

# FLOOD PREPAREDNESS AND COMMUNITY RESILIENCE IN SOUTHERN LIMBURG



Photo 1: (Source: Twan Wiermans)

Title: Flood Preparedness and Community Resilience in Southern Limburg

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## ABSTRACT

Local communities surrounding the Maas in South-Limburg have dealt with flood risks for generations. In 1993 and 1995 the Maas reached critical high water levels, which caused large-scale flood disasters. As a response, powerful flood defenses were installed under the 'grensmaas' plan. However, climate change developments in the past decades, resulting in more frequent and intensive rainfall patterns, have ensured that not all flood risks are taken away, despite the presence of these engineered defense systems.

With regard to the possibility of future floods, this research aims to assess social impacts of past flood events, and flood preparedness through examining the development of implemented preparedness measures in governance (social resilience), and community resilience building strategies over time to see what elements did – or did not – contribute to disaster risk reduction. The paper then investigates if, how and to what extent community resilience building strategies are incorporated and strengthened in these preparedness measures.

A qualitative research approach was adopted in which both inhabitants and planners engaged in the implementation or creation process of preparedness measures were interviewed. Results were triangulated using document and media analysis. It was found that community resilience is decreasing, as local communities underestimate the risks due to increased sense of safety the flood defense systems and thoroughly adapted preparedness measures have brought along. A sense of urgency to engage in flood preparedness or community resilience seems to be lacking among inhabitants, especially within newcomers.

Community resilience building strategies are incorporated in the preparedness measures, but remain largely passive. Finally, this research proposes three policy recommendations for preparedness measures to actively enhance community resilience through promoting the sense of urgency within Maas communities

**Key words:** floods, flood preparedness, preparedness measures, social impact assessment, community resilience, social resilience, disaster risk reduction.

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## 1. INTRODUCTION

The Maas river is an international river that flows through parts of France, Belgium, and the Netherlands before emptying into the North Sea. The Maas and its tributaries form a crucial part of life in the Netherlands. Through shipping traffic and leisure related activities, the Maas brings about large economic benefits. Moreover, the river serves as an important source for drinking water and functions as an important ecosystem for allowing various species of wildlife to thrive. Therefore, there are great national interests in maintaining, preserving and managing the quality of the river Maas (Rijkswaterstaat, 2021). However, this river can simultaneously be seen as a threat since its discharge levels are highly dependent on the amount of rainfall and snowmelt within the catchment area. In 1926, 1993 and 1995, extreme, long-lasting periods of rainfall caused the river to reach unprecedented high discharge levels and flood its overflow planes, damaging nearby communities. Flooding hazards can cause great socio-economic and environmental disruption to the affected communities. Vulnerabilities in the communities surrounding the Maas exposed local inhabitants to socio-economic damages (e.g. evacuations, property damage) as well as emotional damage (e.g. fear, worry). During the most recent Maas flooding of 1995, roughly 250.000 people were evacuated, mainly in the province of Limburg. The total economic damage was estimated at around 74 million euros, and local affected communities still cope with feelings of fear, loss and anger (De Limburger 2021).

Resulting from these floods, new mitigation measures were implemented by national and local governments aimed at reducing future negative impacts. In 1997, the programmes ‘Maaswerken’ were introduced. These consisted of a set of ongoing projects addressed to build better high water protection systems and provide room for the river in all areas of the Maas. Under the ‘grensmaas’ project, that was implemented as part of the ‘Maaswerken’ around the Maas in South-Limburg, the river was deepened and widened, floodplains were broadened, dykes were relocated and raised, and sluices were installed along the course of the river. The aim of the plans was to protect inhabitants against water levels that occur once in 250 years. Moreover, the ‘grensmaas’ project was also realized to facilitate shipping routes and create more natural areas and green spaces around the river (Rijkswaterstaat, 2018). Further action to enhance flood preparedness was taken through setting goals for flood risk protection, prevention and crisis management in the case of high water level hazards (Ministry of infrastructure and Water Management, 2015). Also, a new, more detailed contingency plan was formulated that states what action needs to be taken at what stages of high water hazards (Veiligheidsregio Zuid-Limburg, 2020). However, ongoing debates about the safety norm of these protective and preparedness measures are causing disagreements between the various stakeholders. Conflicting interests about increasing safety standards in relation to growing costs, reduced liveability and protection of cultural heritage have caused frictions among authorities and affected communities (De Limburger, 2021; De Limburger, 2021).

Despite the protection and prevention efforts, global climate change will result in more extreme weather patterns with increased precipitation rates. Therefore, climate change developments will alter the frequency and intensity of rainfall and snowmelt and thus alter the amount of fluvial discharge of the Maas in the future (Devkota *et al.*, 2020; Lavell *et al.*, 2012). This will enlarge the risk of high water levels and flooding of the South-Limburg region despite the presence of the aforementioned flood defense systems. Risk management embodies more than just technological defense systems and engineered solutions, but requires careful understanding of social dimensions of risk too. Especially with regard to climate change, addressing people’s exposure and vulnerabilities is key to reducing disaster risks (Peduzzi, 2019; Imperiale & Vanclay, 2021). Communities living in the flood-prone regions of the Maas river basin will need to develop resilience to reduce their vulnerability and exposure to flood disasters and evolve to a way of living that can better cope with the increasing water levels and flood risks. In order to build and sustain community resilience, efficient preparedness measures such as early warning systems can facilitate this process through monitoring, planning, communication, training and enhancing disaster risk awareness (Johnston &

Paton, 2001). If communities are actively involved in such preparedness procedures and develop knowledge on adequate and timely flood response, then they become collectively more resilient to flood risks (Mehring *et al*, 2018; Herovic *et al*, 2018). On the other hand, experts engaged in the planning and implementation processes of these preparedness measures can develop resilience by learning from past failures. Stronger resilience and coping strategies allow for better control of the preconditions of a disaster through reducing and addressing vulnerabilities within a community. Flood protection measures such as dykes or quays also reduce vulnerabilities from a technical perspective. Next to flood prevention engineering measures, building and maintaining community resilience is crucial to enhance disaster risk reduction (DRR).

This paper aims to fill these gaps and analyse the local social processes that led to community resilience in the South-Limburg Maas river basin, examine the existing preparedness measures and investigate whether, how and to what extent they engage and strengthen community resilience in this area.

### 1.1. RESEARCH AIM AND QUESTIONS

The aim of this research is to investigate the implemented preparedness measures and understand whether, how and to what extent these engage and strengthen community resilience in flood-prone areas of the Maas river in South-Limburg. Disaster preparedness consists of several components that will be discussed in-depth throughout this research. The central research question this paper aims to answer is: *“To what extent do preparedness measures implemented in the flood-prone regions of the Maas river basin in South Limburg engage and strengthen local community resilience?”*

The results of this research can be used to contribute to the disaster risk reduction and flood prevention discourse by providing further insights on the drivers and constraints that lead - or do not lead - preparedness measures to build community resilience and enhance DRR and flood prevention in flood-prone regions in South Limburg. Through adopting a qualitative research method approach, the perceptions and experiences of local inhabitants associated with past flood events, and local people’s coping strategies and activities to reduce flood risks will be investigated. Additionally, a qualitative approach allows us to comprehensively examine the preparedness measures that are in place and how these are perceived by local communities. Data from semi-structured interviews will be triangulated using document and media analysis.

The following sub questions will guide the research process:

1. What is community resilience, and how can it be defined and understood in the context of DRR, disaster preparedness and flood prevention?
2. What were the most disastrous flood events that occurred in the South Limburg region?
3. What were the negative social impacts that affected local community wellbeing as perceived and experienced by local inhabitants during these flood events?
4. How did local people living in flood-prone areas of the Maas in South Limburg put community resilience in action and develop it over time to cope with the negative impacts of floods, and enhance local prevention and preparedness measures in the region?
5. What are the preparedness measures that have been implemented in local communities after these disastrous events?

6. To what extent do these preparedness measures include community resilience-building strategies in their design and implementation?
7. How are these preparedness measures perceived by local communities living in these flood-prone areas of the Maas?
8. What influence do these preparedness measures have on the cognitive and interactional dimensions of local community resilience?

## 2. THEORETICAL FRAMEWORK

### 2.1. SOCIAL IMPACTS OF DISASTERS

A good understanding of social impacts of flood disasters can help to effectively manage the recovery process and make recovery interventions capable of understanding and reducing the negative consequences of the disaster on affected local communities, and addressing local community needs. Social impact assessment (SIA) is also a useful tool in the preparation phase of a disaster. SIA has the potential to enhance the capability to foresee likely (social) impacts, and reduce vulnerabilities by raising hazard awareness or by proposing adequate prevention and preparedness measures (Aledo *et al.*, 2021), thereby playing a key role in enhancing DRR and community resilience (Imperiale & Vanclay, 2016b).

Disasters can have a large variety of impacts on people or communities depending on, among others, the characteristics of the hazard and the social, cultural, economic, political, historical and environmental compositions of the affected community. It is therefore important to recognise and adopt a community-specific approach during social impact assessment (Vanclay, 2002). Social impacts can manifest themselves both in the quantitative and qualitative domain. Vanclay (2002) continues to make a distinction between social impacts and social change by stating that while these concepts relate to each other and might overlap, they differ in the sense that social change is not a result of local social compositions. Social impacts are classified as the following impacts on: (Vanclay 2002; Becker & Vanclay 2003).

- people's daily life
- Community life
- Culture
- Politics
- Environment
- Health & Wellbeing
- Personal & property rights
- Fears, perceptions and aspirations



Planning interventions, based on SIA, that are aimed at disaster preparedness can have significant social and environmental impact as well (Slootweg *et al.*, 2001). Slootweg *et al.* (2001) argue that planning interventions can modify the physical environment (and its functions), and thus may also alter social structures and vice-versa. This impact is not inherently negative, but can also be positive.

## 2.2. DISASTER PREPAREDNESS

Disaster preparedness can be seen as the extent to which an individual or community is capable of effectively preparing for and responding to a disaster situation. It encompasses multiple practices from private precautionary measures (e.g. adapting your home to reduce possible flood damage) to risk knowledge or risk awareness (Kreibich & Thieken, 2008). Disaster preparedness, in this paper, is defined as the set of behaviours and measures - tangible or intangible - taken by people, communities or authorities that manifest themselves in between the phases before (hazard research) and after (disaster research) disaster impact, in order to anticipate action and respond more timely and effectively (Tierney & Sutton, 2006; Gillespie & Streeter, 1987). This definition of preparedness takes into account the multiple geographical scales (household, local, regional, national) on which these actions can be taken as well as ensuring an appropriate distribution of resources for disaster response (Tierney & Sutton, 2006). These resources can also be tangible and intangible through for example knowledge spread or training & exercise. How disaster preparedness is perceived within a community is strongly dependent on external factors; for example past experiences with these hazards (Kreibich & Thieken, 2008, Becker *et al.*, 2012; Fox-Rogers *et al.*, 2016). As mentioned before, disaster preparedness can take many forms, and it is often addressed to enhance coping strategies and community resilience. Resilience in the form of preparedness behaviour and action-taking in individuals is increasingly likely when this behaviour is sustained by the community and by authorities (Johnston & Paton, 2001). Disaster preparedness focuses on empowering local communities, and their localities and resilience before disasters occur (Tierney & Sutton, 2006).

## 2.3. PREPAREDNESS MEASURES

Preparedness measures are the set of measures and planning interventions imposed by authorities that are aimed at increasing disaster preparedness within a community. This paper identifies the main type of preparedness measures as implemented in the focus area of this research (Southern Limburg). Numerous preparedness measures are actively being carried out by different governmental bodies on national, regional and local level (Ministry of infrastructure and Water Management, 2015; Veiligheidsregio Zuid-Limburg, 2020; Rijkswaterstaat, 2021; Waterschap Limburg, 2021).

- Monitoring of discharge levels, analysis and predictions of flood risks and early warning systems; making sure communities have enough response time.
- Planning of crisis situations/scenarios; detailed plans that accurately describe what actions are taken by which organisations at certain discharge levels. This includes evacuation plans.
- Risk assessment; regular new assessments and tests of flood risk and, if necessary, make adjustments in planning.
- Citizen collaboration in risk management; engaging citizens and citizen organisations in decision making processes.



- Educating, training and practice of crisis situations; raising risk awareness by providing information and enhancing disaster response by training institutions to properly use and/or distribute resources.
- Distribution of adequate resources; ensuring affected communities receive proper resources for effective disaster response (e.g. pumps, mobile dykes, sandbags).
- Effective communication before and during a disaster situation. Thereby improving self-sufficiency in disaster situations through enhancing protective behaviour in individuals and communities.
- Recovery interventions; compensating possible economic or emotional damage, and cleaning possible environmental damage.

Challenges in effective implementation of the above mentioned measures can be divided into technological and societal challenges. Over-reliance on technology can be dangerous, given that technological monitoring and prediction models contain relatively high degrees of uncertainty (Xu *et al.*, 2007). Societal challenges are related to translating information from early warning systems (EWS) to the public, and ensuring good communication so that EWS can be adequately understood by local inhabitants and trigger effective community response (Basher 2006; Perera *et al.*, 2020). EWS are therefore not only tangible alerting mechanisms, but also comprise careful information and communication to make them have their desired effect (Basher, 2006). The level of community engagement is important for planners to keep in mind during the creation and implementation process of these measures. Given that communities are heterogeneous entities, preparedness measures need a high level of community involvement in order to increase their effectiveness (Mehring *et al.*, 2018; Imperiale & Vanclay, 2019). If implemented correctly, through adequate community engagement and empowerment strategies, preparedness measures have the potential to enhance the cognitive and interactional dimensions of community resilience (Herovic *et al.*, 2018) and improve DRR (Pappenberger *et al.*, 2015).

## 2.4. COMMUNITY RESILIENCE

In recent years, community resilience has frequently been conceptualised in academic literature, and it has moved from a rather blurred and vague concept to a more clear definition. This paper adopts the conceptualisation of community resilience as described by Imperiale & Vanclay (2016a; 2016b; 2021). Community resilience is defined as a dynamic set of - cognitive and interactional - social processes that enable local people and communities to learn from past failures, crises and disasters and transform towards addressing local vulnerabilities, risks and impacts and enhance (future) community wellbeing. This allows communities to respond to disruption and change through processes of adaptation. Community resilience has cognitive and interactional dimensions. The cognitive dimension encompasses the learning capabilities from past (flood) disaster and adaptation strategies such as: perceptions of shared needs, vulnerabilities and capacities; feelings (e.g. empathy); attitudes (e.g. caring, social responsibility); local knowledge, beliefs, values, narratives, sense of community, sense of place and sense of risk. The interactional dimension covers the adaptation processes of transformation and how this learning can be seen in practice, through collaborative actions and behaviors, including mutual aid, cooperation and socially-sustainable governance (Imperiale & Vanclay, 2021)

Community resilience, rather than being a fixed set of skills, capacities, preconditions or desired outcomes, is a dynamic process that enables people to harness their capacities and resources and achieve their desired outcomes when they are challenged to cope with negative risks and impact of crisis situations or disasters. The community goal is not to return to a similar pre-disaster state, but rather to be able to find a way to reduce vulnerability and learn to cope better with these hazards in the future.

Understanding community resilience also requires understanding of local communities' approaches in developing coping strategies. Whereas imposed, top-down 'command and control' approaches have the potential to destroy the effectiveness of community resilience by disregarding localities, the bottom-up approach is more effective as it takes local community mechanisms into account (Imperiale & Vanclay, 2016). This bottom-up approach demands that planners and decision-makers have to enact effective community engagement and empowerment strategies while planning, implementing, and maintaining DRR and preparedness measures (Cavaye & Ross, 2019). A better understanding of community resilience on the local scale, allows for better SIA and better assessment of the impact of disaster preparedness measures.

## 2.5. SOCIAL RESILIENCE

Whereas community resilience looks at the processes of learning and transformation towards sustainability in times of crises and disasters at the local community level, social resilience refers to the ability to which societies learn and transform towards sustainability across multiple scales of social-ecological governance (Adger, 2000; Kwok *et al.*, 2012; Matarrita-Cascante *et al.*, 2017; Imperiale and Vanclay, 2021). Community resilience focuses on community dynamics, while social resilience focuses on changes in governance which are determined not only by the power of social institutions and social networks, but also by the pre-existing economic or political state (Kwok *et al.*, 2012).

Within this paper, social resilience is regarded from an institutional or planner's perspective as the adaptive capacity of institutions to adjust their policies and planning interventions based on the learning processes that occur at the local community level from past failures. Social resilience then also encompasses the transformation processes of old policies into new, improved real life policies or measures for more effective outcomes in terms of DRR and resilience. In short, social resilience, here, is defined as the process of looking at pre-existing institutional policies and preparedness measures and transforming these to improve their effectiveness by learning from past flood events and reflecting on which elements contributed - or did not contribute - to greater wellbeing, while taking into account the current social, political, economic and environmental characteristics of the community and of the dynamics of local community resilience.

## 2.6. DISASTER RISK REDUCTION

The conceptualisation of disaster risk reduction (DRR) used in this paper is based on the United Nations International Strategy for Disaster Reduction (UNISDR) definition of DRR: "*the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.*" (UNISDR, 2019). This encompasses all actions and measures taken that are aimed at reducing the risk of disaster throughout all stages of risk management. A disaster can be seen as the product of vulnerability and hazard. While a hazard is the potential, future occurrence of a natural phenomenon or physical event having negative effects to vulnerable and exposed elements, vulnerability can be understood as the degree to which humans (and their tangible and intangible belongings) are exposed to a hazard, in any form (van Aalst *et al.*, 2012).

Reducing disaster risks can partly be achieved through prevention measures and technological defense systems. Within the focus region of this paper, numerous techno-scientific efforts at flood risk reduction were taken in the form of the aforementioned 'grensmaas' plan. The other part of DRR requires understanding of social dimensions of disasters to better evaluate the underlying social factors of people's exposure and vulnerabilities to the (flood)

hazard, and learn how to reduce these (Peduzzi, 2019). For example through increasing people’s risk awareness. The DRR concept is closely interlinked with disaster preparedness and community resilience. Disaster preparedness, as a key component to DRR, is aimed at reducing these social vulnerabilities and exposure through preparedness planning and preparation, which lead to improved community adaptation strategies that can minimize the negative impacts of a hazard.

## 2.7. CONCEPTUAL FRAMEWORK

The conceptual model (*figure 1*) shows how the key concepts, as established in the theoretical framework above, relate to and interact with each other. Past preparedness measures were aimed at limiting the negative impacts of a past flood event. Flood events that took place in the past caused community resilience to emerge within the affected communities. Factors that shape this community resilience, such as risk awareness, a sense of community, sense of place, sense of empathy, social responsibility towards those most exposed and/or affected within a local community, influence the willingness of people to learn and transform from past failures and enhance future policies and interventions. Personal experiences with past flood events strongly influence the preparedness perception and behaviour of an individual or community towards flooding hazards (Fox-Rogers *et al.*, 2016; Kreibich & Thieken, 2008). For example, disaster preparedness in communities that have personally experienced flooding impacts in the past is higher than disaster preparedness in communities that have never experienced this before.

Preparedness measures continuously transform through a process of social resilience based on SIA, risk assessment and lessons learned from previous disasters. Ideally, these learning lessons should include understanding of affected local people’s needs and perceptions, and the design of effective local community resilience-building strategies. This ultimately leads to the creation and implementation of new preparedness measures which should engage and strengthen the resilience of communities in their localities and help them cope with future high water hazards.

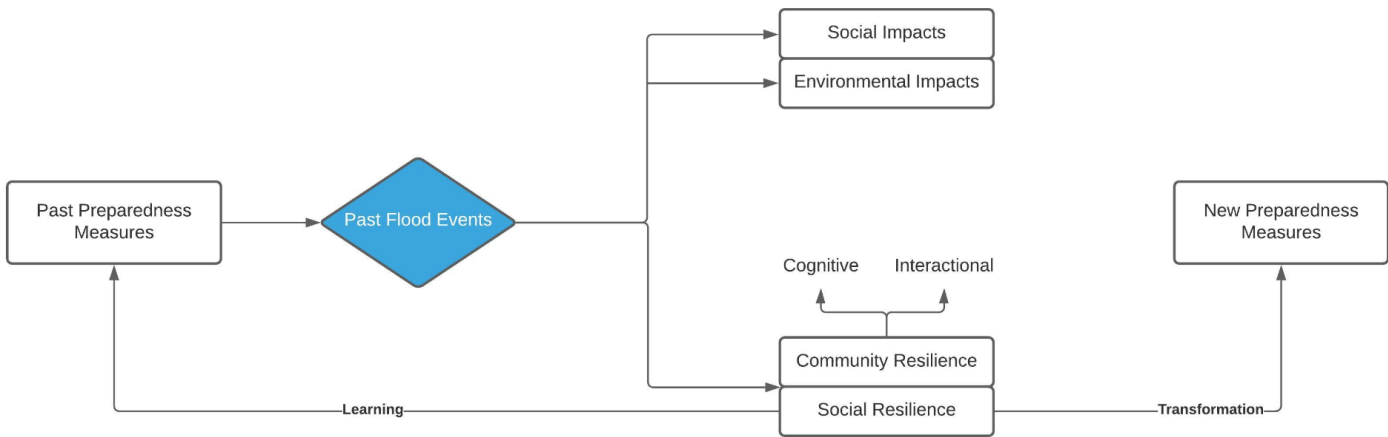


Figure 1: conceptual framework. (Source: this paper)

## 3. METHODOLOGY

### 3.1. PRIMARY DATA COLLECTION

#### 3.1.1. INTERVIEWS (SEMI-STRUCTURED)

The primary data for this research was collected in the form of semi-structured interviews. Semi-structured interviews allow for primary data collection that adheres to a desired structure, but simultaneously leaves room for the interviewee to talk freely about their views, experiences, feelings and attitudes towards the topic. As these aspects play a key role in this research, the main focus of this paper will be on qualitative interview data, which is then triangulated by secondary data. The interview guide used during the semi-structured interviews can be found in *Appendix A*.

The aim of the interviews was to answer the main research question and the subquestions. Topics included: past and current preparedness measures, the perception of disaster preparedness, experiences with past flood events, (negative) impacts of previous flood events and how they relate to the emergence/development of community resilience over time. This qualitative data was collected by interviewing inhabitants and planners within the research area. Several initiatives are set up in this region that are aimed at raising risk awareness, enhancing disaster preparedness, communication with authorities and defending community interests.

Through interviewing both local inhabitants and planners that are active or have been active in the South Limburg region, this paper gained an understanding in flood history as well as in the negative social impacts on affected people's wellbeing. Asking questions addressing the implemented preparedness measures has provided an overview of how inhabitants within the research area perceive these measures and how that was influenced by their previous experiences with high water threats. Moreover, the interviews yielded examples of community resilience over time, and whether and how local community resilience was engaged and strengthened by past preparedness measures. In the reflection process, this paper can assess the relationship between the cognitive and interactional processes of community resilience and preparedness measures. Interview data was transcribed and coded with the use of 'Atlas.ti'. The coding tree can be found in *appendix B*.

#### 3.1.2. RECRUITMENT OF PARTICIPANTS

This research conducted 10 semi-structured interviews to gain sufficient qualitative data that could be triangulated using secondary data collection. The characteristics of the interviews can be seen in *Figure 2*. Within the group of interviewees, planners and inhabitants are distinguished. Interviewing planners will give an expert insight into how preparedness measures are implemented in practice and how learning and transformation processes have changed these measures over time. This data can provide insight on the planner's role in this process, as well as assess the negative impacts from past flooding events from a professional's perspective. The recruitment criteria for planner interviewees were established as (1) the planner is or has been active in the South Limburg river basin, (2) the planner is/was engaged in the creation or implementation process of preparedness measures within the region. All planners that were interviewed also have experience with high water themselves.

Inhabitant interviewees must be representative for the target population in order to properly analyse and interpret the qualitative findings. The target population in this research consists of people that live within flood-prone regions of the river Maas in Southern Limburg and have experienced impacts from at least one flood event in the past. The selection criteria for inhabitant interviewees were based on (1) The inhabitant lives within the research area, (2) The

inhabitant has experienced at least one flood event in their lifetime, (3) the inhabitant engages in, or has engaged in, some form of community resilience in the short term and/or long term after a flood event.

This paper adopted a mixed sampling approach of purposeful sampling and snowball sampling to recruit interviewees. Purposeful sampling has yielded planner and citizen participants based on the abovementioned selection criteria, and was found through acquaintances and contacting local authorities and communities in the target area via email. A snowball sampling method was used from the first interview onwards. The recruitment process started from the 15th of March 2021. Due to government set regulations with regard to the Covid-19 pandemic, the interviews took place via google meet or by phone, depending on the interviewee's preference.

<b>Interview</b>	<b>Role</b>	<b>Organisation</b>	<b>Location</b>
Interviewee 1	Planner	Waterschap Limburg	South-Limburg
Interviewee 2	Inhabitant	-	Itteren
Interviewee 3	Inhabitant	-	Grevenbicht
Interviewee 4	Inhabitant	-	Illikhoven
Interviewee 5	Inhabitant	-	Borgharen
Interviewee 6	Inhabitant	-	Borgharen
Interviewee 7	Inhabitant	-	Itteren
Interviewee 8	Inhabitant	-	Itteren
Interviewee 9	Planner	Consortium Grensmaas	South-Limburg
Interviewee 10	Planner	Rijkswaterstaat	South-Limburg

Figure 2: Characteristics of the interviewees (Source: this paper)

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### 3.1.3. ETHICAL CONSIDERATIONS

Throughout the research process, total anonymity of the respondents was ensured. No names, addresses or any other information that could identify the identity of the respondent were used during the analysing and coding process. Interviewees were fully notified of the research aims and goals and were asked to sign a consent form beforehand. The respondents could have withdrawn their participation for any reason if they had wished to do so. On top of that, during the qualitative data collection process, the author has avoided influencing the interviews in any way possible by maintaining a neutral perspective. This is key in preventing positionality and ensuring the power balance between the researcher and the respondents was equal.

## 3.2. SECONDARY DATA COLLECTION

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### 3.2.1. MEDIA ANALYSIS

Next to semi-structured interviews with local inhabitants and experts engaged in the design and implementation of preparedness measures, this paper made use of media & document analysis to support the primary data collection

method. This paper retrieved media articles from the Nexis Uni database provided by the University of Groningen. Relevant governmental documents on risk assessments and preparedness measures were mainly retrieved from authorities such as the ministry of infrastructure and water management, Rijkswaterstaat, Waterschap Limburg or other local authorities which concern themselves with implementing preparedness measures and planning interventions within the region. This paper used media analysis to gather data on past flood events and attitudes and discourse towards flood preparedness and flood safety. This was useful in shaping the questions for the interviews and triangulate findings.

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### 3.2.2. DOCUMENT ANALYSIS

Complementing this media analysis, this paper used government documents to gather data on the preparedness measures that are put in place as a response to the past flooding, and what their intended effect is. The flood risk management plan for the Maas and the contingency plan (Ministry of Infrastructure and Water Management, 2015; Veiligheidsregio Zuid-Limburg, 2020) were useful tools to investigate what, and the extent to which, preparedness measures are implemented. This information aided in properly setting up the interview guide, and triangulate findings. Preparedness measures can be perceived differently by individuals or a community as to how they are intended, therefore it was helpful to interview both planners and inhabitants. Triangulating findings using document and media analysis are useful for supporting arguments and broadening perspectives, thereby reducing possible biases.

## 4. RESEARCH AREA

Within the geographical areas of the Dutch Maas river basin, this research will focus on the Maas river basin in South-Limburg where interventions were made under the ‘grensmaas’ plan, and where safety region South-Limburg is active, as seen in *figure 3*, for multiple reasons. Firstly, the Maas in Southern Limburg is the first part of the river that flows through the Netherlands. Before there were properly established international cooperation networks, Southern Limburg would have the least preparation time when high water levels were announced (Municipality of Maastricht, 2017), and was decisive in the proper communication of water- and discharge levels to other Dutch Maas communities that were located further downstream. Secondly, this region has experienced the most disastrous consequences of flood events in 1993 and 1995 from any other region in Limburg in terms of socio-economic and environmental damage (Wind *et al.*, 1999), with the villages of Borgharen and Itteren playing a central role. Thirdly, due to regular high peaks in discharge levels, especially during winter seasons when there are low evaporation rates, this region is potentially at-risk despite technological interventions that were made under the grensmaas plan (Xu *et al.*, 2007). The possible height water can reach during flood events is also depicted in *figure 3*.

# Research Area

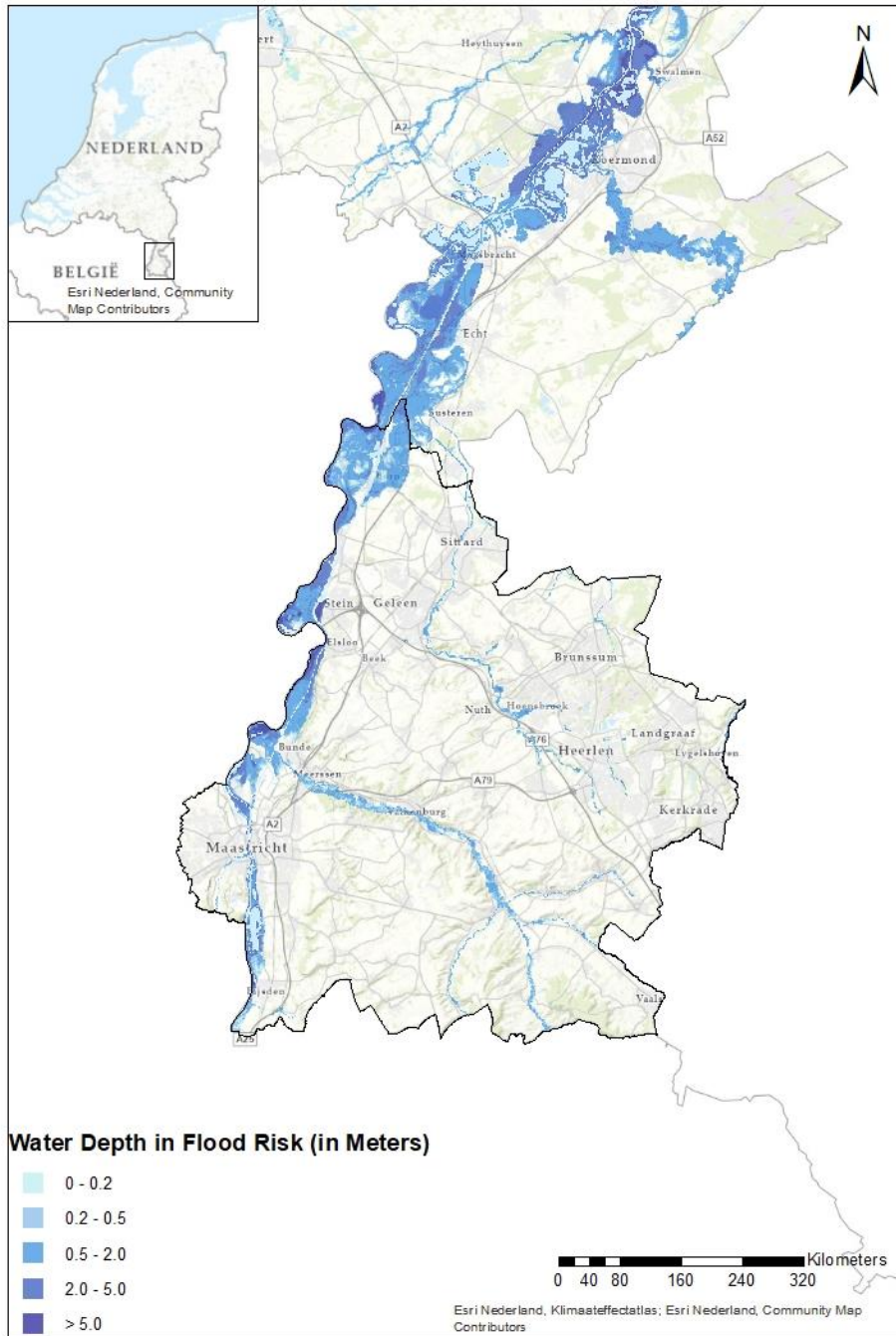


Figure 3: Research area (source: Esri; Risicokaart.nl)



## 5. RESULTS

### 4.1. HISTORY OF FLOODS

The South-Limburg region has a long history with the Maas river, and its nearby communities have developed a close relationship with the river over the past centuries. The region is characterized by various floods and high water issues. Inhabitants of nearby communities were used to the fact that the Maas would break its banks every so often due to a lack of adequate protective systems. Yet, these high water events were not perceived as threatening or harmful to overall community well-being. In contrast, the rising Maas was mostly perceived as positive, beautiful or exciting as explained by interviewee 3: *“In ‘81 we first had reasonably high water in the summer. That was impressive and beautiful, and there was no nuisance whatsoever, so I merely thought it was beautiful.”*

Only in 1926, 1993 and 1995 these regular high water events reached a critical point due to unprecedented discharge levels further upstream. This led to massive flood events, large-scale evacuations and serious property damages throughout South-Limburg. The water levels would reach heights of +46.10, +45.90, and +45.71 NAP (Normaal Amsterdams Peil) respectively, measured in Borgharen (Rijkswaterstaat, 1995). During these flood events, the river water would flood streets, thereby cutting off access to whole communities and would come up into people’s homes causing connection to services such as electricity or gas to be cut off. This left inhabitants that did not opt for evacuation in the dark and cold. Interviewee 7 describes the fear the water caused at those moments: *“All of a sudden you are in the dark, there is no heater and you have nothing anymore. It was very frightening, at night. It was pitch black, there was only candlelight.”* Interviewee 9 also experienced this fear, but adds to that the fear of property or economic damage: *“You can’t imagine what it means when you are locked up with a meter of water in your own home, without electricity, in the cold, without any perspective. You really get the idea ‘my god, I have to pay for all this, how am i going to recover?’. Especially the fear of what the after-damages are.”*

During the flood events of 1993 and 1995 the municipalities, in collaboration with the safety region South-Limburg, Waterschap Limburg and Rijkswaterstaat issued an evacuation, with concerns that the current crisis would aggravate due to a possible dyke breach. Some inhabitants, especially the elderly were evacuated along with cattle.

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#### 4.1.2. IMPACT OF PAST FLOODS

The flood events of 1993 and 1995 were perceived as a disaster by most interviewees. Later, these were also classified as a disaster by the government. As a result, a national disaster funding (Nationaal Rampenfonds) programme was initiated by the national government, where direct and indirect costs related to flood damage were largely compensated. All interviewees mention that they, and their community had significant water nuisance. Interviewee 2 states: *“After the disaster of ‘93, I had a lot of garbage. I had to restore furniture, there was mud everywhere. You encounter it for months after. It was very, very unpleasant. We were lucky the municipality could cover most of the costs.”*

While most interviewees mention that there was an emotional impact resulting from the flood events, this was mostly reserved for the elderly, which were the most vulnerable within the communities. Sparse mobility of the elderly impairs the ability to move their belongings or evacuate when the water comes up too high. Interviewee 5 illustrates this: *“The emotional impact on the elderly who couldn’t move their own belongings was the highest. The second time in ‘95 they were evacuated immediately, they never wanted to experience it again.”*

Few interviewees mention that they do not believe the floods left any significant emotional damage. Interviewee 6, for example, says: *“In those Maas villages, the emotional impact was not big at all. Back in the day the Maas would*

*flood at least once a year, so people were used to it. This time it was extreme of course, but I don't believe that there was a lot of emotional impact in Borgharen at that time.*”. Economic impacts and property damage, on the other hand, were observed across all interviewees. For example, interviewee 7 elaborates on the significance of economic impact from flood events: *“When the Maas retreated, it was one big mess. (...) the houses are wet from the inside and outside (...) all the stuff that is wet or broken, that was actually the biggest impact.”*

From the interviews it can be stated that the flood events left no long-lasting emotional impacts, and, especially in relation to economic impacts, were rather insignificant. Also, the people who did suffer emotional consequences opted to move shortly after notices interviewee 8: *“The [emotional] impact wasn't too big, in our village the people were used to high waters, of course. There were people who moved out back then, they never wanted to experience it again. (...) but that disappeared rather quickly.”*

During impact assessment, it was found that in 1993 in the province of Limburg a total sum of 253,8 million guilders (115 million euro) in damages was reported, of which 38% property damage. In 1995, this was about 165 million guilders (75 million euro), of which 25% was property damage (Wind et al., 1999). An explanation for this discrepancy was the increased preparedness of institutions and inhabitants of 1995 in relation to 1993. Data on flood impact in 1926 remains insufficient.

Additionally, the flood disasters of 1993 and 1995 acted as a catalyst for policy development on the construction of improved defensive structures and creating room for the river. It demonstrated the need for the grensmaas plan to be put into action. Now that most of these protection measures have been engineered in South-Limburg, the area is protected against water levels with an occurrence of 1:250 years.

#### 4.2. DEVELOPMENT OF PREPAREDNESS MEASURES OVER TIME

Flood preparedness and former flood preparedness measures before the flood of 1993 were generally perceived as unsatisfactory by the interviewees. Prediction models were largely inaccurate, and proper authority response was sluggish, and in some cases not even present (Rijkswaterstaat, 1995). This was partly due to poor (international) communication and cooperation, which caused the region to receive relatively late warning signals, thus leaving limited preparation time for the government and inhabitants. The absence of scripted disaster scenarios and the lack of proper emergency training of governments and inhabitants also contributed to a very chaotic process, as interviewee 5 describes: *“In '93 there was a complete surprise of water. Nobody knew what to do. Everything was chaotic, it was one big mess. Emergency services were not ready, the municipality was not ready, the fire department was not ready, we weren't ready.”*

Moreover, nobody expected it was possible for the water to reach such heights and discharge levels, especially since almost no one had any references towards floods apart from numerous harmless high water events in the past. Communities and authorities did not know what to do, and the region had to rely on external assistance from Germany. Interviewee 8 explains: *“People were not prepared at all. 1926 was the last time. The Maas would often be high, it's a rain river, but that it would really break its banks; nobody expected that. In '93 that was a complete surprise. It was just mayhem, a lot went wrong, also in government assistance. They had to rely on the Germans (...) The governments were totally surprised and ill prepared, we could not expect anything from them. They had the biggest trouble regulating everything.”*

The failure of timely and effective EWS contributed to poor flood preparedness and a chaotic (preparation) process. Interviewee 2 elaborates on this by stating: *“Then came 1993, that was very bad. Enormous high water and there was almost no warning in advance. They had no clue how the situation would unfold. (...) It was a big mess to put it*

*lightly. We were evacuated by services from Aachen (Germany) because the municipality just couldn't handle it. The fire department came to help, but they had not enough resources nor people. It was one big mess."*

From the quotes above, it can be concluded that flood preparedness measures in 1993 were insufficient to adequately contribute to DRR. Roughly a year later, in January 1995, the Maas broke its banks again. Although some interviewees mention that it was unexpected that the Maas would flood twice in such a short timespan, flood preparedness was undoubtedly greater when compared to 1993. The flood event of 1993 has ensured that local communities were made aware of risks that are paired with the river. Social resilience processes of evaluating, learning and transformation from the 1993 disaster have also yielded new and improved flood preparedness measures. For instance, existing monitoring and data systems were analysed and improved, and evacuation processes were now planned in advance, so that communities were evacuated before the flood occurred. This is depicted by interviewee 8: *"After that [1993] they started recording statistics for when certain discharge levels would cause high water, the government also started to create all sorts of booklets, warnings etc. (...) People were warned in advance, in '93 that wasn't the case."*

The committee 'Watersnood Maas' was appointed in 1994 to make recommendations on how to improve future flood resilience through creating emergency plans, stimulating communication and coordination between governments and inhabitants, and improving river monitoring (Rijkswaterstaat, 1994). Improved monitoring and prediction models could translate to effective EWS, giving local communities and authorities more preparation time in anticipation of a flood. This meant that in 1995, monitoring and EWS provided about 12 hours of preparation time, doubling the situation of 1993 (Rijkswaterstaat, 1995; Waterschap Limburg, 2020). Emergency plans were adjusted in dialogue with local representative groups, based on elements that went wrong in the 1993 flood. An example of a lesson that was drawn, was the timely relocation of vehicles. Interviewee 7 illustrates this by specifying: *"In '93 many cars were not moved on time. Now the contingency plan states that everyone must move their cars to beatrixhaven at a certain discharge level. (...) Back then [1993], that went wrong and a lot of cars got destroyed. In '95 that went better, a lot was learned"*

After two disastrous flood events, the need for action was proven. This was partly realised with engineered solutions under the aforementioned grensmaas plan, but also through addressing vulnerabilities with improved preparedness measures. After the 1995 flood, the preconditions of the disaster were thoroughly analysed. Based on those results, preparedness measures have been adjusted to build social resilience and minimize future flood impact. The safety region (Veiligheidsregio Zuid-Limburg) has adjusted their protocols and scenario planning in such a way that it is made clear who acts at different emergency stages. Waterschap Limburg trains their employees yearly on proper distribution of their resources, with practicing to place pumps and installing mobile quays. Waterschap Limburg also introduced voluntary dyke guards within local Maas communities to inspect dyke quality when water starts to rise. In short, authorities are now highly prepared for emergency situations. A majority of interviewees, among which planners and inhabitants, confirm this: *"Those protocols are so full nowadays, that if high water were to come, the government would know all about it and not be surprised by the water anymore."* (Interviewee 3).

Furthermore, technological advances allowed for the rapid improvement of social resilience processes. Information is becoming more accessible through the internet, and monitoring instruments are becoming increasingly accurate, leading to improved and more effective EWS. Planner 10 notes: *"Technological advances have helped us tremendously. Nowadays, we work with calculation models and computer models. (...) There are no more models based on physical observations."*

It is important to note that as time progresses, new planners engaged in implementing these measures are coming in, and are increasingly likely to have no previous experience in dealing with floods. Therefore, in order to be effective, these preparedness measures must be updated and practiced regularly to transfer and maintain crucial practical knowledge. Interviewee 7 stresses this argument: *"Circumstances can change, even if they are only small things (...)*

*you see now that people are leaving at the Waterschap and at the dyke guards, the knowledge has to be kept up to date all the time.”*

### 4.3. EMERGENCE OF COMMUNITY RESILIENCE

Local communities surrounding the Maas were highly aware of the risk associated with the river. Before many had even experienced a flood event, early community resilience building strategies were already adopted. In general, interviewees were closely involved with the Maas. It was frequently mentioned that local inhabitants were knowledgeable about the periodic fluctuations in water levels, and adapted parts of their living environment to cope with the rising water. Planner 1, who is closely concerned with inhabitants of the region, illustrates that local communities had adapted parts of their home to the possibility of occasional high water events: *“Villages situated close to the Maas have the historical tradition that the Maas would rise every now and then. Therefore, they furnish their homes in a certain way. They didn’t use wooden floors, but stone floors. (...) They had a measurement point in their homes or backyards so they would know: if the Maas will rise this high, I know it will be that high in a couple of days.”* Adopting these early coping strategies and having risk awareness ensured that many interviewees never feared the Maas. The fact that the Maas would rise periodically was accepted and anticipated.

As these coping mechanisms get passed on throughout the years, the inhabitants develop a special relationship with the Maas, where it is in their DNA to be involved with flood preparedness, resilience building strategies and other matters regarding the Maas. Planner 9, who is also very involved with communities in South-Limburg, confirms this: *“A vast majority of inhabitants of Maas villages have often lived there for generations, and formed a special bond with the Maas. Cherishing the river as a panorama, but also a hate-love relationship that lies within their genes. That’s why they are prepared to engage in flood preparedness.”*

It can be concluded that communities were reasonably resilient before the extreme discharge levels of 1993 and 1995 occurred. Upon analysing community resilience in response to floods, two different dynamics regarding the emergence of community resilience and cooperative action have played - or are playing - a role.

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#### 4.3.1. COMMUNITY RESILIENCE IN ACTION

In the periods during a flood, all interviewees recollect excessive cooperative actions being undertaken aimed at minimizing negative flood impacts. Interviewees mention the spontaneous collaboration and cohesion that emerged in dealing with floods and their aftermath. As soon as the risk developed, local communities started helping each other by putting furniture high, opening shelters, and taking care of the elderly. In the direct aftermath of a flood, all interviewees mention collective action being undertaken such as cleaning each other’s house and setting up fundraisers to recover property damages. Social cohesion, sense of community and sense of risk in times of a common threat, such as a flood event, grows tremendously. Inhabitants find themselves in a similar situation, therefore are dependent on each other and contacts between inhabitants are significantly strengthened, as stated by a vast majority of interviewees. Interviewee 5 describes the increased community resilience and cohesion when a common threat arises: *“In the period during a flood, there was a lot of cohesion. You would be flabbergasted to see who would help you put your furniture high, clean your house etc. (...) That was fantastic, and after that it gradually became less every time. It is not what it was anymore.”* As much as it is in their nature to be involved with the river, referring to interviewee 9, it is also in their nature to assist their community whenever the river floods. The negative consequences of a flood generate a social responsibility to help. This is illustrated by interviewee 6: *“The general rule was: you put your belongings dry, then you go to your parents to put their belongings dry, then you went on to help others, people in the neighbourhood. That went almost automatically. When the water was gone, the community collective cleaned everything.”*

A common threat unites. However, protective measures have developed in such a way that communities around the Maas in South-Limburg are protected for water levels that occur once in 250 years. On top of that, current preparedness measures ensure that adequate action can be taken in anticipation of a high water level. These developments have massively contributed to a feeling of safety among local inhabitants, according to interviewee 2: *“Some people are aware that high water could come, but I should add to that, people do feel very safe now.”*. Media analysis confirms this increased sense of safety (De Limburger, 2020). These developments have contributed to the second, long-term dynamic that is observed with regard to community resilience.

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#### 4.3.2. COMMUNITY RESILIENCE IN THE LONG RUN

Since flood frequency and likelihood are declining, the sense of urgency for communities to engage in flood preparedness, protective behaviour and local initiatives is also declining. The majority of interviewees state that they notice the need for incorporating coping mechanisms in their community has almost been nullified by the safety and prevention measures. This is illustrated by interviewee 4: *“In this community, nobody is worried anymore because there has been created a lot of space for the river. (...) People say it’s nonsense when we start walking [as dyke guards], they more often think these are unnecessary protocols.”*. Media analysis points out that around 93% of inhabitants of Limburg are not occupied (anymore) with floods or flood risks, and around 80% is not prepared to adapt their homes to flood risks (Limburg, 2016; NOS, 2016).

The sense of safety in local inhabitants is causing more and more reliance on government preparedness and engineered safety structures, whereas addressing their own vulnerabilities does not get as much attention. Enhanced risks concerning climate change developments are not entirely fathomed by interviewees. For example, interviewee 8 even speculates that governments are being too cautious in their approach to tackle climate change risks: *“Personally I don’t really see it [effects of climate change]. There is undoubtedly a changing climate, (...) but I am not afraid of that. (...) They [government] are being too careful, I don’t think it directly affects high water.”*

As more time progresses without occasional small flood events, risk awareness in local communities is gradually fading. Their reference level is almost gone, especially when they are surrounded by dykes. Planner 10 elaborates: *“The danger at the moment is, we haven’t had high water in a long time, so the realisation of urgency is decreasing”*.

This deterioration of community resilience is worsened by the influx of new residents from outside these communities. These newcomers have no prior experience in dealing with floods or frequent (harmless) high waters, and therefore are, in general, less aware of risks and less familiar with coping strategies. Planner 1 continues: *“The older inhabitants still know the situation from before, but the new inhabitants don’t have a reference anymore; they don’t know what might happen.”* Newcomers are likely to not calculate flood risks when furnishing their homes. For instance, they might place their fuse box on the ground floor, while older residents traditionally place it on the first floor. Interviewee 5 elaborates on this: *“I just think it’s not in people’s heads anymore. People would absolutely not know what to do. But I also became wiser through disasters and damages. (...) the central heater used to be placed on the floor, but now we have one that hangs (...). If you would move here, you wouldn’t take that into account.”* Being actively involved with the Maas is not as natural to them as it is to the elder residents.

Because the perceived common threat within communities is lessened, social cohesion, shared sense of community and social responsibility are also eroding, especially in the face of an aging population. Interviewee 6 shares their experience: *“I notice that, ever since the fear of the water is decreased, the social cohesion is also lessened (...) The fear was really the connecting factor.”* Unless the sense of urgency grows, inhabitants will be less likely to engage in interactional components of community resilience, such as cooperative action or (bottom-up) initiatives, aimed at reducing vulnerabilities. It is observed from the interviews that on the one hand, increased government preparedness

and engineered structures contribute significantly to DRR, but they also indirectly inhibit local residents from taking action to reduce vulnerabilities to support DRR.

Despite this general observed trend, community resilience is still observed within the South Limburg region. Local inhabitants, among which some interviewees, take cooperative action aimed at DRR as voluntary dyke guards that Waterschap Limburg have introduced. In most Maas communities, established neighbourhood networks are active that oversee communication networks between governments and inhabitants. For example, 'Buurtnetwerk Borgharen' or 'Dorpsraad Itteren' are made up of voluntarily involved residents who work together to improve communication and ensure the village's liveability. These networks were also crucial in the preparation and aftermath of the 1993 and 1995 disasters. Consortium grensmaas, the organisation that carries out the grensmaas projects, have also established representative groups with a similar goal to encourage communication and preserving liveability.

It has also been observed that whenever a threat arises, narratives emerge inside communities. As people begin to notice the growing water levels, they begin to discuss the situation and reminisce about the flood events that happened earlier. This is shown by interviewee 7: *"At the moment the Maas is rising, (...) then it is a discussion point. If you walk along the Maas everyone is talking about it. How it was back in the day, and they also say 'what is it going to be?'. You can see a certain vibration arise, kind of like reliving the situation. People are not concerned then, but wary."* During such moments, interviewees mention that narratives and social cohesion among inhabitants start to develop. This is often not long-lasting as it attenuates whenever the Maas retreats again. Other narratives are still being crafted. One interviewee is creating an exposition in which people's stories and experiences regarding high water are highlighted along the history of Maas communities.

So, merely when a risk is approaching community resilience and cooperation towards flood preparedness is increasing. The sense of urgency, as often stressed by planners, is generally not as present anymore, especially for the newcomers. It is crucial that action needs to be taken in order to stimulate flood preparedness even before risks emerge. This will maintain the sense of urgency for future generations with regard to climate change risks.

#### 4.4. INCLUDING COMMUNITY RESILIENCE BUILDING IN PREPAREDNESS MEASURES

The fading sense of urgency and community resilience, according to the interviewed planners, is a source of concern. Planners warn that risks are largely being underestimated. Increased flood risk and potential impact in the future due to climate change could be much higher. Interviewee 9 confirms this concern: *"I believe many inhabitants don't realise that if climate change carries through, (...) and in extreme scenarios you wouldn't speak about wet feet, but life threatening situations. Measures that project grensmaas has yielded won't be enough then and the water would flood the villages again."* Because it is dangerous to rely solely on engineered solutions, it is critical to include (and restore) community resilience building in preparedness measures in order to promote DRR.

From the interviews it was discovered that current preparedness measures aim to include community resilience building strategies. Over the past year, preparedness measures have changed, and more detailed emergency and evacuation plans have been formulated. The bottom-up organised neighbourhood networks were actively involved during crisis situations of 1993 and 1995, as they were the ones with most knowledge on localities. When these emergency plans are updated by the safety region South Limburg, neighbourhood networks are able to advise on elements that are effective or ineffective. Planner 10 elaborates: *"We also look for these neighbourhood networks in some regions. In the preparedness phase, plans are aligned with them: 'does this fit with you?' or 'is this how you see it?'"*

Consortium Grensmaas made use of representative groups (klankbordgroepen) to implement grensmaas projects in consultation with local inhabitants. These groups had regular contact with Consortium Grensmaas and other stakeholders to discuss matters like flood safety, liveability and preparedness. Here, the importance of structural communication between stakeholders in governance was stressed. Interviewees who took part in these representative groups mention the social distance between these inhabitants and governments was significantly decreased. Interviewee 2 confirms this: *“Since the introduction of representative groups at the consortium, (...) the access to government institutions is improved and easier.”*

Planner 1 adds that at Waterschap Limburg, new policies increasingly aim to engage local communities in decision making processes. *“With the planning of preparedness measures, engaging communities is becoming more and more common. All governments increasingly seek connection to locals.”* (Interviewee 1). The voluntary dyke guards introduced by Waterschap Limburg allow for local communities to actively engage in flood preparedness. These dyke guards are trained regularly and called up when water levels start to rise to inspect dyke quality and prevent possible dyke breaches. Other attempts to engage local communities and include community resilience building in preparedness measures have largely been passive. Rijkswaterstaat makes information regarding (predicted) water levels public, but it is up to the residents to assess it. Safety region South-Limburg occasionally trains for crisis situations, but these are mainly aimed at people within their own organisation or companies (Ministry of Infrastructure and Water Management, 2015). In addition, the government has ensured that high water leaflets are available in some communities, describing the procedures that would be performed at certain water levels.

Despite improved (international) communication networks, governments should take more action to actively promote community risk awareness in preparedness measures to enhance a sense of urgency and boost community resilience building, particularly among newcomers. With an increased sense of flood risk, these newcomers (but also older inhabitants) can adopt further coping strategies into their living environment, such as adapting their homes to the possibility of future floods. Concerns among planners should actively be shared with local communities. Maas communities in South Limburg should also be more actively involved in preparedness measures by for instance holding structural community education sessions on climate change threats or holding occasional ‘dry drills’, in which emergency situations are enacted and inhabitants can participate.

Social resilience has to take into account the dynamic of local community resilience. When this resilience is weakening, policies have to evolve to a way that stimulates community resilience building in an active way. The lacking sense of urgency has to be addressed to achieve this.



## 6. DISCUSSION

The strength of this paper lies in the gathering of qualitative data, triangulated with document and media analysis to discover community resilience building and how that is included in preparedness measures. Data gathering of both planners and inhabitants gave different views on the topic, and therefore covered as many aspects as possible. Due to time and word constraints within the writing process of this paper, the author was unable to gather data from planners active within all institutions concerned with flood preparedness, but rather had to select a few. Also, only inhabitants with flood experience were interviewed, while interviewing ‘newcomers’ would also yield useful data.

The research aim to investigate how and whether preparedness measures engage community resilience building strategies, was researched through qualitative data gathering in the form of semi-structured interviews. Qualitative data gathering allows more insight into local communities’ attitudes towards flood risk and preparedness measures, and how exactly they put community resilience into action. Therefore the chosen research method yielded the most useful data in terms of validity. As the results of this research relate solely to the South-Limburg region, which has been impacted by floods most severely, the results cannot be generalised for all Maas communities in the Netherlands, Belgium and France. As the Grensmaas projects are almost finished, other projects included in the ‘Maaswerken’ such as the ‘Zandmaas’ in North-Limburg have not been finished yet. This creates another dynamic with regard to people’s resilience, sense of safety, sense of urgency and implemented flood preparedness measures, and might result in different findings.

This research aimed to answer the central question: *to what extent do preparedness measures implemented in the flood-prone regions of the Maas river basin in South Limburg engage and strengthen local community resilience?* Through semi-structured interviews with local residents and planners closely related to the region that are responsible for implementation and/or creating preparedness measures, it was found that community resilience strategies were traditionally adopted by Maas communities in South-Limburg. During flood events the cognitive and interactional dimensions of community resilience came into being and all sorts of cooperative action was taken out of a social responsibility to help. This has helped in minimizing the emotional impact of flood events. Economic impacts were still largely observed. It was found that flood disasters of 1993 and 1995 have also triggered social resilience to emerge in governance structures, where planners and policy makers have learned from past failures and improved these into new, enhanced preparedness measures. As the sense of safety has increased within the region, due to the development of engineered structures and these preparedness measures, the sense of urgency to incorporate and put community resilience into action is decreasing. This declining sense of urgency is exacerbated by the influx of new residents into these Maas communities. Past experiences with floods influence the way in which flood risk is perceived (Fox-Rogers *et al.*, 2016; Kreibich & Thieken, 2008). New inhabitants that never experienced flood events and the consequent resilience that emerged, are generally less aware of urgency or risks than original inhabitants. However, the results showed an overall decline in risk awareness within communities. Planners, on the other hand, warn of this decreasing risk awareness, especially since consequences of a flood would be much higher due to climate change. Only when risks emerge, community resilience in the form of risk awareness, spreading narratives and social cohesion also emerge.

This paper found that community resilience strategies are still being put into action, but significantly less than when the Maas was regarded as a common threat. Through governance improved preparedness measures include community resilience building by, for instance, dyke guards or representative groups, but remain largely passive. In the future, preparedness measures should include more active community resilience strengthening strategies to accommodate for the ‘downward spiral’ of resilience in South-Limburg Maas communities.

## 7. CONCLUSION

To address the fading sense of urgency within local communities, planners should aim to further engage and strengthen community resilience building in preparedness measures that will sustain itself in the long term, so that newcomers are also actively engaged and can address their own vulnerabilities. With the introduction of dyke guards or representative groups, preparedness measures have proven to be capable of doing this. However, preparedness measures should move to a more active way of addressing this sense of urgency through promoting risk awareness, as this was found to be the weakest component of community resilience. Currently, the majority of community resilience-building strategies in preparedness measures are passive. As for policy recommendations, more active involvement of local inhabitants in preparedness measures is necessary. The concerned municipality could place a memorial board for the 1926, 1993 and 1995 disasters to stimulate narratives even in times where there is no threat. Furthermore, governments should regularly organise education meetings for inhabitants to actively educate them on the influence of climate change on flood risk, this can be realised in collaboration with neighbourhood networks. Also, a large-scale ‘dry drill’ can be organised in which a flood disaster is simulated, and inhabitants can participate. This demonstrates the sense of urgency, and allows for preparedness measures to be tested in practice. A dry drill, which took place in North-Limburg in 2015, was proven to be an effective tool in building community resilience and social resilience simultaneously. (Veiligheidsregio Limburg Noord, 2015).

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## Interview guide - Inhabitants

### Introductory questions:

- Are you comfortable with recording this interview?
- What kind of work do you do or have you done?
- Where do you live and do you enjoy living in this neighbourhood/community?
- Are you aware of the research aim and the purpose for which this interview data will be used?

### Past flood experiences:

- Which past flood experiences have you witnessed in your lifetime? And what is your recollection of that period?
- Which negative social impacts do you think these past flood events have had on the community wellbeing? (and its surroundings)
- To what extent do you think past flood events are still a relevant topic of discussion within your community?
- How prepared were you or the authorities on the imminent flood risk?
- Based on past flooding events, to what extent do you worry that a flood event might occur in the future?

### Coping strategies (Community resilience):

- Is there a strong sense of community in this area?
- Do you think past flood events have helped in strengthening a sense of community?
- If you have experienced a flood disaster, do you remember any collective initiative being undertaken by you and your community to cope with the negative impacts of floods in your municipality?
- To what extent do you think these past flood events have strengthened these collective initiatives?
- Who are the people in your municipality or area that are most exposed and vulnerable to the negative impacts of floods?
- Are there collective initiatives being undertaken within your community to reduce the risk of future floods disasters in the place where you live?
- If so, what are these initiatives?
  - What are the main drivers that led people to organise these initiatives? (feelings, reasons etc.)
  - What aim do you want to achieve with these initiatives?
  - What people in your municipality participate in these initiatives?
  - Do these initiatives strengthen the solidarity, cohesion and sense of risk among people living in your municipality?
    - If so, in what ways? (e.g. building up of a website, developing narratives and knowledge to enhance people's sense of flood risk, sense of community, sense of place, enhance empathy and social responsibility towards the most affected and the most vulnerable)

Preparedness measures:

- What preparedness measures are currently in place that you are aware of?
  - Have you heard of early warning systems in the municipality?
  - Have you heard of training and education programs in the municipalities?
  - Have you heard of monitoring in the municipalities?
  - Have you heard of any other preparedness measures in the municipalities?
- Do these preparedness measures engage local people?
- To what extent have these preparedness measures strengthened the community initiatives undertaken in your municipality?
- To what extent do you concern yourself with protective behaviour, risk awareness and preparedness measures?
- Do you have confidence in the government/authority action being taken in the case of high water?
- How can these preparedness measures be enhanced (if at all) in your opinion?
- How prepared would you, and authorities/help be if a flooding would occur?

Concluding questions:

- Do you feel like you have relevant information or experiences that you were not able to elaborate on during this interview?
- Do you have any other questions or concerns regarding the research?

## **Interview guide - Planners**

Introductory questions:

- Introduce yourself and research!
- Are you comfortable with recording this interview?
- What is your occupation as a planner entail?
- In what region are you active?
- Are you aware of the research aim and the purpose for which this interview data will be used?

Past flood events:

- What can you tell me about past flood events that occurred in the region?
- How did these events impact the region?
- Do you know of preparedness measures that were in place at that time?

Preparedness measures:

- What preparedness measures are currently in place and what are their aims?
- What is your role as a planner with regard to preparedness measures currently in place?
- How did preparedness measures evolve over time?
- What do you think are the working elements of preparedness measures with regard to encouraging local initiatives?



- Do you notice support or resistance with regard to these preparedness measures? (how are they generally perceived by people you work with/for?)

Coping strategies (community resilience):

- Are collective initiatives being undertaken by (local) people to reduce the risk of floods in the municipality?
  - If so, can you provide some examples?
- How did these initiatives evolve over time?
- How do you think the preparedness measures implemented engage local people and strengthen these initiatives?
- To what extent do you encourage local initiatives in your work?

Concluding questions:

- Do you feel like you have relevant information or experiences that you were not able to elaborate on during this interview?
- Do you have any other questions or concerns regarding the research?
- How do you see the future of your role as a planner with regard to climate change?

APPENDIX B: CODING TREES

