectively. Their activities were at the one hand directed towards collectively preparing insurance dossiers, and at the other to lobbying towards relevant authorities for flood protection.

Comparing divergent discourses and practices

Our results show a clear gap between the discourses prevalent among public officials and residents of the flood-prone areas in the Dender basin. Most governmental actors believe precautionary actions at household-level can in some cases form a useful flood risk strategy and should therefore be encouraged among the population. A majority of citizens by contrast appears very sceptical towards household-level flood measures and deems the government primarily to exclusively responsible for

[5] Decree of 19 July 2013 modifying various provisions of the Decree of 18 July 2003 related to the Integrated Water Policy, *Belgian Official Journal*, 1 October 2013.

their protection. While the discourses present within governmental administrations are primarily inspired by an economic perspective, considerations of fairness and legitimacy dominate the discourse among the population.

Between these discourses, however, a number of bridging points are present, which offer the opportunity to link them. Indeed, the Flemish government itself has not yet developed a clear viewpoint of the implications of the MLWS discourse for the distribution of costs and benefits. Its public officials are in favour of encouraging flood protection measures at property-level and are taking first steps hereto, but it is not defined explicitly whether citizens should take the financial responsibility for this protection as well. Up to this moment, a political debate on this topic still needs to take place within Flemish and provincial governments. Among governmental authorities, there exists a considerable variety in their viewpoint on individual flood risk responsibilities. In general, local authorities show more reluctance towards citizen co-delivery in FRM, most likely because they are more sensitive for possible electoral consequences of the new approach and thus argue from a legitimacy, rather than an economic perspective. Public officials at all levels acknowledge that the emerging discourse is not in line with the dominating attitude among the population. Although formal law does not grant property owners in residential areas an automatic right to build, informal norms make it almost infeasible to refuse building permits in these zones. Some interviewed officials argued it would be 'unjust' to refuse owners a permit on a plot they had bought as residential area, in spite of its flood vulnerability.
On the other side, residents are not entirely hostile towards individual protection measures either. 72% claims to have taken some form of precautionary actions, of which 32.5% structural measures. Residents of Overboelare state that only when the government takes sufficient action, they would do an additional effort. Hence, they do not principally refuse private responsibility, but expect it to be preceded by governmental commitment. Although residents mention 'flood protection is a government responsibility' as one of the principal reasons not to take measures, our research data revealed that 54% would be willing to take measures.
These bridging points offer opportunities to align the divergent discourses at place. We believe this will be necessary to maintain and enhance the effectiveness and legitimacy of the current policy on flood risks, as we will explain below.

Closing the gap, from co-evolution to co-production and back

In our theoretical framework, we stated that FRM is defined by co-evolutionary processes between state and society. In each of these subsystems, actors develop their own flood risk strategies. Which strategies are decided upon is influenced by developments taking place in the other subsystem. In the Flemish basin of the Dender, FRM has long been presented as a governmental responsibility. Consequently, citizens have little invested in developing active flood risk strategies themselves. In the context of increasing flood risks, however, this co-evolution appears to have become suboptimal; while residents take little or no action, water managers are increasingly faced with the fact that they can no longer manage flooding on their own. Therefore, it is argued by policymakers that responsibilities should be shared between state and society, by including them in the delivery of FRM. This way, a more fruitful co-evolution could emerge.
Following the framework of Mees et al. (2012), however, the division of public-private responsibilities needs to take into account both considerations of fairness, effectiveness, efficiency and legitimacy. Current discourses among public officials and population appear generally to have a limited focus on respectively the effectiveness/efficiency or the fairness/legitimacy criterion, which challenges the shift pursued by the government.

Today, Flemish FRM is focused on input/output rather than throughput legitimacy; i.e. it legitimises its FRM through authorized institutions delivering effective output rather than including citizens in its decision-making (see Hartmann & Spit, 2016). Although active public involvement is strongly encouraged by the EU Floods Directive (Art. 10), public participation in Flemish FRM is generally limited to later phases of the decision-making process and more passive forms of interaction (Van Rossen, 2003; Mees et al., 2016). Overall, the Flemish population accepts its limited participation possibilities since FRM is considered exclusively the competence of the government. But if the government proceeds to transfer flood risk responsibilities to private actors it will weaken its input and output legitimacy, because it relies on actions taken by these actors for its effectiveness. Considering the currently prevailing attitude among the population of the Dender basin, it is unlikely residents will accept this new role without more intensive opportunities for participation.
Indeed, several scholars point out that a shift towards sharing flood risk responsibilities with private actors cannot be accomplished without including them in the decision-making as well (Steinführer et al., 2009; White et al., 2010; Roth & Winnubst, 2014). Hence, a plea is made for a shift from input and output to throughput legitimacy (Hartmann & Spit, 2016). In their comparison of the US, Australia, UK and the Netherlands, Meijerink & Dicke (2008) observed that shifts towards an FRM based on private interests are accompanied by increasing possibilities for private actors to participate in policymaking. Whereas Dutch flood risk policy remains strongly directed to public interests but is limited in its opportunities for public participation, the opposite applies to the UK.
Remarkably, we do not witness a similar trend in Flanders. While the Flemish government strives for enhanced citizen involvement in the implementation of its policy, no corresponding involvement is provided for in its decision-making. In its 'progress report on water nuisance' of 2015, the government announces that water safety plans will be drafted at catchment scale, based on the results of the FRMP-study (CIW, 2015). While this could be a good opportunity to open up the decision-making, current pilot projects include only governmental stakeholders in early stages. Nonetheless, the survey of Tempels et al. (submitted), found that about 42% of the population wishes to be involved in finding solutions to the flooding issue in the Dender basin.

As discussed above, sharing responsibilities (co-delivery) without involving residents in decision-making (co-planning) challenges the legitimacy of FRM. We thus argue that the government should open up the debate and allow residents to participate in FRM decision-making processes. It should however be careful on how to do so. Boonstra and Boelens (2011) argue that public participation processes set up by the government are too strongly based on governmental preconditions, resulting in many cases into just a 'public support machine'. In contrast to a hierarchical structure as is in place today, sharing responsibilities requires a horizontal governance system (Boonstra, 2015). Instead of merely complementing co-delivery demands with co-planning, we therefore believe it would be more desirable to strive for a comprehensive form of co-production, which anticipates and responds to co-evolutions taking place within the society subsystem. Hence, co-production should not only be comprehensive in terms of the different stages in which citizens are involved, but also by paying attention to developments evolving outside the policy cycle itself. In deliberation, it is discussed what is the scope of the problem, what should be the objectives of FRM and by which measures should these be pursued, and what should be the role of all the involved parties bringing these into practice.

Through comprehensive co-production, a more balanced distribution of responsibilities could be attained, setting conditions to make co-evolutionary planning processes possible. Instead of pre-defining objectives and measures, water authorities and spatial planners engage with the dynamics at place in other FRM subsystems. The exact ways in which societal goals (such as lowering flood damages) are attained are thus unknown beforehand. This "planning of undefined becoming" is not aimed at developing policies on itself, but at building networks and dynamics of mutual actions (Boelens & De Roo, 2016). In deliberation, authorities and citizens define their mutual roles and

responsibilities in FRM. Instead of introducing top-down objectives and solutions or exclusively supporting bottom-up initiatives, policymakers horizontally cooperate to capitalize, strengthen and complement existing social and economic capital. All actors involved, i.e. authorities, residents and other societal actors, have their own relative independence in their sphere of action. Therefore policymakers should acknowledge the discourses and framing of problems and solutions prevalent among non-governmental actors. Consequently, the results of these processes will never be fixed, but emerge in the co-evolving domains of actors, their networks and changing surroundings.

This dual approach sets out two complementary roles for governments. On the one hand, co-produced policies allow policymakers to set legitimized conditions for increased personal flood risk responsibilities. By including citizens both in FRM agenda-setting and decision-making, input, output and throughput legitimacy become intertwined. On the other hand, governments can participate in co-evolutionary processes, so that FRM is not only a matter of governmental action, but that all actions that influence flood risks, including those of societal actors, become aligned.

Conclusions

Similar to several other countries in Europe and beyond (e.g., Johnson & Priest, 2008; Bubeck et al., 2013; Walters, 2015), authorities in Flanders show an interest to increase the involvement of citizens in the delivery of flood risk management (FRM), in order to improve its effectiveness and efficiency. Given the fact that the trend towards co-production in FRM is relatively recent, literature remains unclear as to what are the opportunities of and barriers to a higher citizen involvement in the implementation of FRM. Following the framework of Mees et al. (2012), this paper compares discourses and practices on citizen co-production among the population and public officials within the Dender basin, and more specifically Geraardsbergen, from the perspectives of fairness, effectiveness, efficiency and legitimacy. By doing so, the paper provides insights into the barriers towards enhancing co-production and reflects on how these could be overcome.

Our research revealed a significant gap between the viewpoint of governmental water managers and residents of flood-prone areas, concerning flood risk responsibilities. While public officials expect from an effectiveness/efficiency perspective that citizens share responsibility in handling flood risks, residents of flood-prone areas in the Dender basin consider it a main or even exclusive responsibility of government (fairness & legitimacy perspective). We argue that this misfit in discourses can potentially hamper the effectiveness and legitimacy of FRM severely.

In order to make a co-produced FRM possible, a clearer distribution of responsibilities is desired. Today, the boundaries between public and private responsibility in Flemish FRM are blurred: informal norms assume the government is responsible for protecting land from flooding, even though the law does not define this. As Mees et al. (2014) point out, an explicit distribution of responsibilities is key for a legitimate FRM. In the UK, France and Germany, first steps hereto were made with respectively the ‘Making Space for Water’ strategy (2004), the Act on the modernisation of civil security (2004) and the “Wasserhaushaltsgesetz” (2009) (Johnson & Priest, 2008; Bubeck et al., 2012; Larrue et al., 2016). In Flanders, the shift towards increased citizen responsibility has up to this moment not been institutionalised in any formal policy document yet.

Institutionalising flood risk responsibilities would be a first but insufficient step to engage citizens in a more fruitful co-evolution between public and private flood risk actions. Several authors claim that an increase in citizen co-delivery should be accompanied by increasing opportunities for public participation in decision-making (co-planning) (Steinführer et al., 2009; White et al., 2010; Roth & Winnubst, 2014). In this paper, we argue that the government should aim for a comprehensive co-

production, which does not only include citizen participation in every stage of the policy cycle but also acknowledges and respects the co-evolutions taking place outside the policy cycle itself. Instead of pre-defining management goals, policy development should allow a “planning of undefined becoming” (Boelens & De Roo, 2016). In deliberation with societal actors, such a process defines common goals and roles of competences and responsibilities. By doing so, policymakers and citizens can foster a more fruitful co-evolution between the state and societal subsystems of FRM.
How could such an approach be applied in the Dender basin? In the near future, the Flemish government plans for the development of water safety plans at catchment level. For now, it remains unclear how participation will be organised in the draft of these plans. We argue it would be wise to involve the residents of these catchments from the start, e.g., through the existing action committees and neighbourhood councils. The results of the FRMP-study could form a useful starting point for discussion but should not pre-define the objectives of the deliberation process. These objectives, the actions to reach them and the role of the involved parties should be determined through the deliberation itself, acknowledging the existing social and material capacities within society. This way, the planned water safety plans could be a first chance to establish a more fruitful co-evolution.

By suggesting a co-evolutionary approach to FRM, this paper elaborates further on co-evolutionary planning theory and contributes to the debate on public-private responsibilities in FRM. The concept of co-evolution has found its way to the theory of spatial planning, because it provides a useful tool for addressing the complex relationships between different land use functions (Boelens & De Roo, 2016). Within the shift towards flood risk management, we believe the co-evolutionary perspective provides valuable insights for the reciprocal adaptive management of land and water as well. Further research is needed to identify conditions to make co-evolution between governments and residents in FRM more fruitful. Pilot cases on the other hand could test and demonstrate the potential of this approach.

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