Analysis of public flood risk perception in Zeeland and Limburg in the Netherlands

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ANALYSIS OF PUBLIC FLOOD RISK PERCEPTION IN ZEELAND AND LIMBURG IN THE NETHERLANDS

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E.S.B.F. Schyns
Student number: 5425247

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Graduation Committee:	Prof.dr. J. Slinger, Policy Analysis TU Delft, Chairperson
	Prof.dr. J. Slinger, Policy Analysis TU Delft, First supervisor
	Dr.Mr N. Mouter, Engineering Systems and Services TU Delft, Second supervisor

EXECUTIVE SUMMARY

In terms of social and economic impacts, floods are the biggest climate-related disasters. Moreover, the severity of floods will increase as climate change intensifies tropical cyclones, accelerates sea level rise, and increases coastal and river flooding. The Netherlands is the world's second-lowest country, making it vulnerable to flooding, mainly since one-third of the country lies below sea level and is surrounded by water. However, the flood defenses have never been more robust, and the technical knowledge regarding flood measures has grown. Nevertheless, the vulnerability of the Netherlands only increases with the increasing population growth, GDP, and economic value. Therefore, flood risk management plans need to be improved, which requires revising policies.

Only 17 days after the flood disaster in 1953, the Dutch government introduced the Delta Committee to primarily focus on improving flood protection in the Netherlands. The goal is to prevent natural hazards or lower the damages caused by these events. In 2012, the Second Delta Committee introduced domestic laws in the Second Delta Plan. The water management style changed from top-down interventions to a more inclusive approach. Including citizens in the flood risk management plans became more critical. Understanding social aspects and their benefits for decision-making regarding flood risk management plans have been known for years, yet the importance has increased progressively. Moreover, conceptualizing people's risk perception is vital for the success of flood risk management policies because it determines the public's level of preparedness for future flood events.

Taking people's flood risk perceptions into account when developing flood management plans increases the societal context for flood risks and management. People's risk perceptions are determined by worry, awareness, and preparedness. Besides, past experiences trigger these factors and influence people's risk perceptions. Moreover, damages caused by floods are the most significant trigger of increasing risk perceptions regarding floods. Furthermore, socioeconomic factors such as age and gender influence people's risk perceptions. It is expected that the elderly and women perceive a higher risk perception than younger people and men.

In 2007, several scholars studied the flood risk perceptions of the people living near the Scheldt Estuary. They analyzed the impact of involving people in decision-making on flood risk management. We refer to this study as Study 2. Study 2 was conducted after Katrina, the hurricane that caused severe floods in New Orleans in 2005. This event was a trigger to activate people's flood risk perceptions and, therefore, used as an opportunity to analyze the flood risk perceptions of the people near the Scheldt. In Study 2, a survey method and workshops were used to collect the data and examine new knowledge's effect on people's perceptions. The results showed that the participation of citizens in the decision-making process could be meaningful and that new information influences people's risk perceptions.

In this study (Study 1), we undertook a longitudinal comparison with Study 2. We also used a survey method to collect the data and capture people's flood risk perceptions. However, this study expanded the area and focused on people from Zeeland and Limburg. Therefore, a cross-sectional analysis was performed to analyze the effect of the different locations on people's flood risk perception. The floods in Limburg during July 2021 were seen as the trigger event that activated people's flood risk perception as people tend to forget about the associated risks shortly after the

event. Therefore, this presented the next opportunity to re-analyze flood risk perception in the Netherlands.

The questions developed for the online questionnaire were based on the questions asked in the survey of Study 2. Respondents could fill in the questionnaire via Qualtrics, a program suited for online surveys and coherent with the requirements of the General Data Protection Regulation drafted by the European Union. The questionnaire consisted of 50% open questions, and 50% closed questions. After collecting the data, several regression analyses were performed to examine the hypotheses. Three dependent variables were determined based on the three factors of risk perception: worry, preparedness, and awareness. Furthermore, text analysis was performed to analyze the open questions. The regression and text analyses were done for both studies separately. Then, the longitudinal comparison analysis was conducted to examine the differences and similarities between Study 1 and Study 2. Also, within Study 1, a cross-sectional analysis was performed to investigate the differences in flood risk perceptions between people from Limburg and Zeeland. Lastly, five interviews were conducted to validate the interpretation of the results. These experts are all involved in either technical or social aspects regarding flood risks and management. Besides, some experts live in Zeeland or Limburg, which means that the validation is somewhat biased as they also have a flood risk perception as citizens besides their professional expertise.

In Study 1, 237 respondents answers the online questionnaire whereby 51% of the respondents live in Zeeland, 25% in Limburg, and 24% elsewhere. The respondents' ages range from 17 to 75, with an average age of 45. The majority of the respondents were men. Furthermore, only 1% experienced a flood at the Scheldt, and 26% experienced a flood elsewhere. We wished to obtain more respondents to increase the validity of the conclusions. Also, the characteristics of the respondents could influence the results. For instance, the level of trust in the Dutch government amongst the respondents was high; however, it could be that only people with trust in the Dutch government filled in the questionnaire. Therefore, the number of respondents is a limitation of this study. However, the obtained response within fewer than two months seems reasonable and resulted in insightful results. In Study 2, 243 respondents filled in the survey and were all located in the Scheldt area. The age of the respondents ranged from 19 to 90, which an average of 54 years old. In Study 2, most of the responders were also men, and 21% of the respondents experienced a flood at the Scheldt. Also, 10% experienced a flood elsewhere. In both studies, preparedness was relatively low, and the level of worry was almost equal. However, the awareness significantly increased in Study 1.

In the cross-sectional analysis, a direct relation was found between the level of worry and people's location. This means that people in Limburg are more worried about flood risks than those from Zeeland. Furthermore, an indirect relation was found between people's locations and awareness and preparedness. Therefore, the results showed evidence that people in Limburg perceive a higher risk perception than those in Zeeland. The longitudinal comparison showed that besides all technical changes, the social aspects of people's flood risk perceptions are pretty similar to 15 years ago. Furthermore, the comparison of the studies resulted in a clear message, in both studies, people tend to trust the government's work to create a flood-safe country. The influence of the involved parties is acceptable to the people. However, people would like the involved parties to be more transparent, to be more included in flood risk management plans, and receive more information to increase preparation for flood events. Therefore, it is expected that if more information is provided and the communication becomes transparent, the people's preparedness will increase.

It was expected that the general level of worry would be higher because of the floods in Limburg in 2021, as flood experiences influence people's risk perceptions. Therefore, it makes sense that the worry level is higher in Limburg than in Zeeland. However, based on literature and the interviews, several explanations are found for the generally low level of worry. First, because of the trust in the Dutch government. Besides, in Zeeland, there is a water culture present that causes familiarity with water, which could also influence people's worry. Furthermore, the floods in Limburg were caused by rainfalls which would have had different consequences in Zeeland. Therefore, this event might not have triggered the worry of people in Zeeland. In addition, people in Limburg lack water culture, according to the aldermen of Meerssen. However, other experts disagree and think that also people from Limburg have a water culture. Yet, it differs from the water culture in Zeeland. In Limburg, the rivers are "life veins" and in Zeeland the sea is a "deluge". Moreover, people might repress fear because they do not want to live with constant anxiety.

In the Netherlands, the participation of the citizens in flood risk management plans increased, as the benefits are known, and the law obligates governmental organizations to do so. In Zeeland, several information evenings are hosted so that people can join and discuss decision-making processes. However, according to experts, communication with citizens can be challenging because of the different knowledge levels. Also, it is time-consuming, and the question remains to what extent the Dutch government needs to increase its transparency. Additionally, there is a cultural anthropological problem whereby the receiver does not always want to receive information. The respondents indicate that they want more information regarding flood preparations. However, according to the experts, the Dutch government provides flood information. Yet, the citizens tend to ignore this because they are occupied with other matters.

Nonetheless, if respondents ask for more information, they should receive this. Moreover, currently, the provided information focuses on creating awareness while the focus should be on creating preparedness. Consequently, transparent communication between citizens and the Dutch government could have already entailed the need to shift from creating awareness to providing information about preparedness.

In Meerssen, a place in Limburg, the practice shows that the involvement of citizens can be valuable. Thereby, five groups have been formed to work on a self-help plan. Within these five groups, local plans of action are created. For example, a contact person who communicates with the municipality during emergencies is pointed out. Furthermore, one of the drafted plans is personally filling sandbags whereby a truck will be sent to a specific location, and people own the bags they need to fill. Additionally, people know where the elderly or other people who might need help filling their bags live, so they create a plan for who will help these people. This example emphasizes the value of including people in flood risk management plans. Moreover, the experts see the value of including local knowledge in local flood risk plans.

Therefore, a policy is recommended to implement two flood risk management plans: 1) to provide general flood information so that the fundamental things to do in case of a flood are clear. Such as turning off the gas. 2) to provide local flood information plans so that the understanding of local evacuation plans is clear. Furthermore, people should be included in developing and implementing these local plans because their local knowledge adds value. Including local citizens will also increase awareness, water culture, and communication lines between citizens and governmental organizations.

For future research, it is recommended to include door-to-door interviews to decrease the distance between researcher and respondent. Besides, door-to-door interviews can increase the number of target responses. However, the combination of open en closed questions is highly recommended, as it gives the responders the option to explain their answers. Also, when performing a longitudinal comparison, scholars must be aware of the restrictions when concluding because it is often not a one-on-one comparison when comparing two different studies. This is because other external factors can also influence the differences or similarities. Besides, for future research, it is recommended to consult an expert before working with Qualtrics. In the basic, Qualtrics is easy to use; however, some advanced settings could prevent missing data due to the technical difficulty we experienced. Also, future research could be conducted about how to include citizens in the decision-making process, analyze how to distribute the responsibilities, and motivate citizens to take action.

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E.S.B.F. Schyns
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ACRONYMS

BWH	Beleidstafel Wateroverlast en Hoogwater
EU	European Union
E&W	Expertise and Water
GDP	Gross Domestic Product
LIR	Local Individual Risk
NGO	Non Governmental Organization
RFR	Room for the River
WOO	Wet Open Overheid

1 INTRODUCTION

Climate change is intensifying tropical cyclones, accelerating sea level rise, and increasing coastal and river flooding, which causes the frequency and severity of flood events to increase [Edmonds et al., 2020; Bradford et al., 2012]. Floods are among the most major climate-related disasters and are labeled the most impactful natural hazard in terms of social and economic consequences [Kellens et al., 2011; Blöschl et al., 2019; Hirabayashi et al., 2013]. In developed and developing worlds, one-third of all-natural hazards are floods [UNISDR, 2018]. Additionally, floods cause a third of all economic losses from all of the natural disasters, and they account for more than half of all fatalities associated with natural disasters [UNISDR, 2018; White, 2001].

Especially in lowland countries like the Netherlands, the political agenda deals with climate change's effect on the flood risk management plans [Edelenbos et al., 2017]. Since about one-third of the Netherlands lies below sea level, and it is located in a delta area, bordered by the North Sea, and has numerous enormous rivers flowing through the country Oude Essink et al. [2010], the high level of political involvement seems necessary. Nowadays, the Dutch flood defenses have never been so strong, so the protection against flooding from the sea and rivers has never been better. Nevertheless, the Netherlands has become more vulnerable to flooding, and the vulnerability keeps increasing. This is because the population is growing, and the economic value and the GDP have increased enormously [Bosoni et al., 2021; De Moel et al., 2011]. However, the technical knowledge regarding flood prediction and its consequences has developed robustly, whereby the calculation of flood risks can be determined more precisely [van der Ven, 2016]. With increased risk comes a need to increase flood-preparedness by implementing new policies and strategies. These implementations require changes and sometimes radical adjustments from the citizens upon which the government needs to anticipate [Edelenbos et al., 2017]. After the catastrophic flood event in 1953, the Dutch government acted by introducing the Delta Committee, which formulated a plan for flood protection [Deltacommissie, 2021]. In 2007, the EU decided that there should be general regulations for flood risk management, so they introduced the Floods Directive, which obliges EU countries to create a solid flood risk management plan [Hartmann and Spit, 2016]. However, when it comes to water management, a 'one-size-fits-all' does not work since water governance arrangements in the EU countries use different instruments and institutions to manage flood risks [OECD., 2018]. So, the Floods Directive is not a precise plan that tells a country what to do. Instead, each country needs to transpose the Floods Directive into their respective domestic water laws, eventually leading to different implementation instruments and institutions [Reinhardt, 2008; Hartmann and Spit, 2016].

In the Netherlands, domestic laws have been drafted in the Second Delta Plan by the Delta Committee since 2012. [Deltacommissie, 2021; Maris et al., 1991]. With the new EU regulations, Dutch water management has gradually changed from top-down interventions to experiments with more participatory and inclusive approaches [Edelenbos et al., 2017]. Generally, it seems more important to include people's perceptions and thus increase stakeholder engagement when it comes to flood risk management [Bradford et al., 2012]. Public decision-makers hope that involving citizens, NGOs, and other social groups will enhance public support for

their decisions and speed up the decision-making process [Edelenbos et al., 2017]. In addition, participation can contribute both to an improvement of quality and democratic legitimacy of policy-making processes [Michels, 2011]. However, including citizens in the decision-making process will change the role of the responsibility of the citizens because the Dutch government cannot guarantee 100% flood risk protection, not even with all the flood defense measures taken. Therefore, the protection level is partly in the hands of the citizens since they determine their risk-preparation activities [De Wit et al., 2008].

Even though the benefits of including social aspects of floods have been known for many years, the understanding of flood risk management has become progressively more important [Bradford et al., 2012]. For example, Terpstra [2010] explained that the campaign "Think Ahead," introduced by the Dutch government in 2006 to increase people's preparedness, could have had a significant impact if the government had taken the public risk perception into account. Without the inclusion of people's perceptions, general information campaigns are hardly ever impactful [Bradford et al., 2012]. Understanding how the public conceptualizes risk is vital to the success of flood risk management policies because it determines the public's level of preparedness for future flood events [Houston et al., 2019].

In 2007, Slinger et al. [2007, 2008]; Marchand et al. [2008] conducted studies to examine people's flood risk perceptions and policy preferences near the Scheldt Estuary. In our study, Study 1, we will refer to the studies conducted at the Scheldt Estuary in 2007 as Study 2 from now on. In Study 2, people's perceptions were collected using a survey method and workshops whereby the influence of new knowledge on people's perceptions was analyzed. Thereby, it appeared that new knowledge in the context of floods impacts people's flood risk perception. The aim of Study 2 was to explore the impact of including people's perceptions in the decision-making process related to flood risk management, something that was uncommon at the time.

Study 2 was conducted following high-level international decision-making in response to Katrina, one of the most catastrophic hurricanes in human history, which caused many severe floods in New Orleans in 2005 [Kates et al., 2006]. During such a disaster, people's flood risk perceptions can change with time [Comănescu and Nedelea, 2016]. Therefore, the scholars used this event as a trigger to analyze the risk perception of people residing near the Scheldt Estuary. In 1953, a catastrophic flood occurred in the Dutch part of the Scheldt Estuary; however, according to Egli [2002], flood risk perception often declines seven years after the flood. Consequently, Katrina might have triggered memories from personal flood experiences or highlighted people's awareness regarding flood risks, which the scholars of Study 2 anticipated.

People's previous experiences with floods strongly influence their willingness to act on flood risk. Someone's risk perception towards floods significantly changes when they have experienced damages caused by floods or if someone close to them experienced the consequences of such as natural disaster. So, the way people interpret flood risk is influenced by how they interpret uncertainty about the danger they face from flooding [Thistlethwaite et al., 2018]. However, most people ignore the threat posed by rare occurrences like floods [Raaijmakers et al., 2008]. Therefore, people are expected to forget about the associated risks shortly after the event [Biernacki et al., 2009]. Hence, the time of the previous flood plays a significant role since it is to be expected that the experience of a flood that occurred long ago is not likely to affect risk perceptions and mitigations today [Grothmann and Reusswig, 2006]. Moreover, a decrease in risk perception is caused by floodless periods [Bosoni et al.,

2021; Raaijmakers et al., 2008].

Therefore, we would like to examine the current flood risk perceptions of people residing in Zeeland and Limburg, whereby the floods in Limburg during the summer of 2021 are expected to act as a trigger that might have increased people's risk perceptions. Hence, the floods in Limburg could create a new opportunity to analyze people's risk perceptions. Moreover, the trigger could be opportune to conduct another survey study regarding people's perceptions of flood risks and management. Then, both Study 1 and Study 2 would use a survey method and could be compared to analyze the similarities and differences between now and 15 years ago.

1.1 RESEARCH OBJECTIVE

This section outlines the research question, followed by six related sub-questions. Each sub-question is answered in Chapters 2 through 5 of this thesis, in general discussion and explicitly at the end of each chapter. The research methods are described following this outline, including the research scope.

1.1.1 Research question

After Katrina, it was expected that people's risk perceptions were activated, which resulted in scholars conducting Study 2. Within Study 2, the focus lay on analyzing the effect of involving residents around the Scheldt Estuary in flood risk management Slinger et al. [2007, 2008]; Marchand et al. [2008]. Several other studies also analyzed the public relation in flood risk management, such as Wolff [2021] who studied ways to obtain a more people-centered approach towards flood management, or Netzel et al. [2021] who emphasized the importance of personal risks before including the public in private flood risk measures. However, both these studies were conducted on a global level. The study of Terpstra [2010] examined people's risk perception in the northern end of the Netherlands at the Wadden Sea coast. This study was conducted in response to a storm that occurred, so they also used a trigger event before analyzing people's risk perceptions. However, this storm did not result in any floods. Furthermore, Kellens et al. [2011] analyzed people's risk perception using a survey method; however, the study area entailed the Belgium part of the Scheldt. Also, several studies such as Voogd et al. [2021] have been conducted, where the trust of inhabitants regarding the Dutch water managers is analyzed. In other words, many studies are conducted considering flood risk perceptions and the involvement of people in flood risk management plans.

Besides, more focused studies are preformed like Gerritsen [2005]; Wemelsfelder [1953] who mainly concentrate on how the disastrous flood in 1953 could have happened based on environmental aspects such as the depth of the North Sea, the specific characters of the storm, and the characters of the dykes, which resulted in insights containing technical and economic aspects about the flood. However, societal aspects or emotional aspects concerning locals are not considered. Similarly, the study of Slager [2021]; Rijksoverheid [2021b] focused on the technical, environmental, and economic aspects of the flood in Limburg last summer. In contrast, Flycatcher [2021] solely analyzed people's views on the government's actions during the floods in Limburg in 2021.

The main finding of this literature study is that none of these studies focus on the longitudinal comparison between people's risk perception now and the results of Study 2. Besides, none of the studies focus on the cross-sectional analysis between the risk perceptions of people living in Limburg and people living in Zeeland.

While both these analyses are insightful as they contribute to the understanding of people's risk perception, which is crucial for flood risk management as it improves the communication that can impact people's preparedness. This is confirmed by, for instance, Bradford et al. [2012] and Keller et al. [2006], who state that understanding people's perceptions positively influences the political agenda to increase community preparedness, risk management, and safety for residents. Hence, the main research question is formulated as follows:

Following the floods in Limburg in 2021, what are the differences between the perception of Limburg respondents and the perception of Zeeland respondents regarding flood risks and management, and how do these compare with the perceptions of the inhabitants of the Scheldt Estuary in Zeeland 15 years ago?

1.1.2 Research sub-questions

The main research question will be answered by answering the following six sub-research questions:

- Sub-question 1: What does Dutch flood risk management look like, and what are its stated aims and policies? *This sub-question is included so that the Dutch flood risks and management are understood, and the reader can comprehend why people have a particular perception.*
- Sub-question 2: What influences people's perceptions of flood risks and management? *Perception is a rather broad concept; therefore, this sub-question is included to explain the used definition for flood risk perception in this study.*
- Sub-question 3: What are the differences between the perception of Limburg respondents and the perception of Zeeland respondents regarding flood risks and management? *This sub-question is answered by the cross-sectional analysis, and it is the first part of the research question.*
- Sub-question 4: What are people's flood risks perceptions in Study 1? *This sub-question is included to summarize the most exciting results of Study 1 and is needed to answer sub-question six.*
- Sub-question 5: What are people's flood risks perceptions in Study 2? *This sub-question is included to summarize the most exciting results of Study 2 and is needed to answer sub-question six.*
- Sub-question 6: What are the differences and similarities between the relevant insights from Study 1 and Study 2? *This is the second part of the research question, and this sub-question will be answered by conducting a longitudinal comparison analysis*

1.1.3 Research method

This study aims to answer the research question by performing a cross-sectional and longitudinal comparison analysis. The research objective is to capture and conceptualize people's perceptions of flood risk management and evaluate them. We used a survey method to capture people's perceptions and analyzed them using regression models. Furthermore, the open questions were analyzed using text analysis. Therefore, both an exploratory approach and a quantitative approach were used. Thus, the research approach is a mixed-methods approach. Both research approaches will be further explained.

The exploratory approach is linked to the empirical data collection by using an online self-administered questionnaire, which will be further explained in Section

4. The survey used open en closed questions to capture people's perceptions of flood risks and management. The quantitative approach was used when performing regression analysis to evaluate the closed questions for Study 1 and Study 2. Within Study 1, the cross-sectional analysis was performed, and after analyzing Study 2, the longitudinal comparison was conducted. Also, five interviews were conducted to validate the interpretations of the results.

1.1.4 Research scope

The sole focus of this study is on people's perceptions regarding flood risks and management. The geographical scope of this study is limited to the people living in Zeeland and Limburg. The initial idea was to solely focus on people who live in Zeeland because of the longitudinal comparison analysis with Study 2 since that study only included people from Zeeland. However, during the period that the questionnaire was online, we noticed that many respondents were located in Limburg. After investigating this, we found out that the willingness to participate amongst the people from Limburg was high. According to the respondents, the need to be heard was triggered by the flood events in July 2021. Therefore, we decided to expand the study area and included Limburg in the study. Whereby, we included the cross-sectional analysis within Study 1, which is a methodological addition to this research.

1.2 LINK WITH MASTER PROGRAM

This thesis is considered an Engineering and Policy Analysis thesis due to its strong focus on the climate crisis that contributes to rising sea levels, which is regarded as a societal grand challenge. The historic flood in 1953 was a starting point for the willingness of flood resilience in the Netherlands. The floods in the summer of July 2021 in Limburg are a warning to keep revising the Delta plan and improve flood risk management for societal safety, costs, and environmental consequences. Besides, conducting a survey amongst locals and analyzing possible policy changes that the Dutch government can make result in examining a multi-actor problem. Hence, the thesis topic is relevant to people, the planet, and profit. Besides, the cross-sectional and longitudinal comparison analyses have not been done yet, so there is also a scientific contribution.

1.3 ACADEMIC AND SOCIAL RELEVANCE

This thesis provides insights from both academic and societal standpoints. From an academic perspective, a longitudinal comparison between Study 1 and Study 2 is performed and will contribute to understanding the differences in risk perception between now and 15 years ago. The longitudinal analysis is not a one-on-one comparison. Not only the floods in Limburg are the reason for a possible change in perceptions, but other external factors like policy and climate change also play a significant role. Besides, even though both studies used a survey method, the timing and respondents do not correspond. Therefore, we can not state a direct relation between the floods in Limburg and the change in perceptions of the people living near Scheldt. However, the comparative analysis can still analyze insightful differences and similarities between Study 1 and Study 2, keeping the comparative restrictions in mind. Also, Study 2 was conducted in response to Katrina, and Study 1 in response to the floods in Limburg. Therefore, a cross-sectional analysis is also performed, which contributes to understanding the differences in risk perception between people from Limburg and people from Zeeland. These analyses open up

new research possibilities, particularly in the field of survey methods regarding risk perceptions in response to a trigger event.

From a societal perspective, contributing to understanding people's risk perceptions will sharpen improvements needed to comprehend social aspects of flood risk management. This study helps understand perceptions, but not how to include them. However, a suggestion has been made on how to increase the level of preparedness based on the respondents' answers. Within the Netherlands, there is a high need for flood mitigation as floods have shown to be catastrophic. Therefore, this study can be used as a benchmark for governance to follow and policy input to analyze. We must keep in mind that one of the primary goals of the Dutch government will always remain the safety of the Dutch society.

1.4 REPORT STRUCTURE

The six sub-questions guide the structure of this report. First, an executive summary is given to explain the process and findings of the thesis, followed by an introduction in Chapter 1. Chapter 2 provides the needed background information regarding flood history and explains the Dutch flood risks and management, which answers the first sub-question. Chapter 3 reviews the relevant literature on flood risk perception and answers the second sub-question. The methods used for this research are explained in Chapter 4, followed by Chapter 5 that presents the results and answers the remaining sub-questions. The main findings are discussed in Chapter 6, and the research is concluded in Chapter 7, providing policy recommendations, acknowledging the limitations of the analysis, and answering the research question.

2 BACKGROUND INFORMATION

This chapter aims at providing the reader with the context of climate change and flood events in the Netherlands. First, the connection between climate change and the increasing number of flood events is examined. Second, the historical flood events in the Netherlands are explored, followed by a deeper study of the two most significant floods for this research. Then the Dutch flood risk management is analyzed, whereby the Delta Plan is described in more detail, in line with answering the first sub-question, then the expected future regarding floods in the Netherlands is defined.

2.1 CLIMATE CHANGE AND FLOODS

From a policy-making and implementation standpoint, climate change represents one of the most complex societal challenges humankind has faced [Council et al., 2011]. Climate change presents us with issues that our current political system is failing to handle Jamieson et al. [2007], and because the challenges are so complex, it is too tricky for purely rational policy-making Urry [2015]. If societies are unwilling to adapt, the frequency and impact of extreme events caused by climate change will increase and negatively influence economic, social, and political systems [Jamieson et al., 2007]. This means that anticipating how to tackle climate challenges is one of the most vital things of our time [McNutt, 2013]. According to Berrang-Ford et al. [2021] it is, therefore, urgent to estimate the global progress on human adaptation to climate change. The sustainability of planet earth has already been in question for too many years, mainly due to humans' behavior [Hardy, 2003]. Human activities have negatively impacted the coastal environment and natural processes, which causes an increase in human exposure to natural hazards [Small and Nicholls, 2003]. The term "natural hazard" refers to an unforeseen or uncontrollable event that threatens human safety [Bokwa, 2013], like earthquakes, tsunamis, hurricanes, drought or floods, whereby according to Jonkman [2005] floods are the most significant natural disaster in terms of human impact and economic losses.

As a result of climate change, flood hazards are expected to increase over the 21st century as the sea levels and storminess are rising. Therefore, the likelihood of extreme water levels is growing and will mainly influence the vulnerability of low-lying areas along the world's coastlines [Small and Nicholls, 2003]. The increase in vulnerability forces countries to revise their flood risk management strategies to prevent catastrophic disasters in the future from happening [Berrang-Ford et al., 2021]. The concept of risk management should be a well-defined approach to address risks from natural, environmental, or human-made sources [Bronstert, 2003; Plate, 2002]. Another crucial reason for improving flood risk management is the increase in populated urban and exurban areas because the population growth creates a broader target for natural geophysical disasters [Swain et al., 2020; Ashley et al., 2014]. Having this reality in mind, targeted policies are urgently needed to prevent future flood events in high-risk zones [Swain et al., 2020; Johnson et al., 2020].

The Netherlands is a high-risk zone as it is one of the lowest-lying countries in Europe Britannica [2019], making it a very vulnerable country to floods [Baan and

Klijn, 2004]. It is concerning that the sea level in the Netherlands is expected to rise by 1.05m by 2100 [Katsman et al., 2011]. Besides, in the Netherlands, floods have increased six-fold during the 20th century and will most likely double again during the 21st-century [De Moel et al., 2011]. This means that the vulnerability of Dutch society has already been unstable for many years. Moreover, the seriousness of the matter keeps increasing [De Moel et al., 2011; Wesselink, 2007].

2.2 FLOOD HISTORY IN THE NETHERLANDS

The Netherlands is the second-lowest country in the world Britannica [2019], with low-lying delta regions whereby three large European rivers discharge in the North Sea, namely: the Rhine, Meuse, and Scheldt [Gerritsen, 2005; Jak and Kok, 2000]. These rivers and the location of the Netherlands in Northwest Europe caused the Netherlands to become a densely populated waterborne trading hub. However, since large parts of the Netherlands are below sea level, living in this country is not without risks. High water levels due to storm surges on the North Sea or due to increased discharges of the rivers are a severe threat to the low-lying parts of the country [Jak and Kok, 2000]. Also, because the North Sea is pretty shallow Wemelsfelder [1953], nearly half the country would be defenseless to floods if there were no measures in place [Baan and Klijn, 2004; Gerritsen, 2005; Jak and Kok, 2000].

Nevertheless, despite the existing constructed flood risk measures, the Netherlands has experienced several severe floods. The following sections will dive deeper into the two specific flood events related to this research: the flood that happened in 1953 by the Scheldt Estuary and the flood in Limburg last summer in 2021.

2.2.1 Flood in 1953

The first flood related to this research is the flood of 1953 by the Scheldt Estuary. The Scheldt river and its tributaries pass through northwest France, the southwest of the Netherlands, and west Belgium, whereby it drains the most heavily populated part of Europe. The Scheldt Estuary discharges into the North Sea in Belgium and the Netherlands, as shown in Figure 2.1 [Wollast, 1993; Broekx et al., 2011].

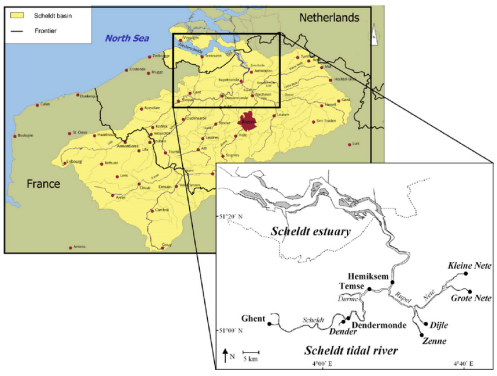

Figure 2.1: Scheldt Estuary [Delvaux et al., 2013]

In 1953, on the night of 30 January to 1 February, the west coast of the Netherlands by the Scheldt Estuary experienced one of most significant floods in Dutch history [Wemelsfelder, 1953; Broekx et al., 2011; Gerritsen, 2005]. That night, the water surpassed the dykes by 50 to 70 cm, particularly at locations where big waves usually never struck, and thus the flood defenses were low.

Yet, most damages were not on the outsides of the dykes but at the inner berm, which demonstrates that insufficient maintenance was not to blame for the disaster. It simply showed that the earth-dikes were not substantive enough to handle an attack from the rear [Wemelsfelder, 1953]. The consequences of the flood were enormous as 200.000 hectares flooded, 1836 people drowned, 100.000 people were evacuated, and 47.300 houses were damaged; all these consequences totalled cost around 250 million euros [Wemelsfelder, 1953; Gerritsen, 2005].

The financial impact was enormous but not comparable to the emotional impact for the locals, families, and friends. "I do not know what to do next, but if nothing happens, we will all drown. Move to higher ground!" said the former major of Halsteren at the night of the disaster [Hage et al., 2015, p. 107]. Even though locals knew absolute safety was an unrealistic concept, after the flood, the willingness towards resilience was more vital than ever [Gerritsen, 2005]. Therefore, only 17 days after the disaster occurred, the Dutch government introduced the Delta Committee on 19 February 1953 [Wemelsfelder, 1953; Gerritsen, 2005]. This committee was constituted to develop measures against flooding risks so that history would not repeat itself. These measures are presented in the Delta plan, which we will further elaborate in Section 2.3 [Deltacommissie, 2021; Rijksoverheid, 2021a].

2.2.2 Flood in Limburg 2021

The second flood related to this research is the flood of 2021 by the Meuse in Limburg. The Meuse is a river that rises in France and flows through Belgium and the Netherlands into the North sea, as shown in Figure 2.2. The Meuse plays a crucial role in industrial development because its length creates a natural route for river transport, which makes the Meuse one of the most important waterways of western Europe [Britannica, 2014].

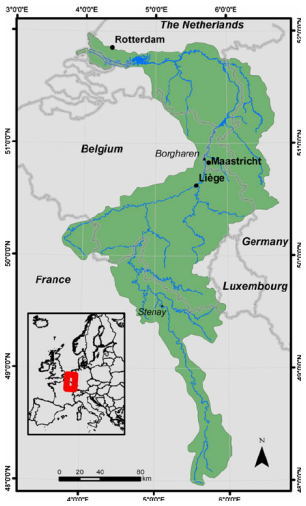

Figure 2.2: The Meuse [Ward et al., 2011]

During July 2021, another extreme flood event occurred within the Netherlands whereby Limburg was flooded because of the heavy rainfall and high waters. According to experts, this event can be considered even more drastic than the flood in 1953 [Slager, 2021; Rijksoverheid, 2021b]. Besides the extreme societal impact, the economic impact was enormous, with total damage estimated between 350 and 600 million euros [Slager, 2021]. According to Professor Bas Jonkman (TU Delft): "This flood broke records in terms of precipitation, run-off, and damage. We have to learn from this to make our system future-proof" [Slager, 2021]. Moreover, the Dutch government called it a national disaster, and as a result, citizens were helped

with damaged non-insurable parts of their house or other possessions [Rijksoverheid, 2022b].

2.3 DUTCH FLOOD RISK MANAGEMENT

After the disaster in 1953, the Delta Committee drafted the safety standards for the primary flood defenses, which apply to the dykes and dunes protecting the Netherlands against flooding from the sea and major rivers. However, the Delta Committee formulated these safety standards in the fifties and sixties of the last century. Since then, things have changed: the population has grown, the economic value has increased, and flood hazard is increasing due to climate change. Besides, the knowledge level of Dutch water management competence, the technical aspects about flooding patterns, and determining flood defense mechanisms failures increased significantly over 60 years. Particularly in light of international disasters such as the Katrina Hurricane in New Orleans Wesselink [2007], the Dutch government fell back on previous success, and (re-)instated a Delta Committee - the Second Delta Committee - in 2008 Verduijn et al. [2012]. It became apparent to the re-constituted Delta Committee that new safety standards were needed in keeping with the growth in knowledge of the hazard and the functioning of the primary flood defenses [Deltafact, 2019]. The Second Committee quickly succeeded in three areas, (1) creating awareness of climate adaptation policy and the issue of safety in Dutch water management, (2) public acceptance of its frame of the problems, and (3) translating recommendations into policy plans [Verduijn et al., 2012]. By 2010, the Second Delta Committee's advice got accepted, and the new Delta Act passed through parliament, entailing a Delta program of action concerning flood risk management, the appointment of a new Delta Commissioner to lead this endeavor, and allocating of dedicated annual funding to this effort [Rijksoverheid, 2022a].

This led to the adoption of a new approach for risk assessment being put in place by 1 January 2017. This legal amendment was the beginning of strengthening the water safety policies in the Netherlands. The old standards were expressed in a probability of exceedance, while the new safety standard is expressed in a flood probability. The probability of exceedance points out the chance of flooding due to exceeding a certain water level, which remains a vital factor for failures in flood defense. However, the new risk-based approach points out when the dikes are no longer able to retain water, causing the dike section to overflow to such an extent that this leads to fatalities or substantial economic damage. This means that the new approach focuses on two aspects: (1) the probability of a flood occurring (2) the consequences caused by the flood. So, the greater the consequences, the smaller the permissible flood probability or, the stricter the standard. The impact of dyke failures plays a crucial role in the new approach. The four most impactful failures are: (1) Overflow and wave overtopping. This could expose the core of the dike, which could lead to damage, and as a result erosion will lead to a dike breach. (2) The inner slope of a dike can shear due to the water's pressure against the dike during high water. The chance of this is highly dependent on the subsoil: if soft clay or peat layers are present, the chance of shearing increases. (3) If the revetment of the dike is damaged, erosion can occur. This failure mechanism is especially relevant in areas where large waves can occur, such as along the coast. Around rivers, there is less chance that the waves will be powerful enough to damage and erode the dike. (4) Piping. During prolonged high water, the water works its way under the dike and starts to flow. When the water stream starts to carry sand, piping occurs and these undermine the dike. The dike subsides and loses its water retention capacity [Deltafact, 2019; van der Ven, 2016; Deltares, 2018].

With the new risk-based approach, the goal is to maintain a safety level of 10^{-5} per year by 2050, which means that the chance of an individual dying as a result of a flood, in most of the Netherlands, should not be greater than 1 time in 100,000 annual on average. For instance, the island of Texel has a safety standard of 1 in 3000 per year, because there is a ridge of high land which all Tesselaars can reach within a short time [Mulder et al., 2020]. This means that the probability of loss of life from flooding is lower than in other areas of the Netherlands, requiring a lower flooding safety standard.

The superscript of safety level is expressed in standard specifications in six categories of flood occurrence from 1 in 300 to 1 in 100.000 per year. This emphasizes the importance of the Local Individual Risk (LIR) factor, one of the most critical aspects for the Second Delta Committee. To reach the goal, the government will focus on areas whereby the chances of significant economic or industrial damage or the possibility of many victims because of urban development are higher than in other areas. Furthermore, the focus is now on dyke sections instead of dyke rings. Previously, most dike rings were protected under the same flood exceedance standard. However, the consequences of flooding can differ per location within a dike ring. Dike sections were therefore selected in implementing the new risk-based approach [Deltafact, 2019; van der Ven, 2016].

Despite substantial changes for the flood safety policies in the Netherlands, the primary focus remains prevention. The majority of flood protection measures are related to dike strengthening or sand nourishment along the coast to strengthen the dunes. Another measure is Room For the River (RFR) where more space is given to the river so that the discharge capacity of the river during a flood is increased. More space is provided for high water flow on the floodplains, so that damage to critical infrastructure, densely populated areas and industrial complexes is limited. RFR is considered a sustainable measure. However, it is often more expensive than dyke strengthening [Deltafact, 2019; van der Ven, 2016; Deltacommissie, 2021].

Since this research will compare citizen's perceptions regarding flood risks with their perceptions in Study 2, it is interesting to see if the change in flood risk management approach has influenced people's perceptions. The perception of the Dutch government and the measures taken to ensure flood safety have changed. The question remains whether the perception of the residents did too.

2.3.1 Delta Plan

The Dutch government wants to ensure that catastrophic natural disasters will not happen in the future or that the damage will be manageable if such events do happen. They are using the Delta Plan as a strategic guideline, a national program whereby different governmental organizations such as the provinces, municipalities, water boards, and public organizations with a great deal of knowledge about water work together towards the same goal. Currently, this goal comprises three main aspects, (1) protection against floods, (2) maintaining the level of freshwater, (3) resilience towards climate change [Rijksoverheid, 2021a; Deltacommissie, 2021; Deltacommissaris, 2021].

In 2012, the Netherlands introduced the Delta Law, which is the basis of the Delta plan. With the Delta Law comes the Delta Committee, who advises the Dutch government about the risks of flood occurrence and the corresponding measures included the Delta plan. The Dutch government wants to protect, prevent and control crises such as flood events. The Minister of Infrastructure and Water Management is tasked with formulating policies regarding protection against floods. She also needs to ensure that the state of the Dutch flood defenses is assessed and

reported regularly, and is ultimately responsible for ensuring that actions are taken to redress inadequacies, if any. The provinces, municipalities, and waterboards all contribute to these tasks. Similarly, other governmental departments contribute to crisis management. The Minister of Justice and Security has the most significant responsibilities as he, for instance, develops the national mitigation plans [Deltares, 2018].

The flood of 1953 triggered the Dutch government to prepare the Netherlands better for future natural hazards. Since then, safety standard for flood defense have been determined, e.g. dike exceedence levels. However, in 70 years, things have changed, and we are facing new risks including: (1) rising sea levels and land subsidence, (2) increased frequency and severity of extreme events such as storms and floods, (3) the Dutch population growth, which means a higher number of potential victims should a flood occur, (4) increased vulnerability with, almost 60% of the Netherlands vulnerable to flooding in the future including the big cities, which are the economic hearts of the country. These risks emphasize the urgent need for the Netherlands to revise the Delta Plan, which has been the focus of the Second Delta Committee since 2019. The following aspects, mentioned by Deltacommissaris [2021], require extra investigation:

1. What are the consequences of the rising sea levels?
2. Do the current strategies and rules of the Delta Plan need to be revised and changed? And how?
3. What measurements need to be determined after 2100?

Besides these three points, the Second Delta Committee issues a new proposal for actualisation of the Delta plan, presented annually by the Dutch King on Prince's Day. The planning follows a six year cycle with the first six years of the Delta Plan explained in detail, followed by six indicative years and the goals to reach before 2050. Every six years, this overview is shared with the European Commission so that there will be not only regional and national shared knowledge but also international.

One of the long-term goals, which is the primary goal of the Delta Plan on flood risk management, is to decrease the chances of dying because of a flood to less than 1 in 100,000 per year. Before reaching 2050, many short-term goals are to be reached, such as described in the Delta Plan of 2021. For example, for 2021-2032, the improvement of 698 kilometers of dikes and 171 hydraulic structures is included in the Flood Protection Program. Besides, the closure of major sea arms and shortening of the coastline by about 700 km is also included. Furthermore, the Rhine and Meuse must have sufficient capacity to discharge river water to the sea to comply with flood risk management standards. The Delta fund created a 200 million budget to develop dyke and dune strengthening and discharge plans, see Figure 2.3. For in the second six-yearly reassessment round of the Delta Plan in 2021-2026, the possible sea level rise of 1 meter in 2100 is an essential factor to accommodate in flood risk management strategies [Deltacommissaris, 2021].

Note that the plans for dyke strengthening, as shown in Figure 2.3 are spread throughout the Netherlands. However, Limburg has no specific plans for dyke strengthening because this would seriously impact the water level in the North of the Netherlands. Since a flood around the Meuse could cause floods in the area of the Rhine. Dyke ring 14, in Rotterdam, which is considered as the most important dyke of the Netherlands as it protects the economic heart, would be put under more pressure [Priemus, 2018]. Therefore, it is more suitable to create RFR plans in Limburg. However, creating RFR is very expensive and involves many societal aspects, like the fact that people might have to move. Therefore, this remains a

difficult flood measure for the Dutch government to implement [Deltares, 2018].

Figure 2.3: Dyke strengthening in Delta Plan [Deltacommissaris, 2021]

2.4 EXPECTED FUTURE

The flood that hit Limburg in July 2021 was beyond the worst-case scenario, and therefore drastic changes are needed to prevent this from happening again. If people do not act upon the climate crisis, the worst-case imaginable will worsen because, in that case, the estimated global mean sea level will rise by 0.84m by 2100. Consequently, 0.2-4.6% of the worldwide population will be flooded annually in 2100 [Hinkel et al., 2014]. Due to this, Pörtner et al. [2019] assume that historically centennial events will occur annually along the coastline in the 21st century, significantly influencing low-lying coastal areas, such as the Netherlands, with all their environmental and socio-economic consequences [Kirezci et al., 2020]. Hence, the fact that the sea level in the Netherlands is expected to rise by 1.05m by 2100 is terrifying [Katsman et al., 2011]. Also, the impact of natural hazards will increase in the future because of the growing population and urban expansion within the Netherlands [Kim and Newman, 2019; Rijksoverheid, 2021a]. Moreover, almost 60% of the Netherlands could be flooded, including the largest cities, which happen to include the economic center of the Netherlands [Rijksoverheid, 2021a].

Currently, around 8.5 million Dutch inhabitants are living below sea level, wherefore it is widely acknowledged that the battle against the North Sea represents a continuing issue for national safety [McRobie et al., 2005]. Hence, one can assume that a well-developed flood risk plan will always be one of the top priorities for the Dutch government and its residents. According to [Vousdoukas et al., 2020] we can efficiently handle the flood damages in the future if we incorporate the correct risk management. After the disaster in 1953, flood risk management became a vital part of the Dutch governmental policies. Thereby, the First Delta Committee was instituted to develop the Delta plan to strengthen the Dutch flood defense mechanism, followed by the Second Delta Committee [Marchand et al., 2009]. A catastrophic event like the flood in 1953 is unlikely to happen again since the Afsluitdijk and

Deltawerken were built and can withstand such floods. However, future threats mean that the Delta plan should be adapted to deal with new threats and events such as the unexpected yet catastrophic disaster of July 2021 in Limburg.

However, studies have shown that the Dutch water systems, spatial planning, and crisis management are insufficient to deal with such catastrophic events. The government stated they would be unable to prevent the future threats climate change is causing wholly; however, they will try to limit the damage and the social problems that result from this as much as possible. Therefore, to anticipate the floods in Limburg 2021, the Minister of Infrastructure and Water management introduced the Beleidstafel Wateroverlast en Hoogwater (BWH) in July. The BWH aims to learn from Limburg's situation so that the Dutch government can anticipate better in case of extreme precipitation throughout the Netherlands. Various parties are involved in the BWH, such as Rijkswaterstaat, the Limburg government, the Union of Water Boards, provinces, municipalities, and the Delta Commissioner. The first gathering was in January 2022, and the following will take place in September 2022. The BWH will issue advice twice a year, and the following are the factors the BWH wants to improve [Rijksoverheid, 2022b]:

1. Increase the water awareness of citizens, companies, and governments.
2. Improve the quality of monitoring and forecasting precipitation and river discharges.
3. Take more outstanding account of the chance of high water periods in the summer.
4. Work on a robust primary water system and regional systems.
5. Keep the probability of occurrence and the consequences of extreme precipitation situations better into account for spatial planning in the Netherlands.
6. Take advantage of existing and future international collaboration.

The Dutch government is aware that to be better prepared for future extreme precipitation, it is essential to be aware of the risks and know what to do in such a situation. In addition, well-functioning water systems and adequate crisis management are essential. It is also necessary to organize our living environment so that it can handle the consequences of the changing climate [Rijksoverheid, 2022b].

Besides the BWH, the Dutch government will introduce a new law in 2023, called the Omgevingswet, which entails a modern and bundled version of the current laws for the living environment. The focus lies on harmony between using and protecting the living environment. This includes legislation and regulations in construction, the environment, water, spatial planning, and nature. The BWH and the Omgevingswet will force the Dutch government to be more transparent and cooperative with the citizens in the future. Also, due to the Omgevingswet, citizens can be more easily involved in processes because it is simply more uncluttered than it used to be [Rijksoverheid, 2022c].

2.5 SUMMARY BACKGROUND INFORMATION

SQ1: What does the Dutch flood risk management look like, and what are its stated aims and policies?

In Chapter 2, the climate crisis has been discussed, including its effect on flooding in the Netherlands. The sea levels are rising, and the expected future is not

looking bright with the possibility that 60% of the Netherlands could be flooded if we do not act upon the climate crisis. The Dutch government's primary goal is to prevent natural hazards or lower the damages caused by these events. Therefore, the Dutch government provides the country with an actualised Delta Plan yearly. Many governmental parties are involved in determining which actions to take to keep the nation safe from flooding. Also, since 2017 the new risk-based approach to flood safety was introduced whereby the focus is no longer on the probability of exceeding but the probability of occurrence and associated consequences. This is all done to reach the long-term goal of lowering the chances of dying due to a flood to 1:100,000 per year by 2050. The short-term goals are focused on strengthening of the coastline, using sand, and, if needed, building or strengthening the dykes and dunes. The Rhine and the Meuse get extra attention according to the Delta Plan presented in 2021, with the plan to create Room For the River around the Meuse. Furthermore, the Dutch government is working on policy improvements so that in the future the safety of our living environment can be ensured.

3 LITERATURE REVIEW ON RISK PERCEPTION AND FLOOD RISK MANAGEMENT

This section aims to provide an initial assessment of the subject of people's perceptions of flood risks and management. The goal is to understand the conceptualization of perception as used in this research so that the results obtained from the survey can be interpreted correctly. First, the approach to the review is outlined, followed by an explanation of Study 2, the relevant previous work from 15 years ago that will be used for the longitudinal comparison analysis. Then, a description and analysis of the concept 'perception' is described in more depth, and its relevance for this research is emphasized and explained. After that, flood risk perception is explained, followed by examining flood risk management, all in line with answering the second sub-question.

3.1 REVIEW APPROACH

Given the need to understand people's perceptions regarding flood risks and management, the literature search started by exploring academic reviews on perception. After which, we searched for the connection between perception and risk associated with floods using non-systematic review. The main goal is to collect and analyse literature to evaluate the existing theories and achieve a robust conclusion and deepen understanding of the implications for policy. We looked for relations, contradictions, gaps, and inconsistencies between studies to reach this goal. The reason for conducting a non-systematic review is because we started at the core of our research field and expanded from that point, whereby some but not all research studies that address our research topic were evaluated, which is in line with a non-systematic review. Also, we tried to include gray literature, which are independent publications that a commercial publisher has not controlled, whether electronic or printed [Siddaway et al., 2019].

For the comparison analysis, we will use Study 2 which is conducted by Slinger et al. [2007, 2008]; Marchand et al. [2008]. This study will give us insight into the perception of residents living near the Scheldt Estuary regarding flood risks and management around 15 years ago. Section 3.2 will elaborate on Study 2 so that the method and outcome of the study are clear. Additional literature is used to confirm statements made in Study 2 [EU, 2007; Klijn and Koppenjan, 2000; Kane and Bishop, 2002; Krywkow and Speil, 2007; Siebenhüner and Barth, 2005].

For the purpose of this research, a definition is provided for *perception*, based on a study of people's perception regarding flood risks and management in Belgium [Kellens et al., 2011]. To emphasize the importance of studying people's perception Bradford et al. [2012]; Brown and Damery [2002] are included in this study, followed by more recent academic studies [Oubennaceur et al., 2022]. It was chosen to include studies based on the used methodology, namely, surveys or interviews, as such approaches apply the inclusion of a societal aspect [Green et al., 1991; Miceli et al., 2008; Mileti and O'Brien, 1992; Scolobig et al., 2012; Zabini et al., 2021].

Including people's flood risk perception became a vital aspect for flood risk management plans over the past years, as highlighted by many scholars such as [Lechowska, 2018]. Improving the understanding of people's perception will positively influence risk communication which affects the decision-making process [Birkholz et al., 2014]. However, assumptions are often made when studying risk communication and people's behavior considering risk-mitigation, as critically analyzed by [Rufat et al., 2020]. Also, Rana et al. [2020] sound a critical note as they emphasized that the perception of flood risk is a two-way street. Not only should authorities understand people's perceptions, but people should also understand the authorities' perceptions to understand the reasoning behind measures.

Understanding people's risk perception is eventually necessary to create a solid flood risk management plan. However, comprehending the theoretical idea behind a flood risk management plan seems to be difficult as there are many different definitions for this matter [Schanze et al., 2007; Plate, 2002]. In 2009, the Dutch government changed its focus from prevention to risk management. As a result, we could more precisely pinpoint the definition of Dutch flood risk management. Yet, the alignment with the Delta plan seems to remain a struggle [Bosoni et al., 2021].

This literature review and analysis were undertaken using the resources available through the TU Delft Library. Consequently, using the snowball method, only highly relevant publications were analyzed. We started small with the understanding of the definitions and slowly expanded to flood-related matters. Keywords from relevant papers were used for further searches, and references were further investigated. Other highly relevant publications by the same authors were also analyzed. This search plan was iterated repeatedly, with trial and error used throughout. Using the opposite method, systematic review, would not suit our study because it would have been hectic to understand flood-related matters and studies if the underlying core definitions were unknown without the relation to floods.

3.2 STUDY 2

The results of this research, Study 1, will be compared to the results from Study 2. This longitudinal comparative analysis can be done because the focus of Study 2 is in line with the focus of Study 1. In Study 2, the main goal was to answer the following question: "How do the local citizens along the Scheldt Estuary perceive flood risk, and what are their policy preferences?" [Marchand et al., 2008, p. 991]. In addition, the impact of new knowledge used in the policy debate on flood risk management of the Scheldt Estuary was investigated. The motive for Marchand et al. [2008]; Slinger et al. [2007, 2008] to do the pilot study was to test the approach for flood risk management as developed by the FLOODsite project. The FLOODsite project consists of three approaches:

1. Flood risk analysis, to determine risk objectively by analyzing and combining probabilities and negative consequences of floods;
2. Flood risk assessment, to understand the perception of risk, to assist societal weighting of costs and benefits of risk and to support decisions; and
3. Design and implementation of physical measures and policy instruments for flood risk management.

Study 2 focused on the first two of the approaches. Unlike the broader FLOODsite project, Marchand et al. [2008]; Slinger et al. [2007, 2008] describe that they widened the study approach by including natural and social sciences instead of solely focusing on determining the biophysical hazard and potential economic consequences

of flooding. The scholar of Study 2 chose to engage with scientists, policymakers, and the public to test the hypothesis that the active involvement of citizens can contribute to knowledge development for a flood risk assessment. The methods used for Study 2 are modeling and scenario analysis, semi-structured interviews, workshops, and questionnaires, which is more comprehensive than the multidisciplinary approach the broader FLOODsite project used. Using these methods, they intended to gain insight into the perceptions of local citizens concerning flood risks. The sample characteristics of Study 2 will be further explained in Section 4.

In 2007, the new EU Flood Directive designates that within the developments of flood risk management plans, all stakeholders should have the convenience to participate actively [EU, 2007]. Regardless, the opinions about the impact of public participation on decision-making processes remained divergent. As Klijn and Koppenjan [2000] point out, this form of decision-making will improve the policies but also decrease the democratic gap between local government and citizens. Moreover, Kane and Bishop [2002] argue that public participation is a challenge, but it is a failure to underestimate the power of public consultations. However, not every occasion is suited for public input. Sometimes, elected decision-makers are needed to make the ultimate decisions. Therefore, they claim that political debate is more effective for cases where differences in opinions and interests are present at the outset. In addition, Marchand et al. [2008] point out several scholars who mention other reasons that influence the usefulness of public participation, such as lack of willingness to participate because of lack of interest or lack of trust in the process, or different knowledge levels that influence the communication between experts and the public [Krywkow and Speil, 2007; Siebenhüner and Barth, 2005]. We believe that it is indeed a challenge to include citizens in a decision-making process and that it requires effort to tackle a lack of trust or different knowledge levels. However, it is expected that the results outweigh the effort and that the participation will positively influence the policies.

Our assumption is in line with Study 2 where the scholars pioneered a way to engage citizens, who are generally not involved in policy development, meaningfully in a normative discussion about flood risk management. They found that the local knowledge level about the local environment, including flood risks, was surprisingly high, realistic, and helpful for flood risk management policy. Remarkable was the difference between the opinions of the citizens and the scientists. Citizens prefer attention for flood recovery measures while scientists want to focus on secondary defense and flood amelioration measures. Moreover, citizens point out the lack of attention for mitigation plans, resulting in a general lack of knowledge regarding evacuation plans. Therefore, the level of personal evacuation plans was relatively high. Policymakers were not surprised by this insight and confirmed that this point needs attention as there are no plans, for example, for environmental clean-up actions. According to Study 2 Marchand et al. [2008]; Slinger et al. [2007, 2008], including citizens' opinions results in more effective flood risk management, which both scientists and citizens prefer.

Also notable was the difference amongst the citizens. People had a deeper appreciation of the dangers of flooding when they spent more time on or near the water than the respondents with no affinity for water. Nevertheless, in the studies, the conclusion was that all but one respondent felt safe. For this study, it is interesting to investigate whether people still feel safe after the flood event in Limburg in the summer of 2021.

3.3 PEOPLE'S PERCEPTION

"Researchers agree that human behaviors, decisions, and actions are driven by their perceptions" [Rana et al., 2020, p. 2]. Nevertheless, the exact nature of perception was never adequately defined [Efron, 1969]. However, for the purpose of this research, it is essential to understand the conceptualization of perception. In this study, perception is the overarching aspect analyzed using a survey method. Within the questionnaire, different dimensions of people's perceptions are investigated, such as their view on safety, flood measures, involvement of government. When referring to people's perceptions, we refer to examining people's awareness, emotions, and behavior regarding the natural hazard flood. This definition is adopted from Kellens et al. [2011], who studies the public perception of flood risk along the Belgian coast, which is in line with our research goal. Moreover, Kellens et al. [2011] also uses a survey amongst the local people to collect their data. However, the difference is that they also include tourists instead of solely focusing on residents, as this study does. Nevertheless, this definition emphasizes that perception of flood risks is vital for policymakers considering flood risk management and safety issues, which conforms with the reasoning in Study 2 as explained in Section 3.2.

According to Bradford et al. [2012], people's perception of flood risks and management is crucial yet generally not recognised as so in the development of flood risk management plans. Historically, this has led to failures as ignorance caused a disconnection between authorities and the people. This conclusion was drawn after Bradford et al. [2012] conducted case studies in Belgium, Finland, Germany, Ireland, Italy, and Scotland. After conducting a literature review, Brown and Damery [2002] draw the same conclusion: the social dimensions of flooding, such as public understanding of the natural hazard, is mainly ignored when developing flood risk management plans. Even though both these studies were done years ago, more recent studies also analyze how to improve flood risk management by understanding the aspect of public perception of flood risks, such as Oubennaceur et al. [2022] who examined this by conducting a survey. These studies used different methods to conclude that including public perception is vital for flood risk management and that this should receive more attention than in current practice. We find it shocking that with a ten-year gap between the literature study of Bradford et al. [2012] and the empirical study of Oubennaceur et al. [2022] it still needs to be pointed out that the including of the public is insightful for policies considering flood risk management. However, based on a survey Rana et al. [2020] stated that it is not only important for the authorities to understand people's perceptions. It is also crucial for people to understand the reasoning behind measures taken by the government so that the willingness to accept these measures increases. This is an interesting statement, and it is understandable since risk communication involves transparency between two parties.

When diving deeper into the literature about people's perceptions, it is inevitable to stumble upon the term risk perception. Perception has a broad meaning; however, the three aspects, awareness, emotions, and behavior, in the definition used for this research are highly connected to people's experience with risks. For example, according to many scholars, the effect on people's perspective towards floods drastically changes when they experience floods with severe damages. In that case, they believe that future events will be even more damaging for them. In contrast, people who have experienced floods without severe damages are more likely to underestimate the likelihood and impact of a future event [Green et al., 1991; Miceli et al., 2008; Mileti and O'Brien, 1992; Scolobig et al., 2012; Zabini et al., 2021]. The studies used either interviews or questionnaires to collect their data, whereby one could argue the bias of this types of methods. However, since every study involved more than 400 responders, we find the corresponding conclusion accurate. So, when a

catastrophic event becomes a personal threat, people's perceptions change as a response; therefore, it is likely that people's opinion becomes more vital in future flood risk management [Whitmarsh, 2008].

Hypothesis 1 (H1): A person's risk perception is expected to be influenced by direct personal experience with flooding.
Hypothesis 2 (H2): It is expected that respondents from Limburg will exhibit higher levels of perceived risk than those from Zeeland.

Engaging people in the arena of flood risk management entails improving the understanding of people's perceptions regarding flood risks and management. Hence, people's risk perception needs to be comprehended to improve the understanding of people's flood perceptions. Ultimately, identifying people's risk perception will improve flood risk management, improving the quality of policy processes. Therefore, we elaborate on people's risk perception and flood risk management in the following sections.

3.3.1 Flood risk perceptions

Flood risk management and flood risk reduction policies have become increasingly dependent on understanding and improving the perception of flood risks in recent years [Oubennaceur et al., 2022; Rana et al., 2020; Kellens et al., 2011; Raaijmakers et al., 2008; Lechowska, 2018]. Naturally, flood risks affects three essential aspects: hazard (flood characteristics and the return period that accompanies them), vulnerability (the possible impact of the event), and risk perception (how impacted stakeholders view a potential risk in terms of its effect on their needs) [Gouldby, 2009]. According to Kellens et al. [2011], both hazard and vulnerability are objective matters which often makes risk a quantifiable variable, in contrast to the aspect of risk perception, which they consider a subjective matter. Including subjective risk assessment is crucial as this incorporates the societal context. Moreover, social aspects can improve the development of flood risk management plans, stated by [Oubennaceur et al., 2022].

As reported by Lechowska [2018], flood risk perception is the determination of the likelihood of flood occurrence and the recognized impact of the results. Raaijmakers et al. [2008] specifies this definition by explaining that risk perception consists of a combination of three factors of risk: awareness, worry, and preparedness. According to Raaijmakers et al. [2008] these factors are needed to analyze risk in a social context because the standard definition of risk, as a product of probability and consequences, is not suited for a pluralistic approach. The focus of the standard risk formula is more about the economic impact, which is in contrast to the necessity of taking flood risk perceptions into account while determining flood risk management. To anticipate this, Buchecker et al. [2013] suggest improving risk communication as the inclusion of communication will improve the social aspects. Oubennaceur et al. [2022] states the same about risk communication, and both studies concluded this using surveys and interviews, so they are based on actual perceptions of people. We believe it is to be expected that people's risk perceptions are better understood when the communication about risk increases. The knowledge level regarding flood risks and management will improve for both people and government, which can result in better policies because the gap between the experts' risk assessments and public perception is decreased. Keller et al. [2006] seems to have the same reasoning for the inclusion of risk communication in the process of developing flood risk management plans. They state that effective risk communication relies on the knowledge of risk perception because limited understanding results in insufficient trust in risk-reducing measures. Furthermore, Rana et al. [2020]; Schneiderbauer et al. [2021] adds that socio-economic factors like, age,

gender, occupation, education, knowledge, and income also play a role considering people's risk perception in addition to people's past experience. For instance, Barnes and Beaulieu [2019] state that risk is a gendered phenomenon: women are more risk-averse than men. According to Jonkman [2005], there is an individual vulnerability factor whereby they investigated that around 70% of the fatalities are male. This high percentage could also be affected because more men are involved in emergency and supporting systems than females. The findings of their studies imply that women have a higher risk perception than men on average. Besides gender, age is often associated with people's risk perception, whereby Adelekan and Asiyanbi [2016]; Liu et al. [2018] state that risk perception becomes higher with age.

Hypothesis 3 (H3): Flood risk perception is expected to be positively related with age and female gender.

It is noticeable that the conclusions of many studies regarding flood risk perception are similar, even though the details of the methods differ. Many of the papers analyzed for this research pointed out that including people's risk perception will improve flood risk management. Also, in many papers, it has been stated that risk communication improves the knowledge level, which influences the gap between people and authorities and improves flood risk-mitigating behavior. However, Rufat et al. [2020] are critical of the conclusions these studies draw because they believe that researchers base their conclusion on three questionable assumptions: 1) that stakeholders are generally aware of flood risk, 2) that stakeholders are engaged in disaster risk reduction, 3) and that the actions of stakeholders can be practical. Moreover, they believe that analyzing flood risk based on the assumptions may result in policies with negative consequences because it turns a blind eye to social and spatial justice issues. The first issue is that the individual responsibility to reduce flood damages is supposed to be a group responsibility. The second issue is that policymakers treat people as isolated units instead of adopting collaborative and participatory approaches. That is why Rufat et al. [2020] emphasize that one needs to be more critical about the link between people's behavior and risk communication and that this needs to be taken into account for academic purposes. They suggest developing a list of requirements for comparison analysis, which is relevant for this research. Ideally, this list will include a set of shared theories, a specification of the variables, and even a selection of decisive questions that enable comparative analysis and long-term monitoring, making results useful for decision-makers. However, the study of Rufat et al. [2020] is a theoretical study, which means that there is no practically applicable underlying methodology used to draw these conclusions. In contrast, the papers they are questioning have used methodologies like surveys or interviews to engage with the people's perspectives. Being critical is also necessary; however, the surveys' inclusion gave the researchers access to analyzing the preparedness, worries, and awareness of the people. The fact that researchers can include and analyze these aspects makes the studies well substantiated.

3.3.2 Flood risk management

It can be concluded that the assessment of risk perception is a vital aspect for flood risk management. According to [Schanze et al., 2007], flood risk management is the process of managing all-natural and societal strategies associated with flood hazards. This means it concerns the actions and decisions taken to reduce the risk and mitigate the consequences in addition to the existing flood risk standards. [Schanze et al., 2007] determined this definition after conducting a workshop with participants with a background in social, natural, engineering, and practical flood risk management. Their book also states that flood risk management consists of three main modes of management: pre-flood, flood event, and post-flood modus. Plate [2002] takes another perspective towards flood risk management and states it can

be distinguished using three variables: the available technology, the availability of financial resources, and the perception of the urgency of the need for protection. These variables determined the level at which floods need to be managed.

In 2009, the Netherlands introduced a multi-modal flood risk strategy owing to the switch from flood prevention to flood risk management Bosoni et al. [2021], which means that the flood risk management style is in line with the definition given by [Schanze et al., 2007]. The Dutch multi-layer approach consists of three layers: reducing flood risk by integrating defensive measures against floods (layer 1), resilient spatial planning measures (layer 2), and effective disaster management measures (layer 3) [Bosoni et al., 2021]. These three layers are not precisely in line with the three main aspects of the Delta Plan goal, as described in Section 2.3. The Delta Plan is more specific as, for example, it also indicates maintaining the freshwater level in the Netherlands; however, the overarching idea corresponds, and the message is clear. The Dutch flood risk management can be enhanced when people's perceptions are included via transparent and improved communication according to the literature. Also, improving risk communication will positively impact people's behavior and knowledge regarding flood risk measures.

3.4 SUMMARY ON PEOPLE'S PERCEPTIONS

SQ2: What influences people's perceptions of flood risks and management?

In this study, we conceptualized perception as the concept of people's awareness, emotions, and behavior considering natural hazards, such as floods. The Dutch government is aware that considering people's perception of flood risks and management is crucial for achieving and maintaining reliable flood defenses. Recent studies emphasize the urgent need to take account of people's perceptions, for example, by improving risk communication.

The three aspects of perception are closely connected to people's experience with risk. Therefore people's risk perceptions turn out to be a vital aspect of developing flood management plans. Consequently, it is argued that risk perception should include subjective aspects to improve the fit between the societal context and flood risk management plans. Hence, risk perception was included in this literature review and defined as a combination of the following three factors: worry, awareness, and preparedness. Past experiences are an important factor in triggering these three factors and thus influence people's risk perception. Furthermore, socioeconomic factors such as age and gender play a role in flood risk perception. It is interesting to investigate whether the literature findings align with the empirical study's outcomes for this research.

4 METHODOLOGY

4.1 SURVEY METHOD

For the purpose of this research, a survey was used to collect the data. A survey is defined as "the collection of information from a sample of individuals through their responses to questions" [Check and Schutt, 2011, p. 160]. Since we used a survey method, we needed to determine the right population considering our research topic and decide on how to regulate the research instrument. In this context, a research instrument is, for example, a structured interview or a self-administered questionnaire. Survey research allows for various methods to recruit participants, collect data, and utilize multiple instrumentation methods. This type of research can use quantitative research strategies (e.g., using questionnaires with numerically rated items), qualitative research strategies (e.g., using open-ended questions), or both techniques (i.e., mixed methods) [Bryman, 2016].

Consequently, surveys are frequently used in social and psychological research since they describe and explore human behavior [Straits, 2005]. The population must suit the study; the population refers to the universe of units from which the sample is selected. The term sample entails the segment of the population that is selected for investigation [Bryman, 2016]. The objective of survey research is to quickly seek information about a large group of individuals' perceptions. Thereby it has been used for many studies when large-population-based data needed to be collected [Ponto, 2015].

In this study, we used an online self-administered questionnaire as the instrument whereby our population consisted of people living in the Netherlands. The sample selected from this population consists of citizens residing near the Scheldt Estuary and citizens living in Limburg. As mentioned, the most common methods for survey research are questionnaires and interviews. The most significant difference between the two methods is that no interviewee is present for the questionnaire; the respondent fills in the question by themselves. Therefore, the researcher needs to make sure that the questions are easy to understand and use more closed than open questions [Bryman, 2016]. The reasons we choose the online self-administered questionnaire over interviews are the following [Bryman, 2016; Ponto, 2015]:

- Questionnaires are less time-consuming than interviews. The online self-administered questionnaire can reach numerous people using online platforms such as social media channels, making the administration quicker than interviews.
- Questionnaires are more convenient for the respondent because they can fill in the questionnaire when it suits their schedule. Besides, there is no social pressure from the interviewee, which means that the respondent can take their time when it comes to filling in the questions.
- Questionnaires are less expensive than interviews because of the time and cost of travel for interviewers.

However, using a questionnaire also has some disadvantages; regardless, we tried to anticipate upon all these disadvantages. The following are the disadvantages of

an online self-administered questionnaire with our corresponding actions to tackle these [Bryman, 2016; Ponto, 2015]:

- When using a questionnaire, there is no researcher present if the respondent does not understand a question. Also, if the respondent wants to add some additional explanation or reasoning for closed questions, this method is restricted. However, we tried to anticipate this by including our contact details and explicitly mentioning that a respondent could always contact us if they had questions or needed additional information. Besides, the questionnaire was tested many times prior to administering the survey amongst people of different ages, education, and demographic backgrounds to ensure that the respondents interpreted the questions correctly.
- A researcher can never be sure who filled in the questions, especially in the case of the online option. Also, respondents are more likely to get tired and stop without completing the questionnaire than someone would if the interviewee kept asking questions. Therefore, there is a higher probability of missing data. However, our sample is quite specific. We noticed that people want to be heard regarding their perception of flood risks and management. We learned from the literature review that experiences with flood damage influence people's risk perception. So, the citizens within our sample are more likely to be willing to share their views.
- The respondent rate could be lower than when using interviews, which is a limitation that comes with using a questionnaire.

4.1.1 Methodological innovation

Solely using a questionnaire to collect data and then using that data for the comparison analysis means that the main focus is on the empirical study, limiting this study's methodological innovation. Creating two, slightly different questionnaires was considered, whereby only one questionnaire included questions about the flood in Limburg, to analyze if the answers would differ based on this aspect. However, the study aims to investigate the impact of the floods in Limburg, which would make the questionnaire without the Limburg-related questions less valuable because then the impact cannot be examined. Besides, administering two different versions on the flood risk perceptions of people living near the Scheldt in Zeeland and people living in Limburg might create additional problems such as getting sufficient people per questionnaire, and ensuring that both questionnaires are representative. Using one questionnaire ensures that the empirical study is sound.

Moreover, there is an academic addition because Study 1 will be compared with the results from Study 2. A longitudinal comparison between such studies separated by a time period of 15 years has not previously been made. Study 2 also conducted a questionnaire to obtain the perceptions of people living around the Scheldt. The online self-administered questionnaire of Study 1 was based on the questionnaire used for Study 2. However, some changes were made, which will be further explained in Section 4.1.4. Also, the cross-sectional study within Study 1 adds to the methodological innovation. The perceptions of people from Limburg are included in Study 1. Therefore, we can analyze the effect on people's location regarding flood risk perceptions.

4.1.2 Sampling and data collection

Many different data collection methods may be used in survey research, but questionnaires and interviews are the most common [Ponto, 2015]. In this study, the online self-administered questionnaire is the data collection method. Whereby the

sample used for collecting the data is a non-probability sample, which means that the data is not collected randomly and that some units of the population have a higher chance of being selected than others [Bryman, 2016]. Obtaining an accurate sample of a population of interest is the goal of sampling strategies in survey research. The sample represents the population's responses since it is often impossible to collect data from the entire population, yet relevant to the present situation. In the ideal situation, all characteristics of the intended population are reflected in the sample [Ponto, 2015].

The online self-administered questionnaire was spread via online channels. We mostly used social media channels such as Facebook, LinkedIn, and Instagram. Hence, people without computer devices or access to the internet are excluded from participation, which is considered a methodological limitation. The online self-administered questionnaire was also spread by word of mouth. We used our network to contact people within the target group, and they spread it amongst their network. This means that a snowball sampling method was then used, a common technique for a non-probability sample. Also, the snowball method is more suited for qualitative survey research than for quantitative [Bryman, 2016]. Our study had a mixed-method approach because the closed and open questions were divided 50/50. Nevertheless, the snowball effect expanded the reach of the target group, which helped to increase the number of responses.

4.1.3 Sampling error

When using a survey method, it is crucial to understand the potential for bias in the instruments and the ability to reduce the bias using specific techniques so that the conclusions drawn from the study are valid. In this research, there are three common types of errors, which we will explain along with the proposed strategies to reduce the error as described by [Bryman, 2016; Ponto, 2015].

The first error is a sampling error, which entails that individuals included in the sample do not represent the characteristics of the population. To anticipate this error, Ponto [2015] suggests defining the population very precisely in terms of factors and putting work into recruiting this target group. Also, make sure that the sample is large and random. However, we have a non-probability sample which means that the randomness is relatively low because we target specific people within our population.The sampling error is almost inevitable, but our sampling aims to keep this error as low as possible. Therefore, we, for instance, deliberately target education institutions for young people and Church congregations for older people within our target group. The second error is the measurement error, which occurs when questions do not accurately reflect the topic of interest, whereby the questions are structured so that the truthful answers are not aroused [Ponto, 2015]. We tried to prevent this by creating a reliable instrument with pre-tested questions and a combination of open and closed questions (50/50) not to steer the respondents. The third error is the nonresponse error, which means that there would be a lack of response from all individuals in the sample [Ponto, 2015]. The return rate is a problematic side effect when using a questionnaire Bryman [2016]; however, we tried to reach as many respondents as possible and created a user-friendly questionnaire whereby responders could quickly go through the online questionnaire.

4.1.4 Questionnaire development

From now on, if we refer to the questionnaire, we refer to the online self-administered questionnaire used for this study. As mentioned, the questions used for this questionnaire were based on the questions used for Study 2. Some of the questions

remained the same, yet several questions were reformulated. Also, some questions were left out or added for this study. Regardless, the common theme stayed the same. The steps we took to compose the questionnaire are the following:

Step 1: Analyzing the questions from the old questionnaire to understand the reasoning behind the questions. Also, the studies were examined to assess the interpretation of the results.

Step 2: Drafting the first version of the new questionnaire whereby the most important aspect of this step is to create a questionnaire so that it is still comparable with the questionnaire of Study 2, yet relevant to the present situation. This questionnaire structured the questions in the same way as in Study 2. Experience, risk perception, measures, evacuation and warning systems, and governments role were the themes of Study 2 and, therefore, the themes of this study. Most of the questions per theme were re-used since the questions were quite general and therefore still accurate regarding flood risks and management. However, some changes were necessary to analyze whether the flood in Limburg was a trigger for people's perceptions. For example, an additional question was included in determining whether the flood in Limburg influenced people's worries, in case people indicated in the questionnaire that they have concerns for the future. Another example is the inclusion of the question of whether the flood in Limburg increased people's need for more education regarding flood risk. Also, we added three additional statements to which people could respond, namely;

1. The decision-making process can be strengthened by considering citizens' perceptions.
2. Policymakers could gain knowledge by hearing citizens' stories.
3. The Delta Plan offers sufficient protection against flooding in the future.

Step 3: The revised questionnaire was checked by both thesis supervisors, after which some revisions were made. These changes were mainly sentence building and a few substantive changes. Steps 2 and 3 required multiple iterations.

Step 4: Pre-testing the first draft of the questionnaire. The questions were first sent to Manon Broers, a journalist, who used her expertise to rephrase words to make them easier to read for the respondents. Also, she helped to create a suitable language for non-academic people. Then, the updated version was sent out to ten people, mostly friends and family, covering an age range from 24 to 83, to examine whether the questions were understandable and interpreted correctly.

Step 5: The obtained feedback was subsequently incorporated, and the questions were updated. After which, Nicolas Dintzner, the Data Steward of the TBM Faculty, checked the most recent version and implemented some changes regarding privacy as well as advising on data management and storage. Therefore, people's names and complete postal codes were left out of the questionnaire. However, respondents still needed to fill in the four numbers of their postal code so that we could know roughly where they live, which is essential as we seek people living in Zeeland and Limburg. Therefore, data from CBS will be used to link the corresponding postcodes to the relevant areas of the Netherlands and filter out the responders who are located in different regions. All the comments by Nicolas Dintzner were first discussed with both supervisors before applying them.

Step 6: Meanwhile, the questions were entered into Qualtrics, a program suited for online surveys and coherent with the requirements of the General Data Protection Regulation drafted by the European Union. We tested the use of this pro-

gram and the layout of the survey several times before launching it [Qualtrics, 2022].

Step 7: When the questions were finished, and the program was completely understood, we updated the final version in Qualtrics. After that, another test round was performed whereby five friends and family filled in the questionnaire to examine whether the questions were still understandable, the program was easy to use, and to get an impression of how the results will look using Qualtrics. The test group consisted of people with different characteristics meaning people with, for example, different backgrounds, ages, and gender.

Step 8: The use of the questionnaire, and appropriate introduction text, as well as the arrangements for data storage and management, were approved by the Ethics Committee of the Delft University of Technology for use in a study involving human subjects.

Step 9: We had a meeting with Shannon Spruit, co-founder of Populytics, a company that is specialized in the connection between people and government via online methods. With her expertise, she helped with the development of a strategic plan to spread the online questionnaire for this study. Considering the budget and time for this research, she advised us to distribute the questionnaire mainly using our network. Consequently, a LinkedIn post was made on March 7th, 2022, whereby we explicitly mentioned we are looking for people living in Zeeland or Limburg so that we reach our target group. We added a video to the post explaining the study in just 30 seconds to make it even easier to understand and to participate. Besides LinkedIn, we also posted on Facebook and spread the questionnaire by word of mouth. The spread amongst the right target group was improved by contacting province, mayors, or local newspapers' social media accounts, who liked or re-posted the post, after which it spread amongst their followers. Hence, the snowball sampling.

Step 10: Recruiting the questionnaire was done until the last day of data collection, the 30th of April. After that, we started analyzing the data by studying the open questions in Excel and the closed questions in SPSS by drafting several models.

4.2 DATA ANALYSIS

After obtaining all the responses, the next step was to prepare the data for the analysis. We used the automatic export function from Qualtrics to SPSS, the program used to acquire the results. After that, the correlation and regression analyses were performed for the closed questions, and the text analysis was used to analyze the open questions. The steps we took to perform the cross-sectional and longitudinal comparison analysis are explained in Section 5. Also, the decision and assumptions made for these analyses are justified and explained in Section 5.

4.3 SAMPLE CHARACTERISTICS

This study was conducted in both Zeeland and Limburg. Study 2 analyzed the effect of Katrina on people's perceptions regarding flood risks and management. Study 2 was focused on the perceptions of people from Zeeland. We analyzed the effect of the recent floods in Limburg (2021) to see whether this triggered people's perception of flood risks and management. This study focused on people's perceptions of Zeeland and Limburg, so the study area has expanded. Also, flood experience influences the choice of this study area. See Section 2 for the explanation of the two

significant flood events. Citizens residing near the Scheldt Estuary will always be involved with water safety since they live by one of the largest European rivers that discharge into the North Sea, which is located nearby. For the Limburg citizens, the same applies as they live by the Meuse, which is another one of the most significant European rivers. This Section explains the sample characteristics of both studies.

4.3.1 Sample characteristics of Study 1

Overall, 237 respondents answered the online questionnaire. Tables A.2, A.1 and A.3 lists the response rate per location divided into Zeeland, Limburg, or Other. Notice that the rate in Limburg is significantly lower than in Zeeland. This is because Limburg was actively included only for the last month, so from March 29th till April 30th, 2022, while Zeeland was included from the first day the questions became online available on March 7th, 2022. We hoped to have received more respondents for both Limburg and Zeeland. However, using an online questionnaire with a time frame of fewer than two months, the response rate seems pretty reasonable. In general, the response rates were highest in Maastricht, Middelburg, and Goes, which makes sense since Maastricht is the biggest city in Limburg, and Middelburg and Goes are one of the biggest in Zeeland. Also, because we used an online questionnaire, some responders were located in other locations than our study area, which is a limitation of online recruiting for participants. However, we still included those responses because they might have friends or family who experienced a flood, which triggered their perceptions of flood risks and management.

Frequencies

Statistics

		age	experience_scheldt	experience_elsewhere	others_experience_scheldt	others_experience_elsewhere	flood_information	influence_limburg	flood_policy	female	Zeeland	Limburg	Other	worries_floods	flood_preparedness	flood_awareness
N	Valid	165	161	161	161	161	142	143	134	162	165	165	165	165	165	165
	Missing	0	4	4	4	4	23	22	31	3	0	0	0	0	0	0
Mean		44.68	.01	.26	.38	.42	.73	.59	.3060	.3889	.51	.25	.24	2.24	.23	.68
Std. Deviation		15.248	.079	.440	.487	.495	.444	.494	.46255	.48901	.501	.433	.430	1.244	.422	.468
Minimum		17	0	0	0	0	0	0	.00	.00	0	0	0	1	0	0
Maximum		75	1	1	1	1	1	1	1.00	1.00	1	1	1	5	1	1

Figure 4.1: Sample Statistics of the variables used for the correlation and regression analysis in Study 1

Figure 4.1 displays the overall frequencies of some of the variables obtained for the questionnaire. Whereby it is given that the respondents' age ranged from 17 to 75 years (mean = 44.94, SD = 15.24). The standard deviation indicates the degree of dispersion in specific data. It indicates how much the observed values differ from the mean. This means that people differ from the average age of 45 years by an average of 15 years, so a very diverse group participated in this study, which makes it more representative. The majority (61%) of responses were completed questionnaires by men. This is contrary to our expectation because the literature review showed that women are more risk-averse. Therefore, we expected women to share their thoughts regarding flood risks and management more. However, in searching for an explanation for this result, we found that opinions on the response varied. Scholars state that men are more likely to complete online questionnaires, while others state that women do so more often [Saxon et al., 2003; Kwak and Radler, 2002]. According to Smith [2008], demographic aspects, academic background, and tenure status also influence the response rate between men and women. So to understand the reasoning behind the fact that more men filled in our online self-administered questionnaire correctly, more research is needed.

We asked several questions related to their experience with floods or whether respondents know people who experienced floods. Only 1% of the respondents personally experienced a flood around the Scheldt, which makes sense as the most significant flood at the Scheldt was in 1953, around 70 years ago, and the oldest

participant is 75 years old. Amongst the respondents, 37% know someone who has experienced a flood around the Scheldt. Furthermore, 26% experienced a flood elsewhere than the Scheldt, and 41% know someone who experienced a flood elsewhere. These percentages are higher because many respondents are located in Limburg, so they either experienced the floods in 2021 or know people who did.

4.3.2 Sample characteristics of Study 2

Overall, 243 respondents filled in the survey during the research conducted around 15 years ago. Figure 5.16 shows the statistics of the data. The first column shows that the average age of the respondents ranged from 19 to 90 years (mean = 54.61, SD = 15.11). The average age is around ten years higher than the average age of Study 1; however, the standard deviation is almost equal. This means that the responders of Study 2 differed from the average age of 54 years by an average of 15 years, which is also a wide range and therefore representative. The majority (69%) of the survey respondents were men, which is quite similar to the 61% of this research.

Frequencies

Statistics

		Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od	worries_floods_od	flood_preparedness_od	flood_awareness_od
N	Valid	243	243	243	243	243	239	238	242	243	237	239
	Missing	0	0	0	0	0	4	5	1	0	6	4
Mean		54.61	.21	.10	.51	.14	.64	.37	.31	2.23	.05	.30
Std. Deviation		15.105	.411	.299	.501	.343	.481	.485	.462	.997	.211	.460
Minimum		19	0	0	0	0	0	0	0	1	0	0
Maximum		90	1	1	1	1	1	1	1	5	1	1

Figure 4.2: Sample Statistics of the variables used for the correlation and regression analysis in Study 2

The most significant difference between Study 1 and Study 2 is that all the respondents of Study 2 were located in the Scheldt area. Therefore, it makes sense that more people experienced a flood at Scheldt (21%). Also, it explains that 51% of the people knew someone who had experienced a flood at the Scheldt. Furthermore, Figure 5.16 shows that 10% of the people experienced a flood elsewhere than at the Scheldt, and 14% knew someone who had experienced a flood somewhere else than at the Scheldt.

Both Figure 4.1 and Figure 5.16 show that the average worry level regarding flood risks is below 3%. So, in general, people's worries have not increased since the studies conducted 15 years ago. It is an interesting results to take into account, that on average people are not that worried about floods in the Netherlands.

4.4 VALIDATION ANALYSIS

To verify the interpretations of the results, five interviews were conducted. Both people from Zeeland and Limburg were included in this validation analysis. We incorporated both technical and social experts. However, the deviation between these two aspects is considered a limitation because the interviewees from Zeeland are mainly involved with the technical aspects and social embedding, while the interviewees from Limburg are solely focused on the social aspects. Besides, the interviewees from Zeeland are mainly focused on long-term policies, while the interviewees from Limburg are more focused on people and the method. The validation could have been improved by including a technical expert from Limburg and a solely social-related expert from Zeeland. Furthermore, four out of the five interviewees are located in either Zeeland or Limburg, meaning they are part of the target group and might have a perception of their own. Hence, there is somewhat

bias in the validation analysis.

The three people involved with the Scheldt Estuary were contacted via email, and the email addresses were obtained via Jill Slinger. The interviews were also scheduled via email and were all conducted via Teams. Furthermore, one of the persons involved in Limburg was contacted via LinkedIn, and the interview was conducted via Zoom. Lastly, the second person from Limburg was contacted via email, however, via personal email since this was a contact within our network. Also, this interview was conducted via Zoom because of, as also accounts for the other interviews, logistical reasons. The interviewees will be introduced in the following two sections, following the structure of introducing the three people related to Zeeland first and then the two people related to Limburg.

The first person is Adrie Provoost, a key advisor for the Dutch government regarding Dyke strengthening projects and a member of E&W. Besides the technical aspects, he specialized in the environmental impact of flood defense measures and was highly involved with the people. Furthermore, he lives in Zeeland and is therefore also a Zeeuwse citizen, part of the target group. With a work experience of 41 years in this field, he is considered a key person. The complete interview with Adrie Provoost can be found in Appendix C. The second person is Samantha van Schaick, a Water Safety Advisor at Waterschap Scheldestromen. As described in her own words, she is involved in multiple projects within the Waterschap, such as the legal assessment of dikes and dunes and policy issues. The primary task of the Waterschap is flood protection in the Netherlands. Therefore, it was insightful to discuss several results of this study. Samantha van Schaick is also part of the target group as she lives in Zeeland. The complete interview with Samantha van Schaick can be found in Appendix D. The third person is Marcel Taal; he has many years of experience in water management, with almost 15 years at Deltares, and before that, he worked at Rijkswaterstaat. He stated, "my goal is to make knowledge valuable in social debate and decision-making processes" E. With all the years of experience and the current involvement in the West-Scheldt, this interview is precious. The complete interview with Marcel Taal can be found in Appendix E.

Also, we talked to two people related to Limburg, who are, therefore, both also part of the target group, Limburgse citizens. The first person is Gerard Ijff, alderman in Meerssen. He has been involved with water almost his entire professional career, starting in Roermond. He is currently still highly involved with the citizens to deal with the consequences of the flood in the summer of 2021. His level of involvement and knowledge regarding water management resulted in the utmost insightful conversation. The complete interview with Gerard Ijff can be found in Appendix F. The second and last person we interviewed is Jacques Eijkelenberg, a professor at Zuyd Hogeschool and advisor within the Atelier Rijksbouwmeester. His expertise lies mainly in the philosophical background, which plays a role in decision-making processes. Therefore, it was interesting to discuss the interpretation of some open questions and analyze the possible reasoning behind some outputs. The complete interview with Jacques Eijkelenberg can be found in Appendix G. Moreover, the outcomes of the five interviews for validating the questionnaire results are explained in Section 5.

5 RESULTS

In this study, we performed multiple data analyses. First, multiple correlation analyses are performed to determine if the predictor variables are multicollinear. Multicollinearity is a statistical phenomenon in which multiple independent variables are highly correlated. In other words, the variables used to predict independence are overly correlated. Since the hypotheses cannot be answered with just the correlation analyses as these analyses ignore the relationships between the other variables. Therefore, we also conducted multiple regression analyses to analyze what effect the independent variables have on the dependent variable. After which, the open-ended questions were analyzed, interpreted, and displayed.

This section is structured as follows. First, the data preparation will be future elaborated on so that the reasoning behind the steps we took is understood, followed by explaining the chosen dependent and independent variables. Since the dependent variables are chosen based on the idea that risk perception is determined by people's worry, preparedness, and awareness, we used these groups as guidelines for the correlation and regression analyses. Hence, the results are explained in the three groups' order. Furthermore, the open questions will be examined, all in line with answering third and fourth sub-question.

This structure is first executed for Study 1 and followed by the same structure executed for Study 2, to answer the fifth sub-question. Then a comparison analysis is carried out to analyze the noticeable difference between the results of both data sets, to answer the sixth sub-question. Lastly, the interpretations of the results are discussed in interviews for validation purposes.

5.1 DATA PREPARATION: STUDY 1

After conducting the online self-administered questionnaire for less than two months, we received 237 responses. As is usual in quantitative analysis, we had to prepare the data and process the missing data. Data will likely have missing values when conducting a regression analysis. In our case, however, some values were missing quite randomly. It turned out that with Qualtrics, a person could skip a question and continue with the questionnaire. Therefore, some questions contained more responses than others, with the number of responses being lower for the last questions and higher for the first questions. This might be caused by the fact that the questionnaire was quite lengthy, but fortunately, Qualtrics also saved the incomplete answers.

Since Qualtrics has an automatic export option to SPSS, we used this statistical analysis software to perform the analyses. This automatic export option immediately puts all the data columns in the right place in SPSS, so the labels and values are filled in right away. This influenced the choice to use SPPS because otherwise, we had to manually fill in all the values and labels.

One of the saved answers was our own completed preview, so we removed that row. This row was not representative as this was a test to check how Qualtrics worked

before putting the questionnaire online. Besides that, there were four rows whereby the process was equal to zero, which means that these respondents did not fill in one single question, so therefore all these four rows were deleted. After which, we still had 139 respondents who had a process of 100%.

Before conducting any analysis, we had to determine which variables to use. In Figure 4.1 an overview is given of the used variables for both the correlation and regression analysis. These variables are chosen based on the hypotheses stated in Section 3. Every variable corresponds with one of the questions asked in the online questionnaire. Table A.4 gives an outline of the variables and their complementary questions. All the additional questions which are not used as input for the variables of the correlation and regressions analysis will be examined and explained in Section 5.4.

Figure 4.1 shows that the valid N value per variable can differ, which also accounts for the missing values whereby the variable 'flood policy' has the most missing values (31). Several steps were taken to obtain these statistics. We created dummy variables for *experience scheldt*, *experience elsewhere*, *others experience scheldt*, *others experience elsewhere*, *flood information*, *influence limburg*, *flood policy*, *flood preparedness* and *flood awareness*, whereby '1' equals yes and '0' equal no. For the variable *flood policy*, the respondents could choose between 'yes', 'no', and 'I do not know' in the online questionnaire. When creating a dummy for this variable, we combined the options 'no', and 'I do not know' because we assumed that in case people chose the 'I do not know' option, they are not 100% sure to fill in yes, and therefore people tend more toward no than yes. This assumption had to be made because a dummy variable only allows for two options. With the variable *female* the value 1 means that the respondent is a female and the value 0 means that the respondent is a male. This is done because the hypothesis states that females are more risk-averse than men, and therefore, we expected more females to fill in the online questionnaire. Hence, 1 equals female.

Furthermore, we created a category dummy for the variable *location*, whereby the respondent's locations were divided into three groups *Zeeland*, *Limburg*, and *Other*. Within every group, a dummy variable is created. For example, within the variable *Zeeland*, '1' means that people live in Zeeland, and '0' means that people live elsewhere. Also, we chose *Zeeland* as the reference category because it is the largest of the three groups.

The three last columns in Figure 4.1 are the three dependent variables, *worries flood*, *flood preparedness*, and *flood awareness*. These three dependent variables correspond to the three groups that determine people's risk perception. The literature study explained that people's worries about the natural hazard, preparedness for future events, and awareness of the possibility of a flood in the future determine their risk perception.

The dependent variable *worries flood* was set as a scale variable from 1 to 5 (1= not at all worried, 2= moderately worried, 3= neutral, 4= somewhat worried, 5= very worried). Some scholars state that a variable can only be set on a scale from 1 to 7. Nevertheless, because this dependent variable is based on one question, there are no values between the five options, so choosing to set the variable as an ordinal would not fit.

The Figure 4.1 shows that 23% of the people think they are prepared for future flood events. So, only 38 people out of the 165 responses seem to be prepared for a flood event. However, 68% is aware that there is a significant chance that another flood event might occur in the future. So, around 112 people know that there

is a possibility for future floods, but only 38 people think they are actually prepared.

The last preparation step was to ensure that the three dependent variables had zero missing values because this would otherwise affect the regression analysis. After excluding rows with missing values for these three variables, the number of valid values equals 165. See Figure 4.1. We dealt with the additional missing values using the listwise option for correlation, which will be further explained in the next section.

5.2 CORRELATION ANALYSIS: STUDY 1

5.2.1 Worry

When performing correlation analysis, we used the listwise option, which means we only looked at the valid data points whereby 100% of the questions are completed. In correlation analysis, this is not necessarily necessary. However, it is often taken into account because a correlation analysis is a precursor to regression analysis, so one wants to perform both analyses with the same number of data points. For the first models, whereby the dependent variable was *worries floods*, we only selected the rows whereby all questions were filled in and excluded the additional rows. As shown in Figure 5.1 this meant we still had 129 valid rows for the analysis. After this, it was noticeable that we had excluded the 1% of people that experienced a flood at the Scheldt, so we excluded that variable. Hence, the independent variable *experience scheldt* is not visible in Figure 5.1.

Correlations[c]

		worries_floods	age	experience_elsewhere	others_experience_scheldt	others_experience_elsewhere	flood_information	influence_limburg	flood_policy	female	Zeeland	Limburg	Other
worries_floods	Pearson Correlation	1	.117	.290**	-.052	.230**	.246**	.452**	-.384**	.133	-.264**	.432**	-.163
	Sig. (2-tailed)		.185	<.001	.562	.009	.005	<.001	<.001	.133	.002	<.001	.064
age	Pearson Correlation	.117	1	.089	-.050	.112	-.012	.098	-.013	-.021	-.079	.183*	-.112
	Sig. (2-tailed)	.185		.315	.576	.205	.894	.268	.879	.809	.376	.038	.206
experience_elsewhere	Pearson Correlation	.290**	.089	1	-.372**	.491**	-.020	.382**	-.135	.153	-.542**	.656**	-.071
	Sig. (2-tailed)	<.001	.315		<.001	<.001	.821	<.001	.128	.084	<.001	<.001	.426
others_experience_scheldt	Pearson Correlation	-.052	-.050	-.372**	1	-.304**	-.042	-.164	.026	-.002	.565**	-.446**	-.201*
	Sig. (2-tailed)	.562	.576	<.001		<.001	.637	.063	.772	.986	<.001	<.001	.022
others_experience_elsewhere	Pearson Correlation	.230**	.112	.491**	-.304**	1	.108	.363**	-.093	.203*	-.397**	.486**	-.058
	Sig. (2-tailed)	.009	.205	<.001	<.001		.225	<.001	.293	.021	<.001	<.001	.512
flood_information	Pearson Correlation	.246**	-.012	-.020	-.042	.108	1	.292**	-.368**	.093	.014	.023	-.045
	Sig. (2-tailed)	.005	.894	.821	.637	.225		<.001	<.001	.296	.871	.797	.615
influence_limburg	Pearson Correlation	.452**	.098	.382**	-.164	.363**	.292**	1	-.427**	.214*	-.386**	.463**	-.045
	Sig. (2-tailed)	<.001	.268	<.001	.063	<.001	<.001		<.001	.015	<.001	<.001	.609
flood_policy	Pearson Correlation	-.384**	-.013	-.135	.026	-.093	-.368**	-.427**	1	-.104	.119	-.323**	.223*
	Sig. (2-tailed)	<.001	.879	.128	.772	.293	<.001	<.001		.241	.181	<.001	.011
female	Pearson Correlation	.133	-.021	.153	-.002	.203*	.093	.214*	-.104	1	.032	.062	-.112
	Sig. (2-tailed)	.133	.809	.084	.986	.021	.296	.015	.241		.721	.484	.206
Zeeland	Pearson Correlation	-.264**	-.079	-.542**	.565**	-.397**	.014	-.386**	.119	.032	1	-.661**	-.502**
	Sig. (2-tailed)	.002	.376	<.001	<.001	<.001	.871	<.001	.181	.721		<.001	<.001
Limburg	Pearson Correlation	.432**	.183*	.656**	-.446**	.486**	.023	.463**	-.323**	.062	-.661**	1	-.317**
	Sig. (2-tailed)	<.001	.038	<.001	<.001	<.001	.797	<.001	<.001	.484	<.001		<.001
Other	Pearson Correlation	-.163	-.112	-.071	-.201*	-.058	-.045	-.045	.223*	-.112	-.502**	-.317**	1
	Sig. (2-tailed)	.064	.206	.426	.022	.512	.615	.609	.011	.206	<.001	<.001	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=129

Figure 5.1: Correlations between independent variables and the dependent variable *worries floods*

As shown in Figure 5.1 the correlation with age is not identified as significant, which means that the correlation is too weak to be considered anything other than zero. However, a positive number of 0.12 would mean that older people are more likely to be worried than younger people. Flood experience elsewhere than at the Scheldt significantly influences the dependent variable. The positive value emphasizes that experiencing a flood increases people's worry about floods. Knowing someone who experienced a flood elsewhere than at the Scheldt also increases people's worries regarding flood risk.

Furthermore, people who need more information about flood risk and how to act when a flood occurs are also more worried. Besides, people whose need for more information and education is influenced by the floods in Limburg are also more worried. As shown, there is a negative correlation with *flood policy*, which means that

the people who indicated that they think the government is doing enough about flood risk policies are also less concerned about flood risks. Also, being a female does not influence the dependent variable, which is not expected based on the hypothesis; regardless, it rejects H3. Nevertheless, a hypothesis cannot be answered just based on correlation analysis. That is why we will test it again in the regression analysis.

Figure 5.1 shows that *Zeeland* and *Limburg* both have an impact on the dependent variable. The negative value explains that people from Zeeland are less worried, and the positive value explains that people from Limburg are more worried about flood risk. This is in line with the expectation that the recent floods in Limburg would trigger people's risk perception.

5.2.2 Preparedness

Correlations[c]

		flood_preparedness	age	experience_elsewhere	others_experience_scheldt	others_experience_elsewhere	flood_information	influence_limburg	flood_policy	female	Zeeland	Limburg	Other
flood_preparedness	Pearson Correlation	1	-.054	-.163	.165	-.058	-.271**	-.184*	.147	-.056	.024	-.114	.101
	Sig. (2-tailed)		.540	.065	.062	.514	.002	.037	.097	.525	.788	.197	.252
age	Pearson Correlation	-.054	1	.089	-.050	.112	-.012	.098	-.013	-.021	-.079	.183*	-.112
	Sig. (2-tailed)	.540		.315	.576	.205	.894	.268	.879	.809	.376	.038	.206
experience_elsewhere	Pearson Correlation	-.163	.089	1	-.372**	.491**	-.020	.382**	-.135	.153	-.542**	.656**	-.071
	Sig. (2-tailed)	.065	.315		<.001	<.001	.821	<.001	.128	.084	<.001	<.001	.426
others_experience_scheldt	Pearson Correlation	.165	-.050	-.372**	1	-.304**	-.042	-.164	.026	-.002	.565**	-.446**	-.201*
	Sig. (2-tailed)	.062	.576	<.001		<.001	.637	.063	.772	.986	<.001	<.001	.022
others_experience_elsewhere	Pearson Correlation	-.058	.112	.491**	-.304**	1	.108	.363**	-.093	.203*	-.397**	.486**	-.058
	Sig. (2-tailed)	.514	.205	<.001	<.001		.225	<.001	.293	.021	<.001	<.001	.512
flood_information	Pearson Correlation	-.271**	-.012	-.020	-.042	.108	1	.292**	-.368**	.093	.014	.023	-.045
	Sig. (2-tailed)	.002	.894	.821	.637	.225		<.001	<.001	.296	.871	.797	.615
influence_limburg	Pearson Correlation	-.184*	.098	.382**	-.164	.363**	.292**	1	-.427**	.214*	-.386**	.463**	-.045
	Sig. (2-tailed)	.037	.268	<.001	.063	<.001	<.001		<.001	.015	<.001	<.001	.609
flood_policy	Pearson Correlation	.147	-.013	-.135	.026	-.093	-.368**	-.427**	1	-.104	.119	-.323**	.223*
	Sig. (2-tailed)	.097	.879	.128	.772	.293	<.001	<.001		.241	.181	<.001	.011
female	Pearson Correlation	-.056	-.021	.153	-.002	.203*	.093	.214*	-.104	1	.032	.062	-.112
	Sig. (2-tailed)	.525	.809	.084	.986	.021	.296	.015	.241		.721	.484	.206
Zeeland	Pearson Correlation	.024	-.079	-.542**	.565**	-.397**	.014	-.386**	.119	.032	1	-.661**	-.502**
	Sig. (2-tailed)	.788	.376	<.001	<.001	<.001	.871	<.001	.181	.721		<.001	<.001
Limburg	Pearson Correlation	-.114	.183*	.656**	-.446**	.486**	.023	.463**	-.323**	.062	-.661**	1	-.317**
	Sig. (2-tailed)	.197	.038	<.001	<.001	<.001	.797	<.001	<.001	.484	<.001		<.001
Other	Pearson Correlation	.101	-.112	-.071	-.201*	-.058	-.045	-.045	.223*	-.112	-.502**	-.317**	1
	Sig. (2-tailed)	.252	.206	.426	.022	.512	.615	.609	.011	.206	<.001	<.001	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=129

Figure 5.2: Correlations between independent variables and the dependent variable *flood preparedness*

Figure 5.2 shows that there are two significant correlations with the dependent variable *flood preparedness*. The negative correlation with *flood information* explains that people who need more information and education are not prepared for future flood events. Since *flood preparedness* is a dummy variable, people are either prepared or not. The correlation with *flood information* seems logical because these people might need information and education on how to prepare themselves. The second, also negative, correlation is with *influence limburg* which means that this independent variable also influences whether people are prepared for floods.

Both these correlations show room for improvement regarding the level of prepared people for future flood events. The statistics showed that many people are not prepared and need more information and education on what to do to increase this. The specific types of information and education the respondents indicated they needed will be explained in Section 5.4.

Even though the correlation with Limburg is not significant, the negative value indicates that more people are not prepared for flood events than there are prepared in Limburg. The recent floods of 2021 might explain this relationship because these floods were so severe that people might expect future floods to be as damaging. Therefore a higher level of preparation is needed, which people seem to find hard to reach.

5.2.3 Awareness

Correlations[c]

		flood_awareness	age	experience_elsewhere	others_experience_scheldt	others_experience_elsewhere	flood_information	influence_limburg	flood_policy	female	Zeeland	Limburg	Other
flood_awareness	Pearson Correlation	1	-.090	.241**	-.179*	.080	.268**	.411**	-.252**	.021	-.272**	.203*	.109
	Sig. (2-tailed)		.308	.006	.042	.370	.002	<.001	.004	.810	.002	.021	.218
age	Pearson Correlation	-.090	1	.089	-.050	.112	-.012	.098	-.013	-.021	-.079	.183*	-.112
	Sig. (2-tailed)	.308		.315	.576	.205	.894	.268	.879	.809	.376	.038	.206
experience_elsewhere	Pearson Correlation	.241**	.089	1	-.372**	.491**	-.020	.382**	-.135	.153	-.542**	.656**	-.071
	Sig. (2-tailed)	.006	.315		<.001	<.001	.821	<.001	.128	.084	<.001	<.001	.426
others_experience_scheldt	Pearson Correlation	-.179*	-.050	-.372**	1	-.304**	-.042	-.164	.026	-.002	.565**	-.446**	-.201*
	Sig. (2-tailed)	.042	.576	<.001		<.001	.637	.063	.772	.986	<.001	<.001	.022
others_experience_elsewhere	Pearson Correlation	.080	.112	.491**	-.304**	1	.108	.363**	-.093	.203*	-.397**	.486**	-.058
	Sig. (2-tailed)	.370	.205	<.001	<.001		.225	<.001	.293	.021	<.001	<.001	.512
flood_information	Pearson Correlation	.268**	-.012	-.020	-.042	.108	1	.292**	-.368**	.093	.014	.023	-.045
	Sig. (2-tailed)	.002	.894	.821	.637	.225		<.001	<.001	.296	.871	.797	.615
influence_limburg	Pearson Correlation	.411**	.098	.382**	-.164	.363**	.292**	1	-.427**	.214*	-.386**	.463**	-.045
	Sig. (2-tailed)	<.001	.268	<.001	.063	<.001	<.001		<.001	.015	<.001	<.001	.609
flood_policy	Pearson Correlation	-.252**	-.013	-.135	.026	-.093	-.368**	-.427**	1	-.104	.119	-.323**	.223*
	Sig. (2-tailed)	.004	.879	.128	.772	.293	<.001	<.001		.241	.181	<.001	.011
female	Pearson Correlation	.021	-.021	.153	-.002	.203*	.093	.214*	-.104	1	.032	.062	-.112
	Sig. (2-tailed)	.810	.809	.084	.986	.021	.296	.015	.241		.721	.484	.206
Zeeland	Pearson Correlation	-.272**	-.079	-.542**	.565**	-.397**	.014	-.386**	.119	.032	1	-.661**	-.502**
	Sig. (2-tailed)	.002	.376	<.001	<.001	<.001	.871	<.001	.181	.721		<.001	<.001
Limburg	Pearson Correlation	.203*	.183*	.656**	-.446**	.486**	.023	.463**	-.323**	.062	-.661**	1	-.317**
	Sig. (2-tailed)	.021	.038	<.001	<.001	<.001	.797	<.001	<.001	.484	<.001		<.001
Other	Pearson Correlation	.109	-.112	-.071	-.201*	-.058	-.045	-.045	.223*	-.112	-.502**	-.317**	1
	Sig. (2-tailed)	.218	.206	.426	.022	.512	.615	.609	.011	.206	<.001	<.001	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=129

Figure 5.3: Correlations between independent variables and the dependent variable *flood awareness*

Figure 5.3 shows the correlation with the dependent variable *flood awareness*. The awareness of floods entails that people are aware that there is a significant chance that another flood will occur in the future. There are several significant correlations shown in the Figure. This dependent variable is binary, meaning it explains whether people are aware or not.

Experiencing a flood influences the predicted variable. However, according to the negative correlation knowing someone who experienced a flood does not mean that people are aware of flood risk. The difference between these two correlations indicates that personal experience influences awareness. In other words, people who experienced a flood are aware of future flood risks.

Furthermore, there is a strong correlation with *flood information*, which explains that people who indicate they want more information are also aware of future floods. Also, *influence limburg* impact the dependent variable. The negative correlations with *flood policy* and *Zeeland* define that people from Zeeland and people who think the Dutch governmental flood risk management plans are sufficient are not aware of future flood risk. In contrast, people from Limburg are aware of future risks that the recent flood events might have triggered.

5.3 REGRESSION ANALYSIS: STUDY 1

We used multiple regression analyses to test the three hypotheses. H1 and H3 are tested with Model 2, Model 6, and Model 10. H2 is tested based on the difference between Model 1 and 2, Model 5 and 6, and Model 9 and 10. The reason why H2 focuses on the difference between the models is because H2 is analyzed using a cross-sectional method to investigate the effect of location on people's risk perception, as explained in Section 4.

Since the independent variable *experience Scheldt* was not included in the correlation analyses, this variable was also excluded from the regressions. When performing the regression analysis, we assumed that there should be no multicollinearity in the data. Multicollinearity is measured by the VIF values as visible in the Figures 5.4, 5.5, and 5.7. This assumption is proven right since all the VIF values are below five. Moreover, the three correlation analyses showed that this assumption is correct

since there are no correlations above 0.80. Therefore, we can state that there is no multicollinearity within these analyses.

Table 5.1 shows the models we obtained from the regressions performed for this research. In the Table it is explained what regressions were done to obtain that specific output. In the following sections, the models will be further explained.

Table 5.1: The models used in Study 1

Models	Characteristics of the regression
Model 1	Linear regression with 'worries flood' as the dependent variable without dummy. See Appendix A.2.1 for results
Model 2	Linear regression with 'worries flood' as the dependent variable with dummy. See Appendix A.2.2 for results
Model 3	Linear regression with 'flood preparedness' as the dependent variable without dummy. See Appendix A.3.1 for results
Model 4	Linear regression with 'flood preparedness' as the dependent variable with dummy. See Appendix A.3.2 for results
Model 5	Logistic regression with 'flood preparedness' as the dependent variable without dummy. See Appendix A.3.3 for results
Model 6	Logistic regression with 'flood preparedness' as the dependent variable with dummy. See Appendix A.3.4 for results
Model 7	Linear regression with 'flood awareness' as the dependent variable without dummy. See Appendix A.4.1 for results
Model 8	Linear regression with 'flood awareness' as the dependent variable with dummy. See Appendix A.4.2 for results
Model 9	Logistic regression with 'flood awareness' as the dependent variable without dummy. See Appendix A.4.3 for results
Model 10	Logistic regression with 'flood awareness' as the dependent variable with dummy. See Appendix A.4.4 for results

5.3.1 Worry

Model 1 was created to analyze the regression output and the significant variables without the dummy. The results show that the $\mathbb{R}^2$ is equal to 0.238 and that *influence limburg* and *flood policy* are the significant variables whereby the latter contains a negative B-value, see Appendix A.2.1. A negative B-value indicates a decrease for the dependent variable when the independent variable increases. So, in Model 1, these two variables influence people's worries considering flood risk.

After adding the dummy variable, the second model was obtained. Figure 5.4 depicts the results of Model 2. See Appendix A.2.2 for the additional outputs of this regression. The $\mathbb{R}^2$ of Model 2 is equal to 0.274, which explains that the independent variables cause 27.4% of the variation of the dependent variable. Also, the $\mathbb{R}^2$ of the second model is higher than the $\mathbb{R}^2$ of the first model, which means that Model 2 has a better fit and that location contributes uniquely to the prediction of people's worries. The 27.4% also indicates many additional variables, such as other personal characteristics that impact the dependent variable.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	1.095	.421		2.599	.011	.261	1.929		
	age	.004	.007	.045	.589	.557	-.009	.017	.953	1.049
	experience_elsewhere	.070	.303	.025	.231	.818	-.530	.670	.498	2.007
	others_experience_elsewhere	-.048	.236	-.019	-.205	.838	-.515	.419	.656	1.525
	others_experience_scheldt	.430	.245	.165	1.756	.082	-.055	.914	.646	1.548
	flood_information	.380	.237	.136	1.606	.111	-.088	.848	.788	1.268
	influence_limburg	.499	.247	.198	2.019	.046	.010	.988	.591	1.691
	flood_policy	-.378	.248	-.140	-1.522	.131	-.870	.114	.672	1.487
	female	.123	.209	.047	.589	.557	-.291	.538	.891	1.123
	Limburg	.988	.365	.360	2.705	.008	.265	1.711	.320	3.122
	Other	.129	.288	.041	.450	.654	-.440	.699	.687	1.456

a. Dependent Variable: worries_floods

Figure 5.4: Linear regression analysis with dependent variable *worries floods* (Model 2)

In the Appendix, Figure A.9 shows that Model 2 is significant since the significance is more diminutive than 5%. In this case, it is even less than 1%, which means it is a valuable model. Figure 5.4 shows the significance of the variables. A variable is considered significant when the value is lower than 5%. However, sometimes variables that are lower than 10%, *other experience scheldt*, are also included but otherwise, only *influence limburg* and *Limburg* are the significant variables. This means that when people indicate that the recent flood in Limburg (2021) influenced their need for information about flood risks, their worry level increases by almost 50%.

Since Zeeland functioned as the reference category, the positive B-value of Limburg indicates that more people worry about floods in Limburg than in Zeeland.

The B-values of the significant variables in Model 1 and 2 are the same, which emphasizes the model's fit. Based on Models 1 and 2 and the correlation analysis, it became clear that location influences people's worries about flood risk, people from Limburg are more concerned than those from Zeeland. Moreover, the floods in Limburg during the summer of 2021 influenced people's level of worry.

5.3.2 Preparedness

The results of Model 3 show that the $\mathbb{R}^2$ is equal to 0.065, and the significant variable is *flood information* with a negative B-value, see Appendix A.3.1. In Figure 5.5 the results from Model 4 are shown. In Appendix A.3 the other outputs of Model 4 are displayed. The $\mathbb{R}^2$ of Model 4 is equal to 0.073, which means that the independent variables cause only 7.3% of the variation of the dependent variable. Also, the $\mathbb{R}^2$ is improved in the fourth model, meaning that Model 4 is a better fit and that the dummy variable influences the model.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.365	.161		2.268	.025	.046	.683		
	age	-.001	.003	-.043	-.495	.621	-.006	.004	.953	1.049
	experience_elsewhere	-.191	.116	-.200	-1.655	.101	-.420	.038	.498	2.007
	others_experience_elsewhere	.079	.090	.092	.874	.384	-.100	.257	.656	1.525
	others_experience_scheldt	.180	.093	.204	1.928	.056	-.005	.365	.646	1.548
	flood_information	-.225	.090	-.239	-2.492	.014	-.404	-.046	.788	1.268
	influence_limburg	-.092	.094	-.108	-.979	.330	-.279	.094	.591	1.691
	flood_policy	.010	.095	.011	.103	.918	-.178	.198	.672	1.487
	female	.008	.080	.009	.099	.921	-.150	.166	.891	1.123
	Limburg	.170	.139	.183	1.219	.225	-.106	.446	.320	3.122
	Other	.182	.110	.170	1.656	.100	-.036	.399	.687	1.456

a. Dependent Variable: flood_preparedness

Figure 5.5: Linear regression analysis with dependent variable *flood preparedness*(Model 4)

The significance of Model 4 is equal to 3.9%, see Figure A.22, which means it is below 5% and therefore a significant model. Figure 5.5 shows that the only significant variable is *flood information* with a negative B-value, which corresponds with Model 3. Furthermore, *others experience scheldt* is on the edge of being significant since the value is slightly higher than 5%.

The only noticeable difference between Model 3 and Model 4 is the B-value of *female*. In Model 3, the B-value is negative, while in Model 4, the value is positive; however, this variable is insignificant. Figure 5.5 also shows high insignificance of the variable *Other*.

Furthermore, the outcome of Model 4 shows that if *flood information* increases, the number of prepared people decreases by 22.5% since this explains that people need education before they feel prepared. Also, when we base significance on a 10% level, the results show that if the number of people who know someone who experienced a flood at Scheldt increases, then the number of prepared people also increases by 18%.

However, the dependent variable in Model 4 is binary, whereby it could be more challenging to interpret the results when using a linear regression model. Usually, a positive B-value means an increase causes the dependent variable to increase with a designated percentage. Yet, a binary variable only has two options, so the dependent variable can not increase in percentage; only one of the two options can increase in numbers. To anticipate, we also performed a logistic regression to check

the robustness of the results from Model 4.

Logistic regressions use a target group in the analysis, whereby in our analysis, the target group for Model 5 and Model 6 is the group prepared for floods. A positive B-value explains that the likelihood of the number of people in the target group will increase. It is almost the prediction of the probability of falling into a target group. However, because the relation between the dependent and independent variables is nonlinear, it is not common to use probability. We speak of odds ratios in logistics models, whereby the B-value presents the logistic odds ratio. For every unit increase of the independent variable, the B-value captures the change in logistics odds. So, a logistic regression creates a linear relation by taking the B-value into account as a logistic odds ratio. Odds ratios explain the ratio of the probability that people are part of the target group in comparison to not being part of the target group. Logistic odds are simply the logistical version of standard odds ratios. To determine the robustness of Model 4, we, therefore, analyze the difference between the B-values of the linear and logistic models.

In the Appendix A.3.3 the results of Model 5 are shown, whereby the Nagelkerke $\mathbb{R}^2$ is equal to 0.178. Scholars interpret this type of $\mathbb{R}^2$ as the same as the $\mathbb{R}^2$ of linear regressions. However, these two values are not the same since the Nagelkerke $\mathbb{R}^2$ is calculated based on the maximum likelihood estimation. Nevertheless, it is common to analyze the Nagelkerke $\mathbb{R}^2$ as if it measures independent variables that can explain the proportion of the total variation of the dependent variable in the current model.

The Hosmer-Lemeshow test is a goodness of fit test for logistic regression, and a non-significant test indicates a good fit. The HL test shows a value of 0.921, so this model is a good fit. Furthermore, the prediction rate equals 79.8%. This means that almost 80% of our sample was correctly predicted in terms of expectations for the target group. Also, the results show that the variable *flood information* is significant and has a negative B-value.

After we added the dummy variable, the Nagelkerke $\mathbb{R}^2$ increased to 0.217. Furthermore, Model 6 also shows a high Hosmer-Lemeshow value, making this model a good fit. Also, the prediction rate equals 79.1%, so there is a slight decrease in this rate in contrast with Model 5. As shown in Figure 5.6, the variable *flood information* remains significant with also a negative B-value. This negative and significant relationship indicates that a unit increase for *flood information* decreases the likelihood for the number of people to be part of the target group. In other words, it is more likely that more people are not prepared for a flood. The Exp(B) for logistic regression explains the number by which the odds ratio of being part of the target group is multiplied if the independent variable increases by one unit. In this case, if *flood information* increases with one unit, the odds of the previous level are multiplied by 0.275. This results in the new odds of being part of the target group at the new level of *flood information*.

To determine the robustness of the models, we compared the B-values of Model 4 and Model 6. The results show no difference between positive and negative B-values with the corresponding independent variables. Also, the significant variable is the same in both models. Thus, Model 4, 6, and the correlation analysis show that people's need for information influences their preparedness. Based on the results, we can state that information about how to act when a flood occurs will increase the number of prepared people.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	age	-.007	.016	.187	1	.666	.993	.963	1.025
	experience_elsewhere	-1.606	.839	3.666	1	.056	.201	.039	1.039
	others_experience_scheldt	1.271	.630	4.072	1	.044	3.563	1.037	12.242
	others_experience_elsewhere	.521	.566	.848	1	.357	1.684	.556	5.102
	flood_information	-1.289	.529	5.934	1	.015	.275	.098	.777
	influence_limburg	-.562	.577	.946	1	.331	.570	.184	1.768
	flood_policy	.142	.558	.065	1	.798	1.153	.387	3.439
	female	.234	.538	.188	1	.664	1.263	.440	3.628
	Limburg	1.367	.995	1.886	1	.170	3.924	.558	27.608
	Other	1.307	.706	3.426	1	.064	3.695	.926	14.747
	Constant	-.933	1.014	.847	1	.357	.393		

a. Variable(s) entered on step 1: age, experience_elsewhere, others_experience_scheldt, others_experience_elsewhere, flood_information, influence_limburg, flood_policy, female, Limburg, Other.

Figure 5.6: Logistic regression analysis with dependent variable *flood preparedness*(Model 6)

5.3.3 Awareness

Model 7 has a $\mathbb{R}^2$ of 0.205 and *flood information* and *influence limburg* are the significant variables, both with a positive B-value, see Appendix A.4.1. The $\mathbb{R}^2$ of Model 8 is equal to 0.205 which means that 20.5% of the variation of the dependent variable is caused by the independent variables, see Appendix A.4. Since the $\mathbb{R}^2$ of Model 7 is equal to the $\mathbb{R}^2$ of Model 8, it means that adding the dummy location has no significant impact of the outputs. However, the correlation analysis did show that there is a significant relation between Zeeland, Limburg and people's awareness.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.600	.162		3.706	<.001	.279	.921		
	age	-.004	.003	-.115	-1.419	.159	-.009	.001	.953	1.049
	experience_elsewhere	.180	.116	.173	1.548	.124	-.050	.411	.498	2.007
	others_experience_elsewhere	-.136	.091	-.147	-1.506	.135	-.316	.043	.656	1.525
	others_experience_scheldt	-.069	.094	-.072	-.733	.465	-.255	.117	.646	1.548
	flood_information	.176	.091	.172	1.941	.055	-.004	.356	.788	1.268
	influence_limburg	.307	.095	.331	3.229	.002	.119	.495	.591	1.691
	flood_policy	-.066	.095	-.066	-.686	.494	-.255	.124	.672	1.487
	female	-.057	.080	-.059	-.706	.482	-.216	.103	.891	1.123
	Limburg	.014	.140	.013	.097	.923	-.264	.291	.320	3.122
	Other	.140	.111	.121	1.269	.207	-.079	.359	.687	1.456

a. Dependent Variable: flood_awareness

Figure 5.7: Linear regression analysis with dependent variable *flood awareness*(Model 8)

Figure A.42 shows that the significance of Model 8 is lower than 1% which means that this is a useful model. Figure 5.7 that there are two significant variables namely *flood information* and *influence Limburg*. This means that the number of aware people increase by 17.6% in case *flood information* increases, and that the number of aware people increases by 30.7% in case *influence Limburg* increases with one unit.

However, for the same reasons as explained for regressions of people's preparedness, a the logistic regression was created as robustness check for the awareness regressions. The target group is set on people that are aware of future flood risks. Model 9 shows Nagelkerke $\mathbb{R}^2$ of 0.347, a non significant Hosmer-Lemeshow, and prediction rate of 77.5%. Furthermore, *flood information* and *influence limburg* are the significant variables with both positive B-values. See Appendix A.4.3.

Model 10 has a Nagelkerke $\mathbb{R}^2$ of 0.357, so this is slightly improved. The Hosmer-Lemeshow remains a high value indicating this model is a good fit. The predicting rate remains the same (77.5%). Also, the significant variables are the same as in

Model 9. Figure 5.8 shows that the positive B-values indicate that a unit increase of the significant variables, increases the likelihood for the number of people to be part of the target. Since both Exp(B) of the significant variables are greater than one, it more that the odds ratios of being part of the target group is higher than not being part of the target group. This is also proven because the value 1 lies in between the lower and upper part of the confidence intervals.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	age	-.022	.017	1.799	1	.180	.978	.946	1.010
	experience_elsewhere	1.432	.868	2.721	1	.099	4.188	.764	22.961
	others_experience_scheldt	-.389	.567	.471	1	.493	.678	.223	2.058
	others_experience_elsewhere	-.872	.575	2.303	1	.129	.418	.136	1.289
	flood_information	1.083	.534	4.115	1	.043	2.954	1.037	8.415
	influence_limburg	1.673	.586	8.135	1	.004	5.327	1.688	16.816
	flood_policy	-.304	.544	.313	1	.576	.738	.254	2.143
	female	-.441	.520	.721	1	.396	.643	.232	1.781
	Limburg	.027	.924	.001	1	.977	1.027	.168	6.279
	Other	.694	.710	.956	1	.328	2.002	.498	8.049
	Constant	.653	.987	.438	1	.508	1.922		

a. Variable(s) entered on step 1: age, experience_elsewhere, others_experience_scheldt, others_experience_elsewhere, flood_information, influence_limburg, flood_policy, female, Limburg, Other.

Figure 5.8: Logistic regression analysis with dependent variable *flood awareness*(Model 10)

The B-values of Model 10 corresponds with the B-values of Model 9. Moreover, the B-values of Model 10 corresponds with the B-values of Model 8, which means the models are robust. Based on the results of these awareness regressions and the correlation analysis, it became clear that education about flood risks will increase people's awareness. Moreover, the floods in Limburg also increased people's awareness.

5.4 OPEN QUESTIONS RESULTS: STUDY 1

The online self-administered questionnaire was divided into several categories to structure the questions. In this part of the report, the open questions are analyzed. Open questions gave the respondents the chance to explain their reasoning and express their opinion in their own words. Most of the multiple-choice questions are used for the regression analysis. However, some are also interpreted in this section because they did not affect the hypothesis as given in Section 3. So, this section will discuss all the questions that are not yet analyzed in the regression analysis. We will be following the categorical structure of the questionnaire to analyze the remaining questions.

5.4.1 Flood risk experience

This section of the questionnaire was related to people's experience with floods. As can be seen in Figure 4.1 several experience related variables were already taken into account for the regression. However, the additional findings are explained in this section. First, the results showed that 80% of the people that experienced a flood elsewhere experienced this flood in Limburg. Also, 75% of the people know people that experienced a flood in Limburg, and 23% know people that experienced the flood in Zeeland in 1953. The high percentage of flood experience in Limburg can be justified because of the recent floods in Limburg 2021.

5.4.2 Risk perception

In the questionnaire, the questions of this section were related to people's risk perception. The three dependent variables were the output of some of these questions. See Table A.4. One of the three dependent variables is the awareness of the possibility of future floods. In the questionnaire, people were also asked what they thought about the frequency of flood occurrences in the future. As Figure 4.1 shows, 68% is aware that there is a possibility that there will be floods in the future. However, people's perceptions regarding the frequency are quite broad. In Table 5.2 the answers are shown. Remarkably, most people (38%) aware of flood risks find it hard to indicate a frequency. They know that there will be floods, but they could not express this in numbers. Amongst the people who did indicate a frequency, most people think it will happen at least once per year or every five years. Furthermore, some people stated that they think there will not be other floods in Zeeland because of the dykes; however, the possibility in Limburg is rather high because of the rivers.

We also find it interesting that amongst the people that are not aware of future floods, some stated that they think "there will never" be another flood. This seems unrealistic given the recent floods in the Netherlands and climate change. However, this might be a hopeful mindset; it is up to interpretation.

Table 5.2: People's perception regarding the flood frequency for future floods

People's answers for the expected frequency	Number of people
At least once per year	15
Every 2/3 years	8
Every 5 years	15
Every 10 years	9
Every 15 years	2
Every 20 years	3
Every 25 years	3
Every 30 years	3
Every 50 years	2
Every century	3
Every 500 years	1
Every 4000 years	1
Definitely expected in the future but not sure about the frequency	42
Definitely in Limburg but not in Zeeland	3
I don't know	1

5.4.3 Measures

This section is related to people's perception of the current measures regarding flood risk management. We asked whether people think that specific areas need more protection than others and 80% of the people agreed with this. The respondents explained that, first of all, everyone needs to feel safe, and everyone deserves protection. However, the government should look at the likelihood of damage, the chance of occurrence, and the consequences. Moreover, the protection should be higher in the areas where these factors score the highest. Also, areas where more people live or have more economic value, should be protected more because this will also reduce the economic damage if a flood occurs.

According to the respondents, the floods in Limburg showed that we need to work on our protection and think ahead. The Dutch government should not build residential areas in high-risk areas in the future. Furthermore, several people indicated that the government needs to consider the consequences for nature when dealing with flood risk management. Three specific answers explained people's concern for

the nuclear power plant in Borsele. These three respondents explained that they think this should be a specific area that needs extra protection to let the surrounding residents feel safe.

We also asked people to indicate to what extent they think the government gives attention to the given flood risk measures and, as a follow-up question, to what extent they think the government should give attention to the measures. The results of these two questions can be found in Figure 5.9 and Figure 5.10. Figure 5.9 shows the perceived attention of the government according to the respondents, whereby it is noticeable that for almost every measure, the perceived attention is little. The measure 'no development of unsafe areas' scored very little attention. At the same time, the previous open questions explained that people think it is quite important, especially for the future, that the government not build in high-risk areas. For both technical and spatial measures, the perceived attention seems enough.

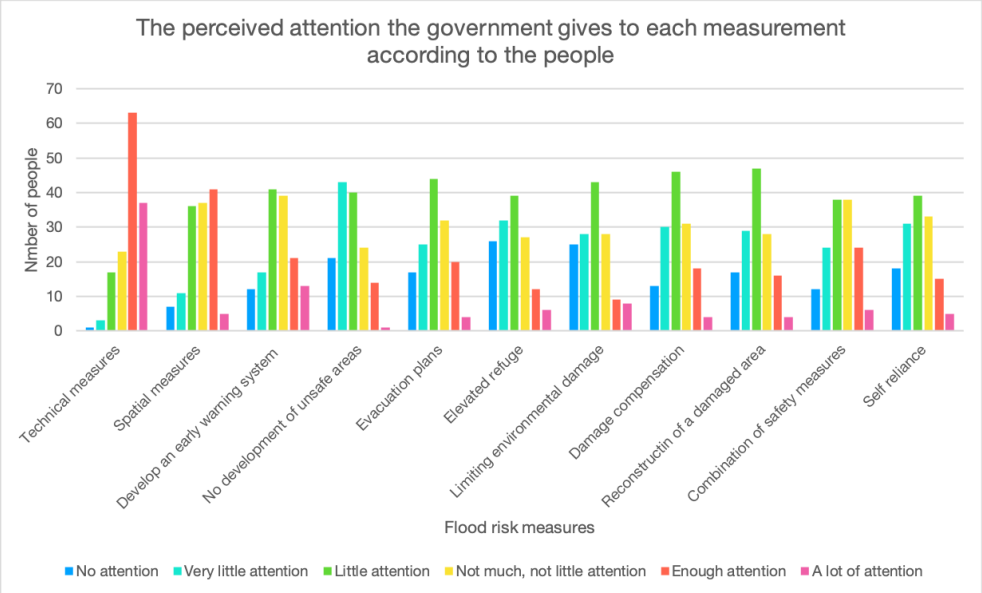

Figure 5.9: Perceived attention of the government toward flood risk measures

However, the exciting results come from comparing the two Figures. Figure 5.10 shows the level of attention people want the government to give to a certain flood risk measure, whereby it is clear that for every measure, people would like the government to at least pay enough attention. This means that the government should divide its attention more than solely on technical and spatial measures. The three most significant differences between perceived and wanted attention are 'No development of unsafe areas', 'Evacuation plans', and 'Elevated refuge'. The first difference was expected as people explained this in one of the open questions. The latter two were also foreseen since the regression analysis showed that people have a high need for education about what to do when a flood occurs.

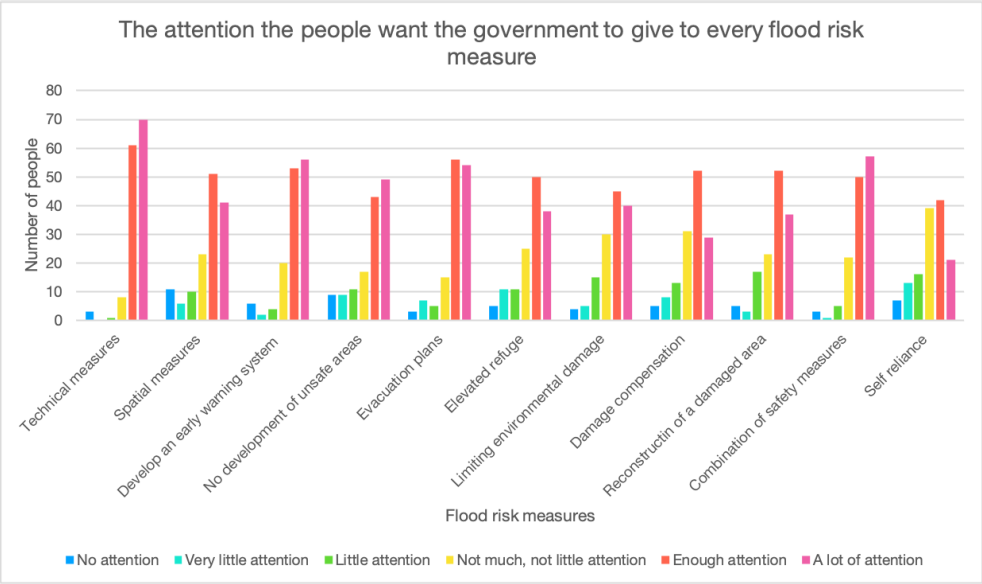

Figure 5.10: Wanted attention of the government toward flood risk measures

Figure 5.10 shows that according to the respondents, much attention needs to be given to the technical measures. This was anticipated because 51% of the respondents are from Zeeland. Thereby it makes sense that they prefer technical measures like dykes, because that is their primary protection against floods.

5.4.4 Evacuation and warning systems

This section captured people's perceptions regarding the Dutch flood risk management plans. The results show that 67% of the respondents do not know the evacuation plans. Amongst the 33% of the respondents who state they do know the evacuation plans, the type of evacuation plans are very diverse. Since this is an essential aspect of flood risk management, it is rather interesting that many people have no clue what to do. People explain that they think that NL-Alert might be a part of the evacuation plan. However, they include a question mark in their answer. In other words, they are not sure, which is concerning because the use of NL-Alert should be straightforward and understood by the Dutch citizens. Besides, many people wrote that they do not trust the use of NL-Alert because they think that it can not be used in case of a flood since the network might be out of order. However, it should be clear that NL-Alert uses a different network and is therefore also deployable, especially in an emergency. It is also interesting that not a single answer includes *overstroomik.nl* since this is the government website that explains almost all questions related to flooding risks and management.

When we asked people what they would do in case of a flood, the answer is almost always "find a safer higher place". People's instinct is to run to a higher place, but something staying is the safer option, which is another educational factor that the Dutch citizens should clearly understand. Furthermore, 68% of the people explained that they have not taken any preventive measures. Also, 86% explained that they never received any information from the government about flood risks or (preventive) measures. The other 14% explained they got information via Social Media, the Municipality, Waterschap or have information because they are professionally involved. 65% of these people are satisfied with the information they got, so the problem is that the information is not getting to the people.

Therefore, it is not surprising that 73% out of the 142 people want more information and education regarding flood risk, flood measures, and flood management. We

asked what kind of information or education people would like to have, which resulted in some very insightful answers. In short, people want a plan which tells them step by step what exactly to do in case a flood occurs. People ask for an informative explanatory video, documentary, flyer, or podcast. The following list provides an overview of all the types of information people want:

- What are the communication channels to use in case a flood occurs?
- How does the alarm process work? How do we, the citizens, find out that flood risk is significant?
- Practical instructions such as a detailed plan of action. Step by step, what to do and what not to do in case of a flood.
- When do we stay home? And when do we run to a higher place?
- Evacuation plans. What are the high refuge places and the routes to get there? What routes remain usable? What are the determining gathering locations?
- How can I protect myself preventive? How can we help each other? How can we help the animals?
- How high is the risk of my home getting flooded? *This can already be found on overstroomik.nl, but apparently, people do not know this.*
- How does it work with insurance? What insurance is needed to ensure financial protection? Can this be fixed preventive or afterwords?

It is clear that people want a clear emergency plan, step by step on what to do before, during, and after the natural hazard. Also, people want this information specific to their locations, and they want to know about the risk and consequences so that they can anticipate them. This need for more information is for 60% of the respondents triggered by the floods in Limburg last summer 2021.

5.4.5 The role of the government

In this section of the questionnaire, people's perceptions regarding the role of the government in considering flood risk management were collected. Out of the respondents, 45% agreed with the statement that flood risk management is a shared responsibility between the government and the citizens. However, more than half (54%) agreed with the statement that the government should ensure flood risk safety in the Netherlands. See Figure 5.11. Even though most people think the government should ensure safety, 70% of the respondents feel that the government is not doing enough regarding flood risk management plans. The relation between these two variables causes concern because people think that the government should ensure safety. Yet, they do not believe that the government is doing enough to ensure this.

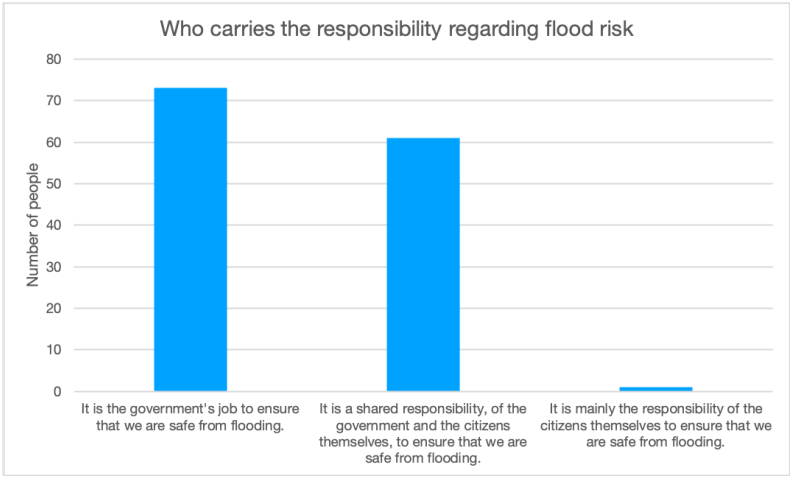

Figure 5.11: Division of the responsibility of flood safety

We asked the respondents to indicate how much influence they think the given people, groups, and government agencies have on flood risk management. After which, we asked how much influence they think the given people, groups, and government agencies should have on flood risk management in the Netherlands. The results of these two questions are shown in Figure 5.12 and Figure 5.13.

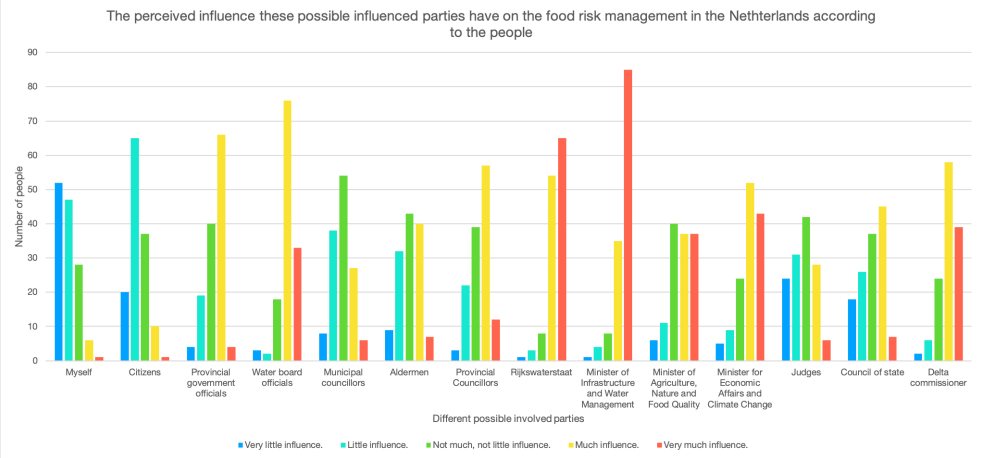

Figure 5.12: Perceived influence of parties regarding flood risks and management

According to the respondents, two groups have the most influence on flood risk management, namely Rijkswaterstaat and the Minister of Infrastructure and Water Management. In contrast, Myself and Citizens are to be found as the ones with the minor influence. When we compare these results with Figure 5.13 we can see that the graphs are pretty similar. The number of people who think that Rijkswaterstaat and the Minister of Infrastructure and Water Management should have the most influence is slightly higher than perceived. Therefore, they remain the two groups that score the highest. The most significant difference is the Delta Commissioner; they should have more influence than they do at this point. Furthermore, the influence of Myself and Citizens should be at least neutral instead of very little to little influence. However, it is noticeable that respondents did not indicate that they think that citizens should have sufficient influence.

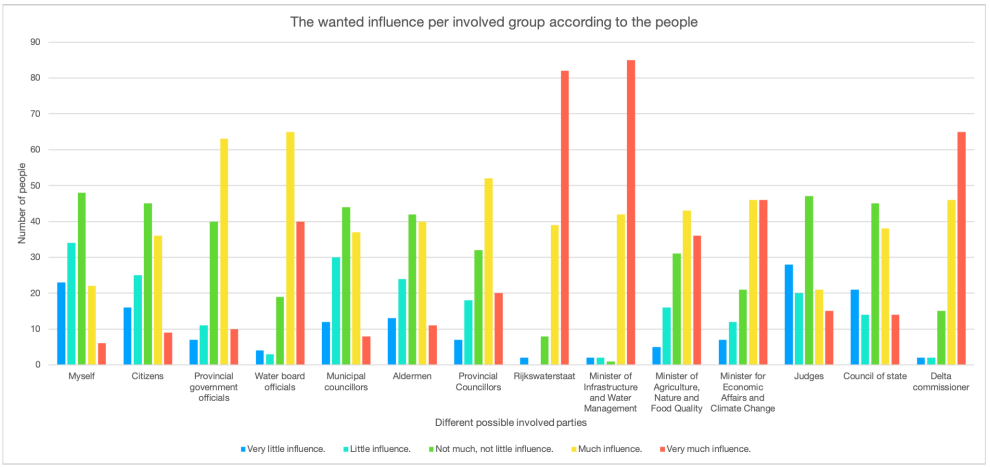

Figure 5.13: Wanted influence of parties regarding flood risks and management

In Figure 5.14 it is shown by which groups the respondents feel most represented. The graph shows that most people feel represented by Rijkswaterstaat, but still, around 23% do not feel represented by any of the listed groups. Instead, these people feel represented by other organizations such as universities, TU Delft or Deltares mentioned, Environmental organizations, Scientists, Veiligheidsregio, Stop Water Nu (village council), Farmers, and the House of Representatives.

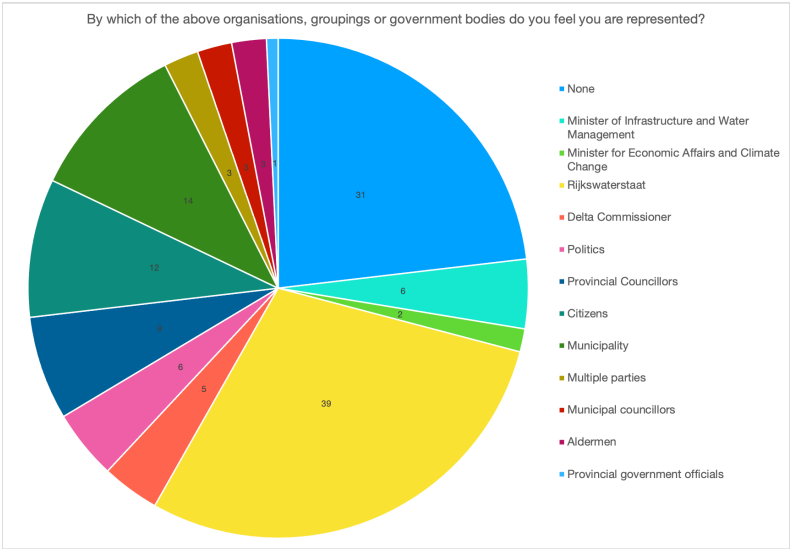

Figure 5.14: Organizations by which the respondents feel represented

In this section of the questionnaire, we asked people if and how they had ever been involved in flood risk management. Around 70% said they have never been involved, and the other 30% are involved in several ways, such as professional, membership with interest groups, joining informative lectures, and Klimaatadaptatie. Alternatively, people find involvement in the fact that they can vote. However, around 60% of the involved people are not satisfied with the response they got from the government authorities to their involvement.

5.4.6 Several general statements

The final question in the online self-administered questionnaire consisted of eleven general statements whereby the respondent needed to indicate their level of agreement. Figure 5.15 shows the results of this question; per statement, it shows the

number of people and their level of agreement.

For the first two statements, the people's opinions are pretty well distributed; the level of disagreement and agreement is almost similar. Furthermore, people are sure that policymakers tend to do the right thing, as the yellow bar is higher for this statement. Also, people seem to agree that policymakers consider several primary interests rather than the public interest. In general, people do not believe in corruption or conflict of interest amongst the policymakers involved in flood risk management. People seem to be indecisive about whether the policymakers waste money. However, people do disagree with the fact that the communication around flood risk management is transparent. It is quite noticeable that most people chose the neutral option to question whether the rules of the decision-making process regarding flood policy are followed. This might mean that people disagree with this statement. The following two statements about the involvement of citizens and their influence on the decision-making process resulted in an unambiguous overall agreement. People see the value of involving citizens in the flood risk management plans. The last statement is distributed precisely evenly. Yet, it is slightly alarming that our flood risk management plan does not give the Dutch citizens the safe feeling it should because, in that case, everyone should agree with this statement.

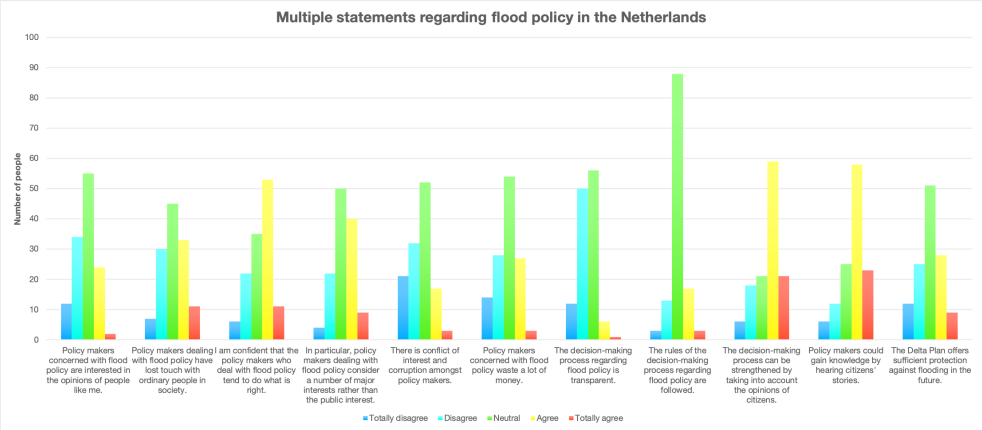

Figure 5.15: Several statements regarding flood risks and management in the Netherlands

5.5 SUMMARY DATA ANALYSIS STUDY 1

SQ3: What is the difference between the perception of Limburg respondents and the perception of Zeeland respondents regarding flood risks and management?

For Study 1, data analysis was performed to analyze the results obtained via the questionnaire. In the data set, a categorical dummy for the locations, Zeeland, Limburg, and Other, was created to test the effect of these locations. The three factors of risk perception, worry, preparedness, and awareness regarding flood risk, were used as dependent variables in several models. The settings of the dependent variable determined the type of regression; for example, because preparedness was a binary variable, not only a linear regression was performed but also a logistic. The output of the models showed that worries about flood risks are influenced by location because people from Limburg are more worried than people from Zeeland. However, the number of prepared people is not affected by the locations, which means that people in Limburg are not necessarily more prepared than people in Zeeland. The number of aware people considering future flood risk is also not directly influenced by location. The results do not show that more people are aware in

Limburg than in Zeeland or vice versa. However, the floods in Limburg (2021) influenced people's need for information and education, influencing people's awareness and preparedness. So, the floods in Limburg indirectly affect people's awareness and preparedness. Therefore, we do state that the results show evidence to support H2.

SQ4: What are people's flood risks perceptions in Study 1?

The most interesting insight in Study 1 is the consistent significance of the variable *flood information*. During the data analysis of Study 1, we created ten different models, amongst which eight of these models contained a significant *flood information* variable. For the models related to people's worry, the variable was insignificant; however, the variable *influence limburg* was significant for both models. The significant *influence limburg* explains that the floods in Limburg 2021 triggered the need for information. Therefore, those models have an indirect relation between information and people's worry.

Furthermore, 86% indicated that they have never received flood information. While amongst the respondents, 73% want more information about what to do in case of a flood. Moreover, the respondents explicitly described what information they thought would improve their knowledge, such as a detailed plan of action per region, information about communication channels, or insurance. This is in line with the fact that people want more attention to evacuation plans and elevated refuges concerning flood risk measures. Currently, 68% of the respondents are not prepared; however, this could change when the government provides the correct information. The respondents indicated that they believe the government tends to do the right things, and the involved parties' wanted and perceived influences are almost equally divided. Thus, people trust their government, and 45% find flood safety a shared task. Furthermore, people believe in the involvement of citizens in the decision-making process regarding flood risks, and most importantly, the transparency of the communication has to be improved. The lack of communication causes issues that could have been prevented; for instance, the indistinctness of the current warning systems indicates that communication regarding evacuation systems should be improved. Providing information regarding flood risks and management might increase the number of prepared people, raise awareness, and decrease the worries so that people feel safe in their country.

Besides, since there is no evidence of a significant relationship between gender and risk perception or age and risk perception, H3 is rejected. We predicted this based on the outcome of the correlation analysis. Furthermore, H1 focused on the relationship between personal experience and risk perception. This hypothesis was tested based on the variable *experience elsewhere* because the variable *experience scheldt* was not included in the regressions. The three most valid models for worry, preparedness, and awareness were Model 2 (Figure 5.4), Model 6 (Figure 5.6, and Model 10 Figure 5.8. Thereby, a relation for personal experience was found in Model 6 ad Model 10, however, on a 10% level. No relation between Model 2 (worry) and personal experience was found, which is against expectations. However, the correlation analysis found a strong positive correlation between personal experience and flood worries. Therefore, because two of three factors had a significant relationship and *worry* strongly correlated with personal experience, we found evidence to support H1.

5.6 DATA PREPARATION: STUDY 2

Study 2 entails the data obtained during the studies scholars did around 15 years ago. As explained in Section 4 some changes were made regarding the questions for the questionnaire of Study 1. The variables used for the correlation and regression analyses of Study 2 correspond with those used in Study 1. However, the questions used to obtain these variables might differ. Table B.1 explains the questions that correspond with the variables, and these questions can be compared with Table A.4 that explains the questions used to obtain the variables for Study 1. The question might differ, but the idea behind the questions remains the same. Therefore, the variables are the interpreted the same.

First, the data preparation of Study 2 is explained, followed by the correlation analysis and regression analysis. The structure of the three risk perception factors, worry, preparedness, and awareness, is also used as a guideline for this results Section. After which, the additional questions will be analyzed in the open questions section.

In terms of consistency, Study 2 was also prepared in SPSS. The complete data set contained 243 responses; however, some variables had missing values. We took the following steps to prepare the data and deal with the missing values. First, we created dummy variables for *experience scheldt od*, *experience elsewhere od*, *others experience scheldt od*, *others experience elsewhere od*, *flood information od*, *female od*, *flood preparedness od*, and *flood awareness od*, whereby '1' equals yes and '0' equals no. With the variable female, the value 1 means that the respondent is a female and the value 0 means that the respondent is a male. Furthermore, the variable *worries floods od* was included as a scale variable, whereby a higher value equals more worries about flood risk. Also, for the variable *flood awareness* the answers 'no' and 'neutral' were combined in order to create the dummy variable.

Frequencies

Statistics

		Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od	worries_floods_od	flood_preparedness_od	flood_awareness_od
N	Valid	243	243	243	243	243	239	238	242	243	237	239
	Missing	0	0	0	0	0	4	5	1	0	6	4
Mean		54.61	.21	.10	.51	.14	.64	.37	.31	2.23	.05	.30
Std. Deviation		15.105	.411	.299	.501	.343	.481	.485	.462	.997	.211	.460
Minimum		19	0	0	0	0	0	0	0	1	0	0
Maximum		90	1	1	1	1	1	1	1	5	1	1

Figure 5.16: Sample Statistics of the variables used for the correlation and regression analysis in Study 2

For the analysis of Study 2, we did not need to create a categorical dummy for location because all the respondents were located around the Scheldt. Therefore, there is no Limburg influence variable in Study 2. The dependent variables for the analysis of Study 2 are the same as used for Study 1, which means that *worries floods od*, *flood preparedness od*, and *flood awareness od*, are the dependent variables. For the same reasons as before, we want to exclude all rows containing missing values for these variables. After excluding these rows, we obtained the statistics of the variables as given in Figure 5.16.

Figure 5.16 shows that 15 years ago, people's worry level on average was relatively low. Furthermore, 4% of the people thought they were prepared for future flood events, which means that around nine people out of the 233 thought they were prepared. The flood awareness was higher than the flood preparedness. Around 70 people (30%) were aware that floods might occur in the future.

5.7 CORRELATION ANALYSIS: STUDY 2

5.7.1 Worry

Again we used the listwise option when performing the correlation analysis so that we only included the rows whereby all variables have values. This resulted in 228 valid rows used for the correlation analysis, see Figure 5.17. The results show that there is only one significant correlation with the variable *flood policy od*. The negative value indicated that the people who thought the flood policy was sufficient were also less worried, which is a logic relationship.

Correlations[c]

		worries_floods_od	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
worries_floods_od	Pearson Correlation	1	.003	.069	.048	-.009	.109	.047	-.207**	.077
	Sig. (2-tailed)		.960	.299	.470	.889	.100	.482	.002	.249
Age	Pearson Correlation	.003	1	.478**	.175**	.118	-.017	-.056	.049	-.224**
	Sig. (2-tailed)	.960		<.001	.008	.075	.800	.403	.465	<.001
experience_scheldt_od	Pearson Correlation	.069	.478**	1	-.132*	.348**	-.085	.042	.042	-.073
	Sig. (2-tailed)	.299	<.001		.046	<.001	.202	.533	.527	.272
experience_elsewhere_od	Pearson Correlation	.048	.175**	-.132*	1	-.190**	.210**	-.040	-.040	-.126
	Sig. (2-tailed)	.470	.008	.046		.004	.001	.549	.550	.057
others_experience_scheldt_od	Pearson Correlation	-.009	.118	.348**	-.190**	1	-.191**	.044	.081	.014
	Sig. (2-tailed)	.889	.075	<.001	.004		.004	.507	.221	.834
others_experience_elsewhere_od	Pearson Correlation	.109	-.017	-.085	.210**	-.191**	1	-.047	-.028	-.057
	Sig. (2-tailed)	.100	.800	.202	.001	.004		.481	.675	.390
flood_information_od	Pearson Correlation	.047	-.056	.042	-.040	.044	-.047	1	.231**	.025
	Sig. (2-tailed)	.482	.403	.533	.549	.507	.481		<.001	.708
flood_policy_od	Pearson Correlation	-.207**	.049	.042	-.040	.081	-.028	.231**	1	-.100
	Sig. (2-tailed)	.002	.465	.527	.550	.221	.675	<.001		.131
female_od	Pearson Correlation	.077	-.224**	-.073	-.126	.014	-.057	.025	-.100	1
	Sig. (2-tailed)	.249	<.001	.272	.057	.834	.390	.708	.131	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
c. Listwise N=228

Figure 5.17: Correlations between independent variables and the dependent variable *worries floods od*

5.7.2 Preparedness

Figure 5.18 that there is only one significant correlation, see Appendix. This correlation indicates a relation between experiencing a flood elsewhere than the Scheldt and the dependent variable. The number of prepared people increased when people who experienced a flood elsewhere increased. Even though the correlation with *experience scheldt od* is not significant, the negative value indicated that the experience of a flood at the Scheldt negatively impacted the number of prepared people. These results might indicate that the experience of a flood influenced people's urge to be prepared. However, the flood in 1953 was so severe that people who experienced it felt like they were not prepared for such an event.

Correlations[c]

		flood_preparedness_od	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
flood_preparedness_od	Pearson Correlation	1	.008	-.058	.148*	.035	.098	.113	-.078	-.007
	Sig. (2-tailed)		.903	.383	.026	.595	.138	.090	.239	.913
Age	Pearson Correlation	.008	1	.478**	.175**	.118	-.017	-.056	.049	-.224**
	Sig. (2-tailed)	.903		<.001	.008	.075	.800	.403	.465	<.001
experience_scheldt_od	Pearson Correlation	-.058	.478**	1	-.132*	.348**	-.085	.042	.042	-.073
	Sig. (2-tailed)	.383	<.001		.046	<.001	.202	.533	.527	.272
experience_elsewhere_od	Pearson Correlation	.148*	.175**	-.132*	1	-.190**	.210**	-.040	-.040	-.126
	Sig. (2-tailed)	.026	.008	.046		.004	.001	.549	.550	.057
others_experience_scheldt_od	Pearson Correlation	.035	.118	.348**	-.190**	1	-.191**	.044	.081	.014
	Sig. (2-tailed)	.595	.075	<.001	.004		.004	.507	.221	.834
others_experience_elsewhere_od	Pearson Correlation	.098	-.017	-.085	.210**	-.191**	1	-.047	-.028	-.057
	Sig. (2-tailed)	.138	.800	.202	.001	.004		.481	.675	.390
flood_information_od	Pearson Correlation	.113	-.056	.042	-.040	.044	-.047	1	.231**	.025
	Sig. (2-tailed)	.090	.403	.533	.549	.507	.481		<.001	.708
flood_policy_od	Pearson Correlation	-.078	.049	.042	-.040	.081	-.028	.231**	1	-.100
	Sig. (2-tailed)	.239	.465	.527	.550	.221	.675	<.001		.131
female_od	Pearson Correlation	-.007	-.224**	-.073	-.126	.014	-.057	.025	-.100	1
	Sig. (2-tailed)	.913	<.001	.272	.057	.834	.390	.708	.131	

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
c. Listwise N=228

Figure 5.18: Correlations between independent variables and the dependent variable *flood preparedness od*

5.7.3 Awareness

The results of the correlation analysis with *flood awareness od* as the dependent variable are not included in the main report because there was no significant correlation found. This means that there was no relevant relationship found between the independent variables and the dependent variable. However, we can not base conclusions solely on the correlation analysis so therefore we still included this risk perception group in the regression analysis to examine the outputs.

5.8 REGRESSION ANALYSIS: STUDY 2

The same assumption as for Study 1 was made when performing the regression analysis of Study 2. There should not be multicollinearity in the data, which was already proved correct because the correlation analysis showed no correlations above 0.80. Moreover, the three linear regression analyses show that the VIF values are below five. So, there is also so multicollinearity in Study 2.

Table 5.3 shows the models drafted for the regression analysis, whereby it is given what regression corresponds with what model. The following sections will explain the output that resulted from the regression analysis. There are fewer regressions conducted in Study 1 because Study 2 does not contain categorical dummy variables, so there is no need for differentiation models with and without dummies. However, since both *preparedness* and *awareness* are also binary variables, both linear and logistic regression is performed for those variables.

Table 5.3: The models used in Study 2

Models	Type of regression
Model 11	Linear regression with 'worries flood od' as dependent variable
Model 12	Linear regression with 'flood preparedness od' as dependent variable
Model 13	Logistic regression with 'flood preparedness od' as dependent variable
Model 14	Linear regression with 'flood awareness' as dependent variable
Model 15	Logistic regression with 'flood awareness' as dependent variable

5.8.1 Worry

The results show that Model 11 is significant at the 5% level with a $\mathbb{R}^2$ that is equal to 0.043, so only 4.3% of the variables influence the dependent variable. Furthermore, there is only one significant variable which is *flood policy od*, with a negative B-value, so an increase causes a decrease for the dependent variable. See Appendix B.3.1. In other words, people are less worried when they think that the flood policies are sufficient.

5.8.2 Preparedness

The results in Appendix B.4.1 show that Model 12 is a significant model at the 5% level with a $\mathbb{R}^2$ of 0.029. Thereby, it can be stated that many different factors influence people's preparedness rather than the independent variables. The variable *flood information od* is significant at 5% level and *experience elsewhere od* is significant at 10% level. Both variables have a positive B-value, meaning a unit increase causes an increase in the number of prepared people.

However, the dependent variable is binary, so a logistics model, Model 13, was created to check the robustness. See Appendix B.4.2. The target group in Model 13 is the group of people prepared for floods. The Nagelkerke $\mathbb{R}^2$ is equal to 0.201, which is an improvement compared to Model 12. Furthermore, the Hosmer-Lemeshow is insignificant, and the prediction rate equals 95.6%. Also, *flood information od* is a significant variable with a positive B-value, similar to Model 12. The Exp(B) is equal to 8.692, so an increase in *flood information od* will multiply the odds to be part of the target group in comparison to the previous level by 8.692. Therefore, the chance of being part of the target group increases compared to not being in the target group.

Furthermore, the variable *experience elsewhere od* is not significant in Model 13. However, the B-value remains a positive sign. The additional variables' B-value also contains the same sign as in Model 12, which indicates the robustness. Based on these results, we can state that the need for information influence people's preparedness.

5.8.3 Awareness

In Appendix B.5.1 the results are shown for Model 14 whereby the $\mathbb{R}^2$ is negative, which means that the model selected does not follow the data trend, resulting in a worse fit than the horizontal line [Chicco et al., 2021]. Since the linear regression was not a fit, Model 15 was created. The results of Model 15, see Appendix B.5.2 show a positive Nagelkerke $\mathbb{R}^2$ of 0.027 and an insignificant Hosmer-Lemeshow; however, this value is relatively low, which also indicates that this model is not the best fit. The prediction rate equals 68.9%, which is higher than expected based on Model 14 and the correlation analysis. Yet, as expected, there are no significant variables in this regression analysis.

Based on the analysis of the data obtained from Study 2, there is no evidence that the independent factors influence people's awareness. Alternatively, it could be that the chosen regression types used for the analysis of awareness are not the best fit for the models.

5.9 OPEN QUESTIONS: STUDY 2

The survey used to obtain Study 2 was structured similarly to the online self-administered questionnaire for this study. Therefore, the same structure for ana-

lyzing the open questions of Study 1 is used for this section. The questions that are not yet analyzed in the regressions will be examined per subsection.

5.9.1 Flood risk experience

The number of people that experienced a flood at Scheldt was significantly higher in Study 2 than in Study 1. Around 94% of the people that experienced a flood experienced the catastrophic flood in 1953. This difference can be explained based on the time of the studies and the occurrence of the flood event. Simply more people who experienced the floods were alive during the previous studies. Also, around 52% of the people who know people with flood experience know someone who experienced the flood in 1953, which is twice as much as in Study 1.

The analysis of the financial questions is not included in this study because due to a technical malfunction of Qualtrics, people's answers seem not to have come through for these questions. This resulted in only five valid rows in Study 1, the first five responses. Therefore, it is chosen not to analyze the results of these questions in Study 2, as these insights can not be compared to Study 1.

5.9.2 Risk perception

The dependent variable *worries flood od* was obtained from one of the questions in this section. Amongst the number of people that indicated that they are worried (2.25%), the reasons for their worries were diverse. People used to be worried because of climate change, several storms and string tides, more ships at sea, and the Netherlands is a low-lying country. Furthermore, the people questioned the strength of the dykes, is the protection strong enough? Nevertheless, 60% of the people indicated that they thought the government did enough regarding preparations for floods.

Also, the dependent variable *flood awareness* was obtained from this section of the survey. Around 70 people expected other severe floods in the future, whereby it appears that the people's expectation was accurate.

5.9.3 Measures

The respondents were asked to indicate the level of attention they thought the government gave to flood risk measures. As a follow-up question, they were asked to indicate the level of attention they thought the government should have given to the measures. The results of these two questions can be found in Figure 5.19 and Figure 5.20.

Figure 5.19 shows the perceived attention of the government according to the respondents, whereby for most of the measures, the perceived attention lies around little to not much not little attention. However, three measures stand out. Both technical and spatial measures are clear enough that attention is given. Also, elevated refuge stands out because very little attention is given to elevated refuges.

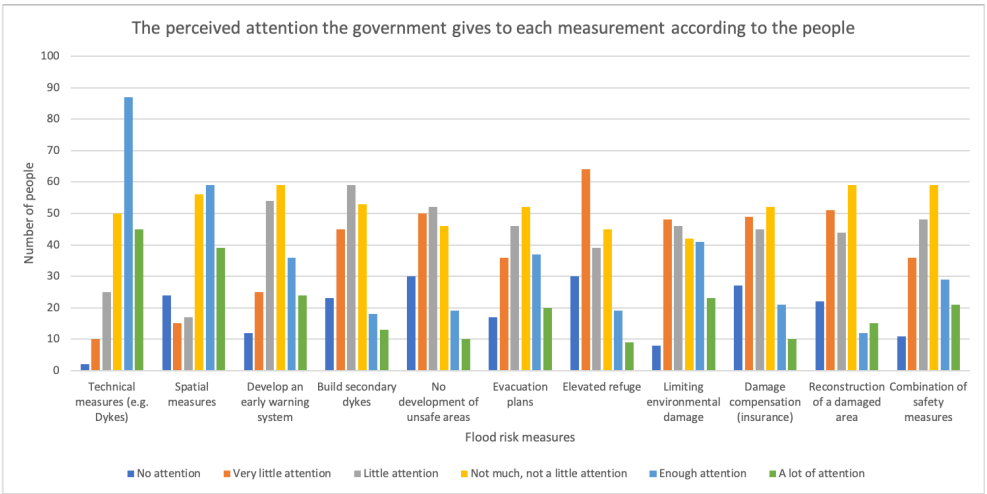

Figure 5.19: Perceived attention of the government toward flood risk measures

The difference with Figure 5.20 is pretty noticeable, which means that the attention the people wanted per measure was very different from the attention the government gave. For almost every measure, people indicated they wanted the government to give at least enough attention to the measures, which means improvement regarding the level of attention was needed. Except for the technical measures, the difference between the two figures is relatively tiny. Contrary, the early warning system has one of the most noticeable difference between the perceived and wanted attention. Followed by evacuation plans and elevated refuge. Also, the perceived attention for spatial measures is much greater than the wanted attention.

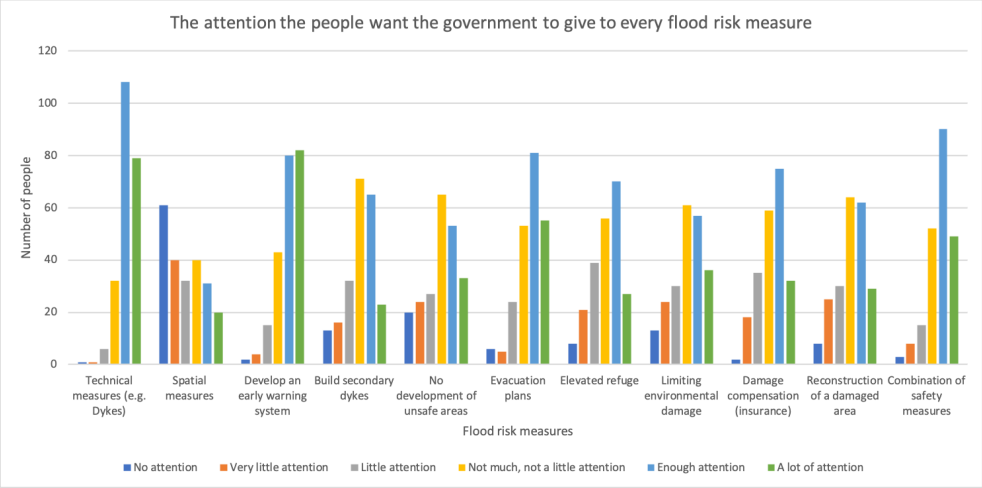

Figure 5.20: Wanted attention of the government toward flood risk measures

5.9.4 Evacuation and warning systems

In this survey section, people were asked about their knowledge and opinion regarding the Dutch evacuation and warning systems. 66% of the people knew the warning system, and amongst them, 60% thought the system was sufficient. The suggested improvements of the others were related to the audibility of the system because the warning system back then used to be a siren. The siren could not reach the people living at a certain distance from the city, for example, people living in the Polders. Other suggested improvements were communication, education and information, and reaching people. For the latter, it was suggested to send out an SMS to

the citizens in case of emergency. This was introduced in the Netherlands in 2012 when the government started using NL-Alert. Also, there appeared to be a need for earlier warning systems so that the citizens have more time to anticipate. Regional warning systems would also work more efficiently, according to the respondents.

In 2007, the siren was used for all emergencies, so the data is no longer accurate since the emergency systems have changed. However, this could be why people answered that closing their windows was the first step they took in case of emergency, followed by turning on the radio to hear instructions. Some answers were more related to floods, whereby people indicated that they would either run to a higher place or stay home in the attic.

Also, the results show that only 4% thought they were prepared for floods, which is an insufficient number and quite interesting because 64% state they knew how to act in case of an emergency. Therefore, the results of these questions do not align. The difference could be caused because the 64% was not specific for flood-related actions. In comparison, the question about preparedness was about whether people were prepared for another flood event.

5.9.5 The role of the government

From the results of the questions related to this section in the questionnaire, 67% thought it was the government responsible for safety. However, just 37% used to think that the flood policy was sufficient. Furthermore, only 32% agreed with the statement that it is a shared responsibility, and 1% thought it is the citizens that are responsible for their safety. People stated it should be the government that ensures safety because the government has the knowledge, expertise, and money to provide this. Also, according to the respondents, citizens pay taxes, so things like this are not their responsibility. However, climate issues are caused by all humans. Therefore, the 32% stated that this is not something to blame the government for, so one can not just assume the government will fix everything. According to the respondents, unexpected things happen, and citizens should anticipate this as well. Furthermore, one respondent stated that it has to be a shared responsibility because the people need to be willing to follow the rules to let the government's work be sufficient, which we thought was quite a factual statement.

According to the respondents, the best way to warn people of upcoming flood events is via TV or broadcast (74%). Regarding spreading information, 44% chose the option for frequent newspaper articles, 28% websites, 21% education at schools, and the additional respondents suggested other means of information and warning via SMS, leaflets, and personal education region-specific information. The need for education has been noticed since Study 2.

Figure 5.21 shows the perceived attention given per indicated group. It is noticeable that people think that Myself and Citizens have the most negligible influence. Contrary, Rijkswaterstaat, the Minister, and the staff of Traffic and Water have the most influence. The other groups have a perceived influence between not much, not little too much attention. Figure 5.22 shows the wanted attention per indicated group, and as can be seen, the wanted attention was somewhat similar to the perceived attention. The most significant difference is that people wished that Myself and Citizens would have more influence on flood risk management in the Netherlands. Moreover, according to the respondents, the Rijkswaterstaat is the most crucial player in terms of a flood policy.

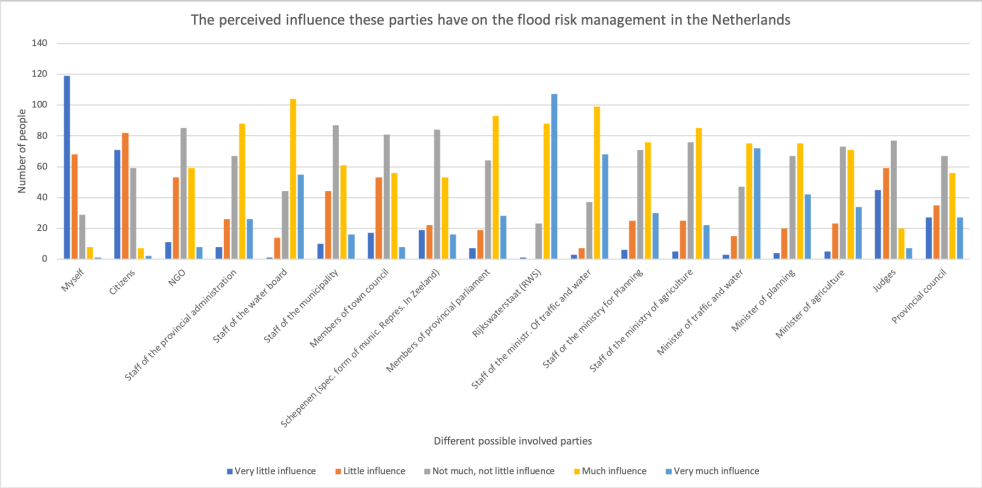

Figure 5.21: Perceived influence of parties regarding flood risks and management

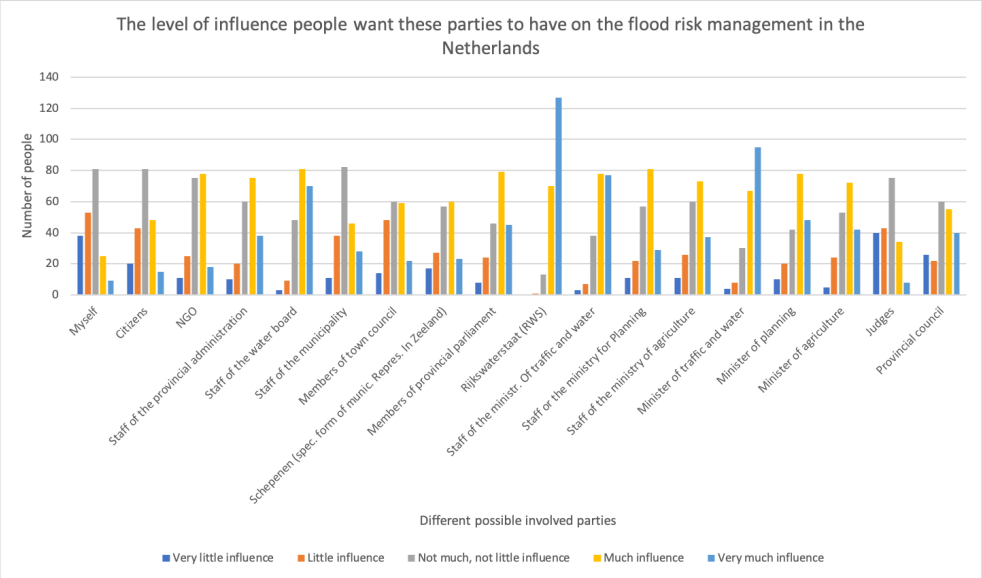

Figure 5.22: Wanted influence of parties regarding flood risks and management

Figure 5.23 shows the groups by which the respondents felt most represented. As seen in the Figure, people were given the option to list all groups that felt represented, not just choose one. Rijkswaterstaat appears the one whereby most people felt represented, followed by the Staff of the Water Board. Also, 46 people indicated that they did not feel represented by any given group. These people explained that they felt represented by Environmental organizations, Weather predictors, Waterschappen, the House of Representatives, and village councils.

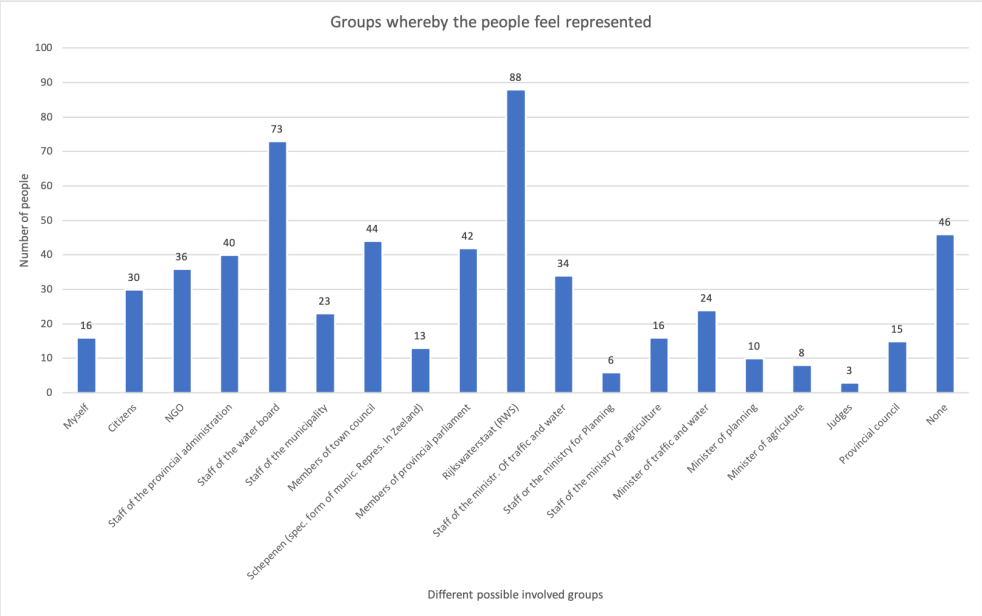

Figure 5.23: Organizations by which the respondents felt represented

Furthermore, in this section, people were asked if they had even been involved in the decision-making process regarding flood risk management in the Netherlands. Around 86% stated that they had never been involved, and most of the additional 14% were professionally involved. However, the rest of the people indicated that they were involved because they went to information lectures, but people did not feel like they were heard.

5.9.6 Several general statements

The final questions entailed several general statements where people could indicate to what extent they agreed with the statement. Figure 5.24 shows the level of agreement of the respondents. People feel that the government is not interested in the citizens' opinions regarding flood risk management. However, the opinion about the contact lost between government and citizens is equally distributed. Most people trusted the government. The following three statements are equally divided if we follow the figure, and the neutral option almost always scores highest for the last four statements. Expect for the transparency statement, whereby many people did not think that the government was completely transparent considering flood risks and management decisions.

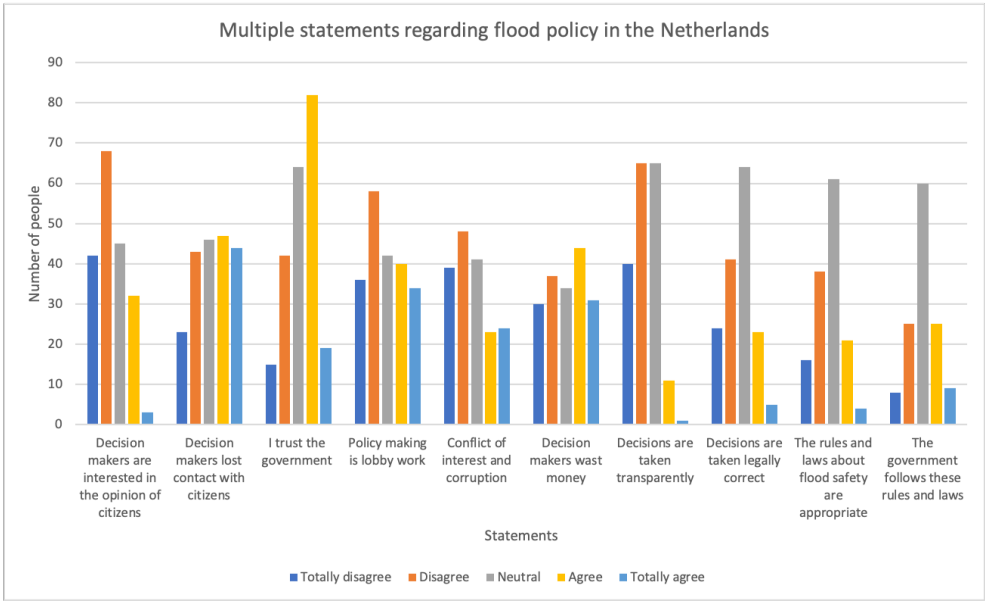

Figure 5.24: Several statements regarding flood risks and management in the Netherlands. *Note: the statements do not precisely correspond with the statements of Study 1*

5.10 SUMMARY DATA ANALYSIS STUDY 2

SQ5: What are people's flood risks perceptions in Study 2?

It is pretty noticeable that the number of significant variables in the regression analyses is low. However, the significant variable is flood information, which appears to influence people's preparedness, as indicated in Model 13 (B.4.2). The reasons for this low number of significant variables will be discussed in Section 6. Also, the analysis of the open questions resulted in several exciting results. For instance, 15 years ago, most people knew the warning system, a siren; however, 60% thought it was insufficient. Interestingly, the alternatives for the suggested warning system are currently used as a warning system, which is considered evidence of the value of including people in the decision-making process.

Furthermore, in general, people trust the government and are satisfied with the level of involvement of the governmental parties. However, citizens would like to be slightly more involved and increase the communication's transparency. Only 4% of the respondents were prepared for flood events, whereby more information, transparency, and involvement were the suggestions from the citizens to improve this percentage. Another remarkable result was the difference in perceived and wanted attention for spatial measures. The results showed that the perceived attention was more significant than the wanted, probably because people from Zeeland were against giving up their private land as a flood measure.

5.11 COMPARISON ANALYSIS STUDY 1 AND STUDY 2

SQ6: What are the differences and similarities between the relevant insights from Study 1 and Study 2?

This section will discuss the longitudinal comparison between Study 1 and Study 2. However, some critical aspects should be considered for the comparison analysis. First, there is a time difference between the studies of around 15 years, which

means that some results of Study 2 are not accurate anymore. For example, in the Netherlands, emergency warning systems have changed since 2007. Also, the respondents of both questionnaires are not the same people, which means that the statistics of both studies differ. These factors that influence the comparison analysis are referred to as comparative restrictions in this section. Because of these restrictions, this longitudinal comparison analysis is not a one-on-one comparison, which will be further discussed in Section 6. In this section, the difference and similarities between Study 1 and Study 2 are further explained, keeping the comparative restrictions in mind. The comparative conclusions drawn from the studies will be done for both the regression models and the open questions.

5.11.1 Comparison statistics

Table 5.4 shows the statistics of Study 1 and Study 2. The differences and similarities between the data sets of both studies are analyzed to make valid conclusions while keeping the comparative restrictions into account. The most apparent difference is the number of valid data points; Study 2 obtained more valid respondents than Study 1. Second, Study 2 was solely focused on people living in the Scheldt area. However, Study 1 focused on both people from Zeeland and Limburg, since this study also contains a cross-sectional analysis. Therefore, the longitudinal comparison is also not focused solely on people from Zeeland.

Table 5.4: Statistics of Study 1 and Study 2

Study 1:	Age	Experience scheldt	Experience elsewhere	Others experience scheldt	Others experience elsewhere	Flood information	Influence limburg	Flood policy	Female	Zeeland	Limburg	Other	Worries floods	Flood preparedness	Flood awareness
N valid	165	161	161	161	161	142	143	134	162	165	165	165	165	165	165
Missing	0	4	4	4	4	23	22	31	3	0	0	0	0	0	0
Mean	44.68	0.01	0.26	0.38	0.42	0.73	0.59	0.3060	0.3889	0.51	0.25	0.24	2.24	0.23	0.68
Std. Deviation	15.248	0.079	0.440	0.487	0.495	0.444	0.494	0.46225	0.48901	0.501	0.433	0.430	1.244	0.422	0.468
Minimum	17	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Maximum	75	1	1	1	1	1	1	1	1	1	1	1	5	1	1
Study 2 (od):															
N valid	233	233	233	233	233	232		230	232				233	233	233
Missing	0	0	0	0	0	1		3	1				0	0	0
Mean	54.36	0.22	0.10	0.52	0.14	0.64		0.37	0.31				2.25	0.04	0.30
Std. Deviation	15.013	0.414	0.299	0.501	0.345	0.480		0.485	0.465				0.990	0.203	0.461
Minimum	19	0	0	0	0	0		0	0				1	0	0
Maximum	90	1	1	1	1	1		1	1				5	1	1

Following the Table 5.11.1 form left to right, we start by comparing the statistics of the respondent's ages. The difference between the average age is around ten years, whereby the average is higher in Study 2. However, both studies have a representative group seeing the minimum and maximum are far apart with a high Std. The following four columns show the statistics regarding people's flood experiences or the experience of people they know. The reason for the higher percentage of flood experiences at Scheldt in Study 2 could be that the study was conducted closer to the date of the event, which might also account for the flood experience of others at the Scheldt. The percentage of flood experience elsewhere might be higher in Study 1 because of the floods in Limburg 2021 and the fact that the questionnaire was also conducted in Limburg, which probably also affected the higher percentage of knowing people that experienced a flood elsewhere. The following column shows that the need for flood information is pretty high for both studies, which is even higher in Study 1 than in Study 2. So, we can state that this is something that the government needs to improve in the future.

Note that the next column is one of the columns that is only filled in for Study 1. This is because Study 2 did not include a Limburg aspect, and therefore there is no data for this variable. This also accounts for the categorical dummy variables Zeeland, Limburg, and Others, which cannot be compared.

Furthermore, the percentage of people who believe the government is creating good policies is somewhat equal. This also accounts for the division between men and women because both studies had more male respondents than females. The level

of worry regarding flood risk was also almost the same in both studies, which was rather unexpected and will be discussed in Section 6. The number of prepared people in study 1 was deficient; only 4% of the respondents were prepared. However, it is also relatively low in Study 1. Since many people indicate they need more information about flood risks and management in both studies, it is not surprising that the number of prepared people is relatively low. However, it is pleasing that the awareness amongst the respondents of Study 1 is higher than those in Study 2. Nonetheless, this could be because, since Study 2, several floods have occurred, such as in Limburg summer 2021, triggering people's risk perception.

5.11.2 Comparison regression models

Figure 5.25 shows the output of the most valid models obtained during the analysis. For all three factors of risk perception, the best-fitted model is included and compared, where possible, with the other study. Model 2 (study 1) and Model 11 (study 2) are both linear regressions with the dependent variable *worries floods*, with different outputs regarding significance. There are no correspondent significant variables, and Model 11 only shows the most obvious correlation; people who trust the flood policies are less worried. Model 2 shows that the impact of living in Limburg and the recent floods influence people's worries. Yet, the influence of Limburg cannot be analyzed in Model 11 since Study 2 was only conducted in Zeeland. Therefore, no comparative conclusions can be made based on these outputs. However, it is noticeable that even though the Limburg factors significantly influence Model 2, the statistics showed that the average worry level of both studies is equal. So, in general, people are not that worried. However, the recent flood in Limburg does influence this variable.

Model 6 (study 1) and Model 13 (study 2) both shows logistics regressions with *flood preparedness* as dependent variable. There is one variable that is significant in both models, namely *flood information*. However, for Model 6, this variable has a negative B-value, and in Model 13, a positive B-value means opposite reactions are triggered when this variable increases. This difference was not expected; however, it can be explained based on the questions used in the questionnaires to obtain this data. Study 2 did not contain a specific question about the need for more flood information or education. Therefore, an assumption was made that more information or education was needed if people did not know what to do. So, it is logical that if people knew what to do, this is positively related to preparedness. The assumption made for this model is one of the limitations of the longitudinal comparison.

Furthermore, Table 5.25 only shows one model as a result of the research regarding people's flood awareness. The results for this dependent variable in Study 2 were not significant. Therefore, Model 15 is not included in this Section. The conclusion considering people's awareness have to be based on the cross-comparison in Study 1 and the statistics for both studies. Hence, no conclusion can be drawn based on the comparison of the regression analyses.

	Linear[a]		Logit[a]					
	Model 2 (Worry study 1)	**Model 11** (Worry study 2)	**Model 6** (Preparedness study 1)		**Model 13** (Preparedness study 2)		**Model 10** (Awareness study 1)	
			Regression Coefficient	*EXP*	*Regression Coefficient*	*EXP*	*Regression Coefficient*	*EXP*
Intercept	1.095 (0.011)	2.224 (<0.001)	-0.933 (0.357)	0.393	-6.227 (0.003)	0.002	0.653 (0.508)	1.922
Age (od)	0.004 (0.557)	-0.001 (0.778)	-0.007 (0.666)	0.993	0.015 (0.620)	1.015	-0.022 (0.180)	0.978
Experience Scheldt (od)		0.257 (0.189)			-1.460 (0.261)	0.232		
Experience elsewhere (od)	0.070 (0.818)	0.155 (0.512)	-1.606* (0.056)	0.201	1.462 (0.129)	4.312	1.432* (0.099)	4.188
Others experience Scheldt (od)	0.430* (0.082)	-0.002 (0.990)	1.271 (0.044) **	3.563	1.300 (0.116)	3.668	-0.389 (0.493)	0.678
Others experience elsewhere (od)	-0.048 (0.838)	0.315 (0.103)	0.521 (0.357)	1.684	1.245 (0.126)	3.474	-0.872 (0.129)	0.418
Flood information (od)	0.380 (0.111)	0.203 (0.148)	-1.289** (0.015)	0.275	2.162* (0.052)	8.692	1.083** (0.043)	2.954
Influence Limburg	0.499** (0.046)		-0.562 (0.331)	0.570			1.673*** (0.004)	5.327
Flood policy (od)	-0.378 (0.131)	-0.452*** (0.001)	0.142 (0.798)	1.153	-1.333 (0.124)	0.264	-0.304 (0.576)	0.738
Female (od)	0.123 (0.557)	0.143 (0.321)	0.234 (0.664)	1.263	-0.106 (0.891)	0.899	-0.441 (0.396)	0.643
Limburg	0.988*** (0.008)		1.367 (0.170)	3.924			0.027 (0.977)	1.027
Other	0.129 (0.654)		1.307 (0.064) *	3.695			0.694 (0.328)	2.002
Adjusted R^2	0.274	0.043						
F test of model	5.841***	2.276**						
Cox and Snell R^2			0.143		0.061		0.252	
Nagelkerke R^2			0.217		0.201		0.357	
Chi-square Hosmer and Lemeshow Test			3.637 (0.888)		7.549 (0.479)		4.665 (0.793)	
Forecast accuracy			79.1%		95.6%		77.5%	

[a] * Significant level at 10%, ** significant level at 5%, *** significant level at 1%.

Figure 5.25: Overview of the regression analysis of the valid models of Study 1 and Study 2

5.11.3 Comparison open question results

The comparison of the open questions is also part of the longitudinal comparison analysis. For this section, the questions will be analyzed and compared following the structure of the questionnaires. While taking the comparative restrictions into account, the differences and similarities will be examined, and conclusions will be drawn where possible.

The comparison is already covered in some questionnaire sections because it was needed to understand the data analysis process. For example, for Section **Flood risk experience**, the difference in the percentage of people that experienced a flood or know someone who experienced a flood has been explained. Also, the higher number of people who experienced a flood at Scheldt in Study 2 and the higher number of people who experienced a flood elsewhere in Study 1 is made clear. Besides, Section 5.11.1 already covered the statistical differences. The following subsections contain the yet to explain differences or similarities; in terms of clarity, the questionnaire sections are described in italic text.

Measures

In both questionnaires, this section focused on the perceived and wanted attention of the government regarding flood risk measures. For both studies, the wanted

attention for all measures was higher than the perceived. So, people want the government to be more involved in all these measures instead of solely focusing on technical measures. However, there are multiple differences between the two studies. In study 2, people indicated that they wanted more attention to the early warning system and less to spatial measures. The warning system was not optimal; that became clear from the questionnaire; therefore, it is understandable that people wish to improve it. In Study 1, however, the difference in perceived and wanted attention regarding the warning system was less significant, and the wanted attention for spatial measures was higher than the perceived. The latter was quite an unexpected results, and is discussed in Section 6.

Nevertheless, there are also some similarities regarding the difference in perceived and wanted attention for flood risk measures. Both studies showed that people wanted greater attention to evacuation plans and elevated refuge. Also, the results showed that the number of prepared people was low in both studies. However, these similarities indicate that people wish to be more informed about how to prepare. If more attention is given to evacuation plans and elevated refuges, it might result in a higher number of prepared Dutch citizens.

Evacuation and warning systems

The evacuation and warning systems have changed since Study 2. However, it is still interesting to analyze that in Study 2, 66% knew the warning systems, while in Study 1, 33% knows the warning systems. We can not literally state that this is halved because of the comparative restrictions, but it does indicate the need for clarification for Dutch citizens. It seems rather logical that the need for information, education, and a clear flood risk policy appears to be an essential factor in Study 1. These variables are almost always correlated or significant in the results.

The role of the government

There is a noticeable difference in people's perceptions about who is responsible for flood safety in the Netherlands. In Study 2, 32% thought it was a shared responsibility between government and citizens, and in Study 1, this percentage was 45%. So, in percentage terms, more people in Study 1 believe that obtaining flood safety is a shared task. Even though most respondents indicate they trust the Dutch government, both studies show that around 70% of the respondents feel that the policies are insufficient. This means that 15 years after Study 2, there is still much room for improvement regarding flood risk management. Also, citizens emphasize the value of their involvement, yet another aspect that has not been improved since Study 2. However, it is interesting that people only want to be involved to a certain extent; they do not want full responsibility. However, the government should at least listen to their input. Both studies showed that around 70% had never been involved, and 60% of the people involved were not satisfied with the response to their involvement.

Furthermore, both studies indicated that they feel most represented by the Rijkswaterstaat, which has not changed. However, around 20% of the respondents do not feel represented by any given group. This percentage might be lower when citizens are more included, or more information about flood risk is provided since both studies showed the significant influence of flood information on risk perception and the lack of communication of any flood information. Moreover, in Study 1, 86% had never been any information about flood risk.

General statements

Most of the statements in the questionnaires are similar. However, some statements were substituted, as explained in Section 4. In this Section, the matching statements will be compared. Respondents were given several statements to which they could agree or disagree. The first statement asked if flood policymakers are interested in citizens' opinion, whereby the level of agreement increased to neutral in Study 1, which aligns with the results from subsection **The role of the government**, whereby more people indicated to be involved in Study 1. However, both studies seem to have a neutral opinion regarding the statement that the policymakers lost touch with the citizens. They might not know or can not say since many people are not involved or never have been. However, people still trust the government, as they already did 15 years ago. Yet, people believe that lobbying work is increasing if we compare the number of agreements of this statement. Few people disagree with the statement regarding corruption amongst policymakers, which means that their trust in the government is slightly less. Nevertheless, the number of people that believe that the government is wasting money is less in Study 1 than in Study 2. However, the respondents in both studies disagreed with the statements that the government is transparent or follows the rules. This means that the Dutch citizens still trust the government; however, they want to be included more. The government could improve this by more transparent communication and committing to the determined rules. These latter actions that the government can take might already influence people's feelings regarding the sufficiency of the flood policies.

5.12 VALIDATION OF INTERPRETATION

During the interviews, some of the results were discussed with the interviewees. In this section, the interviews' outcomes are analyzed and summarized, and we connect the outcomes of the interviews were possible. This section is divided into three sub-sections: the main topics discussed during the interviews. Last, a summary of the most insightful results from the validation interviews is given.

5.12.1 Communication and information

In the interviews, communication between governmental organizations and citizens has been a topic of conversation. Both Provoost [2022] and Schaick [2022] explained that communicating with citizens can be difficult, especially when explaining challenging topics, such as the new risk norms. The new norms include a high level of technical calculations, which are not easily explained. Provoost [2022] emphasized this when he said that he had trouble remembering the calculations immediately after retirement. Furthermore, he described communication as a bridge that does not exist between the one that builds the scenario and the one that experiences it. There is a lack of communication about information between the Dutch government and citizens. However, according to Taal [2022]; Schaick [2022]; Ijff [2022], closing this bridge is tricky because how do we know if the citizens want the information? The problem is that citizens often state that they do not receive any information, yet they do. However, it passes them because they are occupied with other matters, so the information ends on a pile and is never looked at. The receiver is not always open to receiving information. For example, Taal [2022] explained that in his opinion, he does not think that people care about the new risk norms because the safety level or feeling of the citizens remain the same.

Nevertheless, every interviewee agreed that the basic information about the general steps one must take in case of a flood should be clear, at least. Moreover, if people ask for more information, they should receive this. However, Ijff [2022] explained

that the desire for information is time-related because, at this point, the need for information is a big topic because of the floods in 2021. Nevertheless, the need and involvement will decrease when more time passes until the next big event happens.

Basically, the communication has to improve to ensure that the essential information is clear. Also, when communication increases, the knowledge level increases for citizens and the Dutch government because the knowledge level amongst the citizens is high according to Ijff [2022]. The others agreed to a certain extent, which means they believe citizens can improve local plans. However, they do not believe citizens can provide additional knowledge which would significantly improve our national flood defense system. This is aligned with Eijkelenberg [2022] as he explained that a hierarchy is needed within the Dutch water management organizations.

5.12.2 Involvement of the citizens

Based on the results of this study, the citizens' involvement has to be improved. Citizens would like to participate more; however, it remains a shared responsibility because citizens do not want full responsibility, which makes sense. After all, according to Eijkelenberg [2022], water management should not be democratic. Experts should be able to make quick discussions without consulting citizens in an emergency. However, the experts indicated that participation is increasing progressively in the Netherlands. For example, in Zeeland, there appear to be information evenings that people can join [Schaick, 2022]. Also, the involvement of the citizens increases because of experience; according to Provoost [2022], Zeeuwse people have a water culture and therefore have knowledge and perceptions regarding related topics. Moreover, Provoost [2022] emphasized that more people should care about the involvement and impact on the people because the Dutch government often acts based on their perceptions without consulting this matter. In contrast, it would work positively to include people's perceptions. Schaick [2022] agreed but to a certain extent because involvement is time-consuming, and the question remains: how much time should the government put into this? Furthermore, how transparent do we need to be because citizens can ask for a WOO and look into files anytime? Taal [2022] agrees and explains that we should ask ourselves; what can we expect from the Dutch government? Moreover, what is involved? Involvement in decision-making processes or involvement in local plans? Furthermore, to what extent do citizens want to be involved? It all came back to the point made by Ijff [2022] about cultural anthropology, does the receiver wants to receive information.

Nevertheless, besides all the obstacles, participation is growing in both Zeeland and Limburg. Ijff [2022] is highly involved in the involvement of citizens. As he described, the municipality has the closest connection with the citizens, and Rijkswaterstaat or Waterschap can never get to this point. Also, they do not need to because if the municipalities have direct connections, the next step is to increase proper communication between governmental organizations to keep each other updated.

Meerssen is the example of the practical implementation of including citizens in flood risk management plans. Ijff [2022] explained some of the actions the municipality took to work with the local people. One of his colleagues has set up support groups in response to the floods in 2021, whereby citizens can share their experiences and express their feeling. "This direct line with citizens results in us knowing what kind of measures they want, and we also get to work together. [Ijff, 2022]" Furthermore, in Meerssen, five groups have been formed to work on a self-help plan, whereby the municipality supervises three groups, and two groups are supervised by Water-stop NU, a voluntary action group set up by citizens. Within these five groups, local plans of action are created. For example, a contact person who

communicates with the municipality during emergencies is pointed out. Furthermore, one of the drafted plans is personally filling sandbags whereby a truck will be sent to a specific location, and people own the bags they need to fill. Additionally, people know where the elderly or other people who might need help filling their bags live, so they create a plan who will help these people. This is just one of the determined plans; the entire interview with Ijff [2022] can be found in Appendix F.

5.12.3 Worry, preparedness and awareness

A water culture can be changed by involving people in water management-related plans. However, in Zeeland, there is no need to change the water culture because, according to the Zeeuwse experts, residents of Zeeland are water people and know how to deal with and live with risks. It is something that all coastal people have, according to [Provoost, 2022]. With this, there is a big difference between Zeeland and Limburg because, according to Ijff [2022], people in Limburg have no water culture. However, the people in Limburg are aware of the possible risks. So, the relatively high level of awareness in the results is verified in the interviews. In addition, Eijkelenberg [2022] explains that the different water culture arises due to the different types of water and their history. In Limburg, the rivers are "life veins", while in Zeeland, the sea is a "deluge".

Furthermore, we talked about the low level of worry in Zeeland and Limburg in Study 1 and Study 2. According to the three experts in Zeeland, the low worry level has to do with the trust in the government. Based on people's experiences with the Dutch government and water safety, they trust it will be handled [Provoost, 2022; Schaick, 2022; Taal, 2022]. This appears to be typically Dutch [Taal, 2022]. Besides, Provoost [2022] emphasized again that it also has to do with the water culture in Zeeland. People have experience, are familiar with the consequences, or have gained built-up trust over the past years. In Limburg, however, the built-up trust cannot play a significant role because Waterschap Limburg only has a short history, so it also has to do with water culture [Ijff, 2022; Eijkelenberg, 2022]. Therefore, low flood risk worry is connected to the fact that there is no water culture, which is the opposite reasoning as in Zeeland. Also, Schaick [2022] gave another possible explanation for the low worry level in Zeeland, the floods in Limburg were caused by heavy rainfalls, and the same rainfalls in Zeeland would not have caused the same effect. In Zeeland, the danger comes from the sea, so the culture and water differ from Limburg. Therefore, the floods in Limburg might not have triggered the Zeeuwse people as much as they triggered the people in Limburg, which also explains the higher level of worry in Limburg than in Zeeland. In addition, Eijkelenberg [2022] explained that the low level of worry is also related to repressing fear. People do not want to live in fear; even though they are aware of it, they do not want to be reminded constantly.

The low level of preparedness is not something that surprised the experts because most of the provided information is about creating awareness. According to Taal [2022]; Provoost [2022] providing information about how to prepare could also cause unnecessary panic, which might be a reason that the government is more focused on awareness. Schaick [2022] also indicated that Waterschap mainly focuses on awareness. Yet, the experts all mentioned that it would help if the government shifted toward more information about preparation. Moreover, according to Taal [2022], the preparation plans should already be drafted, so it is a matter of communication. For example, the municipality of Meerssen provides information on their website, which is known amongst the local public [Ijff, 2022]. Furthermore, Schaick [2022] explained that Waterschap once created a flyer about steps people should take. However, then the issue of receiving was raised again. This flyer mostly like will end up on a pile of garbage.

5.12.4 Spatial measures

The result about the wanted attention toward spatial measures was significantly higher in Study 1 and Study 2, which caused some uncertainties during the interviews. First, what are spatial measures? It is a comprehensive concept and was mostly unclear to the interviewees, so we have to consider this a limitation because it could also have been unclear for the respondents. Second, we talked about depoldering and RFR as examples for spatial measures, but Taal [2022] explained there is a big difference. Depoldering is mostly for nature restoration, while RFR is a true flood risk measure. Also, he asked if we included the consequences of RFR in the question? Would people still want more spatial measures if it was indicated that they should give up some private land? Besides, Schaick [2022] explained it could also differ because of the general shift in flood measures, and nature has become an increasingly important factor. Both Provoost [2022] and Ijff [2022] talked about the possibility of implementing RFR in Limburg. However, Ijff [2022] is in favor of fast actions, while Provoost [2022] thinks it is a very delicate measure and, therefore, the implementation takes time, as we have seen in other places in the Netherlands.

5.12.5 Summary of the validation interviews

The results regarding the needed communicative improvement were discussed during the interviews. Some governmental organizations sometimes find it hard to communicate with people as they do not know someone's knowledge level. Furthermore, the communication between government and citizens is not the only problem; it could also be that the communication between citizens and, for example, a municipality is correct, as in Meerssen. However, communication between the different involved governmental organizations is the issue. For example, when a severe flood occurs in Meerssen, Veiligheidsregio Limburg gets involved, but how does this work in terms of communication? How and who informs the Veiligheidsregio about the determined agreements? Who informs them about who the local contact person is? During an emergency, it should not be the case that different governmental organizations provide different information about actions that citizens should follow. So, many practical aspects of communication about flood risk management need to be improved.

In the results, the respondents stated that they have seldom received any flood information, yet, they also state that they do want to receive this. However, according to the experts, this is problematic because the provided information is often ignored. It appears to be an issue that sometimes the receiver does not want to receive information. Also, because flood risks are time-related, the topic is highlighted after an event but slowly disappears again until a new event occurs. Nevertheless, general flood preparation information should be provided and known amongst the Dutch citizens. Therefore, the government should shift from providing information with the focus on creating awareness and instead focus on increasing preparedness. This could also explain why the level of awareness is much higher than the preparedness.

In Meerssen, the practice shows that citizens can be involved in creating local flood risk management plans. The experts' perceptions were mostly aligned regarding this aspect, meaning they all see the value in increasing citizens' participation in local flood risk plans. However, when the involvement of the citizens increases, communication needs to be extra improved as well. Also, all experts acknowledge that the local knowledge of the citizens has a strong positive effect on local flood risk plans but not on the national flood risk management plans.

The reason for the low flood risk worry in Zeeland and Limburg appears to differ because of the different water cultures and waters in these locations. According

to the experts, the built-up trust in the Dutch government and water management organizations could explain a low level of worry, which is probably the case for Zeeland. However, in Limburg, it could also be that the level of worry is low because there is a different water culture. The floods in Limburg in 2021 probably caused worry to score higher in Limburg than in Zeeland. However, it must be remembered that these worries are time-related and will decrease solely over the years until another severe event occurs.

Lastly, spatial measures appear to be quite a broad aspect, which was interpreted differently by the experts. After discussing that it has to do with depoldering and RFR, several statements were made. RFR is something that would work in Limburg but not in Zeeland. Depoldering is about giving back to nature, not a direct flood risk measure. According to the experts, the difference between Study 1 and Study 2 was probably caused by the inclusion of Limburgse people.

Most importantly, all the experts agreed with the need to increase the participation of the Dutch citizens. Meerssen provides an example of the inclusion of citizens in flood risk management plans. However, the involvement of the citizens should be limited to a local level, which means that participation in, for instance, local evacuation plans could be valuable. Yet, including citizens in extensive decision-making processes could be time-consuming and less valuable because the needed knowledge regarding the problematic technical aspects is probably present amongst the involved experts. Flood risk management organizations need a hierarchy because it is not suited to become democratic.

6 DISCUSSION

In this research, we analyzed people's perceptions regarding flood risks and management in the Netherlands. Therefore, we conducted an online self-administered questionnaire to collect the perceptions of people, with the focus on people living in Zeeland and Limburg. To this end, a set of variables was considered to analyze the three aspects of risk perception: worry, preparedness, and awareness. The regression analyses were performed to examine a cross-sectional and longitudinal comparison analysis. A cross-sectional analysis was performed to analyze the effect of location on people's risk perception, done in Study 1. Besides, the regression analysis was used to test the three hypotheses of Study 1. The longitudinal comparison was used to compare Study 1 and Study 2. In this Section, the results will be discussed for respectively Study 1, Study 2, and the comparative analyses. Furthermore, the methods used in this study, survey method, cross-sectional analysis, longitudinal analysis, and interviews, will be discussed.

6.1 STUDY 1

6.1.1 The relation between flood experience and risk perception

In Section 3 we explained that several scholars such as Thistlethwaite et al. [2018]; Zabini et al. [2021]; Scolobig et al. [2012] state that flood experience undoubtedly influences people's risk perception because, as a reaction to their experience, people tend to become more worried in the future. As expected, many scholars agree with the statement and confirmed a strong and positive relation between flood experience and worry about flood risk Damm et al. [2013]; Grothmann and Reusswig [2006]; Heitz et al. [2009]; Ruin et al. [2007]. However, the results showed that a flood experience at the Scheldt did not significantly influence one of the risk perception factors. In contrast, experience elsewhere than at Scheldt influenced preparedness and awareness but only on a 10% significance level. Therefore, the results are not entirely in line with the literature study. Based on the studies of Green et al. [1991]; Halpern-Felsher et al. [2001]; Scolobig et al. [2012], the difference could be explained because they proved that personal experience often only influences risk perception positively when the experience was associated with personal damages due to the flood. The respondents' answers regarding damages and financial consequences did not come through in Qualtrics, which could be why no connection between experience and personal damage has been made and, therefore, affected the output of the influence on experience and risk perception in the models. Besides, the little relation between flood experience at the Scheldt and risk perception could also be influenced by the fact that only 1% of the respondents experienced this flood, which is a low and non impactful percentage.

Nevertheless, the results of Study 1 did show a relation between experience elsewhere and people's preparedness. In the literature, the conclusions regarding this relationship are divergent. Several scholars confirm the positive relation [Ejeta et al., 2018; Thistlethwaite et al., 2018]. On the other hand, the correlation and significance of variables in the regression analysis are frequently low in other studies Barendrecht et al. [2021]; Lindell and Hwang [2008]; Grothmann and Reusswig [2006],

which is more aligned with the results of Study 1. According to Raaijmakers et al. [2008], preparedness does not only indicate the preparatory measures people take but also the possibility of recovery afterward. Lindenschmidt et al. [2018] agree with this, and they state that experience influences the preparatory and the recovery actions. However, the questionnaire used for Study 1 did not included questions regarding recovery actions.

Furthermore, Model 10, see Figure 5.8, showed a relation between experience elsewhere and awareness at a 10% level, which also partly indicates the connection between flood experience and risk perception. This result is confirmed by Lindell and Hwang [2008] who concluded that awareness rises together with flood experience. Bradford et al. [2012] agrees with the relationship between people's experience and awareness. However, they indicated that demographic factors also contribute to awareness. Study 1 does not correlate with the latter statements because no relation was found with age or gender. However, the influence of location was somehow present in Model 10 because the floods in Limburg influenced people's need for more information and education. Hence a significant relation with the variable *influence limburg*. According to Lechowska [2018] people's risk awareness is influenced when people know they live in a high flood risk area, which could explain the significant relation between the floods in Limburg and the need for information. Also, Shen [2009] explains that access to information significantly affects people's awareness in flood-risk areas. This statement is confirmed in Model 10.

6.1.2 The relation between location and risk perception

We investigated the effect of people's location on their risk perception by testing H2, whereby we found evidence that people from Limburg exhibit a higher level of risk than those from Zeeland. A similar result was found in the study of Fuchs et al. [2017], who proved that people's location has a significant impact on their risk perception, whereby especially people from risk areas perceived a higher risk perception. Also, Duží et al. [2017]; Brilly and Polic [2005]; Heitz et al. [2009] state that risk perception is associated with living in risk areas. Furthermore, Model 2, see Figure 5.4, showed that the people from Limburg are significantly more worried about flood risks than those from Zeeland. This outcome was expected because of the floods in Limburg in July 2021. Also, Grothmann and Patt [2005] explain this relationship as their study proves that the more recent the past event, the more risk perception is heightened, which is also confirmed by Comănescu and Nedelea [2016] who explain that risk perception changes over time. The interview with Ijff [2022] confirmed this statement, as he said that flood risk perception is time-related.

Also, Biernacki et al. [2009] and Bosoni et al. [2021] explain that even in high-risk areas, the level of worry decrease when no floods have occurred in the past years. Furthermore, Raaijmakers et al. [2008] proved that people's risk perception depends on the expected severity of the flood in certain areas. In Limburg, people might expect future floods to be as severe as the floods were in 2021 because people usually assume future floods to have the same impact as the previous events [Howe, 2011]. Therefore people's current risk perception might also be higher in Limburg than in Zeeland. Schaick [2022] described another reason for this difference: the heavy rainfalls, which caused the floods in Limburg, would not have caused that level of severity in Zeeland. In Zeeland, the danger comes from the sea, so Zeeuwse people might not be that triggered by the floods in Limburg.

6.1.3 The relation between age and gender, and risk perception

The correlation analysis of all three risk perception factors showed no sign of relation with age or gender. The regression analysis confirmed this insight because, in Model 2 (Figure 5.4, Model 6 (Figure 5.6, and Model 10 (Figure 5.8, no significant relation was found between any of the dependent variables and age or gender. Therefore, H3 was rejected, which means that based on our results, it cannot be assumed that older people are more worried than younger people and that women are more worried than men. However, this was somewhat unexpected because, in Section 3, different scholars explain several reasons how age and gender influence people's risk perception, such as [Zabini et al., 2021; Schneiderbauer et al., 2021; Rana et al., 2020]. Moreover, Adelekan and Asiyanbi [2016] explain that people become more risk-averse when they get older, which was in line with Kellens et al. [2011]; Liu et al. [2018], and this is also confirmed in a more recent study by [Eryılmaz Türkkan and Hırca, 2021]. However, many studies indicate no significant relationship between age and risk perception [Qasim et al., 2015; Armas et al., 2015]. Another possible reason for a relationship between age and risk perception was proved by [Harlan et al., 2019], who explained that older people are more likely to live in unprotected, flood-prone areas. However, it could be that this does not account for the respondents of the questionnaire because many people of different ages might live together in one location.

In contrast to the results of this study, in literature, it is often implied that women tend to worry about risks more than men [Poortinga et al., 2011; Brown et al., 2021]. However, other researchers such as Bradford et al. [2012] have shown no significant relationship between gender and risk perception. Moreover, Bee [2016] states it is rather sexist to base risk perception on gender instead of solely basing it on knowledge and power, which according to the author, includes the constant negotiation of resources, responsibilities, and knowledge. Based on the somewhat divergent outcomes, in other studies, regarding the relationship between these demographic factors and risk perception, this study's insignificant relation is considered rather unexpected yet ordinary.

6.1.4 The relation between flood information and risk perception

According to Lechowska [2018] people's awareness is influenced when people know they live in flood-prone areas. Therefore, Raaijmakers et al. [2008]; King [2000] find it evident that societal awareness can be increased by sharing information and increasing education. This statement is confirmed by Shen [2009] who explains that when there is little information provided, people's risk awareness decreases. Also, Oubennaceur et al. [2022] explain that providing the correct flood information can positively influence people's awareness and preparedness. Amongst the respondents of Study 1, 68% is aware of floods, yet the need for flood information was the most significant variable. Thus, information might not be needed to influence people's awareness but to increase their preparedness and lower people's worry. Zabini et al. [2021] emphasize this as they explain that when people are aware it does not mean that they are also prepared.

The results of Study 1 showed a significant negative relation between people who want more information regarding flood risks and the number of prepared people. A similar result was found by Botzen et al. [2009], who discovered a positive relationship between people's knowledge about floods and their action to preventive measures. Many other studies plead a positive relationship between flood knowledge and preparedness [Tarchiani et al., 2020; Shrestha et al., 2021; Samaddar et al., 2012]. We found one study whereby no relation was found between people's knowledge and their preparedness [Siegrist and Gutscher, 2008]. Also, additional fascinating

insight was found by Konieczny et al. [2020] who discovered that the priority of the level of preparedness amongst people decrease when there is a time of no flooding. However, many studies have demonstrated that knowledge affects perceptions of risk. For instance, Biernacki et al. [2009] explain that people need the knowledge to create a perception about flood risk, which is gained from previously obtained information. Also, Bubeck et al. [2012] state that people's preventive actions are influenced by flood information. People who received practical information about flood protection took more mitigation measures than the people who did not acquire that information. The studies of Raaijmakers et al. [2008]; Botzen et al. [2009]; Burningham et al. [2008] anticipate this because they discovered that flood-preparedness is low among those unfamiliar with the causes of floods.

All these studies correspond with the results of Study 1. Therefore, we argue that increasing food information would increase the number of prepared people in the Netherlands. Besides, we believe that the Dutch government might focus too much on improving people's awareness while the focus should be on providing information about preparedness. For example, in the BWH, one of the focus points is still to increase people's awareness because they believe that being prepared starts with being aware Rijksoverheid [2022b], so it seems as if the Dutch government underestimates the level of awareness of the Dutch citizens. Moreover, all the experts agreed that the focus is on creating awareness, not preparedness, and agreed that this should shift. However, they also explained that providing information and communicating about flood risks can be challenging because of different knowledge levels. Also, cultural anthropological aspects play a role, it is often unclear if the receiver wants to receive the information. The Dutch government provided information, but this mostly ended up in the garbage. Nevertheless, all experts agreed that at least the basic flood information about the preparation steps, such as turning the gas, ensuring enough water, and keeping warm, must be well-known amongst the Dutch citizens [Provoost, 2022; Schaick, 2022; Ijff, 2022; Taal, 2022; Eijkelenberg, 2022].

6.1.5 Measures

In Study 1, it is quite clear that people want the government to pay more attention to *no development in unsafe areas*, *evacuation plans*, and *elevated refuge*. The latter two correspond with the need for information to improve the preparedness of the Dutch citizens. This is an expected outcome following the significant variable *flood information*. Also, Keeney [2004] explains that to be prepared for disaster events, a developed evacuation system is needed to limit the consequences. Furthermore, the preparedness can be strengthened by improving education about floods.

[Vousdoukas et al., 2020] explain that flood risk measures should be implemented structurally, which means that it is essential to identify priority regions. This is in line with Study 1, whereby 80% of the people stated that specific areas need more flood protection than others. Also, [Swain et al., 2020; Johnson et al., 2020] agree with this statement because both papers explain that high-risk zones need targeted policies to prevent future flooding. In the interview with Ijff [2022], he said that people are currently working on self-help plans to influence their risk, and according to [Netzel et al., 2021], personal risk is a crucial factor for flood risk perceptions.

6.1.6 Evacuation and warning systems

The results showed that amongst the respondents, not everyone is familiar with the currently used warning systems. Even though the Dutch government has been

using NL-Alert since 2012, the connection between flood warning and NL-Alert is unclear. This discovery contrasts with the study of Korf et al. [2021] who indicate that most Dutch citizens are content with NL-Alert as a warning system. Moreover, the government advocates using NL-Alert because they can include a description of actions people should follow in response to an emergency. In contrast, the siren cannot do this, which the government uses to emphasize their preference. According to Gutteling et al. [2014], a less recent study, people graded NL-Alert with a 6.4/10, which is only slightly more than sufficient. Furthermore, they indicated some uncertainties amongst the Dutch safety regions whether NL-Alert was used as means of communication or as an alarm device. So, after two years, the use of NL-Alert was not clear to our safety regions, making it more understandable that people are also clueless. However, a more recent study Bos and Konings [2020] showed that 47% of the respondents indicate they want an NL-Alert text in case of a flood. During the interview Schaick [2022] explained that she thought the result of Study 1, whereby 70% stated not to know the warning systems, could be explained by personal experience. It could be that people have never experienced receiving an NL-Alert in case of a flood because they never experienced a flood. This might make sense because only 1% experienced a flood at Scheldt, and only 26% experienced a flood elsewhere. Also, Provoost [2022] indicated that experience influences the knowledge regarding warning systems. However, we believe the warning systems should still be known as it is part of preparing for a flood event. Regardless, both experts explained that the warning systems are pretty under control in Zeeland. Waterschap provides the local news channels with the needed information, and if it reaches a severe level, the local municipalities take over and control the evacuations. In Limburg, the warning systems are different, so based on the interviews, the warning systems are location-specific, and per location, this should be communicated with the citizens. However, we notice that the experts stated that the warning systems are known amongst the locals, which contrasts with the study's results. Further research regarding the knowledge of warning systems per region is needed to investigate this difference.

Another interesting study considering the use of NL-Alert is the study of [Flycatcher, 2021], whereby they analyzed what the residents thought of the state of affairs during the floods in July 2021. They surveyed 758 residents in the flooded areas in Limburg. They discovered that only 40% received an NL-Alert, and those people graded it with a 6.2/10, which is almost the same as Gutteling et al. [2014] discovered. Also, 43% of the people did not know an NL-Alert was sent out. Besides, the needed information came from neighbors, friends, or family. One of the primary outcomes was the need to improve communication Flycatcher [2021], which is in line with the outcome of the interviews. Also, respondents explained that the information that was provided came too late. People want more information to be more prepared the next time, which is in line with Study 1.

6.1.7 The role of the government

Study 1 showed that the Dutch citizens trust their government and feel represented by the Rijkswaterstaat. Furthermore, 45% feel that it is a shared responsibility between them and the government to create a safe feeling regarding flood risks. However, still, 54% feels that it is the government that should take full responsibility, which is in line with the study of [Terpstra and Gutteling, 2008] who also proved that most people feel that it is the government who should protect its citizens. However, in the same study, half of the people thought disaster preparedness was a shared responsibility. According to Hegger et al. [2017] it is typically dutch to collectively deal with flood risks, yet the government often takes the lead, which corresponds with the statement of [Taal, 2022]. Also, according to Dutch law, the national government is responsible for keeping the country habitable and for protecting and

improving the environment [Suykens et al., 2019]. Essentially, this obligation is incorporated into the Second Delta Act, including a safety provision for each Dutch citizen. The safety norm is expressed as a probability of being killed by a flood of not more than 1/100.000 per year, explained in Section 3 by, for instance, [Deltafact, 2019]. Even though Dutch citizens have a formal responsibility of mitigating floods on their properties, legal responsibility is purely limited to paying taxes [Bergsma et al., 2012]. However, it appears from the results of Bergsma et al. [2012]; Snel et al. [2022] that the citizens wish to be more informed about how to be prepared which increase their responsibility. This is also in line with the study of Tullos [2018] who discovered that Dutch citizens consider flood risks to be controllable. All these findings are in line with Study 1, which showed that people want flood information and want to be more involved in the decision-making process. However, according to Eijkelenberg [2022], we must remember that decisions regarding flood risk management plans should not become democratic. The hierarchy within this field is needed in times of emergencies when quick and crucial decisions have to be made. We agree that experts should make a final decision during floods. However, the increase in participation focuses more on local plans, not on creating a democratic atmosphere.

6.2 STUDY 2

The main discussion of Study 2 is about the low number of significant variables because the reasons behind specific output, similar to Study 1, are discussed in Section 6.1. Furthermore, the outputs that differ from Study 1 will be discussed in Section 6.3. Therefore, this Section will focus on discussing the possible reasons that might have affected the low number of significant variables.

In this research, the data used for Study 2 was not primarily because the researchers of this study did not directly collect it. The data was collected by other researchers 15 years ago and has been made available for this study's longitudinal comparison. According to MacKenzie et al. [2017]; Moritz et al. [2008] it is rather tricky to deal with historical data. Nevertheless, several quantitative modeling techniques could cope with potential problems. These studies refer mainly to problems related to imperfect detection or false presence. However, this is inevitable when using a survey method, which is considered the be a limitation. Another study that emphasizes the difficulties of using nonprimary data is Squitieri and Chung [2020] who explains it is important for researchers to know how and why the data was collected, as well as what the specific characteristics of each data variable are. This will enable scholars to estimate bias, identify additional sources for data that may be needed, and determine an appropriate statistical analysis method. For the purpose of this research, we collaborated with the primary researchers of Study 2, who explained how and why the data was collected. Nevertheless, we could have interpreted specific characteristics or output subjectively different than Study 2 initially did, which could have influenced the significance level.

Furthermore, Tingley and Beissinger [2009] describe that comparing old and new data is challenging because of the changing external factors such as environmental modifications. For instance, we discovered that between the period of Study 1 and Study 2, the warning systems in the Netherlands have entirely changed. This might be an external factor which Tingley and Beissinger [2009] pointed out as influencing a comparative analysis. Furthermore, they also explained that comparing a survey is more difficult if both surveys are not conducted in the exact locations within the same period. This is the case for this study. Also, Hilden [1981] adds that a comparison between studies from different periods frequently suffers from survey-specific dissimilarities in methodology, observer skill, weather, effort, and other related fac-

tors.

These mentioned factors could have influenced the low number of significant variables within the regressions of Study 2. Also, the possibility of inherent bias might have influenced the output of Study 2. Therefore, we should also consider this for the comparative analysis discussion in the following Section.

6.3 COMPARISON STUDY 1 AND STUDY 2

6.3.1 Low level of worry

The statistics of both studies showed that the worry level is below 3%, which contrasts with our expectations. For Study 1, we explained that we thought it would be higher because of the recent flood event in Limburg, which influences people's risk perceptions [Grothmann and Patt, 2005]. Therefore, it does makes sense that the worry level in Limburg is higher than in Zeeland. Also, flood risk perception is time-related; it fades over a period [Bosoni et al., 2021; Ijff, 2022]. Consequently, the low worry level of Study 2 is more understandable because the flood in 1953 was 54 years ago, and the trigger event, Katrina, was not a direct experience for people around the Scheldt area. Furthermore, the low average worry level in Study 1 contrasts with the expectations of [Provoost, 2022]. However, it did not necessarily surprise him because especially people from Zeeland have learned how to cope with water by having dealt with it their entire lives, which is also proven by [Burningham et al., 2008]. Also, Schaick [2022] added that it might be low because people notice the actions taken by the government, such as maintaining dykes. However, this is slightly in contrast with the results of Study 1 and Study 2, which respectively show that 70% think that the government is not doing enough regarding flood risk management and that only 37% believed that the flood policy was sufficient. Another explanation given by Schaick [2022] for the low level of worry, especially in Zeeland, is that the effect of the heavy rainfalls, which caused the floods in Limburg, would have had different impacts in Zeeland. Rainfall is not as threatening for Zeeland as for Limburg. In Zeeland, the danger comes from the sea, which creates their water culture [Eijkelenberg, 2022].

6.3.2 Trust in the government

Another reason for the low average of worry amongst the respondents of both studies might be the high level of trust in the government. Both studies indicate that they trust the Dutch government, and according to CBS [2022] the trust in the Dutch government only increases. This is aligned with Taal [2022] because he was also not surprised about the low level of worry amongst the responders. With his experience at Rijkswaterstaat, he knows that people feel represented by Rijkswaterstaat and that, indeed built-up trust plays a role in water safety.

Risk perception is strongly influenced by trust in authorities to manage hazards, especially when personal knowledge about the hazards is lacking [Siegrist and Cvetkovich, 2000]. Citizens often misjudge uncertainty and risk due to inadequate knowledge [Houston et al., 2019]. Trust reduces the complexity and burden of evaluating risk by relying on the opinions and judgment of trusted experts instead of independently evaluating hazards. The perception of flood risk and the associated sense of dread are reduced when trust is established. Consequently, citizens delegate responsibility for the construction and monitoring of flood control systems to risk managers [Terpstra, 2011; Viglione et al., 2014].

However, according to Di Baldassarre et al. [2013] too much trust in the government and flood protection has its downsides. Moreover, too much trust in the protection and only remembering flood events for a short period will result in underperceiving flood risks. In contrast, a lack of trust and flood memory that sticks will result in an overestimated risks. This negative association between trust in flood protections and risk perceptions is confirmed by Grothmann and Reusswig [2006], who also adds that it is negatively correlated with preparedness. This is in line with the results as in both studies, trust is high, but preparedness is low. However, Terpstra [2011] explains that trust is also built on experience, which means that observing the performance of flood defenses may give individuals insight into the quality of flood risk management. They may adjust their trust in flood controls and risk perception based on observations, which is also stated by [Voogd et al., 2021]. As mentioned, Schaick [2022] confirms this by explaining that a low level of worry might be influenced by the noticeable actions taken by the involved parties.

However, Ijff [2022] indicated that trust is not the only possible explanation for a low level of worry. Since water boards in Limburg exist for a shorter time than in Zeeland, the built-up trust could be much more robust in Zeeland. Also, Limburger's people do not have a water culture: "the citizens look a bit anxious to the Meuse, and the Meuse looks a bit anxious at the citizens. And that is all". Because of the difference in culture and difference in water, the level of worry has many external factors. In contrast, Eijkelenberg [2022] explained that Limburgse people have a water culture, yet it differs much from the one in Zeeland because of the different types of water.

Moreover, culture is always related to water, especially near rivers. We agree that there must be a water culture in Limburg, yet understand that it differs from the culture in Zeeland. Further research is needed to analyze other reasons behind the low worry level and the difference in water culture between Zeeland and Limburg.

6.3.3 Involvement of citizens

The results showed that citizens want to be more involved in flood risk management plans, however, to a certain extent. Including citizens is quite a challenge, according to Terpstra and Gutteling [2008], because it is difficult to discuss topics while people's knowledge levels are not aligned. This is confirmed in the studies of [Marchand et al., 2008; Krywkow and Speil, 2007; Siebenhüner and Barth, 2005], who explained that especially the different knowledge levels, lack of willingness to participate, or lack of trust in the process play a crucial role. However, Kane and Bishop [2002] mention it would be a failure to underestimate the power of public consultations. Several recent studies agree with this statement, such as Edelenbos et al. [2017] who explain that effective flood risk management plans result from increasing the efforts of local stakeholders and their interactions with governmental actors. Also, Wolff [2021] emphasized the importance of flood risk management to becoming a multi-stakeholder problem. Furthermore, they suggest future research to analyze the impact of transparency. Rana et al. [2020] conducted a study whereby they examined the impact of transparency, concluding that both parties should be transparent for optimal results and so that all involved stakeholders understand the information that is provided. This is in line with the results whereby the respondents that the communication should become more transparent.

The difficulty of including people in decision-making processes was also discussed during the interviews. Provoost [2022]; Schaick [2022]; Taal [2022] indicated that, for instance, explaining how to work with the new risk standard can be complicated. It was discussed that communicating with citizens can be challenging also because authorities do not know to what extent people want to be included. This

also accounts for proving information. Does the receiver always want to receive information? Based on their experiences, two interviewees explained that sometimes people indicate that they did not receive information. However, they probably did, but they did not process this. Besides, Taal [2022] emphasized that we should ask ourselves: what can we expect from the government? Also, Schaick [2022] explained that involving the citizens is time-consuming. These are all factors that must be considered when increasing citizens' involvement in flood risk management plans, which might have slowed down this process so far. Yet, we argue that people's knowledge level might be underestimated; however, future research on this aspect is needed to understand the knowledge level of Dutch citizens fully.

Also, the interviews with Provoost [2022]; Schaick [2022] gave us insights into citizens' current participation. According to the interviewees, there has been significant progress in including citizens in flood-related decision-making processes. The local governmental organizations in Zeeland try to be more transparent and increase the involvement of the citizens by, for example, organizing information evenings that everyone can join to share their perceptions. An increase in transparency will positively influence the relationship between the government and its citizens Song and Lee [2016], so that, for instance, the percentage of people that thought the government was not doing enough might decrease.

Furthermore, Ijff [2022] also explained that the involvement of the citizens in flood risk management plans is increasing. In Meerssen, for example, locals participate in drafting self-help plans, whereby communication between the municipality and the citizens increases. However, an increase in communication between municipality and citizens results in additional problems that must be solved before another flood event. These problems arise due to the security region's ignorance of the agreements between citizens and the municipality. If the security region needs to get involved, they must be updated before different authorities act according to different plans. Hence, the question remains how, when and who keeps them updated about the local plans.

The most important aspect regarding the involvement of citizens is that all interviewees agreed that participation is essential regarding flood risk management. However, it is best to solely involve people in local flood plans because people probably have the biggest impact and knowledge regarding local aspects. This is fairly consistent with the results as the responders indicated that they did not want total responsibility but do want to be heard as they think their input is valuable from the flood risk management plans. Many studies mentioned in Section 3 also state the importance of including people in flood risk plans, such as [Houston et al., 2019; Oubennaceur et al., 2022; Rana et al., 2020].

6.3.4 Difference in preparedness

The percentage of prepared people in Study 1 was higher than in Study 2. However, the percentage remains relatively small. The discussion about people's preparedness can be found in Section 6.1.

6.3.5 Difference in awareness

The difference in awareness might be caused by the floods in Limburg in 2021 because these floods triggered people's risk perception. Also, Study 2 was done after Katrina, meaning no recent event had occurred in the Netherlands, which has a different influence on risk perception [Bosoni et al., 2021; Raaijmakers et al., 2008]. Moreover, personal experience, or knowing people who experienced a flood,

impacts people's risk perception Green et al. [1991]; Halpern-Felsher et al. [2001]; Scolobig et al. [2012]. However, the percentage of people who experienced a flood was higher in Study 2, but the percentage of people who know someone that experienced a flood was higher in Study 1. Therefore, based on the results, flood experience might not have the most significant effect on the difference in awareness because no variable was significant at a 5% level or less in Model 10 5.8 or Model 15 B.30.

6.3.6 Different wanted flood measure

We noticed that the number of people who want more attention to spatial measures is significantly higher in Study 1 than in Study 2. The low level of wanted attention in Study 2 was, according to Provoost [2022]; Schaick [2022], because of the strong resistance against depoldering. Primarily farmers and others are against giving up their private land. Therefore, Provoost [2022] and Schaick [2022] find this outcome surprising, particularly as 50% of the respondents are from Zeeland. In Limburg, spatial measures are more likely related to RFR, and according to Ijff [2022] suitable in Limburg as a flood measure. However, he also stated that people have been working for over ten years to implement this, so more action should be taken. According to Thaler et al. [2020] the Netherlands scores low in terms of procedural justice considering compensation for spatial flood risk management. Even though the decision criteria are transparent, the water authority makes the final decisions regarding compensations. There is almost no genuine opportunity for people to appeal such a compensation decision that affects them.

Also, during the interview with Taal [2022] he explained that the difference between depoldering and RFR should be considered. Depoldering is not a flood risk measure, as it could be solely to restore nature, while RFR is mainly used for flood risk defense purposes. Furthermore, he believed that the question asked was too broad for responders to interpret, which we find a reasonable argument. We also think that the way the question was asked might have influenced the outputs because people might not know what spatial measures are and, therefore, misinterpret the question. However, this is somewhat speculative and could only be checked by contacting some respondents.

6.4 METHODOLOGICAL DISCUSSION

6.4.1 Survey method

The most challenging part of using a survey method is getting respondents. The process of recruiting people is time-consuming and requires the full attention of the researchers during the period that the questionnaire is online. Also, according to Kellens et al. [2011], nonresponse can cause bias. Those who choose not to complete the questionnaire may have informative reasons for doing so. Additionally, the online aspects created a distance between respondents and researchers, which would have been different if more door-to-door questionnaires had been conducted. Face-to-face contact creates a better understanding for both the interviewer and interviewee [Barriball and While, 1999]. However, there has been some communication with the respondents, whereby several feedback points were addressed; some questions contained multiple questions in one, and for some respondents, this was not very clear. Furthermore, using Qualtrics does not work flawlessly on mobile phones, and it works better on a computer. Lastly, the questionnaire was too long. For future research with a survey method, it is highly recommended to shorten an

online questionnaire, to lower the number of people that do not finish the questions.

Even though the basics of Qualtrics are easy to use, this program also caused some limitations for the data analysis. First, it appeared that respondents did not have to fill in a question to continue to the following questions, which resulted in randomly missing data values. Also, some questions, specifically those related to damage caused by flood experience, were only asked of the first five respondents. We have no explanation why this happened, but it resulted in the elimination of the damage caused by floods aspects in the analysis, which is a limitation since personal damage due to floods influence people's risk perception [Green et al., 1991; Miceli et al., 2008; Mileti and O'Brien, 1992; Scolobig et al., 2012; Zabini et al., 2021]. So, when using Qualtrics, it is recommended to engage an expert in installing the settings in Qualtrics. Nevertheless, the use of Qualtrics created an option to reach many people in only a short period easily, and it is coherent with the requirements of the General Data Protection Regulation drafted by the European Union. Also, Qualtrics has an automatic transfer to SPSS, which saves time regarding the data preparation.

Therefore, the survey method is still endorsed, and using an online self-administered questionnaire is a valid method to reach many different people in a short time. For example, the variable age showed that the sample consisted of a representative group because of the high standard deviation. Furthermore, the use of 50% closed questions and 50% open questions resulted in many insights in addition to the answers to the closed questions because, for example, people were given the option to explain their chosen answer for a closed question. Therefore, this balance between open and closed questions is highly recommended when using a survey method.

However, there are some questions we would have asked differently now that we have analyzed the data. First, the question related to people's worry regarding flood risks would be changed. In the questionnaire, people could choose between level 1 (not worried) to level 5 (very worried). However, in hindsight, we would change the answer options to a simple yes or no. Because based on the insights of the data analysis, it might be possible to combine the three factors in future research if all questions asked are binary. The variables of preparedness and awareness were binary; if worry had been a binary variable as well, then in SPSS, more efficiently, a combination of the three variables could have been made to create one variable called *risk perception*. Regardless, the models related to the three risk perception factors (worry, preparedness, and awareness) still provided information regarding people's flood risk perceptions yet divided them into categories.

The second change would be for the question related to the level of attention people want the government to give to specific flood risk measures. In Study 1, people were not restricted and could indicate that they wanted a high level of attention for every flood measure; therefore, for almost every measure, the wanted attention was higher than the perceived attention. In contrast, in Study 2, people were restricted in indicating which measures should obtain the highest level of attention. Therefore, according to the researchers, this resulted in a more thoughtful process about the priority allocated to the measures. So, for future studies, a restriction would be installed in Qualtrics, if possible, to create a more reflective process.

Lastly, the cross-sectional study was added after it turned out that people from Limburg were also interested in participating in this study. The initial study was focused on people from Zeeland, and therefore the questions regarding people's flood experiences were focused on the flood at the Scheldt or elsewhere. However, after the questionnaire was online and people from Limburg participated, and the cross-sectional comparison was added to the study, it would have made more sense to change the flood experience questions. The questions could have been related to

either flood experience at Scheldt or flood experience in Limburg, so the questions were more connected to both target groups. However, we obtained the same information via the open question in the questionnaire used for Study 1, where people could indicate the specific location they experienced the flood, if elsewhere than the Scheldt. Regardless, we believe it would have been more targeted if we had changed the question.

6.4.2 Cross-sectional comparison

Within Study 1, we performed a cross-sectional comparison to analyze the differences in flood risk perceptions between people from Zeeland and Limburg. As mentioned, the cross-sectional comparison was included after discovering the willingness of people from Limburg to participate in the online questionnaire. The impact of the cross-sectional comparison might have been more significant if the questions had been more targeted at both Zeeland and Limburg. For example, the questions related to flood experience. Still, the questionnaire obtained the needed information from the open questions, yet it is argued that people might feel more included when the questions are more targeted.

For future research, cross-sectional is recommended when analyzing the influence of a specific aspect. For instance, like in this research, the effect of people's location on their risk perceptions. The influence of a specific location, such as Zeeland or Limburg, on people's risk perceptions. Cross-sectional analysis is a helpful tool to dive deeper into one specific aspect and analyze the influence of that aspect. Based on the study's insights, additional elements regarding risk perceptions can be analyzed using a cross-sectional analysis. For example, based on the interviews, it would be interesting to dive deeper into the effect of the water culture on people's risk perception between Limburg and Zeeland.

6.4.3 Longitudinal comparison

Also, a longitudinal comparison between Study 1 and Study 2 was performed. The lesson learned from performing this comparative analysis is that restrictions must be identified and considered. In this study, the longitudinal comparison is not a one-on-one comparison because external factors such as policies and climate change can also influence people's risk perceptions. Furthermore, the survey was conducted over a different period and amongst different respondents. However, these restrictions do not mean that a longitudinal comparison is less valuable. Quite the opposite. However, scholars must be aware of the restrictions when drawing conclusions based on the comparative analysis.

The longitudinal comparison demonstrated the value of analyzing the results of questionnaires that have been conducted with a time difference of 15 years. Moreover, it gave insights into social similarities even though technical aspects of flood risk management have changed substantially. With this, we mean that in both Study 1 and Study 2, respondents indicate that, for example, they want to be more involved in flood risk management plans or that they want to improve transparency and communication, and that in both questionnaires, it appears there is trust in the government. These are insights that were obtained by performing a longitudinal comparative analysis. Another lesson learned from performing this analysis when investigating people's risk perceptions is always to perform the analysis after a trigger event because, according to many scholars and interviewees, people's flood risk perceptions are fading over time Bosoni et al. [2021]; Raaijmakers et al. [2008]; Ijff [2022]. Therefore, analyzing the people's risk perceptions using a trigger event is more insightful and increases the validation of the longitudinal comparison.

6.4.4 Validation interviews

The effect of the validation interviews can be nuanced by the interviewees' perceptions. The people with whom we discussed the interpretations of the results and several outcomes of this study are also primarily people within the target groups. This is because four interviewees live in Zeeland or Limburg, so they likely also have flood risk perceptions besides their professional expertise. However, the interviewees are key persons in this field, and with many years of work experience, we expect the bias to be limited. Nevertheless, the bias must be considered. During the interview Taal [2022] mentioned this by saying that his answers would differ when answering as a professional or citizen. So, the experts are also aware of this matter. Regardless of the nuance, interviewing experts or professionals is a valuable tool for validation because it provides insights into specific interpretations of the results, which is very challenging to find in literature.

7 CONCLUSION AND RECOMMENDATIONS

This section presents the conclusion to the research and addresses the research questions. First, a summary of the research is given, followed by the answer to the main research question. Furthermore, the situation assessment is described, following the policy recommendations. Also, the limitations are discussed, and the impact of the limitations on the conclusions is mentioned. Lastly, ideas for future work and proposed, including method implications.

7.1 SUMMARY

As a low-lying country, the Netherlands is vulnerable to flooding. With rising sea levels due to climate change and an increase in population, GDP, and economic value, this vulnerability will increase even more. Therefore, the Dutch government implemented the Delta Plan, which includes all domestic laws and plans for flood resilience. The Netherlands is surrounded by water whereby three large European rivers discharge in the North Sea, the Rhine, the Meuse, and the Scheldt. The two major flood events in 1953 at Scheldt and in 2021 in Limburg emphasize the high-risk areas and the constant risks that Dutch citizens must deal with. In 1953, a storm caused a major flood on the west coast of the Netherlands, with enormous financial consequences. However, even worse, this traumatic event emotionally impacted the residents, their friends, and their family. The Dutch government acted to prevent a recurrence of such a disaster by introducing the Delta Committee only 17 days after the event in 1953. However, in July 2021, a more severe flood, in terms of financial impact, occurred in Limburg. Heavy rainfall and high water caused an enormous volume of water to overflow the river banks.

Scholars analyzed people's perceptions regarding flood risks and management at the Scheldt in 2007 (Study 2). These studies were conducted after Katrina, the hurricane which caused severe floods in New Orleans in 2005. People's flood risk perceptions need a trigger event to be activated because most memories regarding such a natural hazard disappear within seven years after the event. So, the flood in 1953 could not be considered a trigger event to analyze people's risk perceptions; however, Katrina was. These scholars emphasized the impact of including people's perceptions in the decision-making process. They used a survey method and workshops to collect the data of the 243 participants, and the results of these studies were used for the longitudinal comparison analysis in this research.

The floods in Limburg in 2021 created another opportunity to analyze people's perceptions regarding flood risks and management. Both people from Zeeland and Limburg are included in this study (Study 1). A survey method was also used whereby an online self-administered questionnaire in Qualtrics was sent out, resulting in 237 responses. Initially, we focused on people from Zeeland; however, the willingness to participate amongst people from Limburg was high due to the recent flood experience in 2021. Consequently, we expanded our study area, included a cross-sectional analysis, and analyzed the effect of people's location on their flood risk perceptions. Also, a longitudinal comparison analysis compared Study 1 with Study 2 to analyze the difference and similarities regarding people's flood risk per-

ceptions after 15 years. The closed questions were analyzed using regression models in SPSS, and the open questions were analyzed using text analysis. Furthermore, the interpretations were validated by five interviews.

Floods are rare occurrences; however, they are incredibly impactful because of the social and economic consequences. According to the literature, risk perceptions consist of three factors: worry, preparedness, and awareness. The floods in 2021 in Limburg triggered people's risk perceptions, whereby people's awareness and worry regarding flood risks were activated. Interestingly, people's preparedness was relatively low; only 23% of the respondents stated they are prepared for future flood events. However, a high percentage (73%) of the people want more information regarding flood risks. Thus, people indicate they need more information about what to do and what not to do during a flood to be better prepared. This is in line with the willingness to be more prepared, which was already discovered in Study 2. Yet, this still exists today, which means that the information provided regarding preparation is still not sufficiently improved; therefore, people are still not prepared.

The results of this study's cross-sectional and longitudinal comparison analyses provide us with the information we need to answer the research question. Therefore, we first return to the research question, after which it will be addressed:

Following the floods in Limburg in 2021, what are the differences between the perception of Limburg respondents and the perception of Zeeland respondents regarding flood risks and management, and how do these compare with the perceptions of the inhabitants of the Scheldt Estuary in Zeeland 15 years ago?

The research question consists of two parts, which we will answer in turn. The direct influence of people's locations on their flood risk perception is that people from Limburg are more worried about flood risks than people from Zeeland. Furthermore, Limburg indirectly influences people's preparedness and awareness because the floods in Limburg in 2021 influenced people's need for information, which is indicated by a significant relation between *flood information* and *awareness and preparedness* in the regression analysis. This means that the difference between the respondents from Limburg and Zeeland is that the respondents from Limburg exhibit higher levels of perceived risk than those from Zeeland.

The second part of the research question compares the studies conducted 15 years ago and this study. This longitudinal comparison is not a one-on-one comparison because of the different external factors for both studies. However, keeping the comparative restrictions into account, the results showed that the average worry level in the studies is the same and is relatively low. This means that people are still not that worried about floods, which is not entirely expected considering the recent floods in Limburg in 2021. However, the studies also indicate that the people trust the Dutch government, which could be a reason for the relatively low average worry level, which the interviewees also verified. However, according to one of the interviewees, the low worry level could also be based on the water culture, which is not highly present in Limburg. Alternatively, because the danger in Zeeland comes from the sea, the floods in Limburg did not trigger the level of worry of people from Zeeland extensively. Consequently, the water culture in Zeeland and Limburg differ. Furthermore, the awareness is relatively higher in Study 1, which is probably influenced by the floods in Limburg in 2021, as this was the trigger event for this research. Also, the preparedness in both studies is relatively low, while the percentage of people that want to receive flood preparation information is relatively high, as mentioned above.

The underlying statement in the results of both studies is the same. Dutch citizens believe that the government works to create a flood-safe country, and the people are satisfied with the divided influence the involved parties have. However, people would like the involved parties to be more transparent, to be more included in flood risk management plans, and receive more information to increase preparation for flood events. Therefore, it is expected that if more information is provided and the communication becomes more transparent, the people's preparedness will increase.

7.2 POLICY IMPLICATIONS

7.2.1 Situation assessment

The need to understand social aspects of flood risk management plans has been known for years; however, the importance has become progressively stronger. Consequently, flood risk management in the Netherlands is already shifting toward more citizen participation as it becomes mandatory by law to do so. Nevertheless, according to the experts, several practical matters still influence the shift toward a higher level of participation of the citizens. First, people believe that water safety is a shared responsibility. Yet, the government should take the lead, not the citizens, which according to the experts, is typical Dutch. However, citizens want to be more involved and, at the same time, not burdened with information. The latter remains a challenging aspect because, based on the results, people do wish to receive more information about how to prepare for future flood events. Nonetheless, the experts stated that based on their experience, the government provides relatively much information. Still, citizens do not process this, as they might be occupied with other matters.

Also, citizens trust the Dutch government, whereby the experts explain that the provided information is not seen as necessary because the government will solve matters. Nevertheless, trust is not the only aspect that influences this. Water culture also plays a role, which appears to differ in Zeeland and Limburg. In Zeeland, the water culture is high, meaning that people know how to live with the risks of a deluge and trust the government. Also, a relatively long flood-less period results in a low level of worry. Furthermore, the floods in Limburg were caused by heavy rainfalls, which would not be as impactful in Zeeland. Therefore, it probably did not affect the worry of people from Zeeland to a great extent.

In Limburg, water culture is less present or at least different from the water culture in Zeeland; however, people's risk perceptions have been triggered because of the floods in 2021. Therefore, the awareness is increased, but according to the aldermen of Meerssen, that is primarily time-related. So, regarding providing information, it is crucial to know that the information receiver wants to receive information. Also, providing the information is time-consuming, and information about awareness is more controllable than information about preparedness. However, according to the results, people want information about preparedness. Moreover, people also indicated they wanted more flood preparation information in the studies conducted 15 years ago. So, the desired and perceived information for flood preparation is not aligned.

Nevertheless, the interviewees explained that besides all the practical issues, the level of participation is increasing. Currently, in Limburg to a greater extent than in Zeeland. For example, in Meerssen, five groups have been formed to work on local self-help plans. The municipality works with a voluntary initiative Water-stop Nu to supervise the five groups and create specific action plans. This example shows the value of including people's local knowledge in flood risk management plans.

People's ability related to this topic is often underestimated. However, the local knowledge of where, for instance, the elderly life, who might need help during a flood, or what the fastest routes to the high places are, are all aspects that help create a solid self-help plan for the locals. However, communication remains one of the essential aspects when performing such collaborative projects. Based on the results and the interviews, it appears that in the Netherlands, more transparency is needed regarding communication. Yet, citizens have to question to what extent the government should be transparent because some flood-related issues or measures require a high technical knowledge level. Thus, information about these aspects could result in misunderstandings or uncertainty. However, an increase in transparent communication will most likely positively affect the process of the decision-making plans. Also, transparent communication between citizens and the Dutch government could have already entailed the need to shift from creating awareness to providing information about preparedness.

7.2.2 Policy recommendations

Risk perception consists of three factors: worry, preparedness, and awareness. As concluded, the level of worry is low, which was also low 15 years ago. The awareness has increased compared to the studies conducted 15 years ago, and the level of preparedness is still relatively low. Therefore, and based on the situation assessment, it is advised to provide more flood preparation information to increase the number of prepared people in the Netherlands. Accordingly, a plan should be drafted to provide general information regarding flood preparation. The general and fundamental aspects regarding flood risks and preparation are unclear, and people wish to receive more information about this. Besides, a plan should be created to provide detailed local flood preparation and evacuation plans. People should be included in developing and implementing these local plans because their local knowledge adds value. Including local citizens will also increase awareness, water culture, and communication lines between citizens and governmental organizations. The five groups in Meerssen provide an example of the effectiveness of including local knowledge and solid communication between citizens and municipalities. So, it is recommended to implement a policy that creates these two plans: 1) to provide general flood information so that the fundamental things to do in case of a flood are clear. Such as turning off the gas. 2) to provide local flood information plans so that the understanding of local evacuation plans is clear. Furthermore, it is advised to provide this information on one clear channel, familiar to the Dutch citizens, and include an explanatory video for both plans as suggested by the respondents. For instance, the local plan could be presented on the municipalities' website, and the general information on the website of Rijkswaterstaat.

Based on the results and interviews, some recommendations are given about what to include in both flood information plans. First, recommendations of aspects to include in the general plan are given, followed by recommendations for the local plans.

The list of recommendations for the **General plan** are the following:

- In the **general plan**, it should be clear for the citizens what the communication channels are in case of a flood. For example, which channels the government uses to provide information about the severity of an upcoming event. Furthermore, what channels are best to use as citizens to communicate with each other.
- In the **general plan**, it should be clear what the flood warning systems are. How do the citizens know when and what kind of natural hazard is com-

ing? Furthermore, how do people know what the severity of the hazard will probably be?

- In the **general plan**, practical instructions should be included. Examples of practical instructions are, for instance, turning off the gas, keeping warm, collecting fresh water, and having a battery radio to follow further instructions should other communication means fail. Most of these practicals are not dependent on the type of hazard nor on the location of the hazard. Hence, the importance of understanding these instructions.
- In the **general plan**, the basic ethical agreements should be included. When do we help other people, and how? For instance, in case we have an elderly neighbor. These ethical agreements can be improved by including local knowledge because most local people will know where the elderly live. So, these aspects are generally included in this plan, but they should be elaborated on in the local plans.
- In the **general plan**, it should be explained when and how we start helping the animals. Also, these aspects are generally included in this plan, but they should be elaborated on in the local plans.
- In the **general plan**, a list should be provided with the websites where people can check the risks of their houses getting flooded, for example, www.overstroomik.nl.
- In the **general plan**, advice should be given about insurance. In the Netherlands, we cannot insure houses against severe fluvial or coastal flooding, only against pluvial flooding. However, there is a national fund to recompense people in such a disaster. These are topics to include in the general plan.

The list of recommendations of the **Local-specific plan** are the following:

- Several items that should be included in the local plans are explained in the list above for the general plan, such as the basic ethical agreements and the plans for saving animals.
- In the **Local-specific plan**, the list of the local channels that will be used during emergencies should be provided. So that citizens know which channels to watch in case of emergency.
- In the **Local-specific plan**, detailed evacuation plans should be included. Step by step, what to do in case of a flood and what not to do. When do people stay home, and when do they leave? What routes remain usable. What are the nearest high refuge places? What are the gathering locations?
- In the **Local-specific plan**, a program should be included with moments for neighbors to come together and discuss their ethical agreements. Also, the outcomes of these meetings should be updated by someone in the municipality so that agreements are aligned.

This study's researchers know that these policy implementations require many hours of consultation and expert knowledge. However, in the long-term, when the Dutch citizens and government are better prepared for future flood events, the social and economic consequences can be more limited; it seems worthwhile to invest time in this process. Moreover, the process could be accelerated by the inclusion of citizens. People who live near water can add insight knowledge, especially regarding the local-specific plan, which will create a more helpful plan. Besides, including citizens might also increase the awareness of the process and results, which could result in more people willing to prepare for future floods, and influence the water culture.

7.3 LIMITATIONS

Given this master's thesis's short research period, several associated limitations need to be considered and contextualized. The most significant limitation is the number of valid respondents, caused mainly by the short recruiting period. Besides, using Qualtrics also contributed to this limitation because people could skip a question and go on to the following questions, which resulted in missing values in the data set of this study. A list of the most relevant methodological and other limitations of our analysis is provided below.

- First of all, as mentioned above, the number of respondents is the most significant limitation. The self-administered questionnaire was online from March 7th till April 30th, so slightly less than two months. Considering this relatively short period, the 237 obtained respondents seem pretty reasonable. In 2007 (Study 2), 242 responses were obtained, meaning the number of responses was almost equal. However, this study's missing values are higher than in Study 2. Besides, the respondents of Study 2 were primarily located in Zeeland, while Study 1 also focused on Limburg. For the longitudinal comparison, it was insightful that still 50% of the respondents of Study 1 are located in Zeeland. However, the additional respondents from Limburg provided the cross-sectional analysis. Nevertheless, more respondents from both Zeeland and Limburg would increase the validation of the main research questions.

- Also, because the questionnaire was mainly conducted amongst people from Zeeland and Limburg, the general conclusions for Dutch citizens in other regions are drawn with circumspection. However, one-fourth of the respondents were from locations other than Limburg and Zeeland, making the general conclusions slightly more valid. Yet, this is also a limitation and a consequence of using an online questionnaire because these respondents were not the target group. This limitation has the same effect on the conclusions as the previous limitation, meaning that more targeted respondents would increase the validation of the conclusions.

- For the longitudinal comparison analysis, it is considered a limitation that it is not a one-on-one comparison. However, this would have been impossible because the same study should have been conducted, including the same questions, period, and respondents, which is unrealistic. Nevertheless, the differences in statistics could have been limited if this study were solely focused on the Scheldt area. Again, the more targeted respondents would increase the validation of the conclusions. However, including Limburg created additional insights and a cross-section analysis, which answered the first part of the research question.

- Furthermore, the transition to a new risk standard is not included in the questionnaire. Instead, the focus lay on enabling a direct comparison between the previous study in 2007. It could have been insightful and accurate to explain the new standard to the respondents through text and then ask questions about their perceptions of the new risk standard. However, this would have made the questionnaire longer and would not contribute to answering the research question.

- The questionnaire contained too many questions, which resulted in missing values, especially at the end of the questionnaire. However, including open questions to elaborate on the closed questions resulted in many insightful results. So, even though it lengthened the questionnaire, the combination of 50% closed and 50% open questions is highly recommended. The missing values impacted the regression analysis's validation, which influenced the conclusions' validation. Yet, as also account for all the other limitations mentioned

above, the conclusions based on the valid data points of Study 1 still result in exciting and valid conclusions. However, the validation could be improved by increasing the number of respondents, including solely target responders, and limiting the number of missing values.

- Also, more respondents would justify conclusions. For example, in this study, the level of trust amongst the respondents was relatively high. However, it could be that only people who trust the government filled in the questionnaire. In other words, the results could be influenced by the characteristics of the respondents. This is a limitation when drawing conclusions based on a sample group. However, the more extensive the sample size, the more valid the conclusions.
- Besides, the use of Qualtrics also resulted in some additional limitations. First, the questions related to the damage caused by flood experience were only included for the first five respondents. Therefore, the questions related to damages resulting from a flood experience had to be excluded from the research and could not be included in the longitudinal comparison. This is considered a limitation because the literature explicitly mentioned that the impact of flood damage on people's risk perceptions is significant. Therefore, the inclusion would have provided additional results which could have influenced the outcomes and the conclusions, especially concerning the comparison with Study 2. Second, the fact that people could answer the following questions about finishing the previous one also resulted in missing values, which influenced the validation of the conclusions.
- The question regarding flood experience elsewhere should have been specified and changed into flood experience in Limburg. However, this was not done beforehand because Limburg was not initially included in the study. Also, it would be mainly for clarification because the open questions identified the specific flood locations; therefore, this limitation does not affect the conclusions.
- Respondents were not restricted when asked to indicate the level of attention the government should give to a certain flood risk measure. Therefore, the results showed that the government should pay more attention to all the flood risk measures, which seems unrealistic. Therefore, it would have been better if a restriction regarding the number of flood risk measures that need the most attention had been implemented in the questionnaire. It could be that a significant difference in wanted flood risk measures between people from Limburg and Zeeland is identified when implementing this restriction, which would influence the results. However, this is somewhat speculative and does not directly influence the conclusions.
- The output regarding the spatial measure was quite surprising. It was not expected that people wanted the government to give more attention to this flood risk measure. Therefore, we believe that spatial measure might be too broad for interpretation, and it should have been specified so that people understood the question better. This was also verified during the interviews, where the experts explained that spatial measures could mean several things, such as Room for the River or depoldering. However, in Study 2, the meaning of spatial measures was more straightforward, as depoldering was current. Clarifying this question in Study 1 would probably result in other outcomes, influencing the conclusions regarding the differences between Study 1 and Study 2.
- Also, the question regarding people's worries should have been a yes or no question instead of indicating the level of people's worry because then all three risk perception factors would be binary. Based on the insights of this

study, it would be interesting to analyze the possibility of modeling risk perception as a dependent variable instead of making regressions for worry, preparedness, and awareness separately. However, it would only give additional insights but not directly influence the conclusions because by analyzing the factors separately, as we did, we also obtained insights into people's risk perceptions.

- Within the regression analysis, the variable for *experience scheldt* could not be included in Study 1 because the impact of the variable was too limited. Only 1% of the respondents experienced the flood at the Scheldt, which is understandable because the flood happened around 70 years ago, whereas this was 55 years ago in Study 2. Therefore, it is inevitable and logical that this number was significantly lower in Study 1 than in Study 2. Regardless, this weakened the longitudinal comparison because this factor could not be analyzed and compared. Hence, this is one of the comparative restrictions that play a role in longitudinal comparison between two studies conducted within a time of 15 years in between.
- During the regression analysis, an assumption had to be made to create the variable *flood information* in the data set of Study 2. Consequently, the interpretation of the results regarding the influence of flood information in Study 1 and Study 2 was distinguishable. However, the dissimilarity made sense because of the different questions used to obtain this variable in both studies. Therefore, the assumption was valid, and the variable was included in the regression analysis for Study 2. Also, because the difference was understood, they had no direct effect on the conclusions. However, future research would be more valid if the questions asked to obtain variables were similar.
- Several results are verified with experts during interviews. However, the deviation of interviewees is considered a limitation because the interviewees from Zeeland are mainly involved with the technical aspects and social embedding, while the interviewees from Limburg are solely focused on the social aspects. This limitation does not directly influence the conclusions; however, the validation could be improved if the social and technical backgrounds were more divided amongst the experts from Zeeland and Limburg. Besides, the interviewees were mainly also part of the target groups, which causes some bias because of their flood risk perception.
- Lastly, in general, we could potentially have interpreted some outputs differently from the scholars in 2007. However, during the entire research, communication between the scholars was undertaken to keep this limitation to a minimum.

7.4 FUTURE WORK

Following the limitations, we will highlight some key points that should be considered when conducting future research. However, remember that the points we present are by no means a complete overview of future work related to this study. The most significant improvement for future research, based on the limitations, is the number of valid responders within the target groups. An increase in valid data points would also increase the validation of the regression analysis and, therefore, the study's conclusions. Nevertheless, we still believe this thesis holds much potential for further development, from conceptualization to results.

The other future research recommendations are mainly related to methodological aspects and other points. The key points are the following:

- When using Qualtrics as the program to perform a survey method, it is highly recommended to consult an expert before publishing the questionnaire. Qualtrics is relatively simple to use in the basics; however, quite advantageous options and settings can be installed to prevent issues we experienced during this research. Using the correct settings could result in fewer missing values, and would improve the value of future studies.
- When using a survey method, it is recommended to keep the questionnaire as short as possible. We experienced difficulties because of the extensive questionnaire. Moreover, door-to-door, in addition to an online questionnaire or as a primary method, might increase the understanding between respondent and researcher. However, remember that the combination of open en closed questions is highly recommended, as it gives the responders the option to explain their answers.
- When conducting a longitudinal comparative analysis with a time frame of several years between the studies, it must be remembered to consider the restrictions. The interpretations must be carefully drafted because, in the time between the studies, other external factors or events could have also influenced the differences or similarities between the studies. That said, it would be insightful to conduct another longitudinal comparison in the future, to analyze if there are trends present.
- Furthermore, we argue that people's knowledge level might be underestimated. Therefore, it would be insightful if future research would anticipate this aspect and conduct a study to fully understand Dutch citizens' knowledge level.
- Future studies should focus on the issue of how to include citizens in the decision-making process, analyze how to distribute the responsibilities, and motivate citizens to take action. It appears that information is needed for citizens to be more involved and prepared, in combination with clear communication about the changing roles of government and the individual in flood risk management in the Netherlands.
- Also, future research regarding the difference in water culture in Zeeland and Limburg and its effect on people's risk perceptions would be insightful. Consequently, this knowledge could be used in the local-specific plans to better understand the risk perceptions of the involved people.

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A ADDITIONAL RESULTS OF STUDY 1

A.1 ADDITIONAL STATISTICAL RESULTS

Table A.1: Response numbers in each location for the categorical dummy group Limburg

	Group	Location	Number of people	% of total
	Limburg	Maastricht	29	
		Valkenburg aan de Geul	1	
		Ohé en Laak	1	
		Bunde	2	
		Ophoven	1	
		Rothem	1	
		Geulle	6	
Total Limburg			41	23%

Table A.2: Response numbers in each location for the categorical dummy group Zeeland

	Group	Location	Number of people	% of total
	Zeeland	Aagtekerke	3	
		Aardenburg	1	
		Arnemuiden	2	
		Axel	2	
		Brouwershaven	1	
		Colijnstraat	1	
		Eversdijk	1	
		Goes	14	
		Graauw	1	
		Hansweert	2	
		Heinkenszand	1	
		Hoofdplaat	1	
		Hulst	3	
		Ijzendijke	1	
		Kamperland	1	
		Kapelle	2	
		Kloosterzande	2	
		Kortgene	1	
		Koudekerke	1	
		Kruiningen	1	
		Kwadendamme	1	
		Meliskerke	1	
		Middelburg	10	
		Noordgouwe	1	
		Oost-Souberg	3	
		Oostdijk	2	
		Renesse	1	
		Rilland	1	
		s Heerenhoek	1	
		s-Heer Hendriks-kinderen	1	
		Sint-Annaland	1	
		Terneuzen	1	
		Tholen	3	
		Vlissingen	4	
		Vogelwaarde	2	
		Waarde	1	
		Walsoorden	1	
		Westkapelle	2	
		Yerseke	1	
		Zaamslag	1	
		Zaamslagveer	1	
		Zierikzee	5	
Total Zeeland			87	50%

Table A.3: Response numbers in each location for the categorical dummy group Other

	Group	Location	Number of people	% of total
	Other	Amstelveen	2	
		Amsterdam	9	
		Antwerpen	1	
		Brugge	1	
		Chaumont-Gistoux	1	
		De glind	1	
		Delft	8	
		Den Haag	1	
		Eindhoven	1	
		Etten-Leur	1	
		Groningen	1	
		Haarlem	3	
		Hei en Boeicop	1	
		Ijsselstein	1	
		Leiden	1	
		Lepelstraat	1	
		Middelharnis	1	
		Middenbeemster	1	
		Rockanje	1	
		Rotterdam	4	
		Utrecht	1	
		Vlaardingen	2	
		Waalre	2	
		Wageningen	1	
		Wateringen	1	
Total Other			48	27%

Table A.4: Explanation of the variables used in SPSS for the correlation and regression analysis Study 1

Variable name as used in SPSS	Type of variable	Question asked in Qualtrics
Age	independent variable (scale)	Age
experience_scheldt	independent variable (dummy)	Have you ever experienced a flood at the Scheldt?
experience_elsewhere	independent variable (dummy)	Have you ever experienced a flood elsewhere?
others_experience_scheldt	independent variable (dummy)	Do you know people who have experienced a flood at the Scheldt?
others_experience_elsewhere	independent variable (dummy)	Do you know people who have experienced a flood elsewhere
flood_information	independent variable (dummy)	Do you need more information about what to do in the event of a flood?
influence_limburg	independent variable (dummy)	Do the floods in Limburg influence your need for more knowledge about the warning system/preparations for floods in the future?
flood_policy	independent variable (dummy)	Do you think the government is doing enough about flood policy?
female	independent variable (dummy)	Sex
Zeeland	independent variable (dummy)	Location
Limburg	independent variable (dummy)	Location
Other	independent variable (dummy)	Location
worries_floods	dependent variable (scale)	In general, how concerned are you about a flood in your area?
flood_preparedness	dependent variable (dummy)	Do you feel prepared for a flood disaster such as the flood disaster in 1953 or the floods in Limburg in 2021?
flood_awareness	dependent variable (dummy)	Do you expect similar or even bigger floods in the near future?

A.2 ADDITIONAL RESULTS FROM REGRESSION ANALYSIS OF STUDY 1

A.2.1 Models corresponding with flood worry

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.534[a]	.285	.238	1.097

a. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

b. Dependent Variable: worries_floods

Figure A.1: Model Summary of Model 1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	57.620	8	7.202	5.989	<.001[b]
	Residual	144.303	120	1.203		
	Total	201.922	128			

a. Dependent Variable: worries_floods

b. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

Figure A.2: Anova statistics of Model 1

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female
1	1	5.307	1.000	.00	.00	.01	.01	.01	.01	.01	.00	.01
	2	1.231	2.076	.00	.00	.10	.04	.14	.00	.01	.08	.00
	3	.794	2.586	.00	.00	.04	.02	.09	.02	.02	.39	.03
	4	.554	3.094	.00	.00	.00	.00	.00	.02	.02	.02	.92
	5	.394	3.672	.00	.00	.40	.00	.58	.11	.00	.01	.01
	6	.313	4.116	.00	.01	.24	.93	.07	.01	.02	.01	.01
	7	.214	4.976	.00	.00	.13	.00	.00	.22	.87	.11	.00
	8	.153	5.895	.03	.29	.05	.00	.07	.46	.05	.28	.00
	9	.039	11.600	.96	.69	.01	.00	.05	.16	.01	.11	.01

a. Dependent Variable: worries_floods

Figure A.3: Collinearity diagnostics of Model 1

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	1.299	.407		3.190	.002	.493	2.106		
	age	.006	.007	.076	.969	.335	-.007	.020	.978	1.022
	experience_elsewhere	.472	.274	.166	1.723	.087	-.070	1.015	.640	1.563
	others_experience_elsewhere	.090	.236	.036	.383	.703	-.378	.559	.685	1.459
	others_experience_scheldt	.201	.221	.077	.910	.365	-.236	.638	.833	1.200
	flood_information	.264	.239	.095	1.106	.271	-.209	.736	.814	1.228
	influence_limburg	.654	.243	.259	2.688	.008	.172	1.135	.641	1.559
	flood_policy	-.575	.242	-.212	-2.376	.019	-1.053	-.096	.745	1.342
	female	.041	.211	.016	.196	.845	-.376	.459	.924	1.082

a. Dependent Variable: worries_floods

Figure A.4: Coefficients of Model 1

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.88	3.26	2.22	.671	129
Residual	-1.943	2.384	.000	1.062	129
Std. Predicted Value	-1.994	1.557	.000	1.000	129
Std. Residual	-1.772	2.174	.000	.968	129

a. Dependent Variable: worries_floods

Figure A.5: Residuals statistics of Model 1

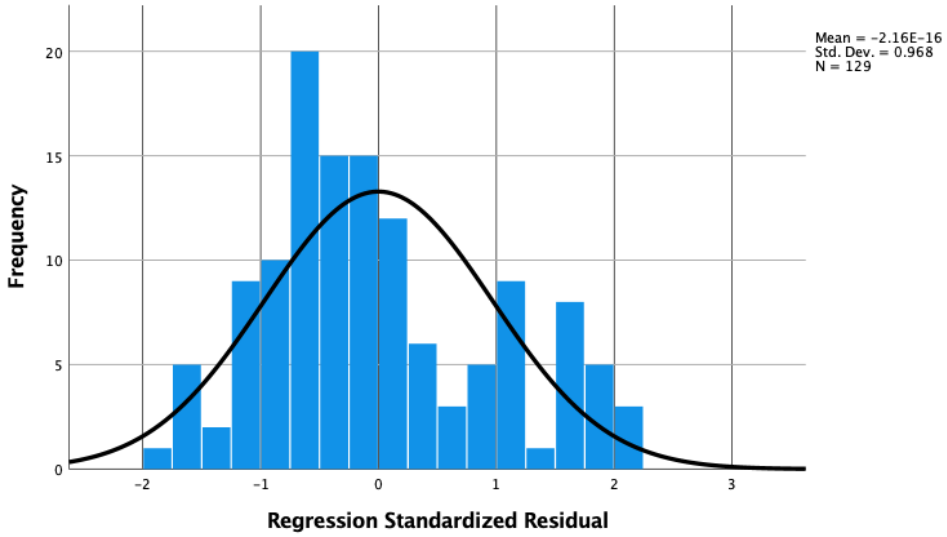

Figure A.6: Histogram of Model 1

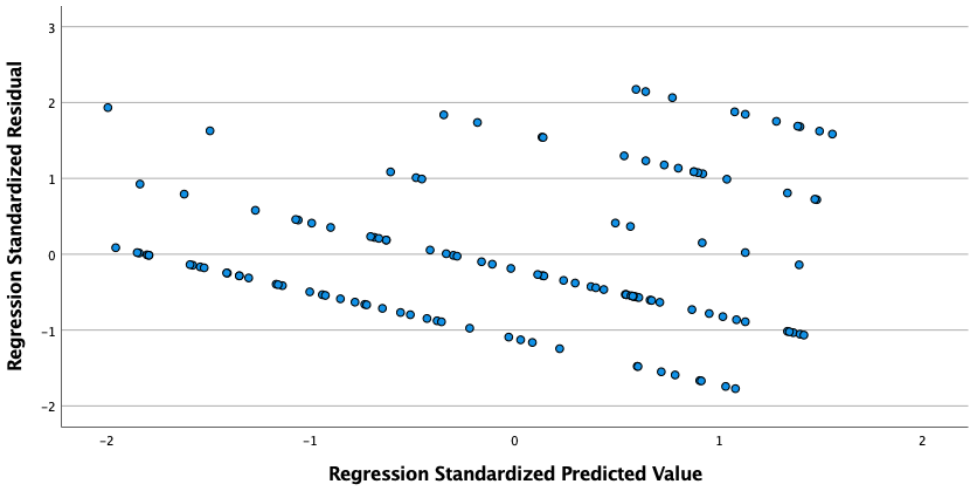

Figure A.7: Scatterplot of Model 1

A.2.2 Model 2

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.575[a]	.331	.274	1.070

a. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

b. Dependent Variable: worries_floods

Figure A.8: Model Summary of Model 2

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	66.855	10	6.685	5.841	<.001[b]
	Residual	135.068	118	1.145		
	Total	201.922	128			

a. Dependent Variable: worries_floods

b. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

Figure A.9: Anova statistics of Model 2

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female	Limburg	Other
1	1	5.895	1.000	.00	.00	.00	.01	.00	.00	.01	.00	.01	.00	.00
	2	1.631	1.901	.00	.00	.04	.01	.05	.00	.00	.05	.00	.03	.04
	3	.992	2.438	.00	.00	.02	.01	.12	.01	.00	.06	.03	.00	.24
	4	.673	2.960	.00	.00	.02	.01	.01	.03	.04	.31	.01	.01	.21
	5	.579	3.191	.00	.00	.00	.01	.02	.01	.01	.01	.82	.02	.00
	6	.352	4.095	.00	.01	.41	.07	.32	.09	.00	.03	.00	.00	.10
	7	.320	4.293	.00	.01	.01	.87	.11	.01	.00	.02	.05	.04	.01
	8	.220	5.173	.00	.00	.34	.00	.01	.34	.40	.03	.00	.09	.01
	9	.188	5.599	.01	.05	.10	.01	.02	.08	.51	.24	.05	.22	.16
	10	.114	7.185	.01	.33	.07	.01	.22	.25	.03	.15	.02	.53	.14
	11	.036	12.722	.97	.59	.00	.00	.12	.18	.00	.09	.02	.05	.08

a. Dependent Variable: worries_floods

Figure A.10: Collinearity diagnostics of Model 2

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.87	3.51	2.22	.723	129
Residual	-2.251	2.307	.000	1.027	129
Std. Predicted Value	-1.868	1.793	.000	1.000	129
Std. Residual	-2.104	2.156	.000	.960	129

a. Dependent Variable: worries_floods

Figure A.11: Residuals statistics of Model 2

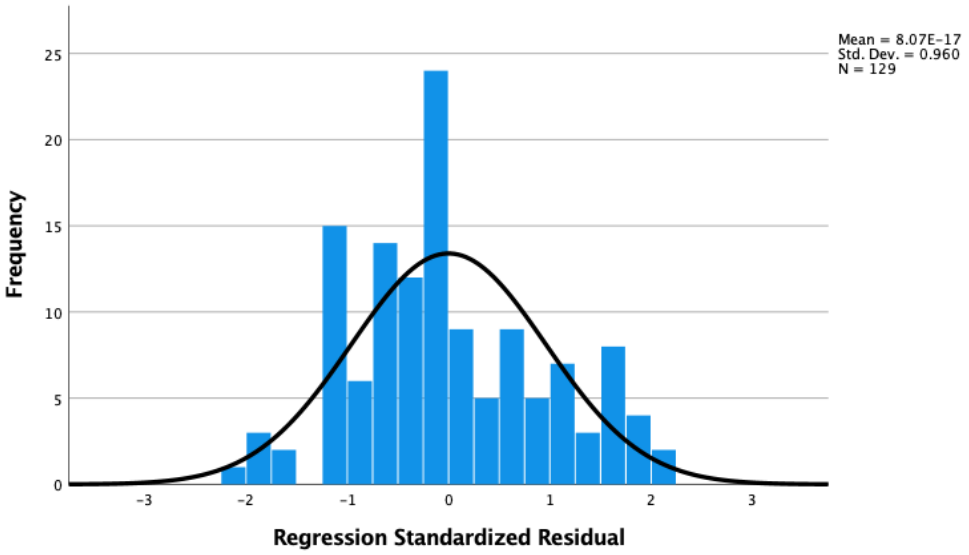

Figure A.12: Histogram of Model 2

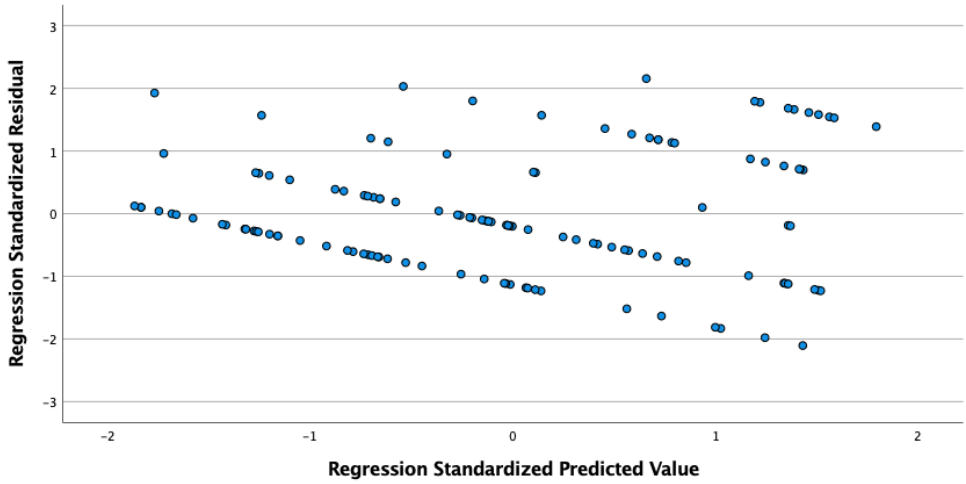

Figure A.13: Scatterplot of Model 2

A.3 MODELS CORRESPONDING WITH FLOOD PREPAREDNESS

A.3.1 Model 3

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.351[a]	.123	.065	.410

a. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

b. Dependent Variable: flood_preparedness

Figure A.14: Model Summary of Model 3

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.841	8	.355	2.111	.040[b]
	Residual	20.183	120	.168		
	Total	23.023	128			

a. Dependent Variable: flood_preparedness

b. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

Figure A.15: Anova statistics of Model 3

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.457	.152		2.999	.003	.155	.759		
	age	-.001	.002	-.045	-.523	.602	-.006	.004	.978	1.022
	experience_elsewhere	-.139	.102	-.145	-1.361	.176	-.342	.063	.640	1.563
	others_experience_elsewhere	.094	.088	.110	1.062	.290	-.081	.269	.685	1.459
	others_experience_scheldt	.107	.083	.121	1.290	.199	-.057	.270	.833	1.200
	flood_information	-.243	.089	-.258	-2.723	.007	-.420	-.066	.814	1.228
	influence_limburg	-.051	.091	-.060	-.562	.575	-.231	.129	.641	1.559
	flood_policy	.010	.090	.011	.113	.910	-.169	.189	.745	1.342
	female	-.017	.079	-.019	-.217	.829	-.173	.139	.924	1.082

a. Dependent Variable: flood_preparedness

Figure A.16: Coefficients of Model 3

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female
1	1	5.307	1.000	.00	.00	.01	.01	.01	.01	.01	.00	.01
	2	1.231	2.076	.00	.00	.10	.04	.14	.00	.01	.08	.00
	3	.794	2.586	.00	.00	.04	.02	.09	.02	.02	.39	.03
	4	.554	3.094	.00	.00	.00	.00	.00	.02	.02	.02	.92
	5	.394	3.672	.00	.00	.40	.00	.58	.11	.00	.01	.01
	6	.313	4.116	.00	.01	.24	.93	.07	.01	.02	.01	.01
	7	.214	4.976	.00	.00	.13	.00	.00	.22	.87	.11	.00
	8	.153	5.895	.03	.29	.05	.00	.07	.46	.05	.28	.00
	9	.039	11.600	.96	.69	.01	.00	.05	.16	.01	.11	.01

a. Dependent Variable: flood_preparedness

Figure A.17: Collinearity diagnostics of Model 3

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.06	.61	.23	.149	129
Residual	-.608	.967	.000	.397	129
Std. Predicted Value	-1.989	2.518	.000	1.000	129
Std. Residual	-1.482	2.359	.000	.968	129

a. Dependent Variable: flood_preparedness

Figure A.18: Residuals statistics of Model 3

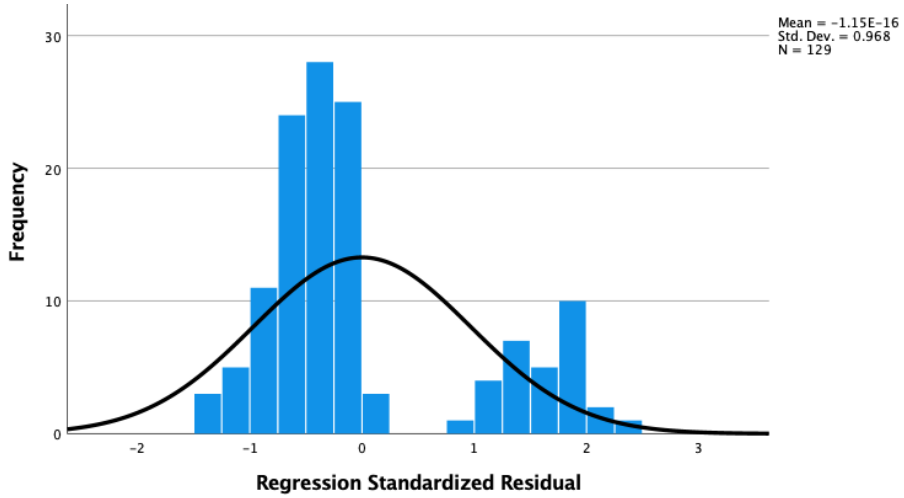

Figure A.19: Histogram of Model 3

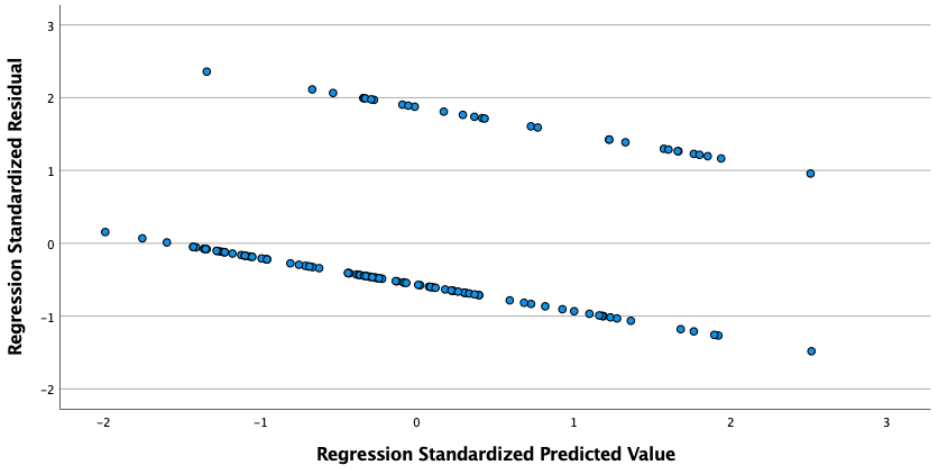

Figure A.20: Scatterplot of Model 3

A.3.2 Model 4

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.381[a]	.145	.073	.408

a. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

b. Dependent Variable: flood_preparedness

Figure A.21: Model Summary of Model 4

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.344	10	.334	2.005	.039[b]
	Residual	19.679	118	.167		
	Total	23.023	128			

a. Dependent Variable: flood_preparedness

b. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

Figure A.22: Anova statistics of Model 4

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female	Limburg	Other
1	1	5.895	1.000	.00	.00	.00	.01	.00	.00	.01	.00	.01	.00	.00
	2	1.631	1.901	.00	.00	.04	.01	.05	.00	.00	.05	.00	.03	.04
	3	.992	2.438	.00	.00	.02	.01	.12	.01	.00	.06	.03	.00	.24
	4	.673	2.960	.00	.00	.02	.01	.01	.03	.04	.31	.01	.01	.21
	5	.579	3.191	.00	.00	.00	.01	.02	.01	.01	.01	.82	.02	.00
	6	.352	4.095	.00	.01	.41	.07	.32	.09	.00	.03	.00	.00	.10
	7	.320	4.293	.00	.01	.01	.87	.11	.01	.00	.02	.05	.04	.01
	8	.220	5.173	.00	.00	.34	.00	.01	.34	.40	.03	.00	.09	.01
	9	.188	5.599	.01	.05	.10	.01	.02	.08	.51	.24	.05	.22	.16
	10	.114	7.185	.01	.33	.07	.01	.22	.25	.03	.15	.02	.53	.14
	11	.036	12.722	.97	.59	.00	.00	.12	.18	.00	.09	.02	.05	.08

a. Dependent Variable: flood_preparedness

Figure A.23: Collinearity diagnostics of Model 4

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.19	.60	.23	.162	129
Residual	-.600	.952	.000	.392	129
Std. Predicted Value	-2.636	2.275	.000	1.000	129
Std. Residual	-1.470	2.331	.000	.960	129

a. Dependent Variable: flood_preparedness

Figure A.24: Residuals statistics of Model 4

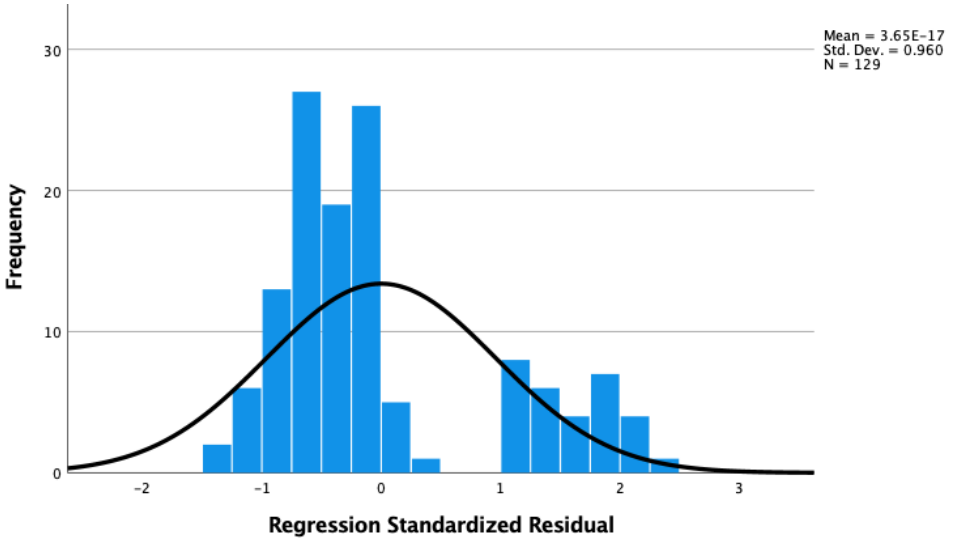

Figure A.25: Histogram of Model 4

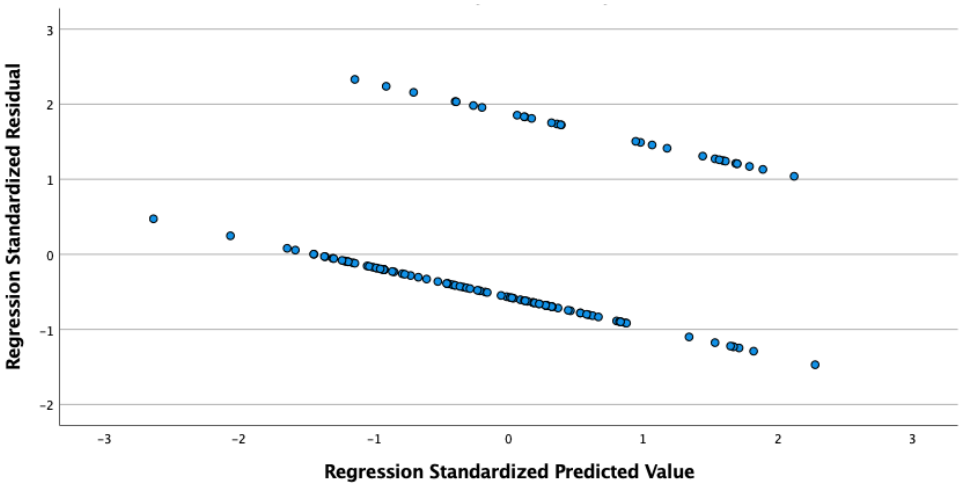

Figure A.26: Scatterplot of Model 4

A.3.3 Model 5

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	123.797[a]	.118	.178

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Figure A.27: Model Summary of Model 5

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.199	8	.921

Figure A.28: Hosmer and Lemeshow Test Model 5

Classification Table[a]

			Predicted		
			flood_preparedness		Percentage Correct
	Observed		0 Nee	1 Ja	
Step 1	flood_preparedness	0 Nee	94	5	94.9
		1 Ja	21	9	30.0
	Overall Percentage				79.8

a. The cut value is .500

Figure A.29: Classification table Model 5

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	age	-.008	.016	.261	1	.610	.992	.962	1.023
	experience_elsewhere	-1.064	.721	2.177	1	.140	.345	.084	1.418
	others_experience_scheldt	.617	.482	1.643	1	.200	1.854	.721	4.767
	others_experience_elsewhere	.599	.545	1.208	1	.272	1.819	.626	5.291
	flood_information	-1.335	.511	6.816	1	.009	.263	.097	.717
	influence_limburg	-.286	.540	.280	1	.597	.751	.261	2.167
	flood_policy	.098	.523	.035	1	.852	1.103	.396	3.072
	female	-.049	.503	.009	1	.923	.952	.355	2.553
	Constant	-.108	.900	.014	1	.905	.898		

a. Variable(s) entered on step 1: age, experience_elsewhere, others_experience_scheldt, others_experience_elsewhere, flood_information, influence_limburg, flood_policy, female.

Figure A.30: Variables Model 5

A.3.4 Model 6

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	119.962[a]	.143	.217

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Figure A.31: Model Summary of Model 6

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.637	8	.888

Figure A.32: Hosmer and Lemeshow Test Model 6

Classification Table[a]

			Predicted		
			flood_preparedness		Percentage Correct
	Observed		0 Nee	1 Ja	
Step 1	flood_preparedness	0 Nee	92	7	92.9
		1 Ja	20	10	33.3
	Overall Percentage				79.1

a. The cut value is .500

Figure A.33: Classification table Model 6

A.4 MODELS CORRESPONDING WITH FLOOD AWARENESS

A.4.1 Model 7

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.505[a]	.255	.205	.411

a. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

b. Dependent Variable: flood_awareness

Figure A.34: Model Summary of Model 7

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.936	8	.867	5.132	<.001[b]
	Residual	20.274	120	.169		
	Total	27.209	128			

a. Dependent Variable: flood_awareness

b. Predictors: (Constant), female, others_experience_scheldt, age, flood_information, flood_policy, others_experience_elsewhere, influence_limburg, experience_elsewhere

Figure A.35: Anova statistics of Model 7

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.652	.153		4.272	<.001	.350	.955		
	age	-.004	.002	-.127	-1.598	.113	-.009	.001	.978	1.022
	experience_elsewhere	.171	.103	.164	1.662	.099	-.033	.374	.640	1.563
	others_experience_elsewhere	-.142	.089	-.153	-1.603	.112	-.318	.033	.685	1.459
	others_experience_scheldt	-.102	.083	-.106	-1.229	.221	-.266	.062	.833	1.200
	flood_information	.177	.089	.172	1.975	.051	.000	.354	.814	1.228
	influence_limburg	.322	.091	.347	3.526	<.001	.141	.502	.641	1.559
	flood_policy	-.039	.091	-.039	-.425	.671	-.218	.141	.745	1.342
	female	-.067	.079	-.070	-.853	.395	-.224	.089	.924	1.082

a. Dependent Variable: flood_awareness

Figure A.36: Coefficients of Model 7

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female
1	1	5.307	1.000	.00	.00	.01	.01	.01	.01	.01	.00	.01
	2	1.231	2.076	.00	.00	.10	.04	.14	.00	.01	.08	.00
	3	.794	2.586	.00	.00	.04	.02	.09	.02	.02	.39	.03
	4	.554	3.094	.00	.00	.00	.00	.00	.02	.02	.02	.92
	5	.394	3.672	.00	.00	.40	.00	.58	.11	.00	.01	.01
	6	.313	4.116	.00	.01	.24	.93	.07	.01	.02	.01	.01
	7	.214	4.976	.00	.00	.13	.00	.00	.22	.87	.11	.00
	8	.153	5.895	.03	.29	.05	.00	.07	.46	.05	.28	.00
	9	.039	11.600	.96	.69	.01	.00	.05	.16	.01	.11	.01

a. Dependent Variable: flood_awareness

Figure A.37: Collinearity diagnostics of Model 7

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.17	1.23	.70	.233	129
Residual	-.929	.746	.000	.398	129
Std. Predicted Value	-2.261	2.303	.000	1.000	129
Std. Residual	-2.261	1.816	.000	.968	129

a. Dependent Variable: flood_awareness

Figure A.38: Residuals statistics of Model 7

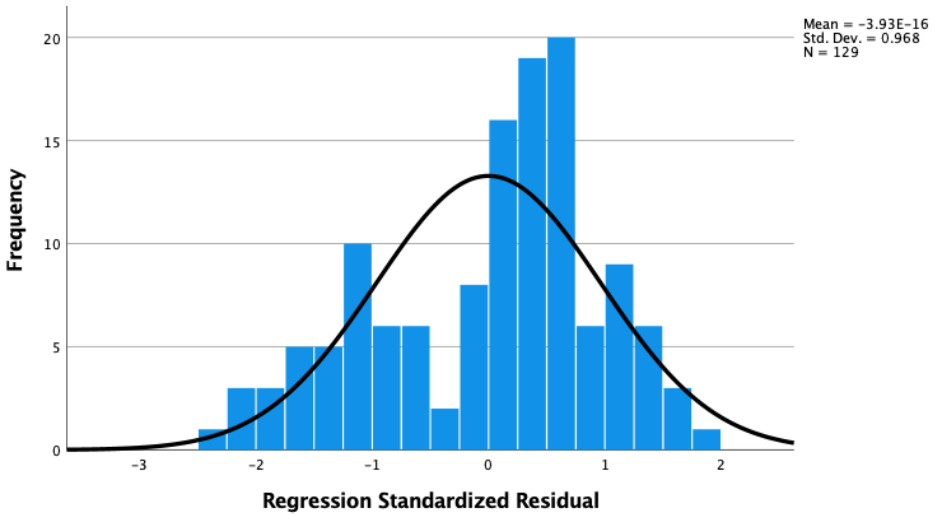

Figure A.39: Histogram of Model 7

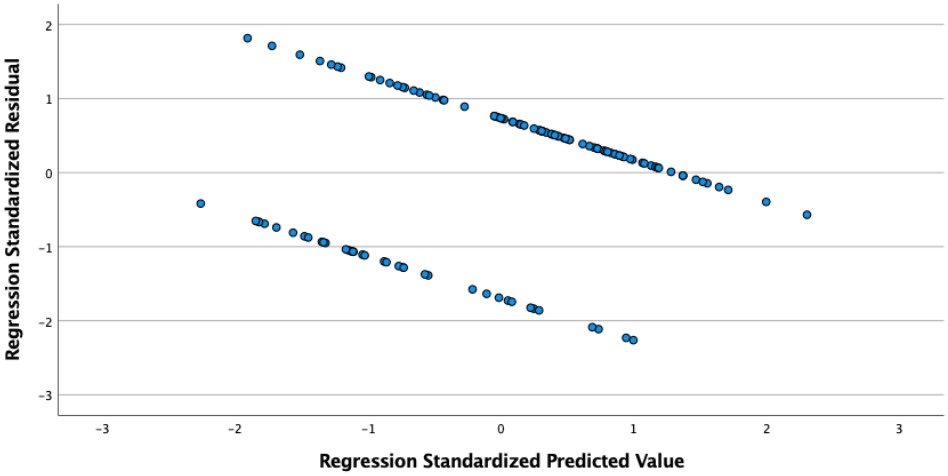

Figure A.40: Scatterplot of Model 7

A.4.2 Model 8

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.516[a]	.267	.205	.411

a. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

b. Dependent Variable: flood_awareness

Figure A.41: Model Summary of Model 8

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.256	10	.726	4.291	<.001[b]
	Residual	19.953	118	.169		
	Total	27.209	128			

a. Dependent Variable: flood_awareness

b. Predictors: (Constant), Other, flood_information, experience_elsewhere, age, female, flood_policy, others_experience_scheldt, others_experience_elsewhere, influence_limburg, Limburg

Figure A.42: Anova statistics of Model 8

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	age	experience_elsewhere	others_experience_elsewhere	others_experience_scheldt	flood_information	influence_limburg	flood_policy	female	Limburg	Other
1	1	5.895	1.000	.00	.00	.00	.01	.00	.00	.01	.00	.01	.00	.00
	2	1.631	1.901	.00	.00	.04	.01	.05	.00	.00	.05	.00	.03	.04
	3	.992	2.438	.00	.00	.02	.01	.12	.01	.00	.06	.03	.00	.24
	4	.673	2.960	.00	.00	.02	.01	.01	.03	.04	.31	.01	.01	.21
	5	.579	3.191	.00	.00	.00	.01	.02	.01	.01	.01	.82	.02	.00
	6	.352	4.095	.00	.01	.41	.07	.32	.09	.00	.03	.00	.00	.10
	7	.320	4.293	.00	.01	.01	.87	.11	.01	.00	.02	.05	.04	.01
	8	.220	5.173	.00	.00	.34	.00	.01	.34	.40	.03	.00	.09	.01
	9	.188	5.599	.01	.05	.10	.01	.02	.08	.51	.24	.05	.22	.16
	10	.114	7.185	.01	.33	.07	.01	.22	.25	.03	.15	.02	.53	.14
	11	.036	12.722	.97	.59	.00	.00	.12	.18	.00	.09	.02	.05	.08

a. Dependent Variable: flood_awareness

Figure A.43: Collinearity diagnostics of Model 8

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.15	1.20	.70	.238	129
Residual	-.907	.745	.000	.395	129
Std. Predicted Value	-2.282	2.102	.000	1.000	129
Std. Residual	-2.206	1.811	.000	.960	129

a. Dependent Variable: flood_awareness

Figure A.44: Residuals statistics of Model 8

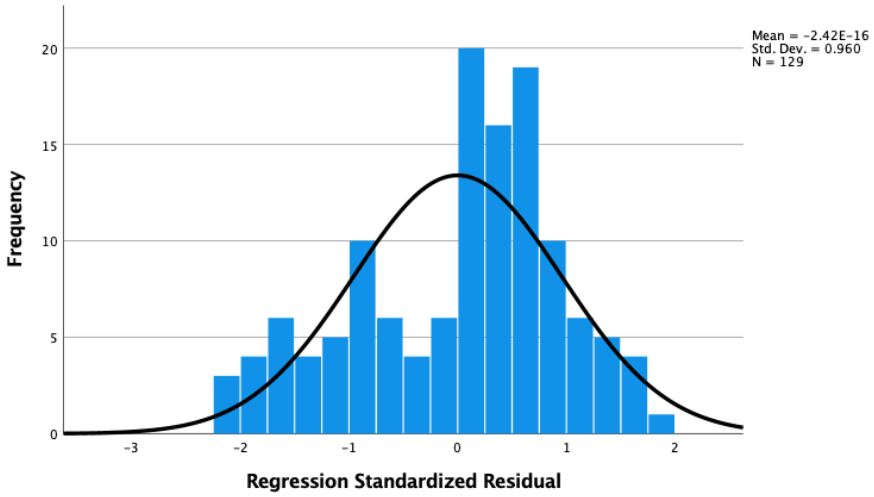

Figure A.45: Histogram of Model 8

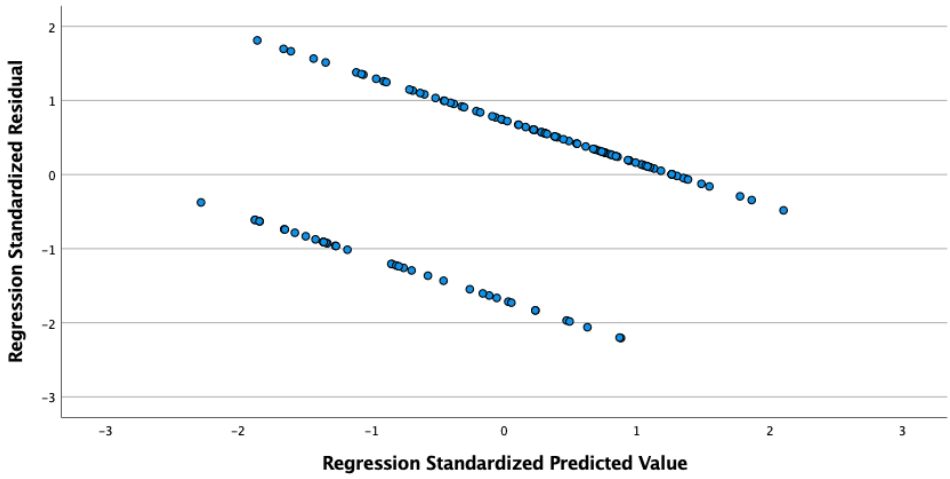

Figure A.46: Scatterplot of Model 1

A.4.3 Model 9

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	121.827[a]	.245	.347

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Figure A.47: Model Summary of Model 9

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.968	8	.651

Figure A.48: Hosmer and Lemeshow Test Model 9

Classification Table[a]

Observed		Predicted flood_awareness 0 Nee	Predicted flood_awareness 1 Ja	Percentage Correct
Step 1	flood_awareness 0 Nee	21	18	53.8
	1 Ja	11	79	87.8
	Overall Percentage			77.5

a. The cut value is .500

Figure A.49: Classification table Model 9

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	95% C.I.for EXP(B) Upper
Step 1[a]	age	-.026	.016	2.520	1	.112	.975	.944	1.006
	experience_elsewhere	1.440	.772	3.478	1	.062	4.220	.929	19.166
	others_experience_scheldt	-.540	.483	1.247	1	.264	.583	.226	1.503
	others_experience_elsewhere	-.893	.564	2.503	1	.114	.410	.136	1.238
	flood_information	1.078	.527	4.176	1	.041	2.938	1.045	8.257
	influence_limburg	1.724	.557	9.579	1	.002	5.608	1.882	16.711
	flood_policy	-.200	.521	.147	1	.701	.819	.295	2.272
	female	-.526	.505	1.084	1	.298	.591	.220	1.590
	Constant	.985	.907	1.181	1	.277	2.678		

a. Variable(s) entered on step 1: age, experience_elsewhere, others_experience_scheldt, others_experience_elsewhere, flood_information, influence_limburg, flood_policy, female.

Figure A.50: Variables Model 9

A.4.4 Model 10

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	120.642[a]	.252	.357

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Figure A.51: Model Summary of Model 10

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.665	8	.793

Figure A.52: Hosmer and Lemeshow Test Model 10

Classification Table[a]

Observed		Predicted flood_awareness 0 Nee	Predicted flood_awareness 1 Ja	Percentage Correct
Step 1	flood_awareness 0 Nee	21	18	53.8
	1 Ja	11	79	87.8
	Overall Percentage			77.5

a. The cut value is .500

Figure A.53: Classification table Model 10

B ADDITIONAL RESULTS OF STUDY 2

B.1 ADDITIONAL STATISTICAL RESULTS

Table B.1: Explanation of the variables used in SPSS for the correlation and regression analysis Study 2

Variable name as used in SPSS	Type of variable	Question asked in Qualtrics
age_od	independent variable (scale)	Age?
experience_scheldt_od	independent variable (dummy)	Flood experience at Scheldt?
experience_elsewhere_od	independent variable (dummy)	Flood experience (other place)?
others_experience_scheldt_od	independent variable (dummy)	Flood experience at Scheldt? (others)
others_experience_elsewhere_od	independent variable (dummy)	Flood experience (other place) (others)?
flood_information_od	independent variable (dummy)	Do you know how react upon a disaster?
flood_policy_od	independent variable (dummy)	Flood protection policy is sufficient?
worries_floods_od	dependent variable (scale)	In general, how concerned are you about a flood in your area?
flood_preparedness_od	dependent variable (dummy)	Are you prepared?
flood_awareness_od	dependent variable (dummy)	Expect more severe floods than 1953?

B.2 ADDITION RESULTS FROM REGRESSION ANALYSIS OF STUDY 2

B.2.1 Correlation analysis of awareness

Correlations[c]

		flood_awareness_od	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
flood_awareness_od	Pearson Correlation	1	.049	.001	.005	.024	-.026	.097	.082	-.049
	Sig. (2-tailed)		.459	.985	.943	.721	.693	.142	.215	.459
Age	Pearson Correlation	.049	1	.478**	.175**	.118	-.017	-.056	.049	-.224**
	Sig. (2-tailed)	.459		<.001	.008	.075	.800	.403	.465	<.001
experience_scheldt_od	Pearson Correlation	.001	.478**	1	-.132*	.348**	-.085	.042	.042	-.073
	Sig. (2-tailed)	.985	<.001		.046	<.001	.202	.533	.527	.272
experience_elsewhere_od	Pearson Correlation	.005	.175**	-.132*	1	-.190**	.210**	-.040	-.040	-.126
	Sig. (2-tailed)	.943	.008	.046		.004	.001	.549	.550	.057
others_experience_scheldt_od	Pearson Correlation	.024	.118	.348**	-.190**	1	-.191**	.044	.081	.014
	Sig. (2-tailed)	.721	.075	<.001	.004		.004	.507	.221	.834
others_experience_elsewhere_od	Pearson Correlation	-.026	-.017	-.085	.210**	-.191**	1	-.047	-.028	-.057
	Sig. (2-tailed)	.693	.800	.202	.001	.004		.481	.675	.390
flood_information_od	Pearson Correlation	.097	-.056	.042	-.040	.044	-.047	1	.231**	.025
	Sig. (2-tailed)	.142	.403	.533	.549	.507	.481		<.001	.708
flood_policy_od	Pearson Correlation	.082	.049	.042	-.040	.081	-.028	.231**	1	-.100
	Sig. (2-tailed)	.215	.465	.527	.550	.221	.675	<.001		.131
female_od	Pearson Correlation	-.049	-.224**	-.073	-.126	.014	-.057	.025	-.100	1
	Sig. (2-tailed)	.459	<.001	.272	.057	.834	.390	.708	.131	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

c. Listwise N=228

Figure B.1: Correlations between independent variables and the dependent variable *flood awareness od*

B.3 MODELS CORRESPONDING WITH FLOOD WORRY

B.3.1 model 11

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.277[a]	.077	.043	.972

a. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

b. Dependent Variable: worries_floods_od

Figure B.2: Model Summary of Model 11

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.210	8	2.151	2.276	.023[b]
	Residual	207.000	219	.945		
	Total	224.211	227			

a. Dependent Variable: worries_floods_od

b. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

Figure B.3: Anova statistics of Model 11

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.224	.310		7.175	<.001	1.613	2.835		
	Age	-.001	.005	-.022	-.282	.778	-.012	.009	.682	1.467
	experience_scheldt_od	.257	.195	.106	1.318	.189	-.127	.641	.656	1.523
	experience_elsewhere_od	.155	.236	.046	.658	.512	-.310	.620	.855	1.170
	others_experience_scheldt_od	-.002	.141	-.001	-.013	.990	-.280	.276	.835	1.197
	others_experience_elsewhere_od	.315	.192	.110	1.635	.103	-.065	.694	.928	1.077
	flood_information_od	.203	.140	.098	1.452	.148	-.072	.478	.935	1.070
	flood_policy_od	-.452	.138	-.221	-3.273	.001	-.723	-.180	.927	1.078
	female_od	.143	.144	.067	.994	.321	-.140	.426	.930	1.075

a. Dependent Variable: worries_floods_od

Figure B.4: Coefficients of Model 11

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
1	1	4.620	1.000	.00	.00	.01	.00	.01	.01	.01	.01	.01
	2	1.212	1.953	.00	.00	.05	.29	.03	.22	.00	.00	.00
	3	.817	2.378	.00	.00	.20	.06	.01	.00	.00	.00	.45
	4	.706	2.558	.00	.00	.09	.21	.00	.59	.01	.10	.01
	5	.668	2.629	.00	.00	.07	.24	.01	.10	.01	.38	.13
	6	.393	3.428	.00	.00	.30	.04	.27	.00	.03	.35	.26
	7	.340	3.684	.00	.00	.03	.03	.46	.02	.40	.16	.04
	8	.220	4.578	.04	.07	.02	.09	.20	.05	.47	.00	.03
	9	.024	13.916	.95	.93	.22	.03	.02	.01	.05	.00	.07

a. Dependent Variable: worries_floods_od

Figure B.5: Collinearity diagnostics of Model 11

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.65	3.05	2.26	.275	228
Residual	-1.588	2.849	.000	.955	228
Std. Predicted Value	-2.209	2.855	.000	1.000	228
Std. Residual	-1.633	2.931	.000	.982	228

a. Dependent Variable: worries_floods_od

Figure B.6: Residuals statistics of Model 11

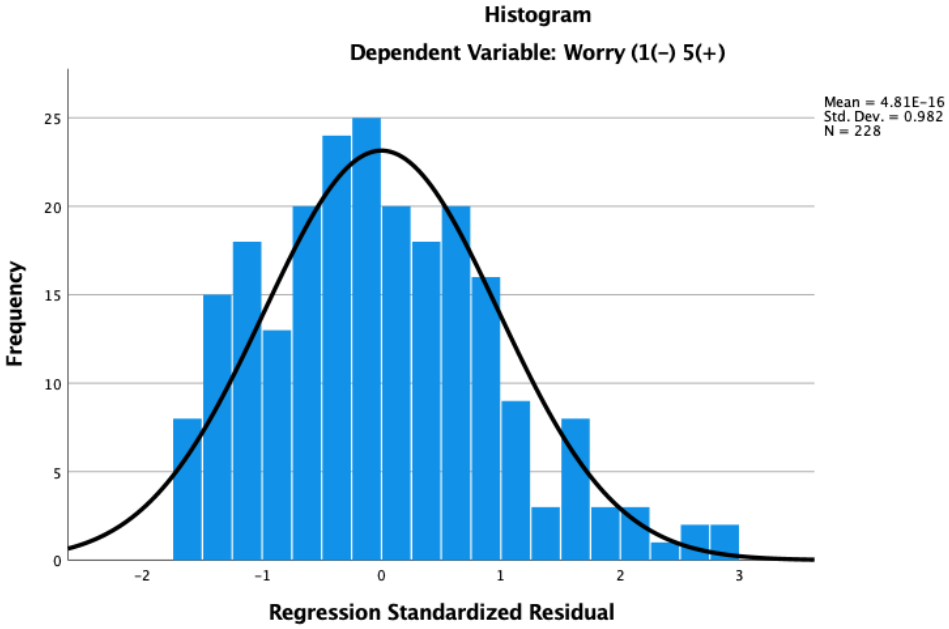

Figure B.7: Histogram of Model 11

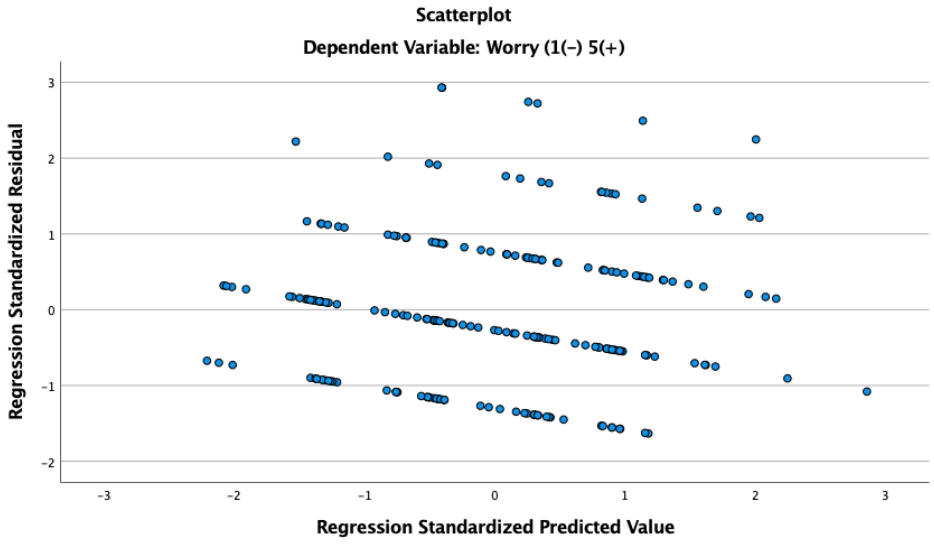

Figure B.8: Scatterplot of Model 11

B.4 MODELS CORRESPONDING WITH FLOOD PREPAREDNESS

B.4.1 model 12

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.251[a]	.063	.029	.202

a. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

b. Dependent Variable: flood_preparedness_od

Figure B.9: Model Summary of Model 12

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.600	8	.075	1.834	.072[b]
	Residual	8.961	219	.041		
	Total	9.561	227			

a. Dependent Variable: flood_preparedness_od

b. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

Figure B.10: Anova statistics of Model 12

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-.029	.064		-.455	.650	-.156	.098		
	Age	.000	.001	.027	.341	.733	-.002	.003	.682	1.467
	experience_scheldt_od	-.042	.041	-.084	-1.044	.297	-.122	.038	.656	1.523
	experience_elsewhere_od	.093	.049	.135	1.905	.058	-.003	.190	.855	1.170
	others_experience_scheldt_od	.044	.029	.106	1.485	.139	-.014	.101	.835	1.197
	others_experience_elsewhere_od	.052	.040	.087	1.289	.199	-.027	.130	.928	1.077
	flood_information_od	.064	.029	.148	2.189	.030	.006	.121	.935	1.070
	flood_policy_od	-.047	.029	-.111	-1.638	.103	-.104	.010	.927	1.078
	female_od	-.001	.030	-.002	-.026	.980	-.060	.058	.930	1.075

a. Dependent Variable: flood_preparedness_od

Figure B.11: Coefficients of Model 12

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
1	1	4.620	1.000	.00	.00	.01	.00	.01	.01	.01	.01	.01
	2	1.212	1.953	.00	.00	.05	.29	.03	.22	.00	.00	.00
	3	.817	2.378	.00	.00	.20	.06	.01	.00	.00	.00	.45
	4	.706	2.558	.00	.00	.09	.21	.00	.59	.01	.10	.01
	5	.668	2.629	.00	.00	.07	.24	.01	.10	.01	.38	.13
	6	.393	3.428	.00	.00	.30	.04	.27	.00	.03	.35	.26
	7	.340	3.684	.00	.00	.03	.03	.46	.02	.40	.16	.04
	8	.220	4.578	.04	.07	.02	.09	.20	.05	.47	.00	.03
	9	.024	13.916	.95	.93	.22	.03	.02	.01	.05	.00	.07

a. Dependent Variable: flood_preparedness_od

Figure B.12: Collinearity diagnostics of Model 12

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.09	.20	.04	.051	228
Residual	-.204	.993	.000	.199	228
Std. Predicted Value	-2.686	3.109	.000	1.000	228
Std. Residual	-1.007	4.910	.000	.982	228

a. Dependent Variable: flood_preparedness_od

Figure B.13: Residuals statistics of Model 12

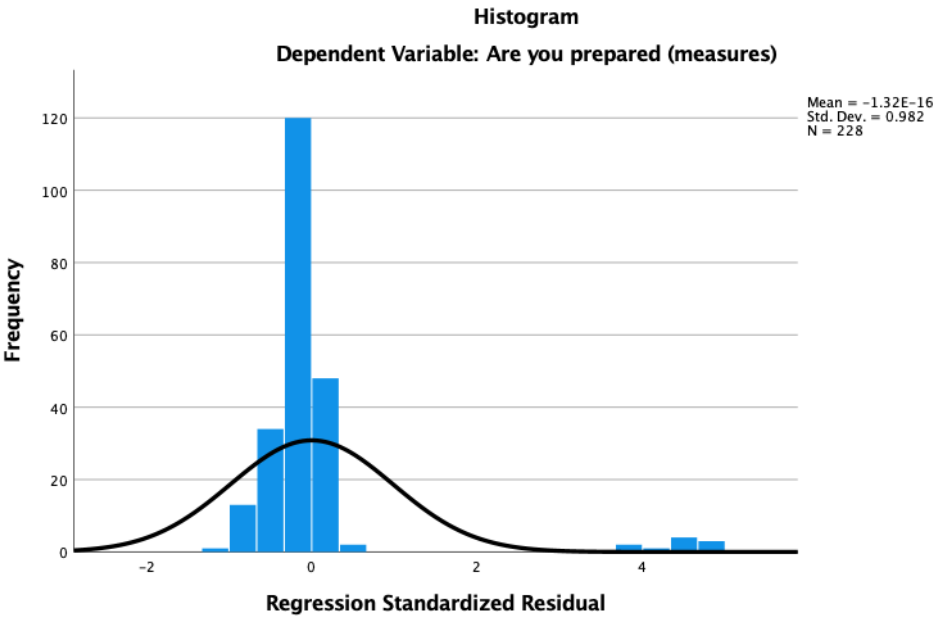

Figure B.14: Histogram of Model 12

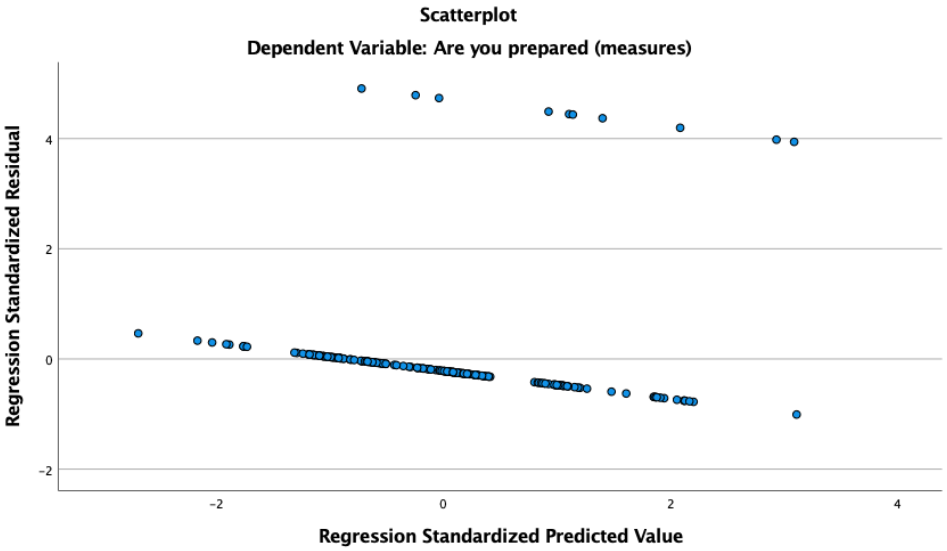

Figure B.15: Scatterplot of Model 12

B.4.2 Model 13

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	67.803[a]	.061	.201

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

Figure B.16: Model Summary of Model 13

Classification Table[a]

			Predicted		
			flood_preparedness_od		Percentage Correct
	Observed		0 nee	1 ja	
Step 1	flood_preparedness_od	0 nee	218	0	100.0
		1 ja	10	0	.0
	Overall Percentage				95.6

a. The cut value is .500

Figure B.17: Classification table Model 13

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.549	8	.479

Figure B.18: Hosmer and Lemeshow Test Model 13

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Age	.015	.030	.246	1	.620	1.015	.956	1.078
	experience_scheldt_od	-1.460	1.299	1.264	1	.261	.232	.018	2.960
	experience_elsewhere_od	1.462	.963	2.304	1	.129	4.312	.653	28.464
	others_experience_scheldt_od	1.300	.827	2.467	1	.116	3.668	.725	18.569
	others_experience_elsewhere_od	1.245	.814	2.342	1	.126	3.474	.705	17.123
	flood_information_od	2.162	1.111	3.789	1	.052	8.692	.985	76.672
	flood_policy_od	-1.333	.866	2.370	1	.124	.264	.048	1.439
	female_od	-.106	.775	.019	1	.891	.899	.197	4.111
	Constant	-6.227	2.066	9.087	1	.003	.002		

a. Variable(s) entered on step 1: Age, experience_scheldt_od, experience_elsewhere_od, others_experience_scheldt_od, others_experience_elsewhere_od, flood_information_od, flood_policy_od, female_od.

Figure B.19: Variables Model 13

B.5 MODELS CORRESPONDING WITH FLOOD AWARENESS

B.5.1 Model 14

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.138[a]	.019	-.017	.468

a. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

b. Dependent Variable: flood_awareness_od

Figure B.20: Model Summary of Model 14

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.936	8	.117	.534	.830[b]
	Residual	47.954	219	.219		
	Total	48.890	227			

a. Dependent Variable: flood_awareness_od

b. Predictors: (Constant), female_od, others_experience_scheldt_od, flood_information_od, others_experience_elsewhere_od, Age, flood_policy_od, experience_elsewhere_od, experience_scheldt_od

Figure B.21: Anova statistics of Model 14

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.147	.149		.982	.327	-.147	.441		
	Age	.002	.003	.064	.786	.432	-.003	.007	.682	1.467
	experience_scheldt_od	-.054	.094	-.047	-.572	.568	-.239	.131	.656	1.523
	experience_elsewhere_od	-.005	.114	-.003	-.046	.963	-.229	.219	.855	1.170
	others_experience_scheldt_od	.019	.068	.020	.275	.784	-.115	.152	.835	1.197
	others_experience_elsewhere_od	-.028	.093	-.021	-.304	.761	-.211	.154	.928	1.077
	flood_information_od	.087	.067	.089	1.290	.198	-.046	.219	.935	1.070
	flood_policy_od	.052	.066	.055	.786	.433	-.079	.183	.927	1.078
	female_od	-.037	.069	-.037	-.536	.593	-.173	.099	.930	1.075

a. Dependent Variable: flood_awareness_od

Figure B.22: Coefficients of Model 14

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Age	experience_scheldt_od	experience_elsewhere_od	others_experience_scheldt_od	others_experience_elsewhere_od	flood_information_od	flood_policy_od	female_od
1	1	4.620	1.000	.00	.00	.01	.00	.01	.01	.01	.01	.01
	2	1.212	1.953	.00	.00	.05	.29	.03	.22	.00	.00	.00
	3	.817	2.378	.00	.00	.20	.06	.01	.00	.00	.00	.45
	4	.706	2.558	.00	.00	.09	.21	.00	.59	.01	.10	.01
	5	.668	2.629	.00	.00	.07	.24	.01	.10	.01	.38	.13
	6	.393	3.428	.00	.00	.30	.04	.27	.00	.03	.35	.26
	7	.340	3.684	.00	.00	.03	.03	.46	.02	.40	.16	.04
	8	.220	4.578	.04	.07	.02	.09	.20	.05	.47	.00	.03
	9	.024	13.916	.95	.93	.22	.03	.02	.01	.05	.00	.07

a. Dependent Variable: flood_awareness_od

Figure B.23: Collinearity diagnostics of Model 14

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.14	.48	.31	.064	228
Residual	-.480	.788	.000	.460	228
Std. Predicted Value	-2.690	2.622	.000	1.000	228
Std. Residual	-1.025	1.685	.000	.982	228

a. Dependent Variable: flood_awareness_od

Figure B.24: Residuals statistics of Model 14

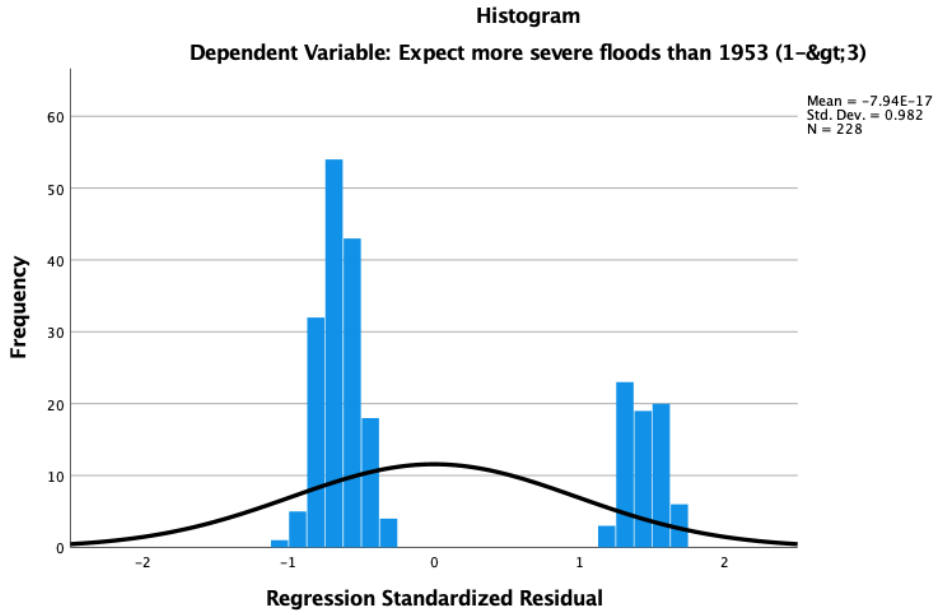

Figure B.25: Histogram of Model 14

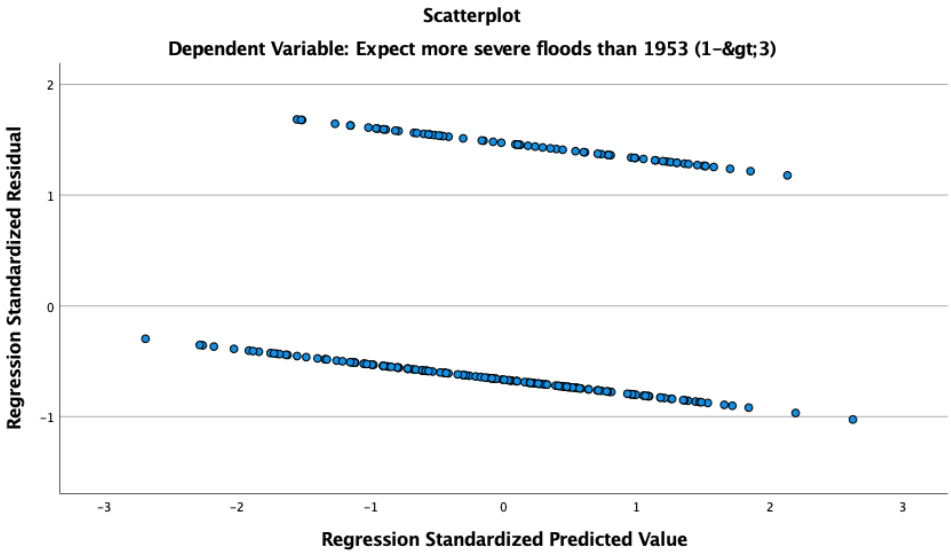

Figure B.26: Scatterplot of Model 14

B.5.2 Model 15

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	278.397[a]	.019	.027

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Figure B.27: Model Summary of Model 15

Classification Table[a]

Observed			Predicted flood_awareness_od		Percentage Correct
			0 nee of neutraal	1 ja	
Step 1	flood_awareness_od	0 nee of neutraal	157	0	100.0
		1 ja	71	0	.0
	Overall Percentage				68.9

a. The cut value is .500

Figure B.28: Hosmer and Lemeshow Test Model 15

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8.746	8	.364

Figure B.29: Classification table Model 15

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Age	.009	.012	.633	1	.426	1.009	.986	1.033
	experience_scheldt_od	-.254	.437	.337	1	.562	.776	.330	1.827
	experience_elsewhere_od	-.020	.528	.001	1	.969	.980	.348	2.756
	others_experience_scheldt_od	.088	.317	.076	1	.782	1.092	.586	2.033
	others_experience_elsewhere_od	-.140	.443	.100	1	.752	.870	.365	2.071
	flood_information_od	.423	.323	1.717	1	.190	1.526	.811	2.871
	flood_policy_od	.239	.304	.617	1	.432	1.270	.699	2.307
	female_od	-.177	.327	.293	1	.588	.838	.442	1.590
	Constant	-1.597	.713	5.017	1	.025	.202		

a. Variable(s) entered on step 1: Age, experience_scheldt_od, experience_elsewhere_od, others_experience_scheldt_od, others_experience_elsewhere_od, flood_information_od, flood_policy_od, female_od.

Figure B.30: Variables Model 15

C | INTERVIEW WITH ADRIE PROVOOST

At the beginning of this interview, two aspects were discussed: First, if we were allowed to record the interview. Second, we asked if we were allowed to use the interviewee's name in this thesis. The interviewee agreed with both questions, which is why their name and the interview are included in this Appendix.

Interviewer: Eva Schyns (ES)
Interviewee: Adrie Provoost (AP)

ES: I started by introducing myself.
AP: I'm Adrie. I studied Civil Engineering and worked in that field in a region in Zeeuws Vlaanderen while working on a dyke strengthening project. However, then I noticed that with these projects, we harm the environment. Therefore, I studied environmental science, and the combination was precious. Jill and I were more about the broader aspects, so we had some very insightful conversations. I was part of the E&W, where the science level was very high. However, as managers of an area, the questions we asked were related to 'how does this impact (us) the citizens?' The balance between the types of people involved in E&W was very valuable and resulted in a high level of advice regarding dyke projects somewhere in the Netherlands, not necessarily in Zeeland. I have worked since 1973, so I have a lot of experience, which helps in the long term. Furthermore, I live in Zeeland which is below sea level. Still, we are familiar with this and therefore we found a way to deal with this aspects related to living near the North-Sea, which is typically for Zeeuwse people.

ES: Okay! Thank you for taking the time to discuss some of the results of this research. Here, I explained Study 1 and Study 2 and the purpose of the conversation: debating the interpretation of some results and additional questions about these results.
AP: Okay clear. Did you also look at relevant literature studies?

ES: Yes, I did a literature study about what is perception; risk perception and what influences people's risk perception. And I compared the results I found with the literature study and also looked at additional studies to understand unexpected outcomes. However, I had a 50/50 division regarding open and closed questions, and especially the open questions and explanations people give are, I think, nice to discuss with an expert like you because it gives a different point of view than when I look at the existing studies.
AP: Do you know the study of Klaas Slager called the 'Watersnood' based on the disasters in 1953?

ES: Yes, my grandfather gifted me this when I started this thesis in February.
AP: Oh, perfect! Because the book quotes some people's experiences, I thought it could be insightful. But you got it, so perfect.

ES: Yes. I went through it! Okay, first question; I wanted to talk about the new risk standard; *explained the new risk standard*. Do you know how this is communicated with the people and if so how?
AP: It was purely an arithmetic reason for safety and failure of flood defenses. It

used to be the chance of exceeding which was clearly understood by the public. And for example, it was clear that the norm was higher in areas with more capital than in for example Wadden area and Zeeland. And also at the rivers the exceeding chance was lower. People understood this. However, the calculations regarding the new norms are very challenging to understand, so the communication was very difficult. It was not easy for the public to understand this, however, the reasons why we operated differently in cities than in polders were more than clear. So the damage/ victims aspect was known, but the new norm was definitely not easy to explain also because the previous standards were so well understood. There may be a chance of exceeding, but this does not mean that the barrier has not yet collapsed. All sort of intern components also play a role, like piping, so it is worth it to actually calculate this and take it into account. Enough reasons to switch to a new norms, but difficult to explain this to the people, so experts should be draft this and try to explain it where possible.

ES: Yes. Because the most significant variable was flood information. 86% never received information but 73% wish to get this. Besides, they want to receive things about what to do; so the focus from the Dutch government might be on awareness but possible needs to shift toward preparedness?
AP: Yes, I understand your point but it is a bit typical for the Dutch government to think from their own perspective and own ministry. There are only a few people that think about; okay but what and how does this impact the region? However, Waterschap tries to share knowledge about that there are steps involved in the so called 'layer approach', the context about this is communicated, but the question is; do people understand this? Also, when I stopped working in 2014, I lost the new risk calculation quickly because its different when being professionally involved or a citizen. So, yes it is not quite understood by the people yet.

ES: Okay, yes but that might be because people never actually received the information to begin with.
AP: Yes and it is just more difficult than the previous norms, that was about estimating water levels and waves etc.

ES: Got it. Another result was that the level of trust is quite high, also the influence of the involved parties was okay. However, people are not quite satisfied with the process, so the transparency of communication, or the involvement of the citizens is something that can be improved. It is not clear what to do in case of a flood, which was also a result in Study 2.
AP: Yes. Per definition these are two different worlds. One drafts the scenario and the other has to experience it. And the bridge in between in apparently not there. It is difficult, but still, it should be explained. Just like in Corona, there were also authorities that addressed the people.

ES: Yes, so could it help if, for example, one organization clearly focused on the communication to create this bridge.
AP: Yes.

ES: Also, the level of worry of the respondents was very low. Moreover, almost the exact same as in Study 2.
AP: What is the percentage?

ES: Only 2.24%.
AP: That is indeed very low. It has to be because of some sort of trust that the government knows what to do. And more based on the experience and that the government showed they can be trusted, more than based on the new risks norm,

probably.

ES: Could it also be that it has something to do with what you told me in the beginning; that the Zeeuwse people are 'strong' and familiar with water and do not give up on hoping it will all be alright.
AP: Yes, but that would probably account for all coastal citizens. The learned how to deal with the involved aspects.

ES: Got it, still it was against my expectations.
AP: It could also be that it is difficult for people and that people just want to trust the government, like they may be always did.

ES: Could be. However, the question was very literally; are you worried about floods? So, I would say that the recent floods influences this.
AP: Yes, then I think it is really about the experience people have the water safety and the government. So, built up trust.

ES: Another result had to do with Spatial Measures. In Study 1 more people are pro this than in Study 2. How can this be? Because I think that desoldering remains an interesting topic in Zeeland.
AP: Interesting result. I am not sure, depoldering is about restoring nature. Farmers etc are against all of this. It is about switching polders, so create a polder for a certain time and then we can use it again for farming. RFR would be better for rivers than around the North Sea. Barriers to the depth of the fairway have been filled with a stone dyke, so that system is something we can still use for a period. So, Zeeland is not really about fixing this in literally 'the width', which is something that would work better for river areas. So, Zeeland wants to keep the 'old' flood defense systems. Also, the most serious investments regarding dykes have been made around the coastal line. So, that is also something that needs to be taken into account.

ES: Okay, so it might be the division of Zeeuwse and Limburgse people that created a division between the results regarding Spatial Measures.
AP: Yes, because RFR would be a better method for river areas.

ES: Okay, but RFR would still impact people living in those areas.
AP: True, it is a difficult topic. For example, the project around Amsterdam and Edam are also an example of how difficult these measures are. The implementation especially.

ES: Yes. Okay, another result was about the warning systems in the Netherlands. A lot of people did not know what the exact warning systems are; or what to do etc. So, I googled - what are the warning systems; which was not that easy to find; also about what to do; it is all very general and basic and definitely not on one clear page or website. What do you think about the warning systems?
AP: In Zeeland, whenever there is spring tide or storm. Then we got 'dyke security', and the Waterschap gets involved. And people will explain this process on TV. And afterward, we get information about the damage etc. So I think that Waterschap does this like it should be done, and keeps people involved in my opinion. Also, there are events where for example schools are involved in informative evenings to keep the knowledge level of people on a certain level. Also, schools are sometimes involved in evacuation plans and dyke strengthening projects. Also, locals are sometimes involved in these projects as well. In Zeeland these things are working like it should, people will probably know where to go etc.

ES: Okay. So maybe the experience in Zeeland influences the level of preparedness regarding Waterschap.
AP: Yes, the knowledge level will probably increase in Limburg because of the floods. Same as here every since 1953.

ES: Okay thanks, I think I covered my questions. Do you have anything you would like to add based on our conversation?
AP: Well, the thing you mentioned about the focus of the provided information is something interesting. Our country keeps getting more divided into people that come up with policies and at the same time have no experience with how it works in practice. The Netherlands is known as a 'top of the bill' when we talk about water safety but obviously, we have to keep in mind that the people actually involved in this, and who experience the floods, need to know where the government is talking about. Too few people actually care about the involvement of people, the participation has to increase if we want to remain the 'top of the bill'

ES: I agree. And I think that participation could only improve the processes related to flood risk management plans.
AP: Exactly.

ES: Okay. Thank you for your time and input!
AP: Thanks, good luck with your thesis.

D | INTERVIEW WITH SAMANTHA VAN SCHAICK

At the beginning of this interview, two aspects were discussed: First, if we were allowed to record the interview. Second, we asked if we were allowed to use the interviewee's name in this thesis. The interviewee agreed with both questions, which is why their name and the interview are included in this Appendix.

Interviewer: Eva Schyns (ES)
Interviewee: Samantha van Schaick (SS)

ES: I started by introducing myself.
SS: I work for the Scheldt currents water board and manage the flood defenses in Zeeland. I keep myself busy with the legal assessment to see if all dikes and dunes are solid and high enough. Also, other policy matters, such as agreements with Rijkswaterstaat about suppression and the location of the primary coastline.

ES: Okay! Thank you for taking the time to discuss some of the results of this research. Here, I explained Study 1 and Study 2 and the purpose of the conversation: discussing the interpretation of some results and additional questions about these results.

ES: The first question relates to the new-risk approach. How did this new standard evolve? And is it adequately discussed with the population?
SS: There have been lectures from the Water Board that everyone could join to explain the new standard. Besides, we try to explain this to people, but this is difficult. In the past, there was a standard that we must adhere to; and it indicated how high the dikes should be. Currently, it is more complicated and also there can be a different standard per each kilometer if the external factors differ. All these things play a role in the new calculations. Obviously, we try to minimize the chances of a flood. However, the case is never zero. So, we try to explain the new standard; however, it is sometimes difficult for citizens to understand because the new standard itself is pretty tricky.

ES: Okay, while analyzing the results, it became clear that people need more information about flooding. Nearly 90% have never received any information, and 73% say they want it. Furthermore, it emerged in the open questions that the type of information people want to receive is mainly a step-by-step plan; what should I do, who should we communicate with, and how can I help others. Is the emphasis of the information passed on awareness or preparation?
SS: Well, people often know if there is a flood, then get information via specific channels, such as disaster channels or the internet. We, the Water Board, once made a card that stated what you need in case of a flood; heat, water, and light. And something of a radio, so mainly the practicalities. It also stated that in case of flooding, ensure you take this with you when you go to the attic, for example. We also have the Zeeland Safety Week once a year, discussing what to bring and what to do.

ES: Okay, so maybe the information is available, but people don't know it's there or where to find it?
SS: Yeah, people might not be able to find it.

ES: What is also striking is that concern in Study 1 and Study 2 is very low. So overall, the worry about flood risks is very low, against my expectation. Do you have an explanation for this? Does trust in government play a role here?
SS: I think so. In recent years we have also had many dike reinforcement projects. So maybe people see this too, and they get amplified, so people think that a lot is happening. In addition, we have had no floods in Zeeland for a relatively long time. I expected the concern would be more severe due to the flooding in Limburg. Much attention has been paid to this in the newspaper; Limburg has an entirely different topography. If heavy rainfall occurs in Zeeland, it is fairly distributed over the total surface, so you get less peak flow and less intense than in Limburg. With us, the danger mainly comes from the sea.

ES: Yes exactly, this ties into one of the questions in the survey. People commented on whether they think this will happen more often in the future; it is not expected in Zeeland, but in the rivers.
SS: Good news for the safety level of the dikes.

ES: Yes, if we are talking about flood risk measures. One of the questions was about different types of flood control measures, and it was striking that in Study 2, the desired attention for spatial measures was deficient. In Study 1, the desired attention for Spatial measures was greater. I was wondering if you could explain this?
SS: Yes, depoldering is always very sensitive, so the results of Study 2 are therefore evident. Perhaps there will be more of a shift; after all, we notice that there is also more room for, for example, wider dyke zones, adding spatial quality. But I'm not exactly sure what you mean by spatial measures. Of course, nature is becoming increasingly important and the use of foreland and the reinforcement of foreland.

ES: So there is a noticeable shift in how and which measures we use against flooding?
SS: Yes, but this is also necessary because in the past, it was just about strengthening dykes and water board decisions, and now with reinforcement projects, a whole participation process is involved. So, you have to sit down with citizens and local residents to discuss everything. So it becomes much more of a collaboration.

ES: And so that participation act has now started?
SS: Well, our dyke improvement projects are part of the HWP program. And there, participation is a mandatory part.

ES: And is this new or has this always been the case?
SS: I hear from colleagues that this has been reinforced recently.

ES: Okay, because my research showed that people trust the government and are satisfied with the parties involved, but not with the process. People would like more transparency about communication. And more involvement. This was also the case in Study 2. People would like to be more involved, not suddenly get the total responsibility, but they want to be heard. We will get the new environmental law in 2023, but is this already happening a bit?
SS: I know that the dyke reinforcements for Hansweert are now being prepared, and residents can join information evenings, which have been there from the start. There are also occasional points of criticism about the communication. It's something we need to learn more and more about and get further and further into.

ES: And do you notice a reaction from the population to these informative evenings in which they can be involved?
SS: I'm not in it, but I imagine they want to be involved.

ES: Yes, the question remains, of course, whether people actually use these kinds of options. That will show in practice.
SS: Yes, the tricky part is that it takes a lot of time. So how much time do you spend on transparency? Every citizen can simply place a WOO request, meaning that the government must share and publicize all documents. But these kinds of things do take a lot of extra time.

ES: I understand. Good to hear that the engagement is being worked on.
SS: Yes, in Hansweert and nationally, because it is simply determined that this has to be done.

ES: One more question about the warning system. 70% did not know what the warning systems are. I googled myself and found it quite challenging to find out what it is and how it works. Of course, it also depends on the regions and how they approach it locally. But I wanted to ask you what do you think of the current warning system?
SS: Well, it depends on what you need to warn for. In principle, as the Water Board, we alert people via our own website or social media from Phase 1 and continue until Phase 3 or 4. But these are also moments when we do not expect major problems, but it is simply shared. PCZ and OmroepZeeland are therefore informed. If a dike fails or there are large-scale problems, the security region takes over and sends out an NL-Alert.

ES: Okay, so do you have an explanation as to why so many people didn't know that NL-Alert is used in the event of a flood?
SS: Hope we don't have to experience this, of course, but for an expected water level, we usually don't expect any major problems, so those are not moments when we would send out an NL-Alert. That is only in a real emergency.

ES: So could it be that people might not have experienced it themselves that's why they didn't know either?
SS: Yes, suppose a dike collapses during a storm, an NL-Alert will certainly be sent, but I have not experienced this yet. But it also depends on the situation because, for instance, we have inlay dikes that can intercept quite a bit of water. Suppose it is near the East Scheldt barrier; for example, it could remain closed for longer. There are all kinds of extra safety precautions to take in an emergency.

ES: So maybe humans don't understand every step behind the screen?
SS: Yes, because we advise, but the municipality must take the following steps. We also saw this in Limburg, where people were warned via NL-Alert. And evacuated by the municipalities. And I assume that the NL-Alert also stated how and what people should do.

ES: Yes, so it also varies by region and type of disaster.
SS: Yes, because you also have regional flood defenses that can slow down and possibly stop the water. All are things that come into play.

ES: And in the future, is it realistic that a roadmap will be made and provided to humans? Would you think this helps with the preparation level?
SS: Yes, but I dare not say that. Because often, information quickly ends up in a pile. We, as Water Board, are working on creating awareness. And maybe making a step-by-step plan is a good idea, but I dare not say this.

ES: Okay, because this came out strongly as answers to the open-ended questions. By that, I mean more information regarding what I should do, how do I explain this to my children, etc. So people want to know what to do next time.

SS: The tricky part is that you can't always see it coming. So how much time do you have to actually do things? Because that plays a role in the strategy, you choose to apply. In Limburg, for example, you can still go to higher areas, but in many parts of Zeeland, for example, this is very difficult.

ES: So a regional roadmap is better than a general one?
SS: Yes because there are many scenarios. But the standard things like turning off the gas or filling bottles with water in advance are things you can and need to know. Also that you have to realize heat and food etc.

ES: Okay, so basic stuff should generally be known? But specific depends on the place?
SS: Yes because that depends on the 'type' area. For example, is it kind of bathtub effect, or an area that is higher?. For example, Hansweert is a kind of bathtub; with the new standard, it appears that water can come up to 4 meters.

ES: Okay, so if there are a lot of details, you can look locally to see what can be done literally. But this is of course a big task.
SS: Yes, but the basic things should be clear to us anyway. For example, a large white sheet can indicate that there are people in the attic or something.

ES: Yeah, okay so these are things that aren't known yet, I guess. And also something that everyone asks about. The emphasis is really on evacuation planning. I think a shift is needed from awareness to preparation. Something striking was also that there is a shift in the relationship between who is responsible. The population considers it more of a shared responsibility than 15 years ago.
SS: Yes, so there just needs to be more control for the citizens on what to do.

ES: Yes, I think so. There needs to be a bridge and more transparency in communication.
SS: Yes, I also thought it was nice to see in Limburg that people came to help and started to help each other. Especially farmers.

ES: Yes, because humans also indicated that they wanted more education on how we should help each other or how we help the animals. All pretty noble questions. Should we help the neighbor if we know that she has difficulty walking?
SS: Was this in Zeeland and Limburg?

ES: In general, people had a lot of questions and ideas. The people of Zeeland were more of what roads we should use because this is really an aspect of Zeeland in case of a flood. And Limburg perhaps a little more about the solidarity.
SS: Yeah interesting. Also for us as a Water Board.

ES: I've actually run through my questions. Do you have anything else you would like to say after this conversation?
SS: No, perhaps the only thing that the Water Board has more of an advisory role and actual evacuation that lies with the municipalities and security region. There is a lot of knowledge and expertise about flood risk and dikes, but we do not evacuate people ourselves.

ES: Okay, clear. Thank you for the time.

E | INTERVIEW WITH MARCEL TAAL

At the beginning of this interview, two aspects were discussed: First, if we were allowed to record the interview. Second, we asked if we were allowed to use the interviewee's name in this thesis. The interviewee agreed with both questions, which is why their name and the interview are included in this Appendix.

Interviewer: Eva Schyns (ES)
Interviewee: Marcel Taal (MT)

ES: I started by introducing myself. Also, here I explained Study 1 and Study 2.
MT: I'm Marcel Taal, Deltares. I am almost working at Deltares for 15 years and before that I worked at Rijkswaterstaat. And I also worked at a consultancy and a NGO (stiching Duinbehoud). So, I have worked at several places regarding water management. My goal is to make knowledge valuable in social debate and decision-making processes. Back then, I worked at the Zeeuwse files but since I worked at Deltares it work at the West-Scheldt files. In general, it is research but there is a lot of strategic advise involved regarding the Dutch government.

ES: Thanks for making some time for this interview. The purpose of this interview is to discuss some of the results and my interpretations of these results. And to analyze whether your interpretations would differ from mine.
MT: Perfect!

ES: The first questions is about the new risk standard. To what extent it this communicated to the public? How does this work in practice?
MT: The answer differs if you ask me as employee at Deltares or as citizens. Because of my profession I now how it works and I'm sure it is communicated, however, I don't think that people really cared about this change. Since, at the end, it is about the safety in our country and this is still the priority and has not changed because of the new standard. Moreover, now we can make even more precise calculations. For example, recently I worked with stakeholders in the Scheldt where we could practice with good nature restoration, and because of the new standard we noticed a part of the dykes that had to be strengthened because that dykes protected a big areas. And then the technical aspects gets a very practical meaning as we noticed that something has to happen quickly because of the new standard. However, nobody felt unsafe or anything because of this dykes because in the Netherlands the flood norms are high, and around the places where these norms account for, around the primary weirs, we never have any issues. In 1953 almost. So, I don't that people care about the new risk standards because they safety has not changed. Besides, I think people care more about sea-level rising etc. But that is a whole other story.

ES: Okay, because I ask this and the results showed that around 86% has never received any information regarding flood risks.
MT: I'm not surprised about this, I think 14% is actually quite high already. Because as citizens I also never received any information, and if I did, then it would have passed me by because it would seems unnecessary or something.

ES: Yeah, I also asked if people wanted to received information. And 73% stated they want more information regarding flood risks. Not solely about the new risk

standard, but any information that has to do with floods. So, people do want to have this but are not receiving it. The government might struggle with the communication or do not believe that people actually want more information and only care about safety.
MT: Very interesting question, because it is quite obvious that if you ask people do you want information, that the answer is yes of course I want more information. Also, we are currently living in a period whereby the government is always wrong, which makes it harder to interpret these answers. What do they mean; website, newsletters? I think some of these things have been send out but people did not notice it because they were watching other things or involved with other priorities at that moment. So want can we expect from the government?

ES: I understand your point, that is why we included an open question in the survey so that people could elaborate on this. Whereby, diverse answers were given. But the main thing was that there are two missing aspects that people would like to get more information about; 1) general step by step plan about what to do in case of a flood, presented on a general website. 2) Local evacuation plans; where should we go; which roads can we still use, do we need to help others and how, etc. All very specific points.
MT: I think that indeed it should be clear where to find information in case of a flood, and it should not be the case that you need to find the correct website. In my personal opinion, if the Dutch government change to layer approach then it has to be clear how these steps work for citizens. For example, if the A12 or so has to stay clear then these things have to be known. I don't think that kids get lessons about this at school. But the awareness has to be there. So, I like the observation and it is also something we can reflect on. What can we do about this? And do we have to do something about this? Because if it is too late and everyone is searching for the right information, that is chaotic.

ES: Yes, but actually the awareness is quite high. So, in my opinion the focus is on people's awareness, however, this should switch to information about preparedness.
MT: Sounds like an interesting conclusion and observation. I think I agree with you, in general the communication is about creating awareness for the people. Maybe because it is not a population form of communication if you talk about preparation, because you might create unnecessary panic. It is understandable that people want to know what to do in case such an emergency happens.

ES: Yes, especially my target group is very awareness of the possibility that a flood can occur in the future. However, it is about the next step; what do we do preventive, during, and after this next event. How do we act in the future.
MT: Yeah, so the results are clear. People do not know how to act. And probably if you google this then it will also not be clear. However, such a plan for Zeeland and Limburg would be very different.

ES: Yes, exactly. Do you think that such a local plan would be realistic? In terms of the expertise we need to draft these plans.
MT: It should be there already, the question is if this is communicated with the people. It should not be the case that these plans need to be drafted from zero. I think that these thinks have been drafted, hopefully. I know that my colleagues have an agreement with Rijkswaterstaat that in case an emergency advise is needed then the agreement is that top specialists drop everything and are available for information provision and advice to the government. So things like that are well organized. That is why I also think that there is certainly an idea of what to do, but these plans are not with the citizens. For example, the water management in Lelystad. So, I think that these things are known. However, still is outside of my scope of expertise.

But I can talk about it out of professional interest.

ES: I understand, me neither. However, based on this research I do know some things of course. I that is why I do believe that it can be solved if the communication can be improved. Especially, if you mention that these plans are available.
MT: It appears that indeed the communication has to be improved. I can understand it from a political point of view because it might cause panic amongst citizens. For example, what happened with videos explaining what to do in case of nuclear disasters. So I understand some form of restraint. Nevertheless, the citizens should be prepared especially if people want to be prepared. Just like the use of siren, which is check every first Monday of the month, so that people know that if they hear this sounds what it means. And then also know what to do; like close the windows etc. But then the information is only provided when the siren goes off, so is that what we want in case of a flood? Or is it provided before hand? We have to think about this and make these steps clear to the people; when and what kind of information is provided. We are a protection Delta but in case something happens we do have to have a plan.

ES: It might also create some trust if it more structured like you suggest. Another results, was that the level of worry amongst the people is rather low, which was against my expectations.
MT: Yes, why?

ES: Because of the results of Study 2, and the recent floods in Limburg in 2021.
MT: So even in Limburg the worry is low?

ES: Yes, however, the level of worry is higher in Limburg than in Zeeland, but still the general level is very low. Based on literature, and other interviews; I came with the conclusions that it might be because of the high level of trust in the Dutch government. People feel represented by the Rijkswaterstaat. However, people do feel like they have knowledge because of living near water their entire lives; so do want to be more involved. Is this realistic? Involvement?
MT: This is already done, but what is the involvement? Citizens have possibility to participate. But what kind of plans do people want to be involved? I think that people want to be more involved in such a way that they know actually want to do in case of a floods. Yet, if people state that they have enough knowledge whereby we can become every more resilient against floods, by strengthening the dykes of dunes, which I don't believe and I don't think that people mean that by involvement. It will be more about detailed local knowledge, such as, the knowledge about where might people are at Sunday or where elder people live etc. Besides, in the Netherlands there are several ways to get involved, people can also get political involved. But again, I'm not sure to what extent people want to get involved. However, logically it is about local knowledge which could decrease the consequences. Also, this type of involvement is for example, already done for nature restoration cases whereby people know where most animals are etc. But water safety is one of the key priorities of the Dutch government.

ES: So, for example, such a local plan is something whereby the citizens should/-could be involved?
MT: Yes. Moreover, they should be because they are the ones that need to actually know what the steps are in case something happens.

ES: Okay. To return to people's concerns. When I just mentioned that it was relatively low, this didn't seem to surprise you.
MT: No, because I have heard this since forever. Rijkswaterstaat also scores high in terms of trust. Moreover, citizens believe that the Dutch government knows what

they do; so in our daily lives we do not worry about upcoming storms or so because they will sort it out for us. But then if something happens, the curve changes. It is just typically like how I know the Dutch citizen.

ES: Yes. Okay so this is aligned with my results.
MT: Yes. The Netherlands has a very good representation regarding water safety. However, the trust is decreased but that is because of other types of files. So, it seems that water safety is another box for people. For example, if because of climate change or so things need to be done differently and if these things affect people directly; then it could become a problem. Then political problems, differences in age groups etc play a role, which is another story.

ES: So you mean that experience is something that influences trust?
MT: Yes. For example, Limburg was an extreme event. And people understand that is was an unforeseen extreme event. And the Geul was not ready and people can understand that. Of course, now we have to anticipate.

ES: So you mean that the basic trust levels are solid.
MT: Yes. And people understand a bit more how water systems work and that we need to anticipate in the future. The norms along the river differ from the norms around the North Sea.

ES: Lastly, in Study 2 people were against spatial measures. However, in Study 1 people were more pro spatial measures. Do you have an explanation for this?
MT: I guess because you have people from Limburg as well. Besides, the discussion about depoldering; that is not a flood measures but a nature restoration. Also, which has to be implemented because of flood measures that we took so we have to give back the nature. So, it's not for the people necessarily but for the nature. RFR in Belgium was quite successfully, is called the Sigma Plan. So, now we know, practically, that RFR works. However, RFR works less if we talk about the North-Sea because then we talk about more water than if we talk about rainfalls. However, the Sigma Plan showed us that is works, and also RFR is now also for safety and not sure of nature restoration.

ES: Okay, so the function of RFR and depoldering differs every much so have asked this to people in one questions; using spatial measures as overarching description?
MT: Yes, because the goal often differs. Depoldering was about farmland vs nature. Also, the debate was totally different.

ES: But, so we do have RFR in Belgium in the Sigma Plan?
MT: Yes, but people were also against this, and also in Nijmegen etc where we implemented RFR, people did not like any of the plans. Now everyone is proud of the achievements. This was also done for safety, and afterwards people are okay with it, which is quite human.

ES: So, these things can be used a lessons for Limburg?
MT: Theoretical yes, but the water difference every much. RFR is really a trend break because we try to focus more on building with nature and keeping nature in mind etc. However, we still also have to include people in this process. Because RFR really create a robust option. It is a trend is the way of thinking of people.

ES: Okay, so RFR needs more time to be hip amongst the people?
MT: Yes, but I'm not 100% sure how etc in Limburg. But I do know we need to have a 'conversation' now about what to do to improve the water safety etc in Limburg.

ES: Yes, but therefore I think it is interesting that spatial measures scored high. Because based on my personal knowledge, and friends in Valkenburg, I know that people do not want to move for RFR.
MT: Yes, but this might not be included in the questions?

ES: No, indeed, so the questions could have been to broad for the people. Answers would have been different if the questions would entail that people need to give up land or their homes etc.
MT: Yes, then the answers would definitely differ very much.

ES: Last questions, is about the warning system; but I guess that we already discussed this as we talked about communication.
MT: yes, but it is still interesting. Because the results do not surprise me, yet, nobody every talks about this, but it is so important. So, the results are very valuable. The story is very clear.

ES: Thank you! And also thanks for the time and have a nice day.
MT: You too, good luck.

F INTERVIEW WITH GERARD IJFF

At the beginning of this interview, two aspects were discussed: First, if we were allowed to record the interview. Second, we asked if we were allowed to use the interviewee's name in this thesis. The interviewee agreed with both questions, which is why their name and the interview are included in this Appendix.

Interviewer: Eva Schyns (ES)
Interviewee: Gerard Ijff (GI)

ES: I started by introducing myself. Also, here I explained Study 1 and Study 2.
GI: How did you decided to interview me?

ES: I was looking at the episode of Hofbar about the current situation in Limburg, where they reflected on how far we have come since the floods last year. And so I saw the interview with you, and your involvement in this, which is why I thought it would be valuable to have a conversation with you.
GI: Okay. I have a certain history with the water. I am originally a chemist, solid-state chemistry, so actually something completely different than say chemistry in water. But when I graduated from Groningen in 1981 and stayed there for a few more years, I started looking for a job at university and became head of the laboratory at the Limburg water board. And that's how I ended up in Limburg because I'm actually not Limburger by origin and I did that in Roermond for eighteen years. I live in Roermond and then in 2002 I was asked if I wanted to become an alderman in Roermond, so I became an alderman in Roermond until 2018. I have experienced a lot there but also experienced a lot in the field of water. Of course, because the Roermond is also located on the Maas. Well, then we had floods 93 and 95. But actually, in 2002 we also had a high water situation that almost went wrong. And well, after that a number of times that every now and then it went just right or wrong. Water continued to haunt me for a while. And then, in 2018 I stopped in Roermond and then I thought: well, it is time to slow down a bit towards retirement, and then in 2020 I was asked if I wanted to become an alderman as a kind of internal director in Meerssen which is located more North than Maastricht, but no doubt you know that.

ES: Yes.
GI: I said yes to that. Well, there were some jobs that needed to be done there to get things back on track. So all went well, until all of a sudden last July, or actually June and July last year, there were two huge rain showers, which suddenly made water an important item again. Until today actually. So then I was again in the middle of the water dossier and then I could of course use the experience from the past to see what is possible in Meerssen and especially to make it clear to the citizens. Well, what are we all doing as governments to prevent this? Because yes, such a storm can always come. But what do you do to limit the massive damage? We have worked hard on this over the past year.

ES: Yes, ok, well a lot of water related experiences. Thank you for making time for me. I'll explain the research a little further. *Here I explained Study 1 and Study 2 and the purpose of the interview.* I'll just start with the first point, which is about information related to flooding. In fact, 86 percent of my respondents said they have never

received information, which is a lot in my opinion, and 73 percent say they would really like to receive information. So I was actually wondering whether, based on your opinion, do you think that Rijkswaterstaat or the water boards could provide more information to citizens?
GI: Yes and no. Look, you should of course always provide as much information as possible. But I think the no is also important. Because what you just said in your introduction was interesting, because you compare Limburg with Zeeland. And then, in addition to the water difference between Zeeland and Limburg, you also have a cultural difference in the population and that can of course influence the result, so imagine that you have Zeeland in Limburg. Then the answers can be very different. Because simply the Limburgers well, let's say, complain more than Zeeland. Or complain less than the Zeeuw. Of course it can go both ways, but at least react differently. And the second element, which I think is very important for a good assessment of your results, is: the Limburgers have no water culture at all, say from Roermond, but the Meuse also flows from Maastricht through the municipality, the citizens look a bit anxious to the Meuse and the Meuse looks a bit anxious at the citizens. And that's all. So that rooting with the water that you have actually grown up with for generations, well, they don't know that here, so that the recipient, say the resident, is also much less open to information. So you can send a lot of information. But if the recipient isn't open to receiving that information, there's no point. I therefore find the entire water culture much more restrictive than, for example, the fact that information does not reach the public.

ES: And do you think last year's floods affect the current view of information? Those people may now be thinking; I would like to receive some more information.
GI: Yes, but that is of course quite limited in time. Look, that is still very topical now, maybe next year too, but in five years it will be a piece of historiography and then you say, remember, we were there; so then you kind of get that attitude. Look, who can tell with passion about the emotions that caused 93 and 95 and the situation in February, where things went well again, for example. Then we also had big problems, but everything went fine. So I think at some point the question of the day will also be who is going to rule. And then you get that the subject drops again until another crisis situation arises and then we understand that everyone is alert again.

ES: Yes I understand it. In the episode of Hofbar, Mark Harbers indicated that we as a country have too little knowledge to actually arrange everything. So about a year after the disaster, not everything has been resolved/restored. And not all new measures have been taken yet because we do not have the capacity for this. What did you think of this statement?
GI: Yes, I disagree with him, I would have made a slightly different statement in that broadcast. Look, when you talk about the total finesse of the total water system of the regional waters that was always behind the horizon, the Geul and the Jeker and the Niers, then what he says is correct. But that said, we already have a lot of information from the Meuse and a lot of work has been done over the past ten, fifteen years. The Maas border north of Maastricht has been completed, but more, many more measures have been taken up to Gennep approximately at this time. So a lot of work has already been done there. The total water system, the regional water and the effect of the regional waters on the water axis at height, so the Meuse, has always been underexposed, but that doesn't mean you can't handle anything. Of course you can already take measures. In the situation in Meerssen, the water came from three sides, from the sky (via rain), via the regional water (which was in fact the showers from the Ardennes), and the Meuse border, which threatened Meerssen from the West. And you can now look at all three, okay, what measures can we take to prevent that huge damage impact. And I thought he was very hesitant about that. And yes, we are now a year further and many studies have been done, which

are also very useful and interesting, but that is of no use to citizens. Citizens find it much more important to, for example, create a buffer at the Pletsmolen, those kinds of measures that citizens want to see. The Deltares report, about the situation from last year, states that a solution could be for Meerssen; compartmentalize the area to the north. And you can sit and wait for someone to investigate this, but you can also go ahead as a Municipality and say okay what would that look like? Perhaps a nice assignment for your successors. And what does that mean in terms of defense mechanism, because if you clear an area through compartmentalization, you clear an area of water but then it goes to another place. And how are those people still protected? So we can certainly do more than he said. But Rijkswaterstaat has already done a lot, especially in Meerssen, especially with regard to overdue maintenance. And as far as I'm concerned, more than the Water Board has done until now. And what we have also been working on a lot is who owns which water boards in that Meerssen area, we have been working on that for six months. Until a few months ago and that we had a cascade in Meerssen that hadn't been maintained at all and hadn't been used for 30 years. And now it turns out that it belongs to the municipality. So for all three governments, it is not well mapped out which things belong to whom. And if you do this correctly, you know who is responsible and who can take action. And then that is something else, that was what the Minister meant by calculating the entire water system.

ES: Okay. So there is also a problem with the transparency and communication between different involved parties? Such as Waterschap, Rijkswaterstaat and Municipalities?
GI: Yes, but this has improved. One of the valuable pieces of advice from the 'Beleidstafel'; is concern for one-sided communication from the government. When I look at Meerssen; Both Rijkswaterstaat and the Water Board are convinced that communication can best run from the municipality. After all, the municipality has a direct relationship with the population. And we as a municipality have a website where we have bundled all the water reports together. We also indicate here if there is a code Yellow, for example and the citizens know if I want to know the current situation about the water, then I have to check the site of the municipality. Even if citizens want to view the reports for their area, they know that this can be found on our website.

ES: And this is the site of the Municipality of Meerssen itself?
GI: Yes, we have a separate chapter on flooding there.

ES: Okay, and the citizens of Meerssen now about this?
GI: Yes. What we also did in Meerssen; my college has started a kind of support group for each area where we have had floods. And let the citizens tell what they have experienced without starting something like 'yes, but that is not from the municipality' or 'yes, but etc'. No, we listen to their stories and what they experienced during this period. And those groups are still in existence, but I think we will disband them in September. But many measures and very direct communication with the population come from these groups. And also a specific what we can do in your area. This has ensured, for example, that in the area where the Geul; where the water has literally flowed through the houses; where the advice was yes open the doors as it literally flows from front to back through the house. And here, for example, someone was trapped in the basement and he couldn't open the door because the water pressure was too high and the water continued to rise. And in the end someone else did get the door open on time. But you understand that this does cause panic. And those citizens have indicated that we want a shot to prevent the water from entering the house again from the garden. Well, we as a municipality think this is a good solution; Water board did not want to participate; but we do it anyway. With the help of the national disaster fund we partly split the costs and

the people get the shot for free. And these people could, for example, go on holiday with peace of mind knowing that the house is better protected. This direct line with citizens results in us knowing what kind of measures they want, and we also get to work together.

ES: Okay, so the knowledge amongst the citizens is high. We also have Water Stopt Nu which is led by citizens. So can I state that you are pro- the improvement of the involvement of citizens?
GI: Yes, I also have a meeting with Water Stops Nu once a month to catch up. And then it is mainly about the water system and how we can prevent a recurrence. What they do is make sure it stays on the agenda. And we also try to take real steps forward from the expert side. For example, we have agreed that we will draw up a kind of self-help plan for that area with five groups in Meerssen. So when the water comes, we use a certain signaling level system, so we get a notification if it gets too high. And that there is also better communication between the municipality and the population; we have to come with sand. If the citizens indicate, yes. Then the municipality comes with a truck to that area and people have bags that they can fill with this sand. And so we can start early with actions. Similar to spreading salt on the roads when it can get slippery. This is also possible with a citizen plan; the neighborhood has a contact person and its own neighborhood app; with which they can also inform each other. For example, who needs help with filling the pockets of 'weaker' people, etc. You can agree on a whole lot of things in advance. We are working with Water-stop Nu to guide three groups and Water-stop Nu to guide the other two. This is fixed and you have to update a few years and then you can always do it like this

ES: This is a very interesting insight. Because people want to be more involved and use their knowledge to, together, be more prepared. In other interviews, the questions I asked related to participation was interpreted differently because they stated that it is difficult to work with people because of different level of knowledge. So, I find it very interesting that in Meerssen, you just do it, and it appears to work.
GI: Yeah, look, we're closest to the civilians. And Rijkswaterstaat or water boards can never take over this. We communicate through website or plans that bring a lot to the fore. And that way we can better involve the citizens. And to come back to the first question; how can citizens not get a lot of information about what is going on? This is also a way to enhance the citizen's sense of water.

ES: Yes. And I also think that the information that is provided focuses on awareness but should be more about preparedness. Also, in the 'Beleidstafel' it was stated that 'we should increase the awareness because only then we can think about how to be prepared'. Do you share this thougt, that the focus might be wrong?
GI: Yes I think this is definitely the case. About ten years ago, an OECD report was published on water management and its organization in the Netherlands. And I was involved in that as Aldermen, but one of the conclusions was that it is so well organized in the Netherlands that nobody is aware that we have a problem here. People assume that it is well arranged; so your comment may refer back to that report. Particularly in the West, the problems are so great that it must also be properly arranged. You can't just leave this to the first best government agency. Some Master's students from Maastricht University, when I was still working in the laboratory, who studied cultural anthropology, told me: You have a social problem, which you translate into research and in the end you come up with social answers. And I think, especially in the technical world, we should make much more use of experience in cultural anthropology. Especially when communicating with the population. How you ensure that the message you want to put out is actually received by the other side.

ES: Yes. And it should be something that has to be done correctly. This definitely needs more attention. Also, the level of worry was very low amongst the respondents. Other interviewee indicate that this has to do with the trust in the Dutch government. Furthermore, they said that this could be because of the experience people have with the government that the water safety in the Netherlands. Do you agree with this?
GI: No. Look, I was born in Amsterdam, so I have a broader picture of water than just Limburg. In Limburg, in principle, nobody dies from water, you can get wet feet and if it gets really bad, it can come to your knees. And then that is different from, for example, in Delft or the surrounding area, where the water can reach a height of 3 meters. So the consequences are different between different areas. There are many areas that are far below sea level and I noticed that awareness is not present in Limburg.

ES: Okay. but the level of worry is also low in Zeeland. Could be because of the culture, because people there are very familiar with water and its consequences. So, might some level of trust might play a role in Zeeland. But then it seems that this is very different than in Limburg.
GI: You have multiple variables; two actually. There is an enormous risk situation in Zeeland, which Rijkswaterstaat and Water Boards naturally anticipate by taking technical measures, so that confidence is also high, and you have the situation in Limburg where the risks are much smaller, but the measures also only have a short history. I think the Limburg Water Board has only been around since the sixties. And in North and South Holland those Water Boards have been around for 400 years and we have noticed the difference.

ES: Okay. I understand that these are two completely different cultures. Another questions; the warning systems were very unclear and unknown amongst the respondents. What do you think can be improved?
GI: You have two things; official warning system that is present in the Meuse and what the Water Board is working on to create this also for the regional places; therefore cross-border. But an entire system has already been set up about for water levels. And you can set it and you will receive a message on your phone when a certain level has been reached. So you don't have to wait for the government; you can already set this yourself on your phone. And then take a good look at what the most convenient value is. So that we get a warning in time. These are also things that we want to improve through those groups.

ES: Okay clear. I created a policy recommendation for my thesis *here I explain the two plans included in Section 7.* The questions was; do you think that this is a realistic policy recommendation?
GI: I would not call it regional but local. Because in Meerssen, for example, we already have five local groups. Something practical that is in line with what you just said; what we have found out about thanks to those groups is for example; where do you leave your car? And these are indeed important issues that are difficult to solve; because important roads must remain accessible. So all kinds of practical points that can be tackled locally. But what should be done regionally, for example, is a signaling system whereby the Water Board helps to understand, for instance, which measuring points should be taken; which limits there are; and how long you have to take measures. Those are things that must be experimentally proved; so we also said we shouldn't start by solving everything completely. No, start somewhere and if we find out in a while that it could be done better, we can always adjust it. So don't look for the ultimate certainty, and literally spend too long on drafting; but just start practically with the knowledge of now and evaluate this and with the experience you have you can still adjust. Besides, in 80% of cases, it's usually not too worrisome cases but in those 20% where it can become extreme cases. Then; we

must arrange that the information and communication that we have achieved with citizen groups is properly transferred to the security regions that take over in those cases. Do we ensure that the link from the security region to the groups that are already active remains correctly? Does that come directly from the regions or are there municipalities in between? Those are real issues that we still run into. Because we should not have all kinds of different organizations giving different information to citizens in the event of a flood.

ES: Yes. Because this is again the communication that has to be improved. And plans should be clear to all parties involved.
GI: The security region deals with all kinds of disasters and water is only a small part of that. An car accident on the highway or something can be resolved fairly quickly. But a water disaster is often long-lasting, so how do you deal with it. Bird flu, for example, was also a long-term situation for which the security region is less well equipped. Because then replacement has to be arranged and these things are not properly arranged; so in disasters that last approximately longer than 24 hours; how do you deal with this in the structure within the security regions?

ES: Okay. So several every practical aspects still need to be address within the involved parties.
GI:Yes, and then you also have the Water Board, which does not have a very logical place in the event of disasters. As I just said, citizens are already working with us during a threatening situation but surrendering this when the other authorities take over then it becomes difficult.

ES: Yes. These are all things can would be interesting and needed to investigate further.
GI: Yes. And we just have to start somewhere. In the Deltares rapport; very interesting but just start with implementing something. For example, they talk about a Dyke at the North of the Geul but then all the water will be at the South of the Geul. And that results in many other issues, which we do not know yet. So, we should not calculate every little detail but just start with something and get results. The sense of urgency is less amongst other authorities than with us. Maybe because we have the direct contact with the citizens. Also, insurance parties will also not cover things every time this will happen.

ES: Yes. And speaking of flood measures. Do you think RFR is realistic in Limburg?
GI: Yes. I mean people have been working on this for over ten yeas. So, where possible, like in Roermond, definitely do this. But this should also be implemented in the regional rivers and bigger streams, such as the Geul. And make plans with for example camping's around these places in case of a flood.

ES: Okay. In the future, we should keep increasing the participation of the citizens?
GI: Yes and include the culture anthropological aspects, which is not always part of a technical organization. And that the receiver actually wants to receive information. Because often people say; the government does not communicate; while people actually received so many letters etc; but these letters end up in the garbage but people do not read this. This is more the problem than the intensity of the provided information.

ES: Okay. So its a two-way street.
GI: Yes. For example, if you want to disconnect a downspout; how do you find out how this work? And find an answers to a specific question you want to ask. So, how do we find information for questions?

ES: Yes, and then for the one who is providing this information; how do to create a place where people know where to find it?
GI: Yes. Because people want to go to a specific website to find everything. And that is the culture anthropological aspect of this, we need to understand what we need to do. All involved parties.

ES: Yes so again it is about practical aspects which are unanswered but should be clear. Ok, I'm through my questions. Do you have anything else you would like to say after this conversation?
GI: Yes, it would be interesting to do future research about this same topic but then between Limburg now and in the future. Because this study is depending on time and external factors that differ between the two studies. But is there a trend? And what do you learn from this study from Zeeland, for the future if you would like to study a comparison in Limburg? And what is the time period for this, 5 years or?

ES: Yes so advice on the method I used, which is also nice for other parts in the Netherlands. Good Point. Thanks for the time and information, very insightful!
GI: Goodluck!

G | INTERVIEW WITH JACQUES EIJKELENBERG

At the beginning of this interview, we asked if we were allowed to use the interviewee's name in this thesis. The interviewee agreed, which is why their name and the interview are included in this Appendix.

Interviewer: Eva Schyns
Interviewee: Jacques Eijkelenberg

This interview was not recorded that is why a list of the most insightful aspects is given:

- Jacques Eijkelenberg worked as an adviser at the Atelier Rijksbouwmeester, where he specialized in the philological and geological aspects. Since he believes that perceptions should be looked at from a broad perspective.
- Risk perceptions play a role in the mentality of the people.
- Rijkswaterstaat is a state within a state, which is something special. However, over the last few years, Rijkswaterstaat has been losing its expertise and is becoming more like a management organization. As Dutch citizens and as a country, we are vulnerable to water. With this vulnerability comes dependence on the experts and maintenance that Rijkswaterstaat provides. And the fear of water is the underlying rooted aspect that almost makes it a tradition to trust the government.
- Also, within the water systems, there is a form of dominance. The government can include people in the process regarding flood risk management plans or other topics. Still, behind the scene, there will always be a form of hierarchy. Because of hierarchy, the water systems will not work because, at the end of the day, these are not democratic systems. There should be a higher level of experts to make decisions. The House of Representatives agreed when they denied the question to make the Waterschap a democratic organization. Also, because people should be authorized to make fast decisions in an emergency, it would take much time to include others in this process.
- Furthermore, trust is also built because we believe that the experts and professionals are responsible and experts. However, the low level of worry has nothing to do with this. That is because we as people do not want to be constantly in fear. We know it is risky to live near rivers or seas, but it is not something we want to be reminded of constantly. No, in fact, we repress our fears.
- Also, it makes sense that the water culture is different in Zeeland and Limburg because there is different history. Some places in Zeeland are literally built, there was nothing, it was all water. And in Limburg, there is so much history around, for instance, the Meuse.
- Water is the most fundamental aspect of life. Without water, there is no culture. And we are all dependent on water. Therefore, it is weird that it can simultaneously be so frightening and beautiful. The water culture is different between Limburg and Zeeland. In Limburg, the rivers are ”life veins”. And in Zeeland: deluge.

- In Valkenburg, agriculture is now so large-scale that the water flows directly into the Geul. This was not the case in the past when it was still held back by the hedges. These are also things that municipalities and council members have approved.

COLOPHON

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