

# **THE EFFECT OF LAND TENURE ON THE ACCESS TO ASSISTANCE FOR THE LONG- TERM RECOVERY OF FLOOD DAMAGE.**

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August, 2023

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Enschede, The Netherlands, August, 2023

Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.

Specialization: Land Administration

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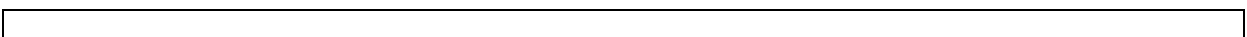
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## ABSTRACT

Climate change intensifies the frequency and severity of extreme floods, exceeding the adaptive capacity of both human and natural systems and inflicting significant harm, particularly among vulnerable populations. In the aftermath of major floods, providing economic assistance becomes vital for restoring the livelihoods and living conditions of affected communities in the medium and long term. Access to this assistance can be facilitated or hindered by social vulnerabilities to flooding, such as land tenure. This study aims to investigate the influence of land tenure on access to repair and rebuilding assistance following major floods, using the 2021 flood in Valkenburg, The Netherlands, as a case study. The chosen methodology for this research is a Social Impact Assessment (SIA) to Flood Risk Management (FRM). The SIA approach enables the identification and evaluation of social impacts associated with loss of life and property, livelihoods, migration, psychosocial effects, and barriers to economic growth and development. In this study, repair and rebuilding assistance refers to financial compensation for repairing household belongings and housing damage. The research encompasses expert interviews, a household survey, and an extensive literature review of flood reports as part of the SIA to FRM. The findings identified three private and public compensation schemas available to affected households. The primary compensation schema involved private flood insurance. When the flood was officially categorized as a disaster, the government introduced the Disaster Compensation Act (WTS) to relieve the economic burden. Additionally, the National Disaster Fund (NRF), which gathers financial contributions from the community, also extended compensation to the victims. Land tenure has a relation with access to assistance, as public and private compensations provide tailored products for owners and renters through home and content insurance. The utilization of tenure information, along with personal data from the "Key Registers" in the Netherlands, is also widely employed to facilitate victim access and enable organizations involved in the recovery process to identify victims and distribute financial aid. The findings also indicate various impacts experienced by households, including uncertainty regarding future floods, increased risk perception, increased workload, and stress. Another common impact reported was dissatisfaction with the assistance process; households' experiences in accessing assistance are split among highly positive or negative, with some receiving adequate assistance and others finding their expectations unfulfilled. The intensity of the impacts during long-term recovery demonstrated variations between renters and owners, indicating that tenure status can shape the experience of flood victims. Moreover, the SIA method proved to be a suitable approach for assessing the social impacts of measures implemented in FRM. It can be concluded that a robust tenure system and disaster management measures reliant on it can help reduce disparities in the recovery of flood victims. Nevertheless, there is room for improvement, and the SIA for FRM provides a helpful framework for evaluating the outcomes of these interventions. Such assessments should be considered when enhancing policies and strategies in preparation for future floods.



## ACKNOWLEDGEMENTS

The present thesis is the culmination of a journey marked by dedication, responsibility, and above all, commitment to my personal, academic, and professional goals. The successful completion of this work would not have been possible without the support and guidance of my supervisors, Funda Atun and Richard Sliuzas. Their knowledge, insightful ideas, and patience have been instrumental in shaping and keeping me motivated throughout the entire process, from the inception of this project to its ultimate realization. Funda always gave me the space and motivation to put my ideas into practice, and Richard has always been positively critical, enhancing my work.

I want to extend my heartfelt gratitude to the Faculty of Geo-Information Science and Earth Observation (ITC) for providing me with the necessary knowledge and tools to develop this research. The expertise of each professional who works there and their care for the students have played a vital role in my academic growth and the academic development of each ITC student.

I would also like to express my sincere appreciation to the experts and professionals outside the faculty who have contributed significantly to this work. I knocked on doors in different organizations when working on the research topic. I am grateful to have had the chance to meet people with passion and great expertise in what they do, people with warm hearts who enjoy sharing their knowledge. Their invaluable assistance during the data collection process and their invaluable advice throughout the development of this thesis have been indispensable.

Furthermore, I am deeply grateful to my friends and colleagues who have stood by me during this demanding journey. Their unwavering support, encouragement, and valuable insights have significantly impacted the development of my graduation thesis. I want to extend a special salute to my friends Carlos, Cham, Arturo, Aulia, Santiago, and Sam, who have greatly supported me during this stage of my academic career.

Last but certainly not least, I owe immeasurable gratitude to my dear family, consisting of my parents, Orfa and Rodrigo, and my siblings, Irvin and Stephanie. Despite the physical distance, their constant love, encouragement, and unwavering belief in my abilities have been my pillars of strength.

To all those mentioned above, and all those that I cannot mention here but were part of my journey. I extend my heartfelt thanks. Your support, encouragement, and warm words have been invaluable, and I am truly grateful for your presence during this period in my life.

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# 1. INTRODUCTION

## 1.1. Background and justification

The frequency and intensity of extreme heat, torrential rains, drought, and fires have increased due to human-induced climate change (IPCC, 2022). These natural hazards have led to disasters that exceed the adaptive capacity of both human and natural systems, resulting in adverse impacts on ecosystems, people, settlements, and infrastructure, particularly among the most vulnerable populations (IPCC, 2022). In response to these challenges, Disaster Risk Management (DRM) implies the application of policies and practices aimed at preventing, managing, and reducing the impact of disasters (Enemark, 2009). The DRM cycle consists of four phases: risk assessment (1), prevention and mitigation (2), preparedness (3), and recovery and reconstruction (4) (Enemark, 2009). The latter is the focus of this research. The recovery and reconstruction phase encompasses activities aimed at restoring normal livelihoods and living conditions of individuals affected by disasters (Tagarev & Ratchev, 2020). These activities include providing immediate relief and supporting medium- and long-term recovery (Tagarev & Ratchev, 2020). Post-disaster assistance, often in the form of insurance or disaster funds (Slomp & de Vries, 2017), plays an important role in helping victims repair damage and rebuild their lives (Kamel, 2012). However, socially vulnerable populations often face barriers to accessing assistance mechanisms (SAMHSA, 2017; White et al., 2001), such as eligibility restrictions and procedural complexities (Wilson et al., 2021).

Disasters stand and happen in specific places (Zevenbergen et al., 2010). Therefore, understanding the nature of the place, its local characteristics, and its relationships with people and goods enables decision-makers to plan better and manage and utilize resources more effectively (Enemark, 2009; Potts et al., 2017). Land Administration (LA) systems conceptualize the relationships between people and land in the form of rights, restrictions, and responsibilities (Enemark, 2009). Sustainable LA systems support DRM in various ways: by ensuring secure land tenure rights, it encourages individuals to undertake disaster mitigation and prevention actions; through land use planning, it helps prevent settlements in high-risk areas and facilitates the implementation of mitigation measures or resettlements; land and property valuation provide inputs for insurance, compensation, tax regulations, compulsory acquisition, livelihood restoration, and serve as a strategic indicator to governments (Enemark, 2009; Mitchell et al., 2014; Park et al., 2019; Potts et al., 2017). From the four LA functions, this research focuses on land tenure. DRM professionals recognize that secure land and property rights contribute to long-term reconstruction, spatial planning, compensation, and recovery, thereby contributing to communities' resilience against natural disasters (Brown & Crawford, 2006). Land-related issues that can arise in the context of disasters and ensuring the security of property and land rights are critical factors in creating resilient communities towards climate change; these aspects are some of the main focus of global initiatives such as the 2030 Sustainable Development Goals (SDGs), the Sendai Framework for Disaster Risk Reduction, and the Voluntary Guidelines on the Responsible Governance of Tenure (De Bruijn, 2020; Unger et al., 2020).

The interaction between LA and DRM is broad, and the present research focuses on the interaction between land tenure and access to assistance following major flood events. In their analysis of past flood events, Rufat et al. (2015) identified land tenure, along with demographic characteristics, socioeconomic status, health, coping capacity, risk perception, and neighbourhood characteristics, as the seven most common drivers of social vulnerability to flooding (Rufat et al., 2015). As a driver of social vulnerability, land tenure significantly influences residents' ability to adopt protective measures and access assistance (Rufat et al., 2015). These differences in land tenure status can lead to disparities in flood susceptibility among different groups, such as owners, renters, squatters, and the homeless (Rufat et al., 2015). Effective access to assistance mechanisms can help affected populations cope with the damages caused by flooding and contribute to their medium and long-term recovery. This assistance encompasses financial assistance for housing and personal property damage.

Post-disaster assistance and the strategies implemented as part of the DRM aim to foster resilient communities. Building resilient communities involves the development of comprehensive strategies that enable society to face hazards of different magnitudes, considering their impact on the economy, well-being, and other relevant aspects during and after the event, including the long-term recovery (De Bruijn, 2020). Adopting a resilience-oriented approach involves more than simply quantifying risk; it requires a clear understanding of system behaviour and the requirements of society (De Bruijn, 2020). Thus, it is essential to comprehend how floods and DRM strategies affect society. In this context, Social Impact Assessment (SIA) has become a beneficial tool for assessing the effects of flooding on society (Aznar et al., 2021; Mahmoudi et al., 2013). While traditionally used to evaluate the impacts of future projects or interventions, SIA has also been applied to analyse the social outcomes of natural hazards and disasters, contributing to reducing communities' vulnerability (Mahmoudi et al., 2013; Usman et al., 2013). By employing an SIA approach, alternative actions can be identified to mitigate the risks and increase societal resilience. Indeed, Aznar et al. (2021) proposed a methodology called "Social Impact Assessment to Flood Risk Management" (SIA to FRM), which facilitates identifying, assessing, and managing the social outcomes associated with floods.

The SIA to FRM approach provides a methodological framework for this research to assess the social outcomes of disaster assistance following major flood events and identify possible influences of land tenure status in the access to assistance and in shaping the long-term recovery.

The case study is situated in the Netherlands, a country with a high risk of flooding but where the population is generally unaware of the associated risks and challenges due to effective water management practices (National Water Plan, 2015). The selected flood event occurred in 2021, concurrently impacting the Netherlands, Germany, and Belgium, triggered by heavy and unprecedented rainfall (Task Force Fact Finding Hoogwater 2021, 2021). Despite the Netherlands' robust flood defence systems, the floods resulted in physical damage to buildings, disruptions in commerce, infrastructure destruction, and agricultural losses (Task Force Fact Finding Hoogwater 2021, 2021). The case study focused specifically on the 2021 flood in Valkenburg, a city in the province of Limburg; the flood is part of the 2021 floods in Limburg.

The research aims to investigate how households accessed assistance and examine the social impacts experienced during their long-term recovery. Potential social impacts may be related to loss of life and property, loss of livelihoods, migration processes, psychosocial effects, and barriers to economic growth and development (Aznar et al., 2021). In addition to providing insights into the relationship between land tenure and access to assistance, this work aims to contribute knowledge regarding social-economic uncertainties in flood risk management in the country. These uncertainties are related to people's behavior in case of a flood, economic flood impacts, and economic and social effects of flood management measures (De Bruijn, 2003). In the context of this research, the term "repair and rebuilding assistance" refers to the financial post-disaster aid provided for repairing personal property and housing damage. On the other hand, "land tenure" pertains to the relationships between individuals or groups and a land parcel or building. Given the broad range of societal sectors affected by flood events and the complexities of people's relationships with land, this research will focus specifically on households, including both renters and owners and the available economic mechanisms that assist them in recovering from a major flood.

## **1.2. Previous research work**

Several research studies have examined the effects of land tenure on access to disaster assistance following major floods and the use of Social Impact Assessment (SIA) in flood management. In relation to land tenure and access to assistance, a study examining recovery outcomes and barriers to disaster assistance following major floods in the United States revealed that renters, low-income households, and racial and ethnic minorities experience more adverse recovery outcomes (Wilson et al., 2021). For example, in the aftermath of floods caused by Hurricane Katrina, it was observed that post-disaster housing and individual assistance programs favored property owners over renters (Kamel, 2012). These findings highlight the importance of understanding the role of land tenure in access to assistance and the potential disparities that can arise in the long-term recovery. These studies reflect the finding of the study conducted by Rufat

et al. (2015), which consisted of a meta-analysis of 67 flood disaster case studies, identifying the main drivers of societal vulnerability to floods. This study shows that land tenure is one of the top seven drivers of social vulnerability to flood, and that is interrelated to other drivers of social vulnerability to flood, such as demographics, socioeconomic status, and coping capacity.

In terms of utilizing SIA for flooding, Aznar et al. (2021) addressed the impact of climate change on flood risk and proposed the "Social Impact Assessment to Flood Risk Management" (SIA to FRM) methodology. This approach aims to systematically identify, assess, and manage the social impacts of floods throughout all stages of the disaster cycle. This recent method builds upon frameworks like the "Risk and Social Impact Assessment" (RSIA) framework introduced by Mahmoudi et al. (2013). The RSIA framework combines traditional Social Impact Assessment with Social Risk Assessment. It enhances the evaluation and management of social impacts in various contexts, including risky projects, natural hazards, and disasters. It employs three main stages: impact identification, assessment, and management.

### 1.3. Research Problem

Recent flood events such as the 2021 flood in Germany, Belgium, and the Netherlands have shown gaps in flood disaster risk management, such as awareness and risk perception of the population, risk insurance, and financial instruments to support built-back better and needs of adaptation and transformation (FKS, 2022). The utilization of an SIA to FRM approach may also contribute to solving questions arising when studying the effects of land tenure and other social vulnerabilities to flood. The study of social vulnerabilities results intricate due to the complexity of factors involved and the amount of data needed to determine their interconnections. Questions such as How are the vulnerability and impacts connected? and How to integrate them into the DRM process? arose at the "Flood Knowledge Summit 2022" held in Maastricht, the Netherlands (Rimmert, 2022). Understanding how land tenure relationships impact the access to assistance for vulnerable populations may help improve assistance mechanisms and address the identified gaps in flood disaster risk management.

### 1.4. Research Objective

The objective of this research is “to determine the influence of land tenure on access to assistance for repair and rebuilding after a major flood event.”. To accomplish this main objective, the research is structured around three sub-objectives, each accompanied by its respective research questions. Table 1 lists the sub-objectives and corresponding research questions.

Table 1: Objectives and research questions.

| Main Objective   |   |  |
|--|---|--|
| To determine the influence of land tenure on access to assistance for repair and rebuilding after a major flood event. |   |  |
| N  | Sub - Objective   | Research Question  |
| 1  | To identify assistance mechanisms for repair and rebuilding after the 2021 flood in Valkenburg and their relationship with land tenure. | <ul style="list-style-type: none"> <li>a) What are the mechanisms for repair and rebuilding after the 2021 flood in Valkenburg?</li> <li>b) What is the role of land tenure in these mechanisms?</li> </ul>  |
| 2  | To describe the effect of the tenure status on the long-term recovery of households after a major flood in Valkenburg.                  | <ul style="list-style-type: none"> <li>c) Which stakeholders are involved in the assistance process for repair and rebuilding?</li> <li>d) To what extent did households receive assistance for repair and rebuilding?</li> <li>e) What were the social impacts experienced by households during the long-term recovery?</li> <li>f) How does land tenure influence the social impacts experienced by households during the long-term</li> </ul> |

|   |  |
|---|--|
|   | recovery?  |
| 3 | <p>To describe the applicability of SIA to FRM as a method to assess the social impacts of DRM interventions.</p> <p>g) What are the advantages of applying SIA to FRM to assess the social impacts of DRM interventions?</p> <p>h) What are the disadvantages of applying SIA to FRM to assess the social impacts of DRM interventions?</p> |

### 1.5. Scope and Significance

This study investigates the effect of land tenure on access to assistance for repair and rebuilding following major floods, using the 2021 flood in Valkenburg as a case study. This research targets public and private institutions and organizations involved in flood disaster management and land administration. The findings may serve as a source of information for future debates about improving existing assistance mechanisms. In addition, the research will contribute to creating knowledge in other areas like flooding insurance, the status of long-term recovery after the 2021 flood in Valkenburg, and using SIA to assess the social impacts of measures taken in Flood Risk Management. Beyond the country context, the research serves as an example to emphasize the significance of accurately documenting land tenure relationships and giving direction on enhancing the recovery phase of DRM. Moreover, it underscores the societal aspect's centrality, which is crucial for DRM and LA as they strive for a sustainable and resilient society.

### 1.6. Conceptual Framework

Land Administration (LA) covers all aspects related to land management, making use of policies and land systems to fulfil its functions related to land tenure, value, use, and development. LA can play an important role in supporting Disaster Risk Management (DRM) by providing information and infrastructure. Section 1.1 highlights this relationship between LA and DRM. On the other hand, DRM utilizes policies and strategies to build resilient communities in the face of disasters, such as flooding. Both the disasters and interventions implemented during DRM significantly impact affected communities. These impacts can be studied and assessed using Social Impact Assessment (SIA), which focuses on understanding how people are impacted and knowledge that can be used to improve any intervention or project.

The conceptual framework, illustrated in Figure 1, explains the interrelation between LA and DRM and the use of SIA to evaluate the social impacts of DRM interventions. The collaborative area (a) exemplifies land and property information supporting the DRM cycle's phases and the increasing use of risk information to carry out LA functions to achieve sustainable development. Policymaking, planning, regulations implementation, and capacity development within this collaborative area are more integral and beneficial when considering LA and DRM's shared interests. Any intervention (b) taken during the different phases of the DRM cycle affects how people interact with each other and their environment. These social impacts can be analysed, monitored, and managed using SIA. The conceptual framework also shows that any collaborative area (a) change will be reflected as social impacts. Since the purpose of SIA is to take actions that enhance positive impacts and minimize negative impacts, any improvement will consequently strengthen the collaborative area, benefiting the fulfilment of the Land Administration (LA) and Disaster Risk Management (DRM) functions. Finally, from the general panorama, the conceptual framework introduces the sub-areas of interest for the research (c) where land tenure facilitates or hinders access to repair and rebuilding assistance, with the effect reflected as positive or negative social outcomes in the long-term recovery. The use of SIA to flood risk management allows the evaluation of these effects.

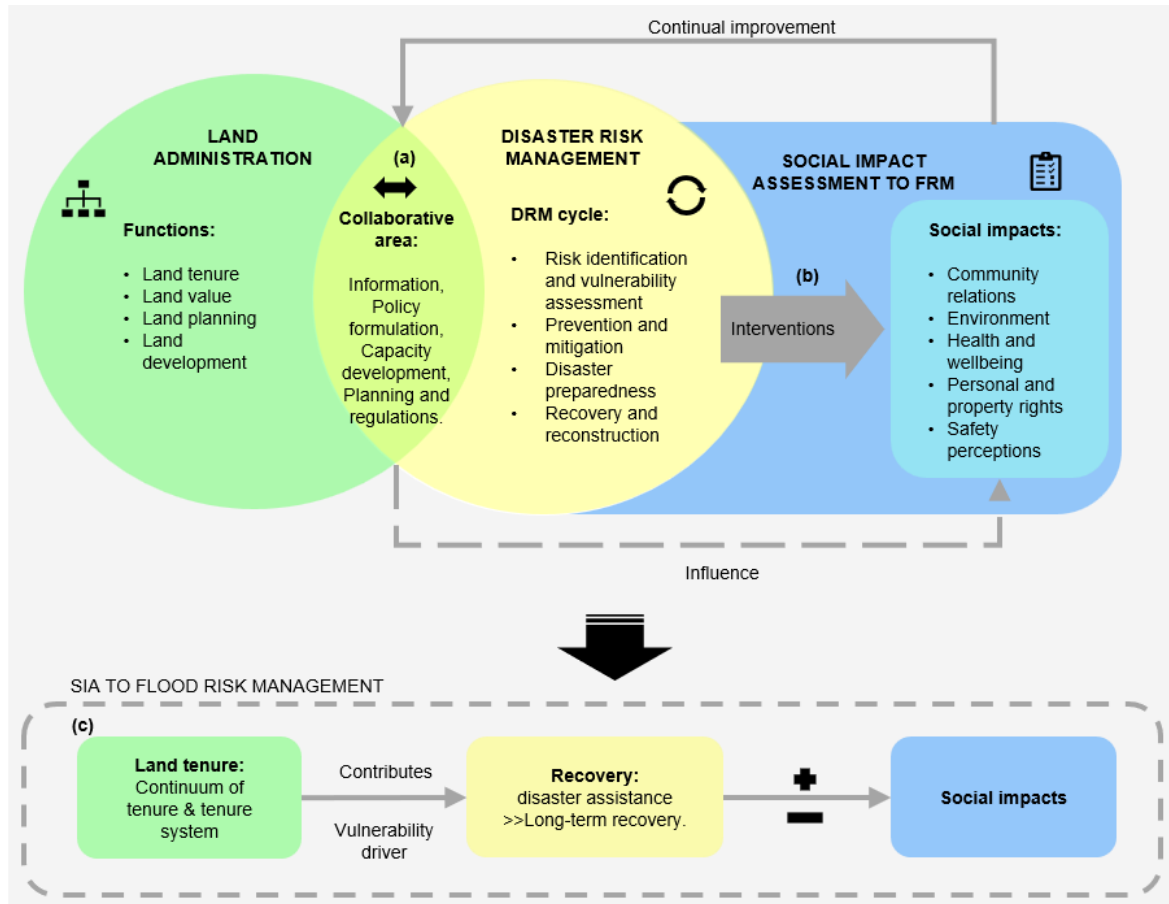


Figure 1: Conceptual framework.

## 2. LITERATURE REVIEW

*The literature review section brings a clear overview of topics relevant to the research; these topics are grouped into three fields: Land Administration, Disaster Risk Management, and Social Impact Assessment.*

### 2.1. Land Administration

Land Administration (LA) encompasses all aspects of land management and is typically a responsibility of the government; it relies on land policy frameworks and information infrastructures to carry out its functions, which include land tenure, value, use, and sustainable development (Enemark et al., 2005). Land administration is commonly seen as an umbrella term that includes the related terms of Land Registration and Cadastre (FAO; UNECE; FIG, 2022). LA systems usually contain information regarding tenure, zoning, value, and land type, which allows one to better understand the place's nature and its relations with people and goods (Enemark, 2009; Potts et al., 2017). Modern land information infrastructures also incorporate information on restrictions, responsibilities, and land-related risks (Enemark, 2009; Potts et al., 2017).

#### 2.1.1. Land Tenure

Land tenure is one of the core functions of LA. According to the UNCCD, it refers to the relationship between people and the land, which is defined by local laws and customs (UNCCD, n.d.). In more simple terms, land tenure determines who has the right to use specific resources for how long and under what conditions (Palmer et al., 2009).

Tenure types are the range of possible land rights, which can be represented as a “continuum of tenure,” as shown in Figure 2; the set of the continuum of tenure types is determined by the country context (UN-HABITAT, 2008). Each continuum represents a different set of rights, varying levels of security and responsibility, and different levels of enforcement (UN-HABITAT, 2008). It is important to note that over a single parcel can exist multiple rights held by different people or groups (Palmer et al., 2009). Some examples of tenure types include freehold (private ownership), leasehold, rental (public or private), cooperatives, and condominiums.

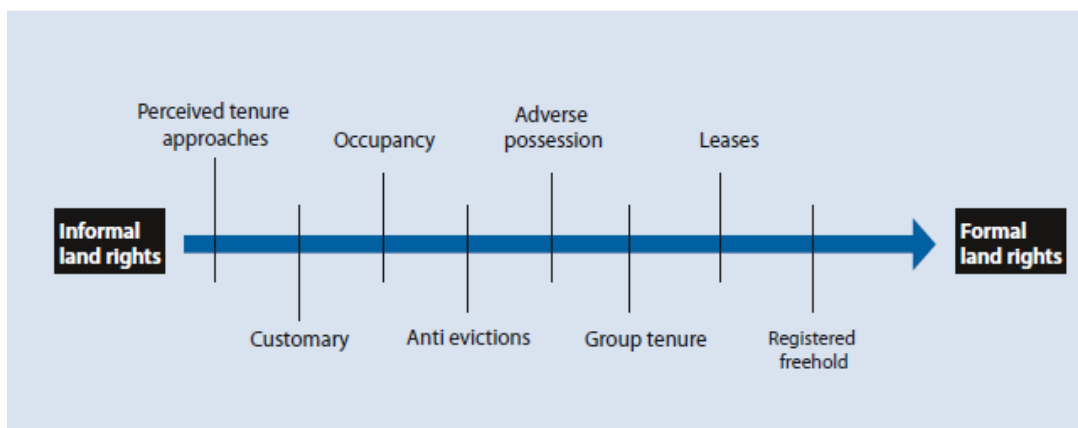


Figure 2: Continuum of tenure types. Source: (UN-HABITAT, 2008)

#### 2.1.2. Key Registers in the Netherlands

The Key Registers serve as the foundation for the Spatial Data Infrastructure in the Netherlands, and it is a system that contains indispensable information for the public sector (Bakker, 2011). The data relating to people, property, and business is organized within ten basic data collections, referred to as key registers,



that are interrelated to each other (Digitale Overheid, 2023). The Cadastre, Land Registry, and Mapping Agency (Kadaster) is responsible for the maintenance of this system (Bakker, 2011), which includes the recording and management of tenure-related information. The diagram in Figure 3 illustrates the ten key registers and their administrative interconnections. There are also interconnections for key registers with spatial data, such as the BRK providing information for the BAG, that are not represented in this diagram (Bakker, 2011).

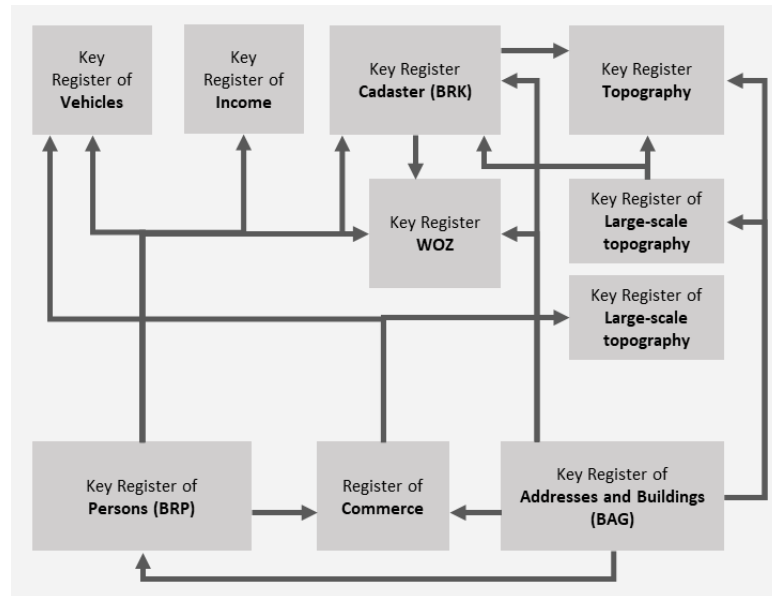


Figure 3: System of Key Registers. Source (Digitale Overheid, 2023)

Three key registers relevant to the research as they record information related to property and people are:

- Key Register Cadastre (BRK) consists of the registration of immovable property, rights in rem, and the cadastral map, which contains cadastral plots (Kadaster, 2023b).
- Key Register of Addresses and Buildings (BAG) comprises information related to addresses and all buildings, accommodation units, pitches, and berths; it is updated by the municipalities and managed by Kadaster (Kadaster, 2023a).
- Key Register of People (BRP) is a database that registers all residents in the Netherlands; the registration is done when obtaining a “Citizen Service Number” (Burgerservicenummer BSN) (Rijksoverheid, 2023). The BSN is a unique personal number assigned to residents after registering in the municipality in which they reside; the BSN is required for most arrangements with the Dutch government (Rijksoverheid, 2023).

## 2.2. Disaster Risk Management

A natural hazard is defined as a “natural process or phenomenon occurring in the biosphere that may constitute a damaging event” (UNISDR, 2009). On the other hand, risk refers to the likelihood of potential losses resulting from the interaction of hazardous events with other conditions, such as vulnerability and exposure (Mucke et al., 2017). As such, Disaster Risk Management (DRM) implies the implementation of disaster risk reduction policies and strategies aimed at preventing, managing, and reducing the risks associated with disasters (UNDRR, n.d.-a). When the DRM is applied to flood, it receives the name Flood Risk Management (FRM). The DRM cycle consists of various phases: risk assessment, prevention and mitigation, disaster preparedness, and recovery and reconstruction (Enemark, 2009). The recovery phase is explained in the following, as understanding its core will facilitate comprehension of the reasons behind disaster assistance and its relationship with land tenure.

### 2.2.1. Disaster Recovery

The recovery after a disaster involves activities aimed at restoring the livelihoods and living conditions of the affected people (Tagarev & Ratchev, 2020). Following the definition given by Tagarev & Ratchev (2020), recovery has two parts: immediate relief and long-term recovery to re-establish health, livelihoods, and material conditions. The United Nations Office for Disaster Risk Reduction (UNDRR) recommends aligning the recovery activities with the principles of sustainable development and “build back better” to reduce future disaster risk (UNDRR, n.d.-b). In the disaster recovery planning process, insurance is described as an essential measure to reduce the financial impact of losses; transferring the risk through insurance is suitable when the severity of the disaster is high, but the frequency is low (Kaushalya et al., 2014). However, in cases where losses are not covered by insurance, alternative mechanisms such as “disaster assistance” can be applied. The Department of Homeland Security (DHS) defines disaster assistance as financial or direct aid to individuals, families, and businesses whose property has been damaged or destroyed and whose losses are not covered by insurance (DHS, 2022).

### 2.2.2. Flood insurance and Government compensation in the Netherlands

The responsibility for specific risks starts with the owner of a building, object, infrastructure, or site, known as individual care (Kok et al., 2021). However, when the damage exceeds the capacity of an individual owner to cover, collective care arises, facilitated either by the government or private insurance (Kok et al., 2021). Some large damages, which the population cannot cover through insurance or savings, can threaten livelihoods (Slomp & de Vries, 2017). Typically, insurance entails the involvement of two parties: an insurer and a policyholder. Through insurance coverage, the policyholder bears certain risks they are unwilling or unable to bear themselves (Kok et al., 2021). The same principle applies to flood insurance, which has an important role in Flood Risk Management policy by enabling the spread of risks across actors, locations, and time (Ermolieva et al., 2017). Flood insurance ensures the availability of funds for covering losses, encourages the adoption of damage mitigation measures, and promotes the efficient utilization of scarce land (Ermolieva et al., 2017).

In the Dutch context, home/contents insurance policies typically provide coverage for a wide range of water damage or flooding, although not all causes are included (Kok, 2005). Table 2 offers an overview of what is typically insured or not, depending on the specific causes of the flood. The rationale behind insuring or not insuring certain causes of floods is explained, with particular emphasis on those causes that help contextualize the situation surrounding the 2021 flood in Valkenburg.

Table 2: Current situation for insurance coverage for different causes of flooding. Source:(Kok, 2005) (Bom et al., 2018)

| N | Description                                     | Insurable? |
|---|---|------------|
| 1 | Water damage in the house                       | Yes        |
| 2 | High groundwater levels                         | No         |
| 3 | Sewer overload                                  | Yes        |
| 4 | Flooding from regional surface water            | Yes        |
| 5 | Flooding or collapse of regional flood defences | Yes        |
| 6 | Flooding or collapse of primary flood defences  | No         |
| 7 | Flooding of areas outside the dikes             | No         |

*Flooding due to failure or overtopping of primary flood defences* is not covered by insurers as water levels cannot be controlled (Bom et al., 2018). Moreover, the widespread impact on large areas simultaneously makes it

unviable for insurers to provide coverage for such damages (Kok, 2005). In case of these unlikely events, the country can employ the WTS as a response mechanism (Kok, 2005). For *flooding in areas outside the dykes*, no insurance or WTS can be implemented as in these areas; the government does not have protection against flooding, and the damage is the responsibility of the owner of the building/site (Kok, 2005).

*Flooding resulting from regional (local) precipitation*, and since 2018 *flooding as a consequence of the failure or overtopping of regional (secondary) defences* can be covered by the insurance policies under the ‘precipitation clause’ in Dutch known as the Neerslagclausule (Bom et al., 2018; Caloia & Jansen, 2021). However, it differs per insurer whether or not to amend the precipitation clause and establish their approach to setting premium levels and conditions (Bom et al., 2018).

### 2.2.2.1. Relevant Policies

In order to understand flood insurance and disaster assistance in the Netherlands, it is important to be familiar with two key policies that outline the criteria for defining a disaster and the application of government compensation in case of disaster:

- **Safety Regions Act:** This policy establishes “the roles, responsibilities, and procedures for disaster management” (IWR, 2011). Article 1 of the Safety Regions Act sets the conditions for a natural event to be declared as a disaster by the Dutch government (AEF, 2023).
- **Disaster Compensation Act (WTS):** Also known as “Wet Tegemoetkoming Schade bij rampen” in Dutch, the WTS provides financial compensation to individuals affected by a disaster for their incurred damages or costs. It primarily applies to floods and earthquakes officially declared disasters under Article 1 of the Safety Regions Act (AEF, 2023). However, the WTS can also be extended to events of similar magnitude to floods or earthquakes (AEF, 2023). Compensation eligibility depends on the damage occurring in a designated area affected by the disaster, and it must be a direct result of the event (AEF, 2023).

Both policies, the Safety Regions Act and the WTS, were implemented following the 2021 Floods in Limburg, which included the flood in Valkenburg. Once the flood was officially declared a disaster in accordance with the conditions outlined in the Safety Regions Act, the Dutch government established the July 2021 WTS to assist affected citizens in the specific geographic areas designated as disaster zones.

## 2.3. Social Impact Assessment

Social impacts refer to any changes in people’s way of life, culture, community, political systems, environment, health and well-being, personal and property rights, fears, and aspirations (Vanclay, 2003). Social Impact Assessment (SIA) is defined as “the processes of analysing, monitoring, and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes involved by those interventions” (Vanclay, 2003). Often a pre-exposure assessment, SIA can be applied post-exposure and, more recently, is also used to analyse the social outcomes of natural hazards and disasters that reduce the vulnerability of communities (Mahmoudi et al., 2013; Usman et al., 2013). The results of the assessment allow the identification of alternative actions to stop harmful consequences and boost benefits; social impacts can be positive or negative, intentional or not, direct or indirect, and the affectations in the long or short term (Usman et al., 2013). The following sub-section provides an overview of potential impacts specific to flooding; these impacts serve as a reference point in the SIA identification stage.

### 2.3.1. Social Impacts to Flood

According to the social impact definition in the “International Principles for Social Impact Assessment” (Vanclay, 2003), there are eight areas where social impacts may arise. These areas should be considered

when identifying potential changes in individuals and the community. Table 3 presents these impact areas along with their corresponding descriptions; in addition, a code has been provided to identify each area.

Table 3: Areas where social impacts can be identified.

| Code | Impact area                | Description  |
|------|----------------------------|--|
| PL   | People’s lifestyle         | How people live, work, play, and interact with one another.  |
| CU   | Cultural                   | Shared beliefs, customs, values, and language.   |
| CO   | Community                  | Cohesion, stability, character, services, facilities, and demographic change.                                  |
| PS   | Political systems          | Access to and level of participation in decision-making and democratization.                                   |
| EN   | Environment                | Quality of the environment; access to and quality of food, public services, access to resources, and land use. |
| HW   | Health & Well-being        | Physical, mental, social, and spiritual well-being.  |
| PP   | Personal & Property Rights | Any economic affectation or experience of personal disadvantage may include a violation of civil liberties.    |
| FA   | Fears & Aspirations        | Perception of safety, fears, and aspirations about the future.   |

The World Meteorological Organization (WMO) provides a repertoire of potential flood-related social impacts. By utilizing the WMO repertoire as a foundation and conducting a literature review of other flood events to confirm that WMO covers almost all possible impacts, Table 4 presents potential flood-related social impacts that may be relevant to the 2021 flood in Valkenburg. These impacts are categorized into "Individuals and Families" and "Communities and Institutions," following the classification proposed by WMO (2016). Additionally, the impact areas corresponding to each social impact have been included based on the descriptions provided in Table 3. Classifying the impacts according to the impact areas aids in comprehending how social impacts can arise, and it will contribute to the analysis; however, it is worth noting that impacts can be categorized in various ways.

Table 4: Potential flood-related social impacts

| N                                  | Social Impact  | Literature                           | Impact area         |
|------------------------------------|--|--------------------------------------|---------------------|
| <i>I. Individuals and families</i> |  |                                      |                     |
| 1                                  | Change in attitude towards the local community, level of satisfaction with the neighbourhood | (WMO, 2016)                          | Community           |
| 2                                  | Community’s identification and relationship with the place (belonging)                       | (WMO, 2016)                          | Community           |
| 3                                  | Perception of the community, community cohesion, integration                                 | (WMO, 2016)                          | Community           |
| 4                                  | Aesthetic quality, insight, and visual impacts   | (WMO, 2016)                          | Environment         |
| 5                                  | Change in the land use   | (Brown & Crawford, 2006)             | Environment         |
| 6                                  | Decline in the value of environmental commodities  | (WMO, 2016)                          | Environment         |
| 7                                  | Reduced availability of food and an adequate diet  | (WMO, 2016)                          | Environment         |
| 8                                  | Modified perceptions of personal health and security, risk, fear of crime                    | (WMO, 2016)                          | Fears & Aspirations |
| 9                                  | Uncertainty as to impacts, development opportunities, and social changes                     | (WMO, 2016), (Whittle et al., 2007)  | Fears & Aspirations |
| 10                                 | Physical health  | (Rufat et al., 2015), (SAMHSA, 2017) | Health & Well-being |

|  |   |  |                            |
|--|---|--|----------------------------|
| 11   | Reduced mental health, stress, anxiety, alienation, apathy, depression, and post-traumatic stress.                        | (Rufat et al., 2015),<br>(WMO, 2016),<br>(SAMHSA, 2017),<br>(Whittle et al., 2007)                           | Health & Well-being        |
| 12   | Workload, the amount of work required to survive/live decently  | (WMO, 2016), (Whittle et al., 2007)  | Health & Well-being        |
| 13   | Decline in the perceived quality of life.   | (WMO, 2016)  | People's lifestyle         |
| 14   | Disruption of everyday life and lifestyle (changing habits).  | (WMO, 2016)  | People's lifestyle         |
| 15   | Disruption of social networks.  | (WMO, 2016)  | People's lifestyle         |
| 16   | Modified leisure opportunities  | (WMO, 2016)  | People's lifestyle         |
| 17   | Access to affordable and quality housing.   | (WMO, 2016), (Wilson et al., 2021),<br>(SAMHSA, 2017)  | Personal & Property Rights |
| 18   | Decline in living standards or level of affluence   | (WMO, 2016)  | Personal & Property Rights |
| 19   | Decrease in autonomy, independence, security, and livelihood  | (WMO, 2016)  | Personal & Property Rights |
| 20   | Fewer opportunities for work, potential diversity, and employment flexibility   | (WMO, 2016)  | Personal & Property Rights |
| 21   | Job loss  | (Rufat et al., 2015)   | Personal & Property Rights |
| 22   | Personal security status, exposure to risks   | (WMO, 2016)  | Personal & Property Rights |
| 23   | Worsening the economic situation, drop in the value of property income, eligibility for loans, real estate values (rents) | (WMO, 2016),<br>(SAMHSA, 2017),<br>(Wilson et al., 2021),<br>(Whittle et al., 2007),<br>(Rufat et al., 2015) | Personal & Property Rights |
| 24   | Dissatisfaction with a project which has not met high expectations  | (WMO, 2016)  | Political systems          |
| 25   | Pushback (objection/opposition to the project), NIMBY attitude  | (WMO, 2016), (Whittle et al., 2007), (Brown & Crawford, 2006)  | Political systems          |
| <b><i>II. Communities and Institutions</i></b> |   |  |                            |
| 26   | Density and crowds (displacement of people)   | (WMO, 2016),<br>(SAMHSA, 2017),<br>(Wilson et al., 2021)   | Community                  |
| 27   | Dependence/ autonomy/ diversity/ viability of the community   | (WMO, 2016)  | Community                  |
| 28   | Social tensions, conflicts, or serious divisions within the community   | (WMO, 2016)  | Community                  |
| 29   | Cultural integrity (maintenance of local culture, tradition, and rites)   | (WMO, 2016)  | Cultural                   |
| 30   | Influence on cultural heritage and other major archaeological, cultural, or historical sites                              | (WMO, 2016)  | Cultural                   |
| 31   | Social values of cultural heritage and biodiversity   | (WMO, 2016)  | Cultural                   |
| 32   | Adequacy of the community's housing   | (WMO, 2016)  | Environment                |
| 33   | Adequacy of the community's physical infrastructure (water supply, sewers, services, and commodities)                     | (WMO, 2016), (Wilson et al., 2021)   | Environment                |

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|    |  |             |                            |
|----|--|-------------|----------------------------|
| 34 | Adequacy of the community's social infrastructure (health, well-being, education, libraries, etc.) | (WMO, 2016) | Environment                |
| 35 | Rights to resources and access thereto   | (WMO, 2016) | Environment                |
| 36 | Workload for institutions, local authorities, regulatory bodies                                    | (WMO, 2016) | Health & Well-being        |
| 37 | Changes in problems of equity/social justice involving minority groups                             | (WMO, 2016) | Personal & Property Rights |
| 38 | Unemployment level in the community  | (WMO, 2016) | Personal & Property Rights |
| 39 | Corruption, credibility, and integrity of the government   | (WMO, 2016) | Political systems          |
| 40 | Level of community participation in decision-making  | (WMO, 2016) | Political systems          |

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### 3. METHODS

*This section presents the research design to answer the research questions, research methods applied, resources required, ethical considerations, and the data collection methods, which include semi-structured interviews and a household survey.*

#### 3.1. Research Design

The chosen research design adopts a "Monostrand conversion design" see Figure 4, which incorporates mixed methods within a single strand (Teddlie & Tashakkori, 2006). This approach allows for the utilization of both qualitative and quantitative methods in the study. Qualitative methods involve employing emerging approaches, open-ended questions, and inductive analysis, with the researcher interpreting the meaning of the collected data (Creswell, 2014). On the other hand, quantitative methods employ more structured approaches, closed-ended questions, numeric data, measurements, and statistical procedures (Creswell, 2014).

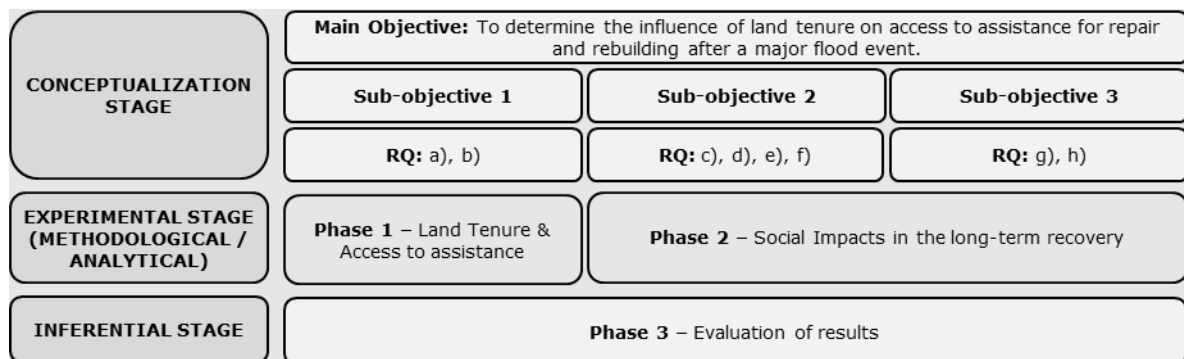


Figure 4: Research design to address the research's main objective, three sub-objectives, and research questions (RQ); for the research questions, refer to section 1.4.

#### 3.2. Research Methodology

The research methodology aligns with the research design and comprises three distinct phases, each involving specific activities, inputs, and outputs. Figure 5 presents a diagram illustrating the methodology. A detailed description of each phase is provided below.

##### 3.2.1. Phase 1- Land Tenure & Access to Assistance

This phase establishes a framework for the research, defining the main concepts and giving the required context for the case study. In addition, during this phase, the assistance mechanisms for repair and rebuilding after the major 2021 flood in the Netherlands are identified and described; their relation with the tenure status is also described. The applied method is a literature review of policies, reports, scientific articles, and official sources. Part of the information was also collected during semi-structured interviews with experts.

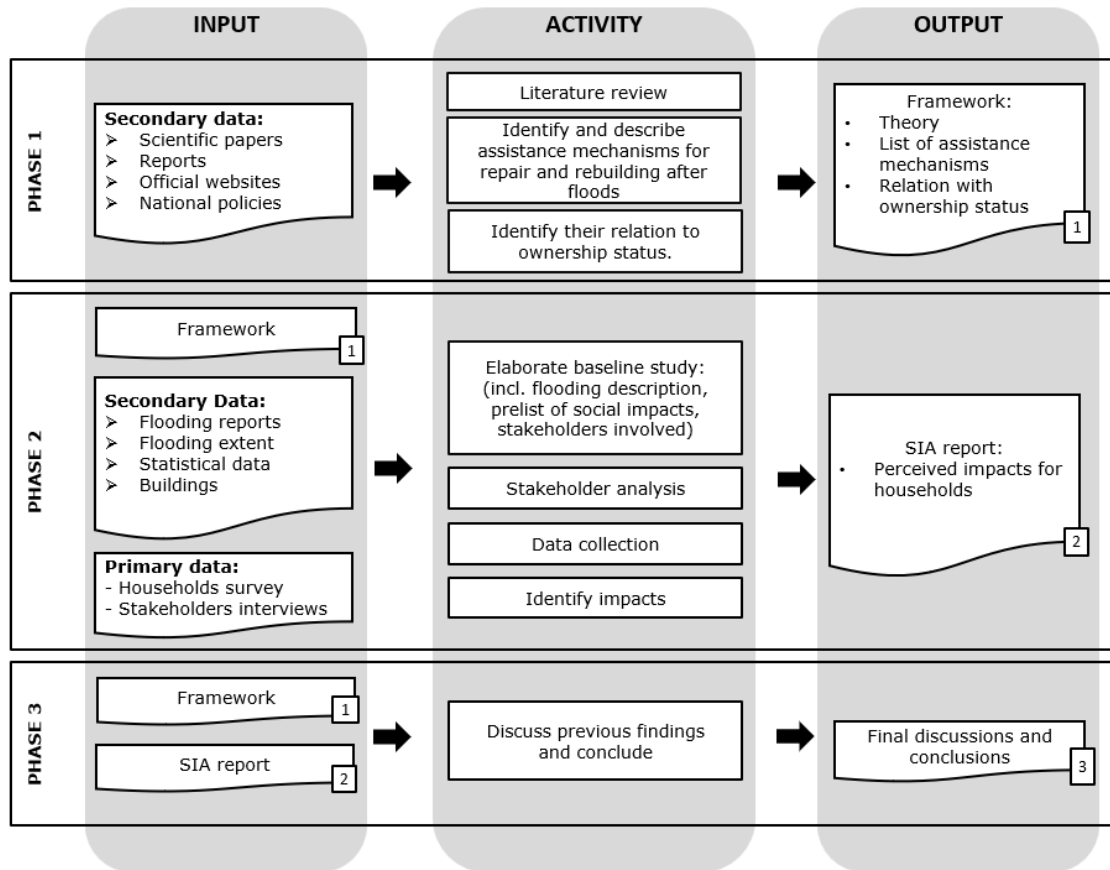


Figure 5: Research method.

### 3.2.2. Phase 2- Social Impacts in the Long-term Recovery

In the second phase, a SIA approach will be applied to the case study of the 2021 flood in Valkenburg. The approach follows the method proposed by Aznar et al. (2021) called SIA to FRM, which comprises four steps:

1. *The baseline study* establishes the framework for analysis, including pre-listing potential social impacts and analysing the flood event and its social context.
2. *Stakeholder analysis* involves identifying and analysing the social actors involved in flood management and those who have experienced flood risks.
3. *Impact analysis* entails identifying social impacts and assessing their characteristics and effects.
4. *Impact management* formulates options/actions for reducing flood disaster risk and evaluating their social, environmental, and economic feasibility.

Steps 1 and 2 were implemented entirely. However, step 3, which involves the full impact assessment, will be partially conducted until impact identification, as the main objective of the research focuses on identifying the social impacts experienced by households during their long-term recovery.

#### 3.2.2.1. Baseline study

The baseline study is covered during the literature review (Section 2), case study (Section 3.5), and the land tenure & access to assistance (Section 4.1).

#### 3.2.2.2. Stakeholder analysis

The stakeholder analysis identifies and characterizes individuals, groups, or institutions that have a direct or indirect relationship with disaster assistance for repair and rebuilding and can participate in decision-



making. A stakeholder matrix was used for identification, a method proposed to identify the stakeholders' levels of influence and interest (Vogler et al., 2017). A stakeholders table was created using a snowball method of scientific and grey literature and classifying stakeholders between decision-makers, third parties, and elements at risk, a classification proposed by Aznar et al. (2021). The stakeholder table was used to identify stakeholders that could be contacted due to their involvement in the 2021 flood and expertise in the assistance process.

### **3.2.2.3. Impact identification**

The impact identification process focused on identifying the existing social impacts experienced by households during their long-term recovery from the flood. To achieve this, pre-listed social impacts related to floods and the areas where these impacts arise were used as a reference. The identification process commenced with a literature review of flood reports to gather initial insights. These findings were then validated and supplemented through semi-structured interviews with experts who are part of the stakeholder analysis. Finally, a survey was conducted among households affected by the flood to gather first-hand information about the elements at risk. The procedure followed for semi-structured interviews and the household survey is explained in detail in the data collection section (Section 3.7).

The identified impacts were coded by combining the respective impact numbers from the pre-listed impacts and the codes assigned to the impact areas (as detailed in Section 2.3.1). After the impacts were identified, a simplified assessment was carried out, using some of the guidelines given in the SIA to FRM approach, such as considering the level of intensity and causes of the impact. The household survey used a familiarity scale to capture the intensity with which households experienced certain situations. This method allowed for identifying those impacts experienced with significantly higher intensity. The households' responses to the survey's open-ended questions also corroborated the identified social impacts. The same intensity values were utilized to identify any differences between owners and renters in terms of impact intensity.

### **3.2.3. Phase 3 - Evaluation of results**

The final phase of the research integrates the findings from the first and second phases, which pertain to land tenure and access to assistance, and the social impacts experienced during the long-term recovery. This integration occurs during the inferential stage, where the findings are analyzed and synthesized. The discussion section (Section 5) of the document examines the findings in relation to the research questions associated with the three sub-objectives. Finally, the conclusion section (Section 6) brings together the research findings from the different sub-objectives and provides a conclusive summary. It addresses the main objective, which is “to determine the influence of land tenure on access to assistance for repair and rebuilding after a major flood event.”

## **3.3. Datasets**

The research incorporates both spatial and non-spatial data, and the necessary datasets and their specifications are provided in Table 5. The spatial datasets are utilized to delineate the areas affected by the flood and identify the elements at risk within those areas. On the other hand, the non-spatial data comprises flood reports, scientific literature, and official sources. All the required data is either publicly available as open access or collected specifically for the study.

Table 5: Datasets and data sources.

| Data   | Source    | Owner                 | Year | License     | Data Format |
|--|-----------|-----------------------|------|-------------|-------------|
| Land use   | Secondary | Land registry         | 2022 | Open access | .shp        |
| Buildings  | Secondary | Land registry         | 2022 | Open access | .shp        |
| Flood extent   | Secondary | (SLager et al., 2021) | 2021 | Open access | .shp        |
| Emergency ordinances   | Secondary | (SLager et al., 2021) | 2021 | Open access | .shp        |
| Administrative boundaries  | Secondary | CBS                   | 2022 | Open access | .shp        |
| Population density   | Secondary | CBS                   | 2021 | Open access | .shp        |
| Statistical data   | Secondary | CBS                   | 2022 | Open access | ND          |
| Households questionnaire   | Primary   | ND                    | ND   | ND          | .csv        |
| Stakeholders interview   | Primary   | ND                    | ND   | ND          | .docx       |
| Reports, policies, local newspapers, historical archives, and scientific literature. | Secondary | Different sources     | ND   | Open access | ND          |

### 3.4. Resources required

The software and tools utilized to collect, process, and analyse the research data are listed in Table 6. In terms of hardware, the researcher's personal laptop was used throughout the research process.

Table 6: Software and hardware required.

| Software   | Hardware  |
|--|---|
| <ul style="list-style-type: none"> <li>Quantum GIS / ArcMap for spatial data processing.</li> <li>Maptionnaire platform for household survey</li> <li>SPSS for statistical analysis</li> <li>ATLAS.ti for interviews coding</li> </ul> | <ul style="list-style-type: none"> <li>Personal laptop</li> </ul> |

### 3.5. Case Study: 2021 Flood in Valkenburg

The selected study area is located in the province of Limburg – The Netherlands, in the city of Valkenburg aan de Geul (hereinafter referred to as Valkenburg). The Geul River flows through Valkenburg before discharging its waters into the Meuse River. The total length of the Geul is approximately 60 km, and the size of the catchment area is about 340 km<sup>2</sup>, of which about 60% is in the Netherlands (Asselman & Jan van Heeringen, 2023). Typically, the Geul catchment experiences annual discharge peaks ranging from 20-30 m<sup>3</sup>/s (Abi Aad et al., 2022). However, a dangerous flash flood occurred due to heavy rainfall over two consecutive days (14 July 10:00 - 15 July 10:00) inundating Valkenburg (KNMI, 2021). According to the KNMI, the return period for this event is estimated to be around 400 years in the current climate conditions, and the probability increases as the earth continues to warm (KNMI, 2021). The KNMI indicates that the chance of an event such as in July 2021 could be three times greater in 2050 and could even be six times greater in 2085 than now (Asselman & Jan van Heeringen, 2023).

Valkenburg has an area of 3,673 ha and a population of 16,167 inhabitants (CBS, 2022). The city has 32 neighbourhoods. Considering the evacuated areas and areas that suffered a power outage, most affected areas are located in the centre. Figure 6 shows a map of the flood extent and the impacted areas in Valkenburg.

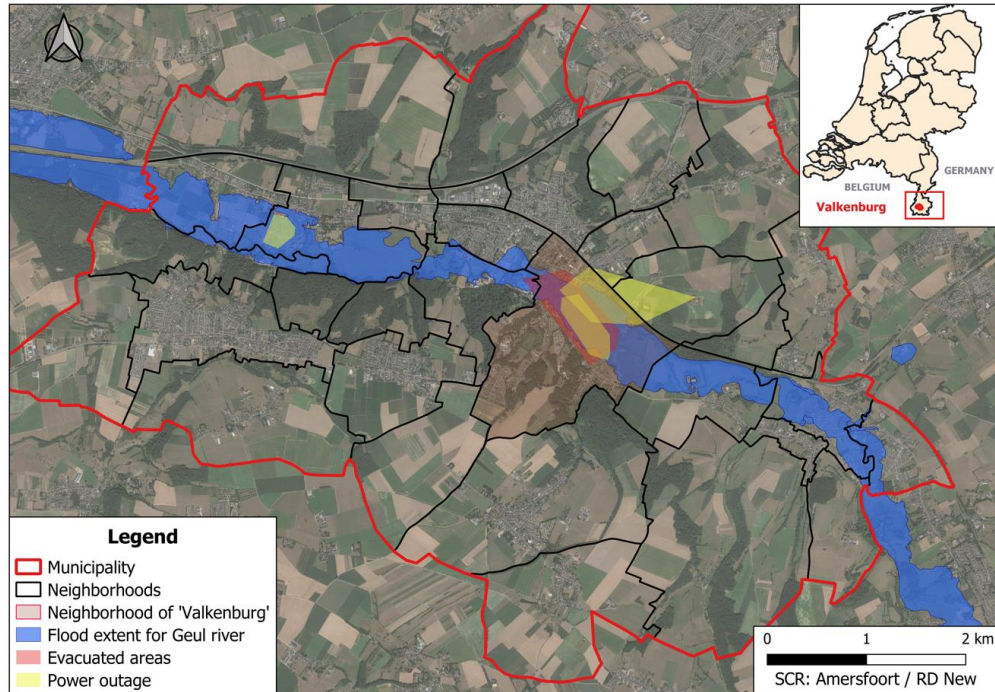


Figure 6: Study area.

Valkenburg is a critical bottleneck prone to flooding during heavy and extensive precipitation periods in the Geul basin (Van Heeringen et al., 2021). The Geul River enters Valkenburg from the eastern side, see Figure 7. After entering the city, the Geul River splits into two branches at the Walramstuw: one flowing left towards the Geul and the other to the Molentak. Both the Geul and Molentak have narrow flow profiles constrained by quay walls and buildings. The quay walls and buildings were not designed to withstand water pressure or retain flooding (Van Heeringen et al., 2021).

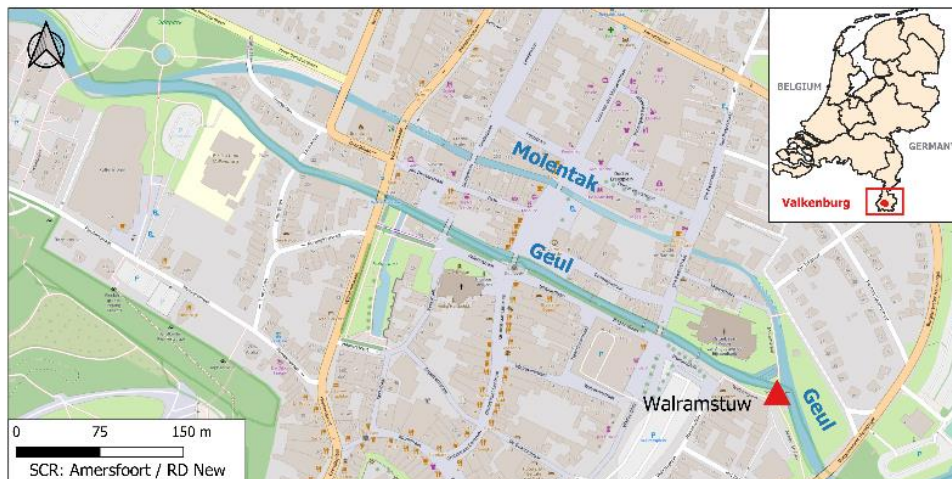


Figure 7: The Geul crossing Valkenburg.

Households reported water depths  $>200$  cm, mainly due to the water in the basements of the house. The most common water depths were between 50-100 cm measured in the house's outside walls and the ground floor (see Figure 8).

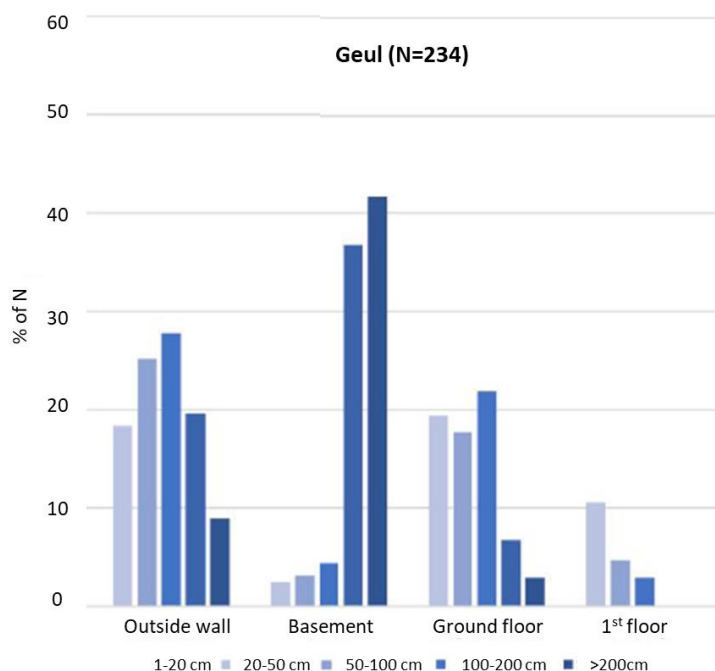


Figure 8: Water depths for different parts of the house. Source: (Endendijk, Botzen, Slager, et al., 2022).

### 3.5.1. Economic Damage

The extreme rainfall and flooding in July 2021 damaged homes, cars, businesses, and government property (Asselman & Jan van Heeringen, 2023). The final advice report of the Policy Table for Flooding and High Water, or "Beleidsstafel wateroverlast en hoogwater" in Dutch, presents an overview of the estimated damage, see Table 7. This estimation establishes the total cost of the damage at 433 million euros for the provinces of Limburg and North Brabant (Beleidsstafel wateroverlast en hoogwater, 2022).

Table 7: estimated economic damage for the provinces of Limburg and North Brabant

| N | Category   | Damage amount (million euros) | Source                  |
|---|--|-------------------------------|-------------------------|
| 1 | Insured damage (houses and businesses property damage) | 210                           | Association of Insurers |
| 2 | Disaster Compensation Act (WTS)                        | 85                            | RVO                     |
| 3 | *Security Regions Act (WVR)                            | 10                            | RVO                     |
| 4 | *Supplementary scheme for municipalities, RVO          | 20                            | RVO                     |
| 5 | *Damage due to business interruption                   | 24                            | RVO                     |
| 6 | Cultivation damage                                     | 9                             | RVO                     |
|   |  | 17                            | Water Authority         |
| 7 | Infrastructure   | 17                            | RWS                     |
|   |  | 1                             | Prorail                 |
| 8 | *Not yet known (e.g., stock exchange policy)           | 40                            |                         |
|   | <b>Total</b>   | <b>433</b>                    |                         |

\*Values are provisional and are expected to vary. Source: (Beleidsstafel wateroverlast en hoogwater, 2022)

The flood damage affected several villages; nevertheless, Valkenburg was by far the largest (Van Heeringen et al., 2021). According to the Task Force Fact-finding Hoogwater 2021, the direct damage plus damage due to business interruption only for the Geul was estimated at 200-250 million euros (Task Force

Fact Finding Hoogwater 2021, 2021). In January 2022, the VU University of Amsterdam, together with Deltares, TU Delft, and HKV Lijn in Water, distributed a questionnaire to households and businesses in the flooded area. The questionnaire results showed that households have an average damage of 50 thousand euros (Endendijk, Botzen, Slager, et al., 2022). Table 8 shows the average damage experienced by households in the total sample, and along the Geul River, it considers home, floor, household effects, and cleaning costs.

Table 8: Average household damage broken down by source. Source (Endendijk, Botzen, Slager, et al., 2022).

| Source            | Total Sample (euros) | Geul (euros) |
|-------------------|----------------------|--------------|
| Home              | 25,000               | 35,000       |
| Floor             | 8,000                | 8,000        |
| Household effects | 17,000               | 20,000       |
| Cleaning costs    | 2,500                | 2,500        |

### 3.6. Stakeholder Analysis

Stakeholders were identified and categorized into three groups: decision makers, exposure units, and third parties. These groupings help to describe the roles played by stakeholders in the access to assistance following the 2021 flood in Valkenburg. Table 9 provides an overview of the identified stakeholders, their respective groups, and a description of each group.

Table 9: Stakeholder Groups. Adapted from (Aznar et al., 2021).

| Group            | Description   | Stakeholders   |
|------------------|---|--|
| Decision makers  | Responsible for designing and implementing FMR measures and actions.            | Ministry of Justice and Security, Province of Limburg, South Limburg Security Region, Waterboard of Limburg, Municipality of Valkenburg aan de Geul. |
| Elements at risk | Directly experiences the impact of the disaster.                                | Households.  |
| Third parties    | Other social actors that have an interest or participate indirectly in the FRM. | Kadaster, Association of insurers, HKV lijn in water BV, Deltares.   |

The stakeholder table, Table 10, presents the identified stakeholders along with descriptions of their functions and specific interests/participation in the process of assistance for repair and rebuilding following the 2021 flood in Valkenburg. The information was collected through a literature review, as shown in the table below. All the reports and publications are open-access.

Table 10: Stakeholder analysis table

| Code | Stakeholder                             | General description   | Stakeholder interests/participation  |
|------|---|---|--|
| S01  | Ministry of Justice and Security (JenV) | The JenV is responsible for the design and operation of disaster and crisis management, including emergency services, civil protection issues, and the annual national risk assessment (Slomp, 2012). | The JenV coordinated the national response to the disaster through the National Coordination Council (NCC), and the ministry, in coordination with other parties, is responsible for the content and implementation of the WTS. The Ministry's Research and Documentation Center (WODC) researched the implementation of |

|     |  |  |   |
|-----|--|--|---|
|     |  |  | the July 2021 WTS and its potential for further improvement (AEF, 2023).  |
| S02 | Netherlands Enterprise Agency (RVO)                | RVO offers information, advice, and financing. RVO draws up regulations, implements them, and ensures compliance with laws and regulations.  | RVO is responsible for preparing the July 2021 WTS and its implementation. RVO collected victims' reports and handled the applications (AEF, 2023).   |
| S03 | Province of Limburg                                | The Province of Limburg is responsible for local policy frameworks and manages (deep) groundwater bodies. The province also deals with accessibility, public transport, spatial planning, and flood protection (e.g., standards for secondary dike systems and construction permits) (Slomp, 2012).  | The province regulates spatial planning and water management at the regional level (IWR, 2011) and ensures a robust regional economy and access to public services. During the 2021 flood, the province coordinated with municipalities and advocated for Limburg's interests at the national level. Additionally, the province provided input for decision-making regarding the content of WTS schemes and the current situation.  |
| S04 | South Limburg Security Region (VRZL)               | The VRZL, comprised of 16 municipalities, the fire brigade, the police, and the medical services, is responsible for disaster or crisis management and preparation on the provincial level for major floods (IWR, 2011) (Slomp, 2012). The organization coordinates with each municipality and develops policies and crisis plans to manage disasters efficiently. | The VRZL's focus is on disaster response, and it plays a limited role in the application of compensation. However, the VRZL has incurred costs that qualify for an allowance under the WTS (AEF, 2023).   |
| S05 | Waterboard of Limburg                              | Waterboards are regional organizations on the same level as municipalities; the Waterboard of Limburg manages surface water and groundwater and is responsible for sufficient water, clean water, safe dikes, and natural water (Slomp, 2012).   | The waterboard collected information for the Quick Scan and advised the central government during the process (AEF, 2023).  |
| S06 | Municipality of Valkenburg aan de Geul             | The municipality is responsible for local spatial planning, land use plan, and building permits (Slomp, 2012). It is also responsible for forming and maintaining the local policy and management of local projects and can facilitate action by promoting and providing subsidies.  | The municipality provides residents with immediate welfare, registers victims, and may help attend to uninsured damage (IWR, 2011) (Rijksoverheid, n.d.). Additionally, municipalities provide information about the damaged area, the extent of financial damage, and other relevant information to aid decision-making (e.g., WTS implementation). Furthermore, municipalities were also victims of the disaster due to the costs associated with repairing local infrastructure. |
| S07 | Verbond Van Verzekeraars / Association of insurers | Group 95 % of insurers in the Netherlands. It connects the insurance sector with the government and society, informs consumers and insurance companies, and conducts statistical research (Verzekeraars, n.d.).  | Provide information for insurers and policyholders regarding insurance coverage and policies such as the "Compensation Act." Insurance companies cover part of the damage.  |

|     |   |  |   |
|-----|---|--|---|
| S08 | Netherlands Institute of Register Experts (NIVRE) | NIVRE, through the Catastrophe Response & Projects Foundation, assists in coordinating and registering claims resulting from major disasters on behalf of the government, municipal authorities, and businesses to ensure a fast and adequate claims settlement process.                               | On behalf of RVO, NIVRE supplied adjusters to assess the damage suffered by victims for implementing the WTS. In addition, NIVRE provided capacity for assessing flood damage during the Quick Scan process (AEF, 2023)   |
| S09 | National Disaster Fund: Giro 777                  | The National Disaster Fund assists disaster victims through civil society organizations. It serves as a bridge between individuals and companies who wish to provide aid and those affected by the disaster.   | In 2021, the National Disaster Fund opened Giro 777 for donations to assist those affected by the severe floods in the southern region of the Netherlands. The assistance was primarily aimed at those who lacked insurance coverage and could not access the WTS (Nationaal Rampenfonds, 2021).  |
| S10 | HKV lijn in water BV                              | HKV is a knowledge company in flood risk and water management; it focuses on advice, research, and product development.  | It has researched social vulnerabilities, e.g., “Evacuation behaviour of those affected during the floods in Limburg in July 2021” (Rudolph et al., 2022).  |
| S11 | Deltares  | Deltares is a knowledge institute with expertise in flood risk, planning, infrastructure, water, and surface resources.  | It has contributed to several aimed at better understanding measures to reduce the risk or consequences of the 2021 flood. Examples of these include: A water system analysis for the 2021 flood (Asselman & Jan van Heeringen, 2023), an Analysis of the flood in Valkenburg (Van Heeringen et al., 2021), and Flood Limburg 2021: Experienced water levels, damage, and risk reduction measures taken (Endendijk, Botzen, Slager, et al., 2022) |
| S12 | Dutch Universities                                | Dutch universities actively research both the technical and social aspects of water management. Some of the universities involved in researching the 2021 flood include <sup>1</sup> Utrecht University, <sup>2</sup> Institute for Environmental Issues (IVM) Free University, <sup>2</sup> TU Delft. | <sup>1</sup> Cooperation in research for applying the Disaster Compensation Act and possibilities for improvement (AEF, 2023).<br><sup>2</sup> Flood Limburg 2021: Experienced water levels, damage, and risk reduction measures taken (Endendijk, Botzen, Slager, et al., 2022)  |
| S13 | Kadaster  | Kadaster is the land registry in the Netherlands; the agency keeps the public register for land and buildings and manages other spatial data.  | Support research and advice on areas related to land management. Kadaster is also responsible for maintaining the “Key Registers.”  |
| S14 | Households  | One of the most affected areas in Valkenburg was the centric neighborhood of ‘Valkenburg.’ The neighborhood has 3,365 inhabitants, mostly settled on the sides of the river, and a total of 1,880 households.  | Require economic assistance after the flooding to ensure long-term recovery.  |

### 3.7. Data Collection

#### 3.7.1. Semi-structure Interviews

Based on the stakeholder analysis, some relevant stakeholders for the study were contacted and invited to participate in semi-structured interviews. The objectives of these interviews were as follows:

- To identify new possible stakeholders interested or involved in the assistance process for repair and rebuilding after the 2021 flood in Valkenburg.
- To know the interviewees' views on the levels of influence and interest of all the identified stakeholders.
- To know the interviewees' perception of the role of the households' ownership status in accessing assistance for repair and rebuilding.
- To identify potential impacts on the households' long-term recovery after the 2021 flood in Valkenburg.
- To identify possible actions to minimize or avoid any identified negative impact.

The semi-structured interviews were designed with ten main questions to guide the conversation and address the established objectives; interviews were conducted online using MS Teams with a duration of one hour. Appendix 1 provides the questionnaire used for these interviews. Within the ten open-ended questions created for the interviews, two exercises were included to better capture participants' opinions on specific topics. The first exercise intended to use Q-Methodology to identify participants' points of view regarding the influence and interest of stakeholders in the implementation of compensation schemas. Nevertheless, due to time constraints during the interview and the different backgrounds of the interviewees, it was not possible to carry out the Q-methodology exercise, as identifying the influence and interest of all stakeholders requires specific knowledge of the assistance process on the administrative side. The second exercise consisted of a survey scale for participants to rate a set of statements about possible social impacts, which were identified in the literature review of reports and scientific publications of the flood. Before applying the survey scale, participants were asked about possible social impacts for households they could identify in the 2021 flood in Valkenburg. The scale was applied after that to enrich the conversation with the participants, as after completing the scale, the ratings given by the participants were discussed to know the explanation for the rated value. Also, sometimes after reading the posed social impacts, participants could come up with other social impacts they had overseen before.

Each interview began with an introduction, where the purpose of the research was presented, and participants were given an opportunity to introduce themselves and discuss their professional experience and their involvement with the 2021 flood. Subsequently, the questions were tailored to the conversation flow and the participants' specific expertise. Depending on the participants' backgrounds and expertise, some interviews were more focused on topics such as flood damage, compensation schemes, or vulnerabilities. Four interviews were conducted; Table 11 provides an overview of the participants' organizations and areas of expertise. Due to the protection of personal data and privacy of the participants, specific details regarding their organizations or personal information are not disclosed. Therefore, each participant has been assigned a code as an identifier.

Table 11: Participants in the semi-structured interviews.

| Code  | Organization           | Area of expertise                         |
|-------|------------------------|---|
| Int01 | Insurance              | Insurance in the 2021 flood               |
| Int02 | University             | Economic damage of the 2021 flood         |
| Int03 | Knowledge institute    | Social Vulnerabilities for the 2021 flood |
| Int04 | National Disaster Fund | Implementation of compensation schema     |



These semi-structured interviews were recorded and transcribed, and the transcription was coded using ATLAS.ti. For the transcription process, certain terms mentioned in Dutch were transcribed with the assistance of a native Dutch speaker; this ensured accurate representation and understanding of the interview content. Table 12 specifies the codes utilized for the coding of the interviews.

Table 12: List of codes used in the transcripts coding.

| N | Code                                     |
|---|--|
| 1 | Cause of Social Impacts                  |
| 2 | Action for Social Impacts                |
| 3 | Social Impacts                           |
| 4 | Flood Damage & Compensation - Valkenburg |
| 5 | Flood Insurance & Disaster - Netherlands |
| 6 | Compensation Process                     |
| 7 | Relation with ownership status           |
| 8 | New Stakeholder                          |

### 3.7.2. Household Survey

The household survey was designed to collect information from the elements at risk; the objectives of the survey were as follows:

- To describe households' socio-economic characteristics, ownership status, and flood exposure.
- To identify the extent to which households accessed assistance for repair and rebuilding after the 2021 flood in Valkenburg.
- To identify potential impacts on the households' long-term recovery after the 2021 flood in Valkenburg.

The main body of the survey had three sections: (1) Flood, Damage & Compensation; (2) Social Impacts and (3) Personal Information. For the implementation of the online survey, the software Maptionnaire was used. The survey created in the Maptionnaire environment can be found in Appendix 3. The section labelled "Social Impacts" was the only section of the survey that distinguished between owners and renters. Depending on their tenure status, respondents answered different batches of questions with slightly different statements about social impacts. Finally, two open questions were added to give the space for the participants to share their experiences during the flood recovery and with access to the different compensation schemas.

To ensure that the rights of participants were respected, the survey minimized the number of mandatory questions. Only questions essential for maintaining the logical flow of the questionnaire or crucial for the research were made mandatory. These included inquiries about the presence of floodwater in the house, water depth, repair time, tenure status, and social impacts. Participants had the freedom to choose not to answer any question and could withdraw from the study at any point. The survey was conducted online and distributed via pamphlets containing a QR code, which were delivered to participants' mailboxes. Participants could scan the QR code to access the survey (see Appendix 2 for the pamphlet), and filling in the questionnaire took approximately 10 minutes. As an incentive to encourage survey completion, participants had the opportunity to participate in a raffle; providing the e-mail for the raffle was voluntary. The raffle consisted of five dinner gift cards valued at 50 euros.

The survey specifically targets households that have been directly affected by the flood. Therefore, the amount of directly impacted households in each neighbourhood was estimated. First, the population directly impacted by the flood was calculated by crossing population density data from CBS, the flood extent, and the neighbourhoods' boundaries. Then the number of directly impacted households was

estimated by multiplying the percentages of the directly impacted population in each neighbourhood and the number of households per neighbourhood. Based on the estimation, this study considers a total of 1.415 households directly impacted in Valkenburg, see Table 13. The target sample size for the survey was set at 65 households, aiming for a 90% level of confidence and a 10% margin of error.

Table 13: Population and estimation of households directly impacted by the flood.

| Neighbourhoods        | Population |                     | Households  |                     |
|-----------------------|------------|---------------------|-------------|---------------------|
|                       | Total      | Flood Direct Impact | Total       | Flood Direct Impact |
| Bergse Heide          | 32         | 0                   | 0           | 0                   |
| Broekhem Zuid         | 1748       | 53                  | 905         | 27                  |
| Geulhem               | 40         | 5                   | 25          | 3                   |
| Keutenberg - Sousberg | 61         | 5                   | 20          | 2                   |
| Plenkert              | 179        | 120                 | 75          | 50                  |
| Schin op Geul         | 638        | 314                 | 325         | 160                 |
| Schoonbron            | 202        | 54                  | 90          | 24                  |
| Sint Gerlach          | 848        | 285                 | 730         | 246                 |
| Valkenburg            | 3316       | 1568                | 1885        | 891                 |
| Vroenhof              | 387        | 26                  | 185         | 13                  |
| <b>TOTAL</b>          |            |                     | <b>4240</b> | <b>1415</b>         |

The pamphlets were distributed in three neighbourhoods heavily impacted by the flood, namely the central neighbourhood of Valkenburg, Schin op Geul on the west side of the city, and Sint Gerlach on the east side (refer to Figure 9). The objective was to target the areas with higher population density; the three selected neighbourhoods concentrate 90% of estimated households. Six hundred pamphlets with the survey QR code were distributed on May 26 and 27, 2023. Six dissemination areas were designated to streamline the distribution process, labelled as letters (A-F) in Figure 9.

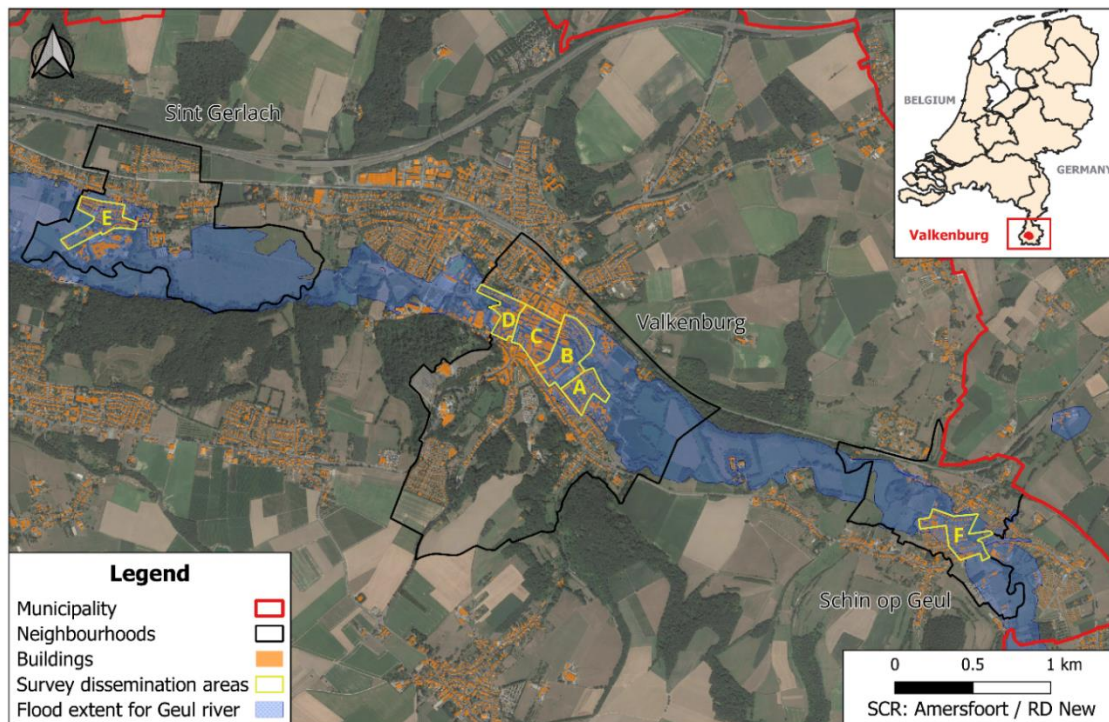


Figure 9: Dissemination areas for the survey.

The researcher and two research assistants personally delivered the pamphlets, placing them directly into the mailboxes. Only mailboxes displaying stickers with the text "Ja - Ja" or "Nee - Ja" were chosen for pamphlet distribution, while mailboxes marked with "Nee - Nee" were intentionally avoided, as they indicate a preference for no correspondence. During the survey distribution, there were opportunities to engage in casual conversations with individuals affected by the flood. These conversations revealed that residents still had vivid memories of the flood, and many were actively dealing with the repair process. These conversations' primary focus was gathering information about the areas impacted by the flood and the water depth. This information ensured an effective survey distribution. Additionally, depending on the availability of the individuals, some extra questions were asked regarding the extent of the damage, the progress of the repair process, and the compensation received. These questions provided further insights into the aftermath of the flood.

### **3.8. Ethical considerations, risks, and contingencies**

Ethical concerns arise from the possible impacts research findings may have, from the data collection (semi-structured interviews and the household survey) and data management as it involves human participants.

The findings may have a positive cultural/social impact, as they contribute information to improve households' access to assistance to repair and rebuild after a major flood. However, the results may be misinterpreted, creating friction among institutions or organizations regarding the work done during the repair and rebuilding process. Therefore, it is essential to contrast the results with information from official sources and experts' opinions on the topic and present them objectively and without assumptions. During the semi-structured interviews, participants may become fatigued due to the length and process, feel uneasy or judged, and fear negative workplace consequences. In the household survey, the survey may trigger negative emotions and memories, and respondents might wrongly anticipate that the research can directly improve their current situation. The mitigation strategies were: using the ethical review provided by ITC, limiting interview duration, explaining the project purpose, respecting privacy, minimizing sensitive survey questions, and clarifying research goals to avoid false expectations.

Regarding data management, pseudonymized transcripts, and household survey data were stored short-term in the cloud using the MS Teams service provided by the university, which is accessed only through the institutional accounts. Long-term data will be stored in the DANS EASY repository using the ITC institutional account for 15 years and restricted access. Only researchers or supervisors can authorize access for future research validation. The data storage provided by the university complies with the GDPR.

## 4. RESULTS

*This section presents the findings for the first two phases of the research: Phase 1 - Land tenure and access to assistance, and Phase 2 - Social impacts in the long-term recovery. In the first phase (subsection 4.1), the three compensation schemas are described, and the role of land tenure in access to assistance is identified. The second phase (subsection 4.2) provides the flood context, including the damage extent and the compensation schemas applied, using the household survey information. It then presents the identified social impacts and the observed differences between renters and owners.*

### 4.1. Land Tenure & Access to Assistance

Three main compensation schemes partially compensated for the damage caused by the 2021 flood. The first is private insurance via home contents and building policies. The second encompasses government assistance, which can provide compensation after a disaster for uninsured damage via the Disaster Compensation Act (WTS). The third mechanism involves the National Disasters Fund (Task Force Fact Finding Hoogwater 2021, 2021), which collects donations from citizens and companies to aid disaster victims. In what follows, we describe the three schemes, their extent of application, and the process through which affected households accessed them. This section's statistical data reference the 2021 Floods in Limburg, of which the 2021 flood in Valkenburg is part.

#### 4.1.1. Private Insurance

The cause of the 2021 floods in Limburg was extreme and widespread rainfall and the overtopping of secondary flood defences. Therefore, as mentioned in the flood insurance section, Section 2.2.2, most of the damage was covered by private insurers under building and contents policies, with insurers that followed the flood advice from 2018 (Verbond Van Verzekeraars, 2021). The Netherlands has a comprehensive insurance system that mandates homeowners to acquire home insurance when obtaining a mortgage. This requirement has led to nearly 100% of households having home insurance coverage (Kok et al., 2021). Some of the most common types of property and casualty insurance that a household can access are:

- Home insurance (Opstalverzekering in Dutch)
- Home contents insurance (Inboedelverzekering in Dutch)

All-risk insurance, which covers flood damage, is not part of the basic home insurance and is offered as additional coverage to the premium (Independer, 2023). As of December 2021, over 50% of homeowners had all-risk insurance coverage, while the percentage for companies and institutions was lower (Kok et al., 2021). However, this percentage has increased since the 2021 floods in Limburg, and currently, the majority of consumers have property insurance against precipitation and local floods (Verbond van Verzekeraars, 2023). The percentage of all-risk insurance went from nearly 60% to approximately 90% (Int01).

Following the 2021 floods in Limburg, insurers received approximately 25,000 claims, 10 percent of which were business claims. The insured damage due to the severe weather in July amounted to 180 – 250 million euros, most of which was in South Limburg, where Valkenburg is located (Verbond Van Verzekeraars, 2021, 2022). Reviewing the website "Independer," specializing in insurance search in the Netherlands, the primary information when looking for property insurance is address, postal code, tenure status (owner/renter), living situation, age, and income. The tenure status defines which type of insurance renters or owners can access. Homeowners can choose between home insurance, content insurance, or a combination of both, while renters can access only content insurance (Independer, 2023). Regarding

premium prices, there is a slight difference between owners and renters. Doing two similar searches for content insurance on the Independer website and changing the tenure status, the cheapest option for content insurance is 12.35 euros for owners and 13.85 euros for renters (Independer, 2023).

In the event of an insurable flood, households with property insurance that covers flood damage can file a claim with their insurer, who will handle the process and verify coverage together with a hustle. If the damage is covered, an insurance company representative will assess the extent of the damage and determine the compensation amount. The insured households will then have the option to be connected with a repair company or handle the repairs themselves.

#### 4.1.2. Disaster Compensation Act (WTS)

After the floods, Limburg was declared a disaster area; the government introduced the Disaster Compensation Act (WTS) to cover damages that are non-insurable, non-recoverable, and non-avoidable (Rijksoverheid, 2021). For this time, the government extended the WTS coverage to include insurable damages not generally known to be covered by insurance; nevertheless, citizens are expected to have adequate insurance for future disasters (Verbond Van Verzekeraars, 2021). Households that applied for the July 2021 WTS could access compensation as described in Table 14.

Table 14: WTS damage coverage for households. Source: (Rijksoverheid, 2021)

| Source                              | Allowance amount                     |
|-------------------------------------|--------------------------------------|
| Home                                | 90% of the damage                    |
| Household effects                   | 90% of the damage up to 36,000 euros |
| Cleaning costs/Prevent worse damage | 65% of the cost                      |
| Evacuation cost                     | 304 euros < 597 euros                |

Households must have suffered damage in the defined disaster area to be eligible for compensation. To start the process, the affected submitted a WTS claim to RVO. After submission of the report, a loss adjuster from the Netherlands Institute of Register Experts (NIVRE) contacted the victim to carry out the valuation; finally, the valuation is sent to the victim; if the victim agrees, RVO handles the application and makes the payment, if the victims do not agree there is the chance of revaluation (AEF, 2023).

It is important to note that the July 2021 WTS covers damages to primary residential functions only and does not include damage to gardens (RVO, 2023). Different interpretations of “Household effects” by loss adjusters resulted in some including garden furniture, barbecues, and bicycles under household effects, while others did not (JenV, 2022). As a result, victims were not treated equally.

As of May 17th, 2023, more than 2,960 reports were made (16.8% property damage, 15.3% household effects), out of which 1,639 have been received, completed, and paid out (RVO, 2023). The total compensation paid out by that date amounted to 70.6 million euros (RVO, 2023), significantly lower than the estimated economic damage during the Quick Scan, which was 1.15 billion euros (AEF, 2023). For the municipality of Valkenburg, 764 reports were made (RVO, 2023). Delays in processing payments may be attributed to RVO's requirement of waiting for victims to receive a response from their insurers before processing the reports (JenV, 2022).

Handling the damages has been mentally challenging for victims, particularly for those who were not eligible for compensation under the WsTS (AEF, 2023). Many affected citizens, entrepreneurs, and governments faced uncertainty regarding the WTS and lacked support during the application process (AEF, 2023).

#### 4.1.3. National Disaster Fund (NRF)

The NRF is a private initiative that aims to gather funds and goods to provide relief for needs caused by disasters in the Netherlands (JenV, 2022). After the government declared the 2021 floods in Limburg a disaster, the NRF collected 11.8 million euros through Giro 777 to assist households and civil society organizations affected by the flood (Nationaal Rampenfonds, 2021). The collected funds were allocated across three budgets: a gift of 2,000 euros for all affected households (5.2 million euros), support for projects proposed by civil society organizations (3.6 million euros), and local funds designated for distressing cases which are households facing difficulties in repairing and not access to other forms of compensations (3.0 million euros).

For the first budget of 2,000 euros, over 2,500 individuals affected by the flood, whether insured or uninsured, were entitled to apply. Since the NRF does not have its own infrastructure, the distribution of the funds was facilitated through the “Councils and Water Boards Tax Collaboration in Limburg” (Belastingsamenwerking Gemeenten en Waterschappen, BSGW), which is responsible for tax collection for water boards and municipalities in Limburg. Following an agreement between the BSGW and the NRF, the BSGW returned the established amount to the affected households.

To apply for the 2,000 euros, affected households submitted applications through the BSGW website. The applications were sent to the respective municipalities for confirmation, which, using the applicant’s home address, verified that the house was inside the flooding area and that flood water had entered the building. If the validation was positive, the BSGW processed the compensation payment, or if it was negative, the applicant could request a reassessment from the NRF. Municipalities also contributed to informing citizens about the possibility of applying for NRF compensation. More than 100 cases arose where people had issues with the application because they did not apply on time or were not correctly registered in the address (e.g., the person recently moved in or moved out). To avoid duplicate payments, NRF funds were only for the primary home, not a holiday home. If the building owner had already made a claim, it could pose difficulties for the renter to access the compensation.

The second budget was allocated to projects proposed by civil society organizations to recover from the flood and prevent damage caused by flooding (Nationaal Rampenfonds, 2022). The third budget, allocated for distressing cases, was distributed among the municipalities based on the number of affected individuals. In this case, each municipality acted as a facilitator, identifying cases that needed additional assistance, and the NRF acted as the contracting party responsible for paying the funds. There was a delay in the payment of these funds as municipalities waited for the insurance settlements in case the person has one or WTS outcomes before authorizing the payments.

#### 4.1.4. Role of land tenure in access to assistance

Upon reviewing the three compensation schemas implemented following the 2021 floods in Limburg, we have identified two distinct manners in which land tenure status influences households’ access to assistance.

Firstly, the availability in the compensation schemas of tailored products for renters and owners. Private insurance offers products such as home insurance, content insurance, and a combination of both. The WTS, on the other hand, provided compensation for the damage to the home and house effects damage. Secondly, tenure information serves as basic information during the access to assistance. Insurers and the WTS require specific details regarding an individual’s relationship with the property (i.e., owner or renter) to assess and provide compensation. Furthermore, information derived from tenure records, such as addresses and personal details, is also required.

In the Netherlands, the BRP key register provides information about people and the BAG regarding addresses and buildings. Tenure information is registered in the BRK, but some data regarding people’s relation with the property can also be found in the BRP. To facilitate the understanding, Figure 10 visually

represents the interconnectedness of the Key Registers—BRP, BAG, BRK—and their interplay with the various organizations involved in the three compensation schemas.

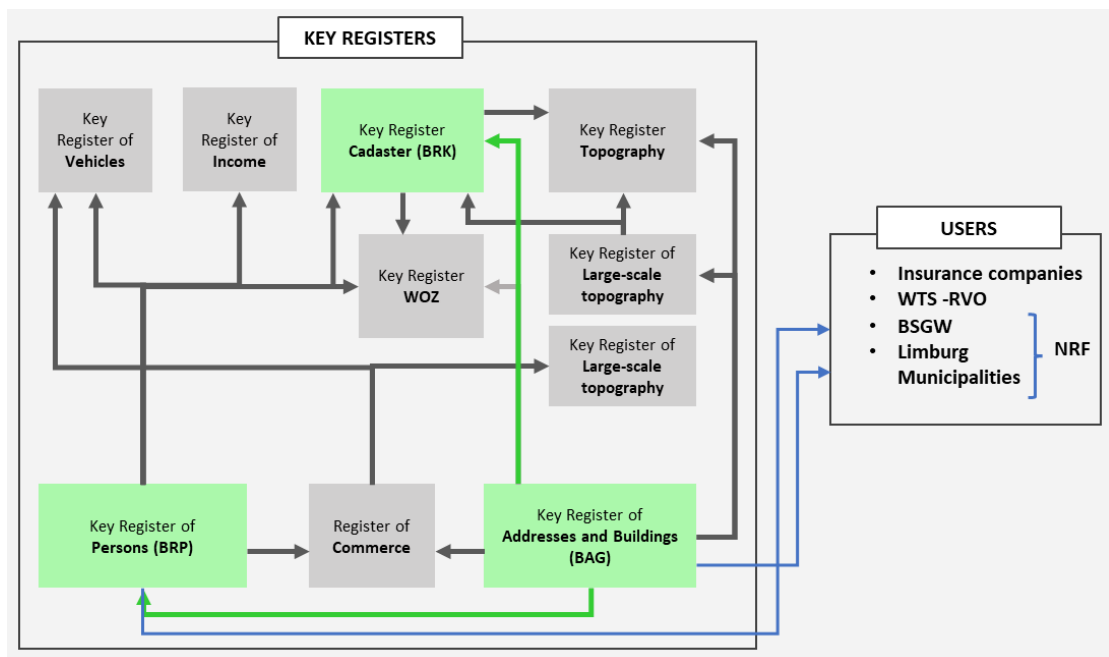


Figure 10: Key Registers providing information for access to compensations. In the figure, the key registers BRP and BAG are highlighted in green, as these key registers directly offer essential information to organizations involved in the assistance process (indicated by links in blue colour). The BRK register is also in green, as it utilizes information from BAG and BRP and provides the primary geographic data for these registers.

The significance of tenure information in the assistance process becomes more visible when considering the NRF as an example. The NRF collaborated with the BSGW and Limburg municipalities to distribute funds. The BSGW levies and collects local taxes, including water, council, and property taxes, on behalf of Limburg municipal councils and water boards (BSGW, 2023). These taxes are addressed for renters (tenants) or owners (landlords); the BSGW uses the BRP as a taxpayer database. In collaboration with the NRF, the BSGW used the same system, but instead of collecting taxes, it distributed funds among the households affected by the flood.

Similarly, municipalities utilized the BRP and BAG databases with information regarding the extent of the flood to verify that applicants were direct victims of the flood. It is also important to notice that the BRP is created using addresses from the BAG for the registration of residents (Gemeente Amsterdam, 2023). Additionally, the BRK is interconnected with the BRP and BAG, providing spatial and tenure-related information.

#### 4.2. Social Impacts in the Long-term Recovery

In order to identify and comprehend the social impacts experienced by households during their long-term recovery, it is important to consider certain factors and circumstances inherent to the flood and flood management that have influenced their recovery process. These factors include the water levels in the houses, economic damage, and access to compensation. To provide context, the results of the household survey are presented and contrasted with a larger study conducted after the Limburg Floods in December 2021. This broader study examined water levels, damage experienced, and the implementation of risk reduction measures (Endendijk, Botzen, Slager, et al., 2022).

#### 4.2.1. Household survey: Flood, Damage & Compensation

The household survey gathered responses from 53 participants, with 600 pamphlets distributed, resulting in a response rate of 8.83%. Among the 53 responses received, eight households reported not having floodwater in their house during the 2021 flood, leaving 45 responses corresponding to households directly impacted by the flood. Considering the answers from directly impacted households and the previously estimated number of directly impacted households in Valkenburg (1.415), the survey achieved a 90% confidence level with a margin of error of 13%. In December 2021, a larger survey was conducted in all flooded areas of Limburg, including Valkenburg, with a sample size of 1,513 households and a response rate of 14.9% (Endendijk, Botzen, Slager, et al., 2022). Some values obtained in the households survey were contrasted with the December 2021 survey to corroborate their accuracy.

Statistics for all the survey questions are shown in Appendix 4. Not all respondents answered questions about personal information. But it is possible to see that 42.22% of the respondents were men, 40% were women, and 17.78 % did not answer. 55.56 % of respondents were between 45 to 74 years old. Additionally, 22.22 % did not respond. Regarding the tenure status, 75.56% of respondents were homeowners, 17.78% were renters, and the remaining percentage did not provide an answer. These proportions closely align with the 83.9% of owners and 15.3% of renters reported in the December 2021 survey.

Regarding the flood extent and damage, Figure 11a illustrates the households' reported water depths and repair times. The most common water depths fell within the range of 100-200 cm. Higher levels result from water entering the basements of houses, as shown in the December 2021 survey, and the most common repair time ranged from 7 to 12 months, as shown in Figure 11b. However, there is a trend of repair times extending beyond a year or still being in progress at the time of the survey (May 2023). These findings are consistent with the estimated repair times of approximately one year reported by households in December 2021.

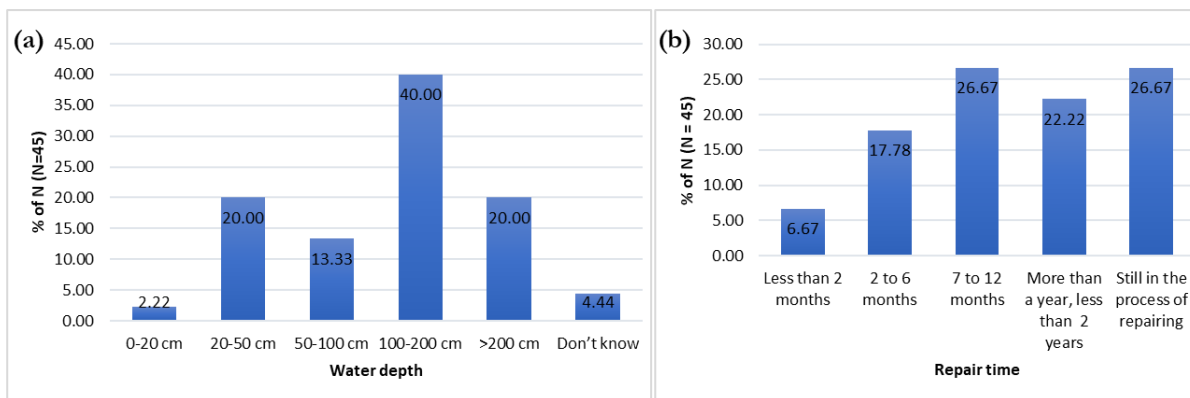


Figure 11: Households responses for water depth, 11a, and repairing times, 11b.

Regarding the damages' costs, the survey revealed a median value of 70,000 euros for building repairs and 20,500 euros for house contents, see Table 15. Not all respondents provided information on the economic damage; nevertheless, obtained values align with those found in the December 2021 study, 20,000 euros for house contents and 35,000 for buildings, as reported by Endendijk, Botzen, Slager, et al. (2022). Since respondents registered higher water depths, the more significant damage to buildings is relatable.



Table 15: repairing costs reported by households

| Source        | Min. (euros) | Median (euros) | Max. (euros) | % of N (N=45) |
|---------------|--------------|----------------|--------------|---------------|
| Building      | 3,000        | 70,000         | 200,000      | 60            |
| House content | 1,500        | 20,500         | 100,000      | 51            |

The most commonly used sources to cover the expenses of repairing the damage were contents insurance (62.22%), home insurance (44.44%), and own sources (44.44%). This information is depicted in Figure 12. As part of the survey, households were asked about difficulties accessing the three compensation schemes. More than half of households did not face difficulties, or these were perceived as small (Figure 13). However, it is possible to notice that answers are grouped in the extremes between “not at all familiar” and “extremely familiar,” particularly for the WTS, 13b, and insurance, 13a. These discrepancies in experiences may be attributed to various factors, including whether the victim received the expected compensation and the specific conditions applied under each compensation scheme, which were discussed in the previous subsections (4.1.1 and 4.1.2).

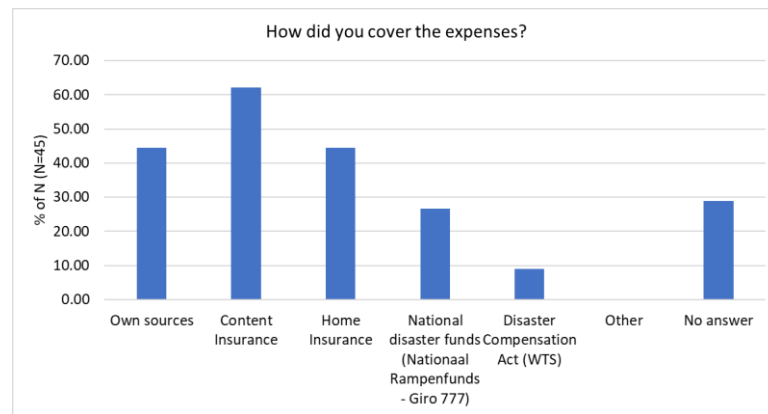
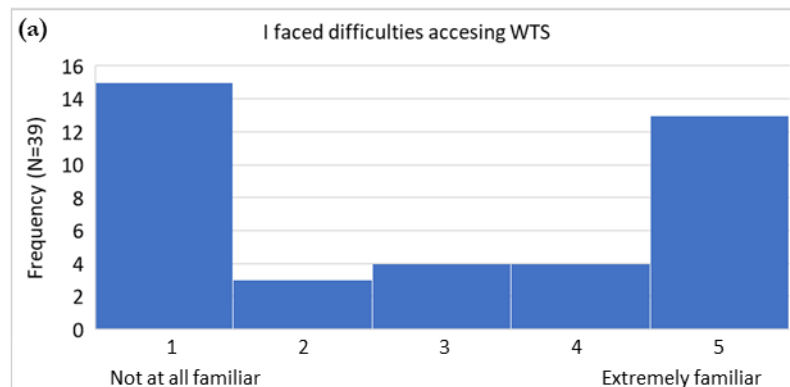


Figure 12: Sources that households used to cover flood damage expenses.



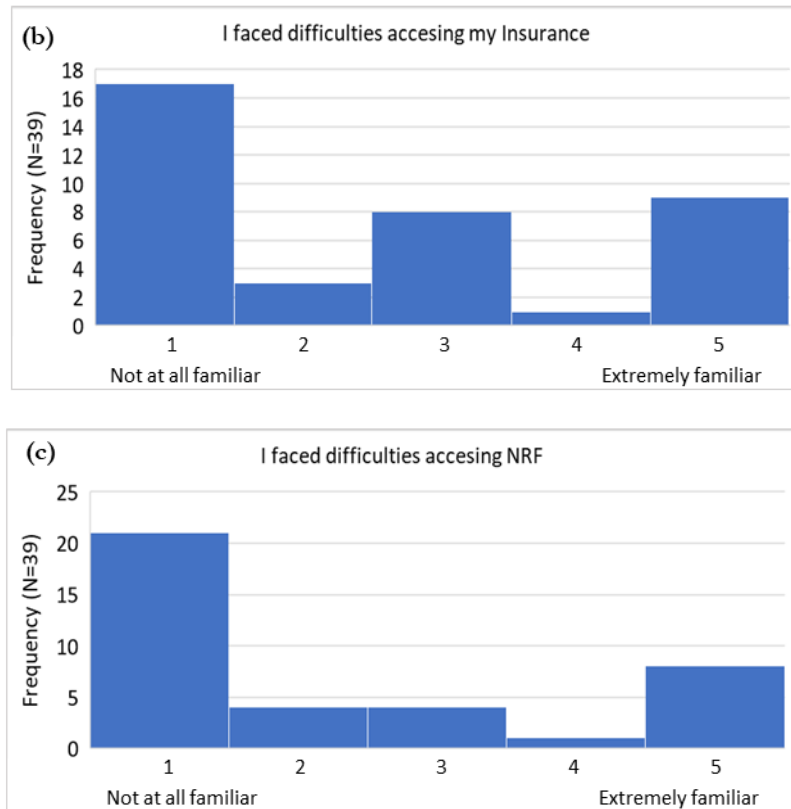


Figure 13: Households' difficulty accessing the different compensation schemes: 13a insurance, 13b WTS, and 13c NRF, rated on a familiarity scale from 1 to 5.

**4.2.2. Social Impacts in the Long-term Recovery**

Based on the information gathered from the literature review and interviews (see Table 16), social impacts that households may experience during their long-term recovery were identified. Table 16 presents the list of these impacts, together with their respective code, impact areas, and descriptions. The codes for the impacts are made of a combination of the code for the impact area and the number of the corresponding impact in the pre-list of social impacts to flood, see Section 2.3.1. It allows us to track how the impacts were selected. The identified impacts pertain to the impact areas: community, environment, fears and aspirations, health and well-being, people’s lifestyles, personal and property rights, and political systems.

Table 16: Social impacts identified for the case study.

| N | Code   | Impact area | Impact   |
|---|--|-------------|--|
| 1 | CO03   | Community   | Strengthening of community cohesion due to participation in community restoration projects following the flood |
|   | <b>Description:</b><br>Community cohesion is favoured when community members collaborate on neighbourhood restoration projects. This collaborative spirit may replicate behaviours observed in the flood's aftermath, such as people offering assistance and cooking for their neighbours (Int03*). The National Disasters Fund funded recovery projects initiated by civil society organizations (Nationaal Rampenfonds, 2021). |             |  |
| 2 | CO26   | Community   | Temporary relocation of people due to relocation during the repair process                                     |
|   | <b>Description:</b><br>People were temporarily relocated due to flood damage (Int03), returning home after days or weeks (Welling, 2022). As of the end of 2022, more than a year after the flood, local media reports still indicated that over 75  |             |  |

|    |       |                     |   |
|----|-------|---------------------|---|
|    |       |                     | houses remained unoccupied due to unrepaired damage (NPO, 2022).  |
| 3  | EN04a | Environment         | Unrepaired house damage caused by the flood.<br><b>Description:</b><br>According to media reports (NPO, 2022), the damage caused by the flood is still evident in houses more than a year after the event. This prolonged impact is attributed to the extended repair periods, primarily because houses in the region are constructed using Limburg marl, which can take up to five years to fully dry (NPO, 2022).   |
| 4  | EN04b | Environment         | Unreplaced house contents damaged by the flood.<br><b>Description:</b><br>Replacing damaged house contents can present difficulties, as many people disposed of their damaged belongings immediately after the flood and lacked proof for insurance claims (Int01; Int03). Moreover, individuals receive reduced compensation, particularly for older household items; the compensation payout can result insufficient for purchasing new brand replacements (Int01). |
| 5  | FA08  | Fears & Aspirations | Increased perception of flood risk<br><b>Description:</b><br>Most flooding reports (Endendijk, Botzen, Slager, et al., 2022) show increased risk perception. The risk perception rises in the most affected individuals, while those who experienced minor impact or merely witnessed the disaster tend to forget the flood experience more easily (Int01; Int03).  |
| 6  | FA09  | Fears & Aspirations | Uncertainty of future flood damage.<br><b>Description:</b><br>Reports and news articles indicate that people are uncertain about the effects and impacts of new flood events. One significant aspect highlighted after the 2021 flood in Valkenburg was economic damage. The unusual and extreme flood events and the coverage provided for the compensation schemes may have also contributed to the uncertainty surrounding the financial implications.             |
| 7  | HW11a | Health & Well-being | Stress from limited finances during the long-term recovery.<br><b>Description:</b><br>A survey realized after one year of the flood shows that people still present certain stress levels due to the flood damage and the handling of the damage (Endendijk, Botzen, Moel, et al., 2022). Residents reported that the compensation provided is partial, with approximately 40% being covered by themselves (Endendijk, Botzen, Moel, et al., 2022).                   |
| 8  | HW11b | Health & Well-being | Loss of belongings that held significant sentimental value<br><b>Description:</b><br>Households had a sentimental attachment to their old living spaces (Int03). Connected to their living spaces are belongings that hold sentimental value for the residents, which were destroyed by the flood. Following the flood, many residents promptly disposed of damaged goods by the flood (Int01; Int03).  |
| 9  | HW12a | Health & Well-being | Increased workload due to the need to finance the repair costs<br><b>Description:</b><br>Some people may work extra time or return to work to cover the expenses of repairing flood damage (Int03).   |
| 10 | HW12b | Health & Well-being | Increased workload due to personally taking care of the house repairs.<br><b>Description:</b><br>News reports indicate a scarcity of professionals available for home repairs and an inflation in regular costs (Int03). As a result, individuals may find themselves dedicated to the repair process (Int04). It is also influenced by the long periods required for repair.   |
| 11 | HW12c | Health & Well-being | Receiving time off from work to attend to the repair process.<br><b>Description:</b><br>Some people have mentioned receiving time off from work to attend to the flood recovery process (Int03)   |
| 12 | PP14  | People's lifestyle  | Change in the habits of households during the repair and rebuilding   |

|    |       |  |  |
|----|-------|--|--|
|    |       |  | process.   |
|    |       | <b>Description:</b>  |  |
|    |       | The time spent on the repair process (Int04), restricted use of certain areas in the house after the flood (Int01), temporary relocation during repairs (Int03), and delayed return to homes even a year later, as reported by news sources, can disrupt people's everyday routines. On average, it took nine months to complete the repairs, with 35% of households taking 6 to 12 months (Endendijk, Botzen, Slager, et al., 2022).  |  |
|    | PP17  | Personal & Property Rights   | Access to affordable quality housing during the repair process.                              |
| 13 |       | <b>Description:</b>  |  |
|    |       | People temporarily move during the repair process, especially when the house is significantly damaged (Welling, 2022). In these cases, they may have to look for affordable places to stay.  |  |
|    | PP18  | Personal & Property Rights   | Temporary reduction of regular household expenses to accommodate flood damage costs.         |
| 14 |       | <b>Description:</b>  |  |
|    |       | A study examining spending patterns following the flood in Valkenburg revealed an average financial impact of 18,045 euros per bank account holder over 35 weeks (Van der Heijden, 2022). During this period, households changed their expenditure patterns due to costs caused by the flood.  |  |
|    | PP22  | Fears & Aspirations  | Increased awareness of flood risk  |
| 15 |       | <b>Description:</b>  |  |
|    |       | The flood experience makes people more resilient (Int03), and it can be reflected in people taking measures to prevent or reduce flood damage. Following the event, the percentage of people with flood insurance coverage increased from approximately 60% to about 90% (Int01). Generally, when there are two subsequent flooding events, the subsequent one tends to cause significantly less damage, as observed in the Netherlands in 1993 and 1995 (Int01).  |  |
|    | PP23  | Personal & Property Rights   | Decrease in the property value   |
| 16 |       | <b>Description:</b>  |  |
|    |       | Property price models demonstrate fluctuations in value, not only in flood-affected areas but also in vulnerable regions(Int02; Int03). It can create challenges for homeowners with fixed mortgages, as the house price decreases while the mortgage value remains unchanged (Int01). However, it is important to note that the reduction in value may not be universally applicable, as people often pay a premium to live near water (Int02).   |  |
|    | PS24a | Political systems  | Dissatisfaction with the compensation schemas applied due to difficulties in accessing them. |
| 17 |       | <b>Description:</b>  |  |
|    |       | According to official flooding reports (AEF, 2023), people encountered difficulties accessing the compensation schemes (Int01; Int02; Int03).  |  |
|    |       | The causes are different for each compensation schema:   |  |
|    |       | <ul style="list-style-type: none"> <li>• PS24a1 - Difficulties accessing WTS: long waiting periods to access, uncertainty about the extent of the compensation, and high expectations regarding the aid offered.</li> <li>• PS24a2 - Difficulties accessing NRF: wait for insurance and WTS decisions before receiving NRF aid</li> <li>• PS24a3 - Difficulties accessing insurance: some households with no all-risk insurance, flood insurance does not cover damage outside the house, need to negotiate the claim with the insurance company, and the time required to process the claim.</li> </ul> |  |
|    | PS24b | Political systems  | Dissatisfaction with flood management.   |
| 18 |       | <b>Description:</b>  |  |
|    |       | People were generally annoyed with government actions (e.g., dike protection standards should be higher, early warning) (Int03).   |  |

The social impact codes enable the tracking of the origin of each social impact. These codes are comprised of two parts: the code for the impact area and the number for the potential flood-related social impact (Tables 3 and 4,

respectively). E.g., the code FA08 corresponds to the impact area "Fears & aspirations." At the same time, the number 08 is associated with the flood-related impact of "Modified perceptions of personal health and security, risk, fear of crime." \*A more detailed description of the interviews can be found in Table 11.

The identified social impacts in Table 16 were validated using the household survey to consult the affected households directly. The survey aimed to determine whether the at-risk individuals indeed experienced these impacts and, if so, to assess their intensity. A familiarity scale was used to capture the intensity with which the households experienced each social impact. Figure 14 displays the social impacts with their short names and codes, arranged in descending order of intensity, based on responses from approximately 39 households. Among the most commonly experienced impacts displayed in the figure are the uncertainty surrounding future floods and the related damage, increased risk perception, loss of belongings with a sentimental value, increased workload due to repair efforts, difficulties encountered with compensation schemes, and change of habits. When looking at the areas where individuals experienced more changes, it is possible to see that the social impacts are mainly related to "Fears & aspirations," "Health & Well-being," and "Political Systems."

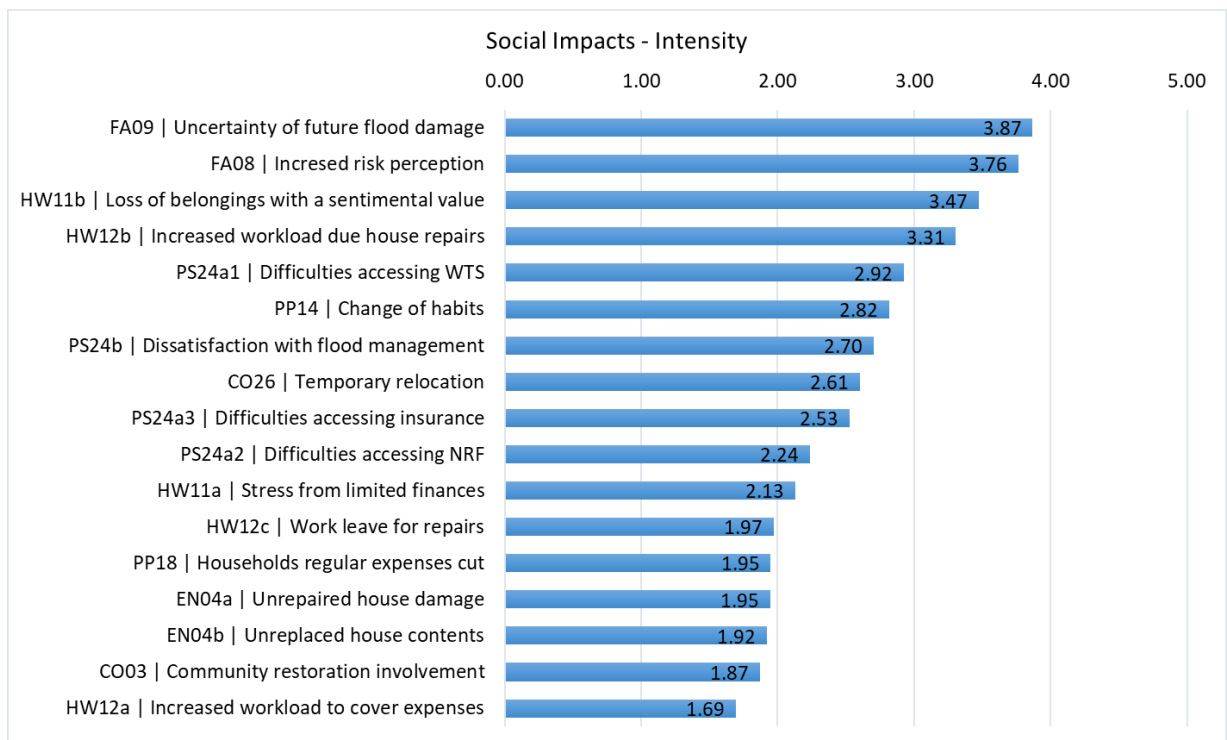


Figure 14: Intensity given by households to the identified social impacts.

Figure 14 presents the difficulties for accessing compensation for each compensation schema, with WTS having the most challenges. Unfortunately, not all impacts from Table 16 were assessed due to an error in the design of the online questionnaire. The impacts that were not considered were: access to affordable quality housing (code PP17), increased awareness (code PP22), and a decrease in property value (code PP23).

The household survey included open questions about long-lasting experiences during their long-term recovery and their experience accessing the compensation schemas. The stories shared by households in the survey provided valuable insights into understanding the main social impacts they faced. The following findings emerged from the experiences shared by households:

- People vividly remember the flood and the evacuation process (Owner01; Owner30; Owner33). Some of these memories are fuelled by factors such as the loss of loved ones (Owner33), the loss of belongings with sentimental value (Renter06), and the overall intensity of the flood experience itself (Owner28).
- The recovery process has been lengthy, lasting over a year, and with some households still repairing at the moment of the survey (Owner04; Owner23). The initial stages were particularly challenging, and the prolonged repair duration has significantly impacted their living conditions (Owner01; Owner07; Owner22; Renter02). A telling statement that encapsulates this experience is, *“It has greatly affected our household, and in the beginning, it even disrupted our lives....our lives have been focused on recovery and renovation for one and a half years against our will, causing stress for our family”* (Owner23).
- Increased workload during the recovery period primarily stems from the restoration efforts, which are further compounded by work and family responsibilities (Owner13; Owner23). A household referred to the recovery process as *“restoration being entirely carried out by ourselves and with the support of our family”* (Owner12).
- Prolonged recovery periods causing stress and discomfort were reported by participants (Owner23; Renter02). Distress still lingers when recalling the flood (Owner07; Owner30). Additionally, there is an emotional impact resulting from losing belongings with sentimental value that cannot be replaced (Renter06). Fresh memories still evoke strong emotions in people, as one individual expressed, *“When I tell the story... I still get emotional”* (Owner30).
- Increased risk perception (Owner01; Owner07; Owner09; Owner22; Owner30). This increased risk perception is fuelled by the fear of experiencing new flood events: *“Every time it rains, I feel alert and somewhat stressed”* (Owner10).
- Dissatisfaction with the flood management due to the feeling of lack of communication (Owner10; Owner26). Not enough presence of authorities (Owner14). Feeling that the recovery has focused more on business than households (Owner15; Owner31). Nevertheless, some people are satisfied with disaster management despite the long compensation process (Owner10; Owner13).
- Uncertainty of future flood events, regarding consequences (Owner22), and preparation for future events (Owner26).
- Temporary displacement, unable to reside at home and provide a stable environment for their family (Owner04).
- Dissatisfaction with compensation schemes. Several reasons contribute to this dissatisfaction, such as unrealistically high expectations (Owner20), lengthy settlement periods (Owner03; Owner04; Owner22; Owner30; Owner31; Owner34), the need to negotiate for compensation (Owner13), receiving compensation based on depreciated values (Renter02), encountering a challenging process (Owner04), and experiencing situations where there was little or insufficient coverage (Owner06; Owner15; Owner20; Owner27; Owner31). On the other hand, some households reported positive experiences of successful recovery (Owner22; Owner34; Renter06; Renter07). These were mainly the cases for families covered by flood insurance (Owner13; Owner22; Owner23; Owner26; Owner33), and that had access to other compensation schemas.
- Households experienced difficulties during the repair process due to a shortage of contractors (Owner20; Owner30), limited availability of materials (Owner04), and increased rates (Owner15).
- Some economic problems arise due to the loss of income from unrepaired rental properties (Owner27), the need to cover most of the repairs using personal funds (Owner04), and tapping into savings (Owner27).

The shared experiences of households revealed still fresh memories of the flood, accompanied by the prolonged recovery process. During the long-term recovery, households reported increased workload,

stress, and discomfort, dissatisfaction with compensation schemes, increased risk perception and fear of future floods, dissatisfaction with flood management, uncertainty about future flood events, temporary displacement during the recovery, difficulties in the repair process, and economic pressures. These findings reaffirm the intensity of social impacts in Figure 14.

#### 4.2.3. Social Impacts among Renters and Owners

Some differences emerge when examining the varying degrees of impact felt by renters and property owners in response to the same social impacts. This contrast in intensity is graphically depicted in Figure 15, illustrating the relative magnitudes of these impacts for both renters and owners. The impacts that presented more significant differences are increased workload and difficulties in accessing WTS which posed substantial difficulties for property owners. In contrast, renters reported higher intensities for unreplaced house contents, unrepaired house damage, and difficulties in accessing insurance.

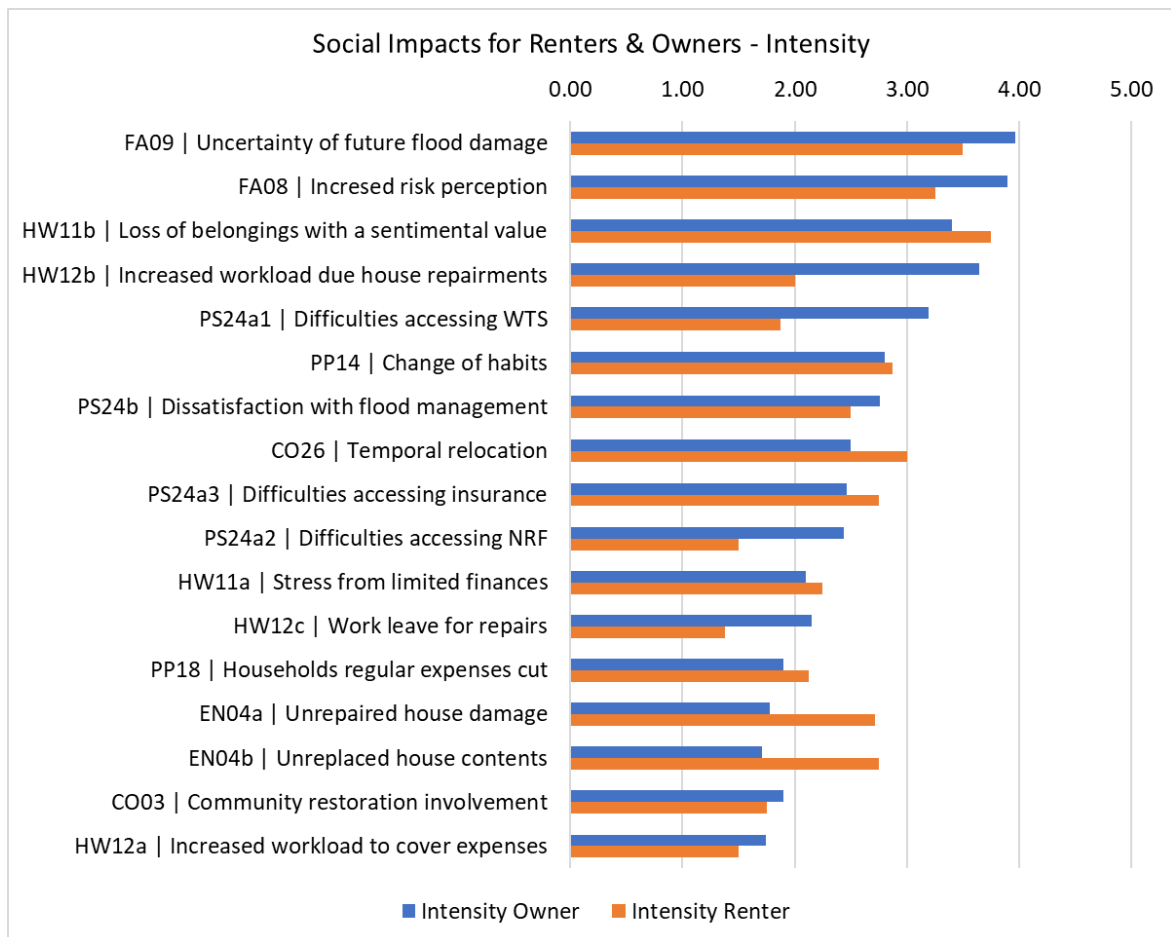


Figure 15: Intensity is given by owners and renters to the identified social impacts. The impact codes allow us to follow the full name and description in Table 16.

Some impacts only apply to one group, such as “the loss of income from unrepaired rental properties” mentioned by Owner27, which was not included in the survey. Identifying such individualized impacts for renters and owners requires digging deeper into the social effects of the flood; carrying out such analysis is complex through a survey. Nevertheless, findings presented in Figure 15 show that renters and owners undergo distinct experiences during flood recovery.

## 5. DISCUSSION

*The discussion section is part of the third phase of the research, which focuses on evaluating the results. In this stage, the obtained results for Phase 1, which pertains to land tenure and access to assistance, as well as for Phase 2, which examines the social impacts in the long-term recovery, are discussed.*

### 5.1. Land Tenure & Access to Assistance

The results show that compensation schemas applied after the 2021 floods in the Netherlands are tailored to address the needs of both affected renters and owners. Private insurance offers home and content insurance coverage through the “all-risk” package, while the July 2021 WTS provided compensation for home and house effects damages similarly to private insurance. Having products that cater to the needs of affected households based on their tenure status facilitates their access to assistance for repair and rebuilding, whether acquiring insurance or applying for the WTS. The NRF operates differently as it primarily focuses on collecting funds and relies on other organizations involved in disaster management to distribute these funds. In this case, the municipalities identified the cases requiring assistance from the NRF and the amounts allocated for each case. Tailored insurance products for owners and renters are also present in Germany and Belgium, countries also affected by the extreme floods of July 2021. In Germany, private insurance also offers home and content insurance; flood coverage is included in the natural hazard package, which is optional (CHECK24, 2023). In Belgium, flood damage coverage is compulsory and included in simple risk “fire” insurance (FPS Economy, 2020). Insurance in Belgium offers property insurance for tenants (renters), home insurance for owners, and home insurance for landlords (KBC, 2023). How households access assistance depends significantly on country-specific arrangements regarding flood insurance and government compensations.

The Netherlands and Germany have voluntary flood insurance systems with optional coverage and risk-based premiums (Tesselaar et al., 2022). As with the July 2021 WTS, the Dutch government has often extended disaster assistance to cover uninsured damage without explicit obligation regarding the probability and extent of compensation (Tesselaar et al., 2022). In Germany, flood insurance has a 46% penetration, and premiums are determined based on a classification system established by the German Insurance Industry (GDV) in 2001 for 98.5% of the addresses in the country (DKKV, 2022). The system has four classes for flood risk: GK1 (every 200 years or less), GK2 (every 100 to 200 years), GK3 (every ten to 100 years), and GK4 (every ten years or more) (DKKV, 2022). In the class, GK4 can be difficult and expensive to get insurance against natural hazards (DKKV, 2022; Neubert, 2023). The 2021 floods in Germany had a direct damage of 34.4 billion euros, with 8.1 billion euros covered by insurance (BMWK, 2023). The "Development Aid Fund 2021", carried out by the federal government and states, offered compensation to households, covering up to 80% of expenses and, in some cases, up to 100% with third-party benefits (Bundesfinanzministerium, 2021). Due to the disincentive to acquire flood insurance, such compensations cause, some states have recently established regulations to compensate in the future only households who cannot take out insurance due to, e.g., high individual risk (DKKV, 2022).

On the other hand, Belgium employs a solidarity insurance system that involves complete cross-subsidization of flood risk, where premiums remain unaffected by risk levels, and insurance uptake is nearly mandatory; nonetheless, certain post-disaster assistance is still provided to uninsured households (Tesselaar et al., 2022). Fire insurance has a penetration exceeding 75% (Tesselaar et al., 2022). While home insurance isn't obligatory, it becomes a necessity when obtaining a mortgage; this insurance typically includes basic fire coverage (KBC, 2023). In the regions of Flanders and Wallonia, tenants are mandated to have liability insurance (tenants' insurance), while content insurance remains optional (KBC, 2023). The 2021 floods in Belgium led to damage amounting to 2.4 billion euros, of which 2 billion euros had already been covered by December 2022. Out of this total, 1.5 billion euros will be gradually reimbursed by the



regions (Flanders, Wallonia, and Brussels) to insurance companies (Assuralia, 2022). The insurance code in Belgium establishes a limit on the monetary burden insurance companies can bear; when the limit is reached, the government steps in to cover the remaining amount up to a pre-established limit (Bruggeman & Faure, 2019). These thresholds for the 2021 floods were adjusted due to their insufficiency to cover all incurred damages fully (Assuralia, 2022). Disaster funds which are the competence of the regions, only make available compensation for damage not insurable for the fire policy (FPS Economy, 2023).

Tenure information is relevant for households to access assistance; knowing people to property relationships serves as a base for insurance or government to provide adequate compensation in the event of a flood. However, other information, such as personal information and addresses, is also relevant. What looks like a simple piece of information, such as addresses, when combined with flood data, can be used to determine the level of risk for each household and to establish their insurance premium as in the classification system applied by the GDV in Germany. These records are part of the “Key Registers” system in the Netherlands. The BRK key register maintains information on parcels and tenure rights; it is interconnected with other key registers and contributes to their construction, like the BRP (record of Residents) and the BAG (record of Addresses and Buildings). Kadaster manages the BRK and BRP, with the BRP being updated by the municipalities and using data from the BAG. The availability, accountability, and ease of access to this information for both public and private organizations enable the identification of victims and facilitate the provision of the necessary services for their disaster recovery. For instance, the distribution of the NRF funds relied on these registers. However, even in a robust system like the “Key Registers,” there are instances where records may not be up to date. During the distribution of NRF funds, more than 100 cases were found where the BSGW could not distribute the funds. These cases refer to late applications but also to individuals not properly recorded in the BRP (e.g., recently moved in/out). This example highlights the importance and challenges of keeping records updated in real-time. It also prompts reflection on the reality of countries without proper records of people and property to rely on in the event of a disaster. Less than half of the world’s countries have registered or mapped the land in their capital cities; less than a third maintain those records digitally (Deininger, 2018).

Looking at the cases of Germany, Belgium, and the Netherlands, it is possible to see that the design of the insurance systems and the ways that governments provide compensation can pose particular difficulties for households to access assistance. The case study in the Netherlands exposed procedural complexities when accessing assistance. One of the reasons for this is that applicants often lacked awareness of the available compensation schemes and were unfamiliar with the specific application procedures and coverage details. The applicants went through a series of filters, starting with waiting for a decision from their insurance company if the household was insured against flood damage. In cases where insurance coverage was insufficient or the household was uninsured, they could then apply for the July 2021 WTS. Finally, if neither insurance nor the WTS provides the necessary assistance, applicants could turn to NRF funds.

The complexity is further compounded by the specific requirements and processes associated with each compensation scheme. For insurance, factors such as the varying flood coverage policies of different insurance companies or households not being aware of the all-risk coverage when acquiring the insurance contributed to the challenges. Regarding the WTS, delays occurred as the government had to decide the extent of assistance, and there was uncertainty surrounding the scope of coverage. The waiting times for a decision in the two previous compensation schemas affected the accessibility to the NRF funds, contributing to longer recovery periods. According to the household survey results, repairs often took more than a year, and in some cases, repairs are still ongoing (refer to Figure 12). These findings align with the results obtained in previous surveys (Endendijk, Botzen, Slager, et al., 2022). It is important to notice that the experiences of households with the compensation schemas are polarized, as illustrated in Figure

13. While access to assistance works for many victims, there are areas that require improvement. The Dutch government is currently analysing these issues for future events (AEF, 2023).

How the system is designed and proper records of people and property can reduce disparities between renters and owners when accessing assistance for repair and rebuilding, as seen in the case study. Understanding the relationships between people and land is particularly important during the recovery process, especially considering that the responsibility for specific risks, such as flooding, starts with the owner of a building, object, infrastructure, or site, known as individual care (Kok et al., 2021). The identified procedural complexities in access to assistance are applicable to both renters and owners. This finding matches common barriers for vulnerable populations, such as eligibility restrictions and procedural complexities (Wilson et al., 2021). The manner in which insurance or disaster funds are provided significantly influences how fast individuals and society can recover from a flood (Slomp & de Vries, 2017). Studying further how other social vulnerabilities to flooding affect the access of flood victims to assistance for repair and rebuilding can help improve flood recovery strategies.

## **5.2. Social Impacts in the Long-term Recovery**

The flood in Valkenburg in July 2021 was caused by heavy rainfall and overtopping of secondary flood defences. It was an extreme and unusual event for the inhabitants of Valkenburg. The experiences of households in their recovery are inherent to how the flood impacted them; 60% of households that answered the survey reported having levels of water over 1 meter (usually high levels are related to water in the basements and in the gardens that are in a lower level than the street). Half of the households had repairing times that lasted more than a year, with some people still repairing at the time of the survey, May 2023. The medium repair costs are 70,000 euros and 20,500 euros for building damage and household effects, respectively.

The access to assistance also affected how households experienced long-term recovery. Even though the Netherlands has good insurance coverage, as it is a requirement for obtaining a mortgage, some households remain unaware that all-risk insurance covering flood damage needs to be acquired as an addition to the basic insurance. Additionally, not all flood damage is covered; flood due to failure of primary defences is not covered, and flood due to failure of secondary defences can be covered since 2018. Still, it is up to the insurer to implement this advice. After the 2021 floods, the high expectations of citizens for government aid through the WTS, the reported long waiting times to process the cases, and the uncertainties in the extent of the coverage left the feeling of in-satisfaction in households, especially those that could not access the WTS. Dealing with the claim process and sometimes waiting long to receive claim settlements were common for WTS and private insurance. These factors also affected the implementation of the third schema raised by the NRF that assigned a budget to help with distressing cases, as households must wait for the decision of the insurance and the WTS before accessing the NRF.

As described, procedural complexities were present; still, there were many cases of successful recovery thanks to the compensation households received. Therefore, households' experiences are polarized, highly positive or negative. Negative experiences can be influenced by high expectations regarding government compensation (Endendijk, Botzen, Slager, et al., 2022). In addition, shortages of contractors and repair materials and the time for homes to dry before starting the repairment also contributed to the extent of the recovery period in the affected areas of the Netherlands. Extended periods for recovery also have been experienced in Germany. Insurance claim settlements in the Ahr Valley, one of the regions hit hardest by the 2021 floods in Germany, continue to be processed two years after the flood (GDV, 2023). Insurers require reconstruction to be finalized before disbursing the full amount; among the factors contributing to these prolonged reconstruction times are material shortages and a shortage of craftsmen (GDV, 2023). By July 2023, 6.7 billion euros of the 8.4 billion euros of damage for insured property have been paid out (GDV, 2023).

The above-mentioned factors related to the impact of unusual and extreme floods and the measures taken played a pivotal role in shaping how victims experienced recovery. The identified social impacts with major intensity experienced by the households were increased risk perception, uncertainty for future flood events, loss of belongings with a sentimental value, increased workload for the house repairs, difficulties accessing the compensation schemas, change of habits, dissatisfaction with the flood management, temporary relocation, and stress. When looking at the areas in which the impacts are categorized, “Fears & Aspirations,” “Health & Well-being,” and “Political systems” are the most commonly impacted areas. It shows that the consequences of floods greatly affect individuals' lives and that the recovery strategies and how they are implemented have a significant impact.

Renters and owners experienced the flood recovery with some differences, mainly in the following impacts: increased workload, difficulties accessing WTS, unreplaced house contents, unrepaired house damage, and access to insurance. These differences relate to the tenure status and its implication; an owner is expected to spend more time repairing building damage and make more use of the compensations available; therefore, owners reported more difficulties accessing the July 2021 WTS. Renters showed major percentages for unrepaired damage to the building and unreplaced house effects; renters also presented slightly more difficulties accessing insurance. Major differences among renters and owners to access to compensations were not identified as per their tenure status. A good registration of people and property in the Netherlands provides a strong foundation for other functions, as in the case of disaster risk management to work, keeping disparities low, at least among renters and owners. The Netherlands has an accurate registration of renters, which is often difficult as per informal renting practices (Osmonova, 2017) and per the difficulties of systems to register all rental properties (Muczyński et al., 2019).

### **5.3. Use of SIA to FRM to assess measures in DRM**

This section discusses the advantages and disadvantages of applying SIA to FRM to assess FRM interventions, highlighting the recovery phase as per the case study. However, it's important to note that comparable SIA frameworks could also be extended to the domain of DRM.

#### **5.3.1. Advantages of using SIA**

The SIA to FRM approach offers some advantages when analyzing the social impacts of the recovery phase after a flood event. Frameworks like the one presented by Mahmoudi et al. (2013) and methodologies like the one proposed by Aznar et al. (2021) provide well-structured and logical frameworks that assist in identifying and analyzing social impacts. These frameworks are particularly beneficial due to the inherent complexities associated with social analysis. Other frameworks, such as the one proposed by WMO (2016) and other more generic SIA tools as provided by the "International Principles for Social Impact Assessment" (Vanclay, 2003), may also be used to support the analysis process. Moreover, the SIA to FRM approach is multidisciplinary, much like FRM itself. Thus, implementing the SIA analysis within the different phases of the FRM process can be advantageous as professionals are used to working in multidisciplinary environments. Integrating this new analysis would aid in better incorporating the social aspect into any strategy or decision-making process. Recognizing social vulnerabilities to disasters has become crucial in the development of effective strategies and policies, as it acknowledges the varied impacts that these vulnerabilities can have.

#### **5.3.2. Disadvantages of using SIA**

There are certain disadvantages associated with the social analysis itself. SIA demands expertise in studying social contexts, and despite having a robust framework, subjectivities within the social analysis process are still present. SIA can become challenging due to the complexity of the factors involved and the amount of

data needed to determine their interconnections (Rimmert, 2022). These challenges are visible when examining interventions within FRM, such as in the recovery phase. The analysis conducted in this study covered three distinct compensation schemas and involved multiple organizations participating in flood management. These organizations have additional responsibilities beyond providing assistance for repair and rebuilding. Recognizing these responsibilities and identifying the most relevant stakeholders requires specialized knowledge in the field.

Additionally, SIA requires diverse inputs, which can pose challenges in terms of data collection. Many of these inputs rely on active participation from all stakeholders, especially those directly impacted by the flood (Aznar et al., 2021). Analysing the social impacts of a specific FRM intervention can present challenges because certain impacts cannot be attributed solely to a single intervention. Instead, they result from multiple actions undertaken throughout the flood management process. Consequently, it is essential to examine social impacts within the scope of the specific intervention being analysed but also within the broader context. This broader perspective allows for a more comprehensive understanding of the outcomes and implications of the study.

## 6. CONCLUSION AND RECOMMENDATIONS

*This section encompasses the conclusions, recommendations, and limitations derived from the research. Moreover, it provides insights for future research.*

### 6.1. Conclusion & Recommendations

The study's results show the interrelation between land tenure and access to assistance for repair and rebuilding after a major flood, like the 2021 flood in Valkenburg, which made part of the 2021 floods that affected the Netherlands, Germany, and Belgium. These findings emphasize the importance of maintaining accurate registers of property, individuals, and their relationships, such as the "Key Registers" system in the Netherlands. This system keeps records of tenure information, personal information, buildings, and addresses; information that facilitates victims' access to assistance; and organizations involved in the flood recovery provide the required assistance. Information derived from this system, such as addresses, in combination with flood data, allows the identification of victims after a flood event but also in the pre-disaster stage to determine if the property is in a high-risk area and, therefore, to set the flood insurance premium or set another type of compensation in case of non-insurability due to high individual risk. Nevertheless, there are ongoing challenges in keeping these records up to date, especially due to informal rental practices and the systems' difficulty in registering rental property. Specific country arrangements for flood insurance and government compensation also affect how households experience flood recovery. Challenges in accessing assistance can arise due to a lack of awareness, unfamiliarity with application procedures, and varying requirements of different compensation schemes. An adequate design of the system and proper records can help reduce disparities between renters and owners.

Disasters inherently lead to social impacts, which are also influenced by the disaster management interventions implemented. This research identified several social impacts in the long-term recovery after the 2021 flood in Valkenburg. The primary impacts include increased risk perception, uncertainty for future flood events, loss of belongings with a sentimental value, increased repair-related workload, difficulties accessing the compensation schemas, change of habits, dissatisfaction with the flood management, temporary relocation, and stress. It is important to note whether households received or not expected compensation influenced households' perception regarding access to assistance and flood management. Looking at the impact areas, "Fears & Aspirations," "Health & Well-being," and "Political systems" were the areas where individuals experienced more changes during the long-term recovery. It is noticeable that, aside from the economic burden of flood damage on households, most of the impacts are on the well-being and emotional side due to the flood experience and how recovery measures were implemented. While comprehensive recovery strategies may not eradicate all identified impacts, they can avoid or mitigate those arising from complex procedures in the access to assistance. Regardless of the ease or difficulty in accessing assistance, the undeniable benefits of flood insurance and compensation schemes remain evident.

Certain differences were observed when examining the experiences of renters and owners during their long-term recovery. Owners were more involved in house repairs and faced greater difficulties accessing compensation schemes. On the other hand, renters experienced more unrepaired house damage and the effects of not having their house effects replaced. No notable differences were found between owners and renters regarding limitations in accessing assistance for repair and rebuilding. This finding can be attributed to the country's effective registration of people and property. Nevertheless, it is crucial to consider how other social vulnerabilities, such as health, demographics, coping capacity, neighbourhood characteristics, risk perception, and socio-economic factors, have influenced the recovery process. Studying these vulnerabilities presents certain challenges, including the availability of information and difficulties in reaching socially vulnerable groups. However, including these groups and understanding their experiences in long-term recovery efforts will contribute to improving strategies to mitigate the effects of future floods.

In this regard, the SIA to FRM approach seems like a suitable alternative for analysing the social impacts of FRM interventions using a well-structured framework and multidisciplinary approach to face the complexities inherent to social analysis; comparable SIA frameworks could be extended to the DRM.

## **6.2. Limitations**

The research encountered some limitations. Firstly, it was challenging to involve all stakeholders. After the 2021 flood, numerous studies using Valkenburg as a case study were conducted. Consequently, the municipality lacked the capacity to address all research requests. Additionally, there were concerns regarding data privacy when sharing information about the residents' experiences. Another difficulty in adding more stakeholders to the analysis was the time constraints associated with long times for contacting and arranging interviews and the limited time for the research. Language barriers also posed a significant limitation, as much of the flood information was in Dutch. Furthermore, since Valkenburg is a small village, most residents felt more comfortable speaking Dutch.

## **6.3. Future research**

Future research should continue with the analysis of the underlying causes of the identified social impacts. Digging deeper into these causes is vital to propose suitable actions in the subsequent phase of the SIA to FRM. Moreover, implementing SIA to FRM, in other case studies, can also help to comprehend how different insurance systems and government compensations affect the long-term recovery of flood victims. These insights can enhance flood recovery strategies by pinpointing interventions that yield positive social outcomes. Similarly, the SIA approach may also capture how different tenure systems better assist disaster recovery. Furthermore, it can be used to assess other interventions of LA and DRM. Exploring how other social vulnerabilities to flooding shape affected communities' recovery will help enhance current strategies to better prepare for future events.

## 7. ANNEX

### 7.1. Appendix 1: Interviews questionnaire

#### PLANNED DURATION SEMI-STRUCTURED INTERVIEW ~60 MINUTES

##### Introduction (5 minutes):

- Thank you for taking the time for this interview. As it is a semi-structured interview, I have prepared some guiding questions, but additional questions may arise during the discussion."
- "Before we begin, may I record the interview? As stated in the consent form provided to you earlier, the data collected during this interview will only be used for research purposes, and all names will be changed or anonymized."
- Context: In July 2021, heavy rainfall caused flooding in Belgium, Germany, and the Netherlands. While flood defenses in the Netherlands performed well, incidents were still registered. To pay for the repairing costs of the flood damage, households used insurance payments, disaster funds, or government compensations (WTS). Access to adequate compensation may have some effects on the medium and long-term recovery of affected households.

##### Questions (50 minutes):

1. What has been your experience with the 2021 flood in the Netherlands?
2. May you describe the process for a disaster declaration in the Netherlands?
  - 2.1. Which institutions are involved in this process?
3. For the compensation method, you have more experience. Could you please briefly describe the process that households followed to access it?
  - 3.1. Which actors are involved?
4. Using the following sentence as a guide, place the identified stakeholder or stakeholder group in the grid according if you agree, disagree, or are neutral towards the statement.

The \_\_\_\_\_ has/ have the most **interest** in the design and implementation of compensation schemas after the 2021 Limburg Flood.

| Disagree |    | Neutral |   |   | Agree |  |
|----------|----|---------|---|---|-------|--|
| -2       | -1 | 0       | 1 | 2 |       |  |
|          |    |         |   |   |       |  |
|          |    |         |   |   |       |  |
|          |    |         |   |   |       |  |
|          |    |         |   |   |       |  |
|          |    |         |   |   |       |  |
|          |    |         |   |   |       |  |

|   |                                     |  |
|---|-------------------------------------|--|
| Ministry of Justice and Security (JenV)           | Netherlands Enterprise Agency (RVO) | Province of Limburg                    |
| South Limburg Security Region (VRZL)              | Waterboard of Limburg               | Municipality of Valkenburg aan de Geul |
| Netherlands Institute of Register Experts (NIVRE) | Insurers                            | National Disaster Fund                 |
| Knowledge and research institutes                 | Dutch Universities                  | Land Registry /Kadaster                |
|   | Households                          |  |

5. Using the following sentence as a guide, place the stakeholder or stakeholder group in the grid according if you agree, disagree, or are neutral towards the statement.

The \_\_\_\_\_ has / have the most **influence** in the design and implementation of compensation schemas after the 2021 Limburg Flood.

| Disagree |    | Neutral |   | Agree |  |
|----------|----|---------|---|-------|--|
| -2       | -1 | 0       | 1 | 2     |  |
|          |    |         |   |       |  |
|          |    |         |   |       |  |
|          |    |         |   |       |  |
|          |    |         |   |       |  |

|   |   |  |
|---|---|--|
| Ministry of Justice and Security (JenV) | Netherlands Enterprise Agency (RVO)               | Province of Limburg                    |
| South Limburg Security Region (VRZL)    | Waterboard of Limburg                             | Municipality of Valkenburg aan de Geul |
| Insurers                                | Netherlands Institute of Register Experts (NIVRE) | National Disaster Fund: Giro 777       |
| Knowledge and research institutes       | Dutch Universities                                | Land Registry /Kadaster                |
|   | Households  |  |

6. Can you describe the conditions affected households need to fulfil to be granted compensation?
7. What are your thoughts regarding the relationship between households' ownership status and access to compensation?
8. After almost two years. How would you describe the long-term recovery achieved in the affected areas?
- 8.1. How has the compensation contributed to the long-term recovery?
9. Based on your expertise and personal experience with the 2021 flood, please read the statements below regarding possible social impacts households may experience during their medium and long-term recovery. Then, estimate whether these statements may apply to the case study.
- 1) Strongly Disagree
  - 2) Disagree
  - 3) Neutral/No Opinion
  - 4) Agree
  - 5) Strongly Agree

| Social Impact  | Rating |   |   |   |   |
|--|--------|---|---|---|---|
|  | 1      | 2 | 3 | 4 | 5 |
| 1. Change of habits due to inability to use affected areas of the home for an extended period of time. |        |   |   |   |   |
| 2. Diminishment of community cohesion due to unequal access to compensation among households.          |        |   |   |   |   |
| 3. Dissatisfaction with other FRM measures taken due to lack of access                                 |        |   |   |   |   |



|  |  |  |  |  |  |
|--|--|--|--|--|--|
| to expected compensation   |  |  |  |  |  |
| 4. Decrease in the neighborhood's aesthetic appeal due to prolonged periods of unrepair house damage.  |  |  |  |  |  |
| 5. Increase in the workload required to live decently due to the additional expenses for flood damage. |  |  |  |  |  |
| 6. Stress for lack of economic resources due to additional expenses for repairing flood damage         |  |  |  |  |  |
| 7. Increased resilience towards future floods due to the acquisition of content or home insurance.     |  |  |  |  |  |
| 8. Reduction in normal household expenses due to unexpected flood repair expenses.                     |  |  |  |  |  |
| 9. Reduction in the property value due to flood damage   |  |  |  |  |  |
| 10. Temporary rent reduction due to unrepaired flood damage to the home.                               |  |  |  |  |  |
| 11. Increase in debt due to acquiring loans for repairing house damage.                                |  |  |  |  |  |
| 12. Difficulty in accessing quality housing  |  |  |  |  |  |
| 13. Increase in risk perception due to the economic implications of flood damage                       |  |  |  |  |  |
| 14. Uncertainty about the economic impact of future floods   |  |  |  |  |  |

9.1. Can you explain the impacts that you strongly agree?

9.2. Based on your experience, are there any other possible impacts that you would like to add?

10. From your area of expertise, which actions could we take to reduce or avoid any possible negative impacts we just discussed?


**Conclusion (5 minutes):**

- Unfortunately, we need to close the discussion. Are there any further points that you would like to add?
- As mentioned, this exploratory interview is a valuable source of information showing an expert's point of view on this topic to clarify what has been done, which stakeholders are involved, and to better connect the research with previous work.
- Thank you

## 7.2. Appendix 2: Pamphlet

Pamphlet for survey distribution in English.

DUTCH IN THE OTHER SIDE



Dear member of the Valkenburg community,

I am Dennis Ushiña, an MSc student at the University of Twente.

I invite you to participate in a study that aims to understand the impacts of flood damage on households.


Your valuable input will contribute to the completion of my thesis.

For questions, please feel free to contact me at [d.p.ushinahuera@student.utwente.nl](mailto:d.p.ushinahuera@student.utwente.nl)

### HOW YOU DID AFTER THE 2021 FLOOD IN VALKENBURG?


Recovering from a flood can be a challenging journey that often requires assistance

To share your experience after the 2021 flood, please follow the link:  
<https://app.maptionnaire.com/q/9y7o9gwm8ot6>  
 Or scan the QR code.



The survey is voluntary, and no personal information is required. It will take approximately 10-15 minutes.

As a token of appreciation, you'll have the opportunity to win one of five dinner gift cards worth €50 each. The raffle will be held on 9<sup>th</sup> June.



Valid at 3250 restaurants across the Netherlands, including Valkenburg.

Pamphlet for survey distribution in Dutch

ENGELS AAN DE ANDERE KANT



Beste lid van de Valkenburgse gemeenschap,

Ik ben Dennis Ushiña, een MSc-student aan de Universiteit Twente.

Ik nodig u uit om deel te nemen aan een onderzoek dat tot doel heeft om de impact van waterschade op huishoudens te begrijpen.

Uw waardevolle input zal bijdragen aan de voltooiing van mijn scriptie.

Als u vragen heeft, kunt u contact met mij opnemen via [d.p.ushinahuera@student.utwente.nl](mailto:d.p.ushinahuera@student.utwente.nl)

### HOE IS HET MET JE GEGAAN NA DE OVERSTROMING VAN 2021 IN VALKENBURG?

Het herstellen van een overstroming kan een uitdagende reis zijn die vaak hulp vereist.

Om uw ervaring na de overstroming van 2021 te delen, volgt u de onderstaande link:  
<https://app.maptionnaire.com/q/9y7o9gwm8ot6>  
 Of scan de QR-code.



De enquête is vrijwillig en er is geen persoonlijke informatie vereist. Het invullen duurt ongeveer 10-15 minuten.

Als blijk van waardering krijgt u de kans om een van de vijf diner cadeaubonnen ter waarde van €50 te winnen. De loterij zal plaatsvinden op 9 juni.



Geldig bij 3250 restaurants in heel Nederland, inclusief Valkenburg.

### 7.3. Appendix 3: Maptionnaire Survey form

Survey form in the Maptionnaire platform.


## How you did after the 2021 flood in Valkenburg?



Going through the process of recovering from a flood can be difficult and often requires support. This study wants to give you a space to share your experience. Your input will help us better understand how certain conditions may change the individual recovery experience.

As a token of appreciation, you'll have the opportunity to win one of five dinner gift cards worth €50 each. The raffle will be held on 10th June.

- You can select your preferred language (Dutch or English) below. The survey will take 10-15 minutes.



English 

## Flooding, Damage & Compensation

What was the water depth in your house?

0-20 cm

20-50 cm

50-100 cm

100-200 cm

>200 cm

Don't know

What was the duration of the repair process following the flood damage?



Less than 2 months

2 to 6 months

7 to 12 months

More than a year, less than 2 years

Still in the process of repairing

## Informed Consent



By filling in this survey, I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

Contact Information for Questions about Your Rights as a Research Participant:

If you have questions about your rights as a research participant or wish to obtain information, or discuss any concerns about this study with someone other than the researcher(s), please get in touch with the Secretary of the Ethics Committee/domain Geo-Information Sciences of the Faculty of Geo-Information Sciences and Earth Observation at the University of Twente by [ethicscommittee-geo@utwente.nl](mailto:ethicscommittee-geo@utwente.nl)

Researcher contact details for further information or withdraw: Dennis Ushiña, [d.p.ushinahuera@student.utwente.nl](mailto:d.p.ushinahuera@student.utwente.nl) / +31687940969

I freely consent to proceed with the survey



## Home Status

My home is

Rented

Purchased

Subletted



 

## 2021 Flood

Did water enter your house during the 2021 flood?

Yes

No

Based on your experience during the flood recovery, please rate your familiarity with the following statements using the scale provided: • Not at all familiar (1) • Slightly familiar (2) • Moderate familiar (3) • Very familiar (4) • Extremely familiar (5)

|  | 1                     | 2                     | 3                     | 4                     | 5                     |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| I temporarily reduced normal household expenses to cover the costs of flood damage | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I increased my workload to finance the repairment costs                            | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I faced difficulties in accessing compensation from the Disaster Compensation Act. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I faced difficulties in accessing compensation from the National disaster funds.   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I faced difficulties in accessing  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

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Based on your experience. Please indicate your familiarity with the following statements using the scale provided: • Not at all familiar (1) • Slightly familiar (2) • Moderate familiar (3) • Very familiar (4) • Extremely familiar (5)

|  | 1                     | 2                     | 3                     | 4                     | 5                     |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| My regular habits changed during the repairment process                          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| During the repairment of my home, I temporarily relocated to alternative housing | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I participated in community flood damage restoration projects                    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Overall, I am satisfied with the management of the 2021 flood                    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I experienced stress due limited financial resources                             | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

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|   |                       |                       |                       |                       |                       |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| I faced difficulties in accessing compensation from my insurance. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I received time off from work to attend the repairment process    | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I performed the house repairs myself                              | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I experienced overprice for professional repair services          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I replaced all damaged house contents with new ones               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I fully repaired the house damage.                                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

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|  |                       |                       |                       |                       |                       |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| I experienced stress due limited financial resources               | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| My perception of flood risk has increased                          | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I am uncertain about the economic damage in case of a future flood | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I lost belongings with a sentimental value                         | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I expected a decrease in the value of my property                  | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

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### Time for your story

Would you be willing to share your experience of the recovery from the 2021 flood and how it has impacted you?

It can be a brief story that has left a lasting impression in your memory.

Would you be willing to share your experience with any of the compensation schemes and how they have assisted you in the recovery process?

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### Personal Information

What is your gender?

Male

Female

Other

Don't want to say

What is your age?

18 to 29 years

30 to 44 years

45 to 64 years

65 to 74 years

75 years or older

Don't want to say

What is your household's yearly income in relation with a minimum wage of €22000?

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**What is your household's yearly income in relation with a minimum wage of €22000?**

- Below the minimum wage
- Equal to the minimum wage
- About 1.5 times the minimum wage
- About 2 times the minimum wage
- More than 2 times the minimum wage
- Don't want to say

**What is your highest completed education?**

- Less than high school
- High school graduated
- Middle - level applied education (MBO)
- Higher Professional education (HBO)
- University (WO)
- Don't want to say



**What is your living situation?**

- I live with my parents(s)/guardians(s)
- I live alone
- I live with my partner
- I live with my partner and child(ren)
- I live with other people (e.g. in a student house, with a brother/sister, etc.)
- Don't want to say



## Raffle

Provide your e-mail only if you are interested in participating in the €50 dinner gift card raffle.

The raffle will be held on June 10th, the results and prize delivery details will be communicated via e-mail.

Your information will not be used for any other purposes and deleted afterwards.

**E-mail**




## Thanks for sharing your experience!

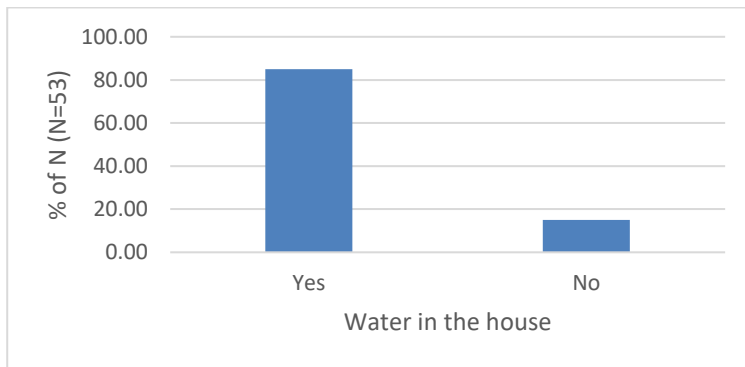
I greatly appreciate the time you have taken to fill in this survey. This will greatly help me in finalizing my thesis and contribute to the further development of knowledge in the social aspects of flooding.

## 7.4. Appendix 4: Household survey results

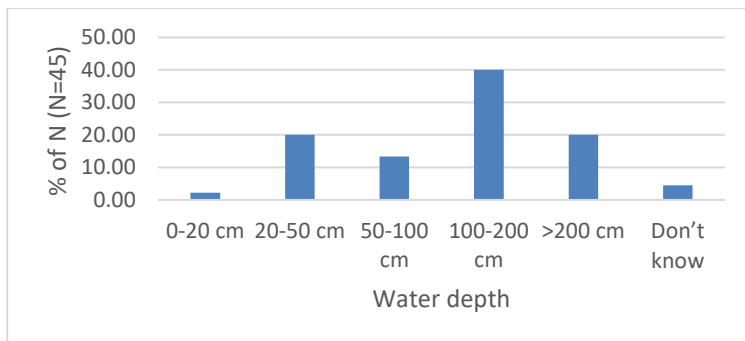
The survey received responses from 53 participants, the majority of whom completed the survey in Dutch. Out of the total respondents, 45 individuals reported experiencing water entering their houses during the 2021 flood. The results pertaining to this particular sample are presented below. For the open question (questions 10 and 11), answers are not included in this appendix due to data privacy.

### 7.4.1. These are the results for each of the questions of the survey

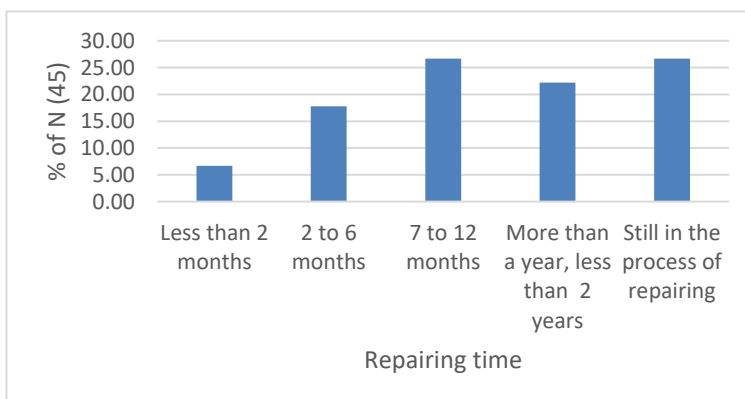
1. Did water enter your house during the 2021 flood?



2. What was the water depth in your house?



3. What was the duration of the repair process following the flood damage?

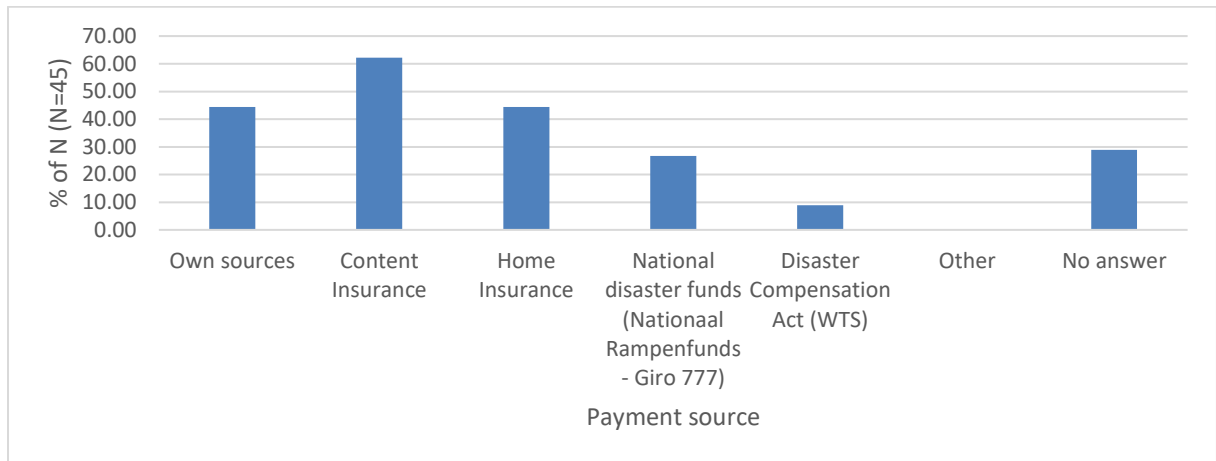


4. Costs for repairing the building and replacing the house effects.

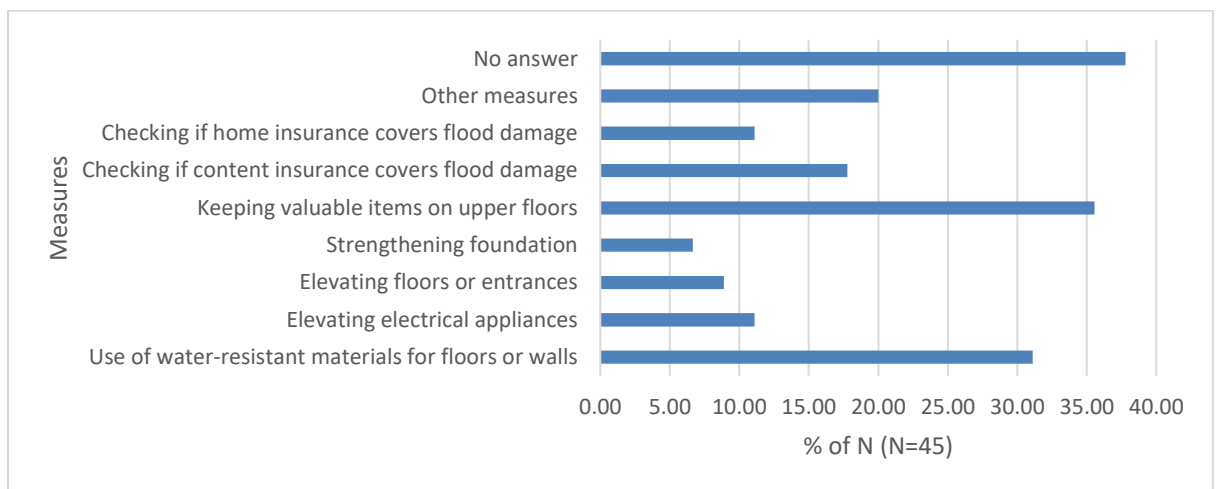
|  | Min (euros) | Median (euros) | Max (euros) | % of N (N=45) |
|--|-------------|----------------|-------------|---------------|
| How much was the approximate cost of repairing the damage to the building? | 3,000       | 70,000         | 200,000     | 60            |
| How much was the approximate cost  | 1,500       | 20,500         | 100,000     | 51            |

of replacing the house contents?

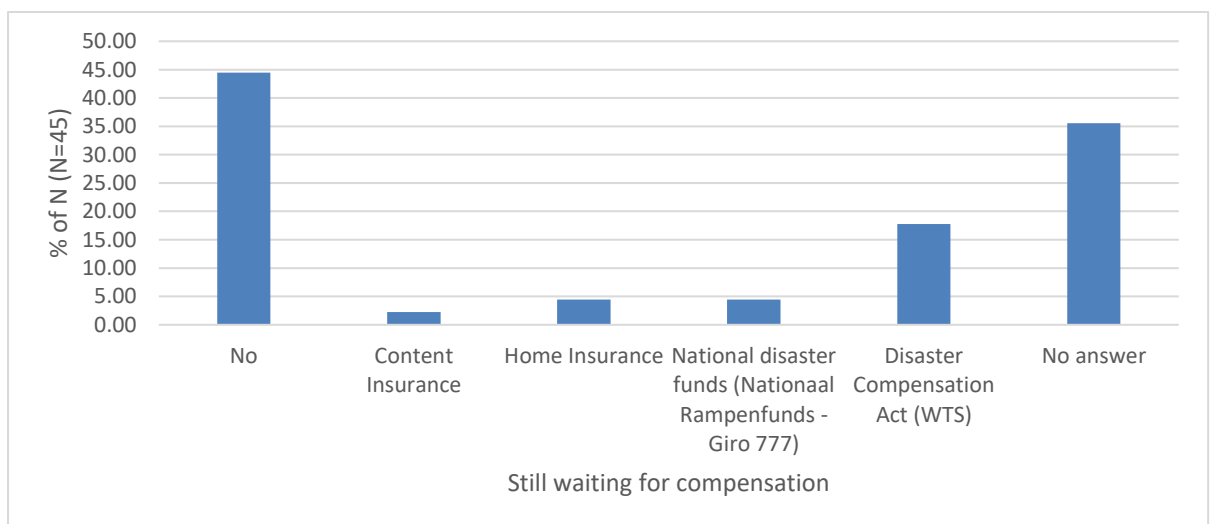
5. How did you cover the expenses? You can select more than one option.



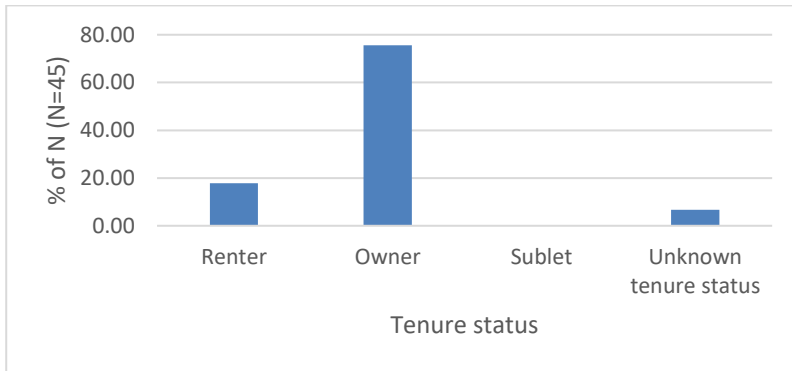
6. Have you taken any measures at home to reduce or prevent future flood damage? You can select multiple options.



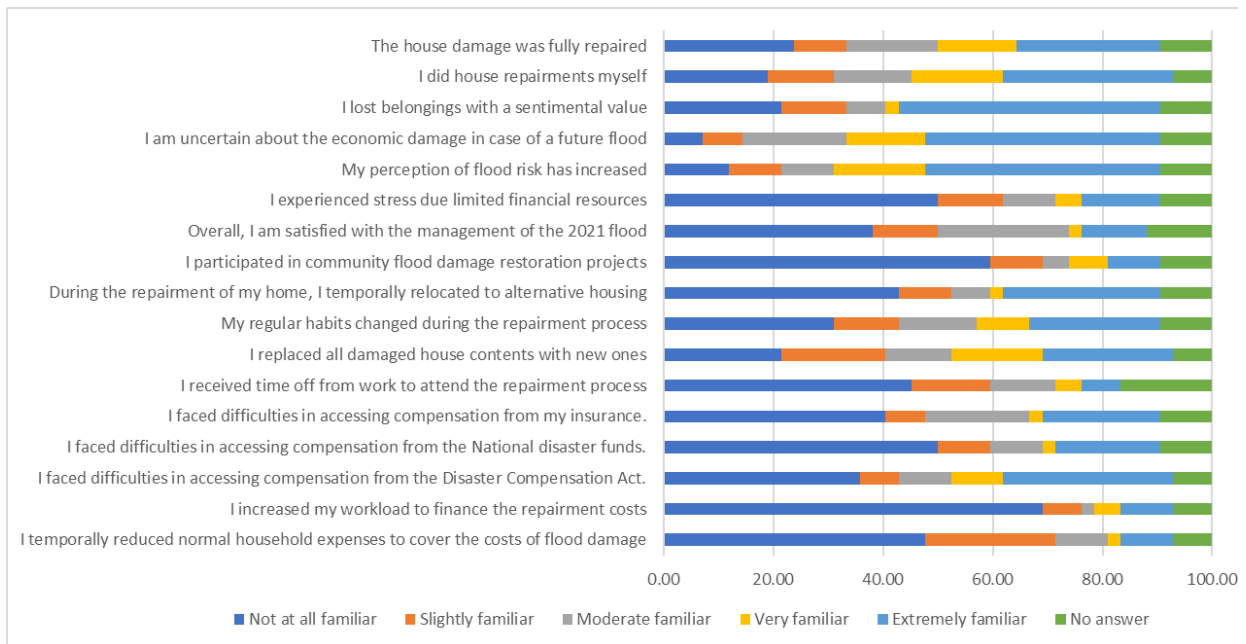
7. Are you still waiting for any expected compensation payment? You can select more than one option.



8. My home is



9. Based on your experience during the flood recovery, please rate your familiarity with the following statements using the scale provided: • Not at all familiar (1) • Slightly familiar (2) • Moderate familiar (3) • Very familiar (4) • Extremely familiar (5).



10. Would you be willing to share your experience of the recovery from the 2021 flood and how it has impacted you?

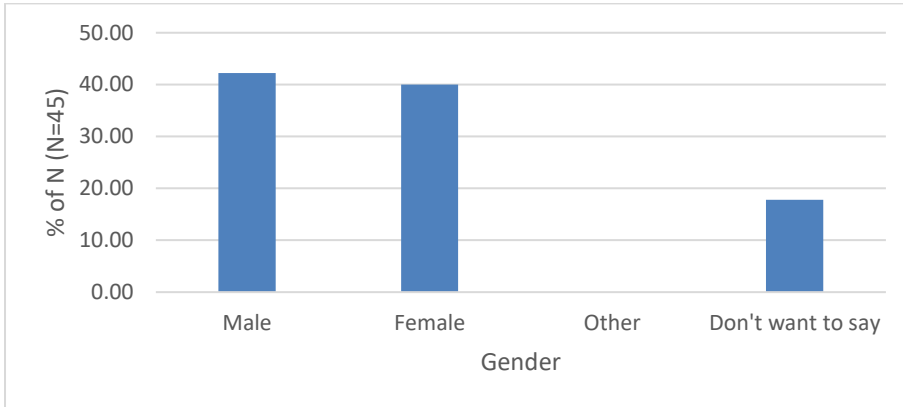
*Not shared here due to data privacy*

11. Would you be willing to share your experience with any of the compensation schemes and how they have assisted you in the recovery process?

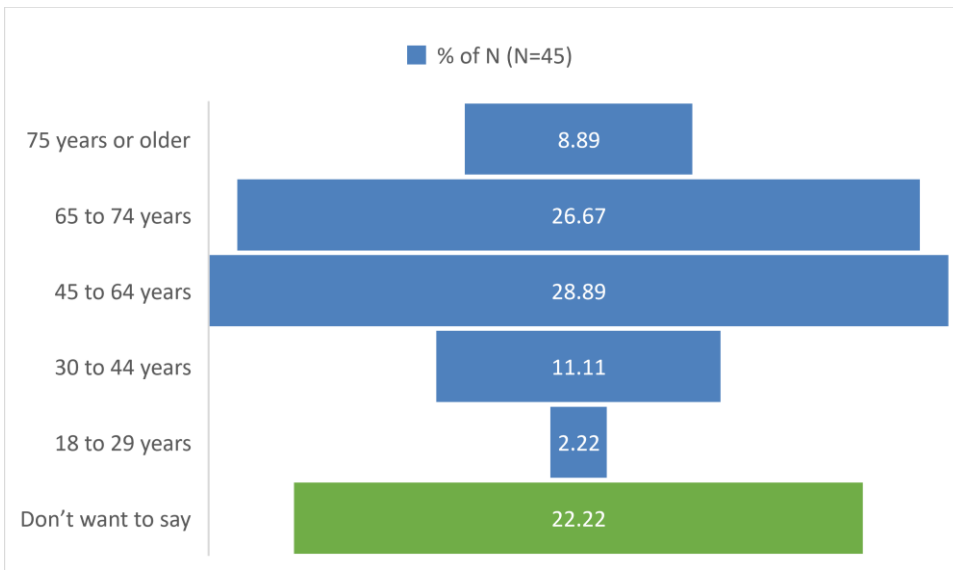
*Not shared here due to data privacy*



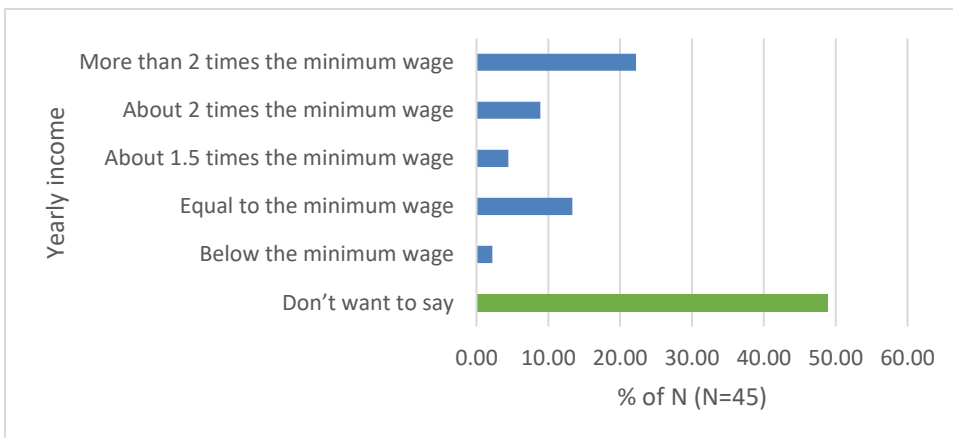
12. What is your gender?



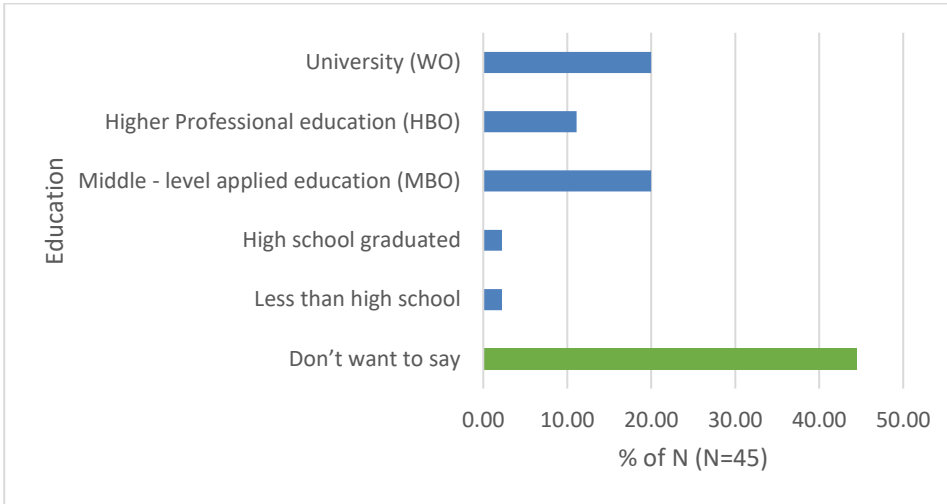
13. What is your age?



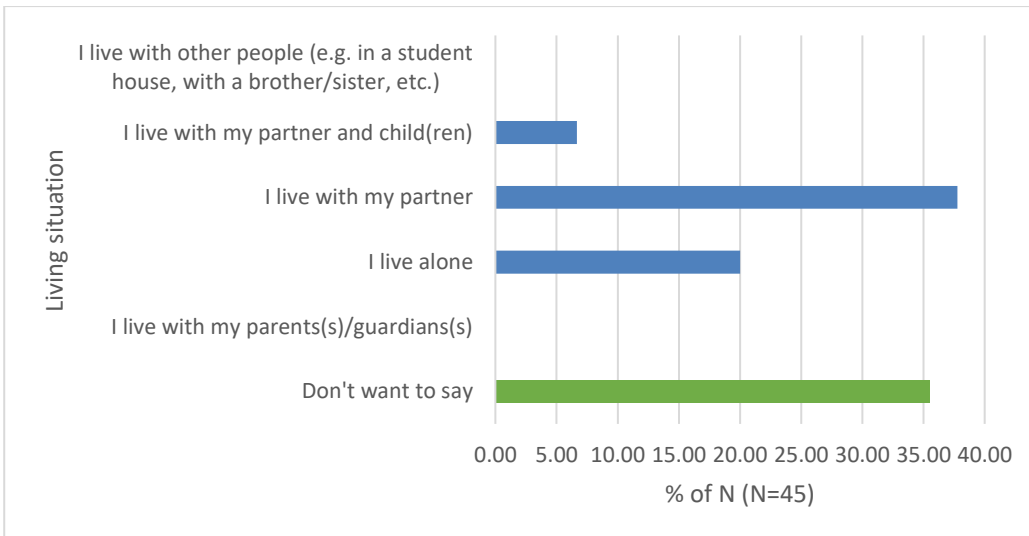
14. What is your household's yearly income in relation to a minimum wage of 22,000 euros?



15. What is your highest completed education?



16. What is your living situation?



## LIST OF REFERENCES

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