

University of Groningen  
Faculty of Spatial Sciences  
Population Studies

Bachelor Project

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**Disaster Risk Reduction and community  
resilience-building actions in Zierikzee:**  
*Coping with climate change risks and impacts in a flood-prone area*

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## **Abstract**

Climate change is an upcoming problem in today's society. With a rising sea level, some flood-prone areas have an increased chance of flood risk. Disaster Risk Reduction is the development of strategies and practices to reduce vulnerabilities and disasters risk (flood risk) throughout society. This case study aims to see what DRR and community resilience-building actions have been, are being or will be undertaken in Zierikzee regarding climate change and impacts.

Using qualitative data collection outcomes on residents of Zierikzee will be used to see if Zierikzee is ready for climate change. Zierikzee is used in this case study because it was based on several requirements. Zierikzee is struck by a past flood, combined with flood prevention measures, and also has future flood prevention measures through a more sustainable project. Small quantitative data is used to support arguments.

Zierikzee is currently working on small initiatives regarding climate change, but the inhabitants completely trust the primary flood prevention measures. There are community resilience-building actions such as the Watersnoodmuseum but different measures should be undertaken. New and accurate emergency plans should be distributed on a local scale to make sure people have a current plan on what should happen during a new disaster.

**Keywords:** Community Resilience, Flood prevention, Delta Region, Disaster Risk Reduction

# 1. Introduction

## 1.1 Background

Climate change is a global issue causing multiple effects. A rise in temperatures, changes in precipitation patterns, more heatwaves, sea-level rise and many other global environmental changes can all be seen as a consequence of climate change (Jackson, 2021). Sea level rise is a great risk for flood-prone areas. Water retaining structures, such as dams and dykes, may not cope alone with the sea level rise that happens due to climate change. In the Netherlands, where one-third of the country lies under sea level, sea-level rise is an issue of great concern the country has to cope with (Netherlands Tourism, 2021).

Projects such as the Afsluitdijk and the Delta Programme are built to prevent disasters such as the Watersnoodramp in 1953. The Watersnoodramp is in the Netherlands the biggest natural disaster of the 20<sup>th</sup> century (Rijkswaterstaat, 2021). In more than 150 places in Zeeland, South Holland and North Brabant, the dykes broke because they could not handle the amount of water. When the second tidal wave happened, even the lives of even more victims were claimed than the first. The Delta Programme consists of storm surge barriers, sluices and dams (Rijksoverheid, 2021).

A problem arose because the Delta Programme did not account for climate change risk and the fast sea level rise in their project (Eenvandaag, 2018). Frank Spaargaren, engineer of the built of the Delta Programme in 1986, "If the Oosterscheldkering has been calculated for a sea-level rise of 40 centimetres. If the whole thing rises by a meter, you can write it off". (Eenvandaag, 2018). In an international study led by Nanyang Technological University, scientists found that the global mean sea-level rise could exceed 1 meter by 2100 if global targets on emissions are not achieved. (Sciencedaily, 2020). The Delta Programme uses adaptive delta management: to respond flexibly to new measurements and insights into, for example, the climate.

This Bachelor Project aims to investigate by using the DRR and resilience paradigm the resilience of people living in Zierikzee and the extent to which climate change risks and community resilience-building strategies were integrated within past flood prevention measures implemented in this area. Findings will be relevant in future DRR and community resilience-building strategies in flood-prone areas.

## 1.2 Aim and Research Questions

In this Bachelors Project, the aim of my research is to investigate flood prevention measures implemented (and likely to be implemented) in the Delta Program within the Delta Region, and, more specifically, in Zierikzee. Using the DRR and resilience paradigm, this research will investigate whether and how climate change risks and community resilience-building strategies were integrated (or will be integrated) in flood prevention measures implemented in the region of Zierikzee included in the Delta Program. The central question of this research is:

*"What Disaster Risk Reduction and community resilience-building actions were undertaken in the flood-prone Delta region of Zierikzee, The Netherlands, to cope with climate change risks and impacts?"*

This central question is used to gain in-depth knowledge of past, present and future DRR and community resilience-building strategies for projects preventing flooding in Zierikzee. This knowledge can eventually be applied to the Delta Region to see the drivers of and constraints to DRR and community resilience strategies, and how these strategies can be integrated within the Delta Programme to better cope with the risk of sea-level rise and other climate change risks.

Secondary questions that will arise out of the central question which will be answered are:

- *What is climate change?*
- *What is Disaster Risk Reduction and resilience paradigm?*
- *What is the Delta Region and how is this region affected by climate change risk?*
- *What is the Delta Program and what are the main past flood prevention measures implemented within the Delta Program?*
- *What were the past flood disasters that affected Zierikzee?*
- *What is the history of social changes and impacts these disasters created in Zierikzee?*
- *Did local people living in Zierikzee put in place their community resilience to cope with past flood disasters?*
- *What flood prevention measures were implemented or will be likely to be implemented in Zierikzee?*
- *Did these interventions engage local people's resilience?*
- *What are the perceptions of people towards these interventions?*
- *How can this resilience be strengthened in planning future flood prevention measures?*

These sub-questions are necessary to get a deeper understanding of: the Delta Region and Zierikzee; the flood risk that characterizes this region and the specific locality of Zierikzee; the past floods and the social impacts created on local people's wellbeing in this specific region; the local community resilience and how this influences local people living in this area at risk; the past flood prevention measures that were implemented in the Delta region, and more specifically in Zierikzee; and how local resilience was engaged and strengthened and/or can be strengthened by future flood prevention measures in this area. Besides potential solutions for both the Delta Region and the community behind the Delta Programme will be discussed.

### **1.3 Structure**

This bachelor project is structured as follows: first of all, a theoretical framework is constructed where relevant literature about the topic is discussed and a conceptual model is developed to explain the theoretical framework combined with the data and result section. After the theoretical framework, data and methods will be discussed. Following this is the result section, where the main results of the bachelor project are explained and where results relevant to the research question are highlighted. The last chapter of the Bachelor Project includes the conclusion. The conclusion highlights the research aim and highlights the relevant results

## 2. Theoretical framework and conceptual model

### 2.1 Introduction

In this Bachelor Project, the climate change-related flood risk characterizing the Delta Region, and more specifically in Zierikzee. And flood prevention measures implemented in this area are analyzed and discussed.

#### 2.1.1 The social dimensions of disaster risk

By definition, disasters always have severe social impacts on the multiple dimensions of local community wellbeing (Imperiale and Vanclay, 2021). Health, community, culture, livelihoods, infrastructure, housing and environments and land are impacts categorized as affecting people's life. (Smyth and Vanclay, 2017). Flooding in socio-economical areas produces a variety of negative impacts on the impacts categorized above. Loss of life, damaged property, destroy communication links and damage infrastructure are just some examples of impacts a flood can have in an area (Floodmanagement, 2013).

A disaster has multiple dimensions: (a) the characteristics of the hazard; (b) the social dimensions of risks and impacts, including how they are perceived, experienced and distributed; (c) the social pre-conditions of disaster; (d) the capacity of local people to learn from past failures and disasters, and to transform towards sustainability at all levels of social-ecological governance; (e) the principles, goals, and methods embedded in disaster risk management and post-disaster interventions; and (f) the effectiveness of the social processes, services, and support available to a community before and after a disaster. (Imperiale and Vanclay, 2021). Understanding a disaster and how to prevent disasters, requires an understanding of all of these dimensions. Although all people are vulnerable to disasters, some people/groups are more vulnerable than others. The root causes of disasters are both the history of past development and associated social change processes and impacts *and* the local vulnerabilities and social risk processes and outcomes that emerge over time. Together with insufficient capacity to reduce local vulnerabilities, risks and hazard exposure, these root causes are also the social pre-conditions of disaster. (Imperiale and Vanclay, 2021).

#### 2.1.2 Hazard

Disaster Risk is understood as the interaction between the impacts (consequence) and the likelihood (probability) of a hazard (Coppola, 2015; Miller et al., 2010). The exact definition of a hazard used in this Bachelor Project is "an event, an agent, or the physical conditions that have potential to cause fatalities or injuries or to affect the multiple dimensions of community well being. The hazard in this project is a natural hazard (flood) caused by a socio-natural problem (climate change). A hazard can become a disaster through risks. The risks associated with the hazard is determined by the characteristics of the hazard, the hazard exposure and susceptibility. The last two concepts are exacerbated by local vulnerabilities. (Imperiale and Vanclay, 2021). The intensity and extent of the risks are influenced by the physical, social, economic and environmental vulnerabilities of a community, which worsen the social impacts and the likelihood of disaster.

A local community can reduce hazard exposure (and thus disasters) by local capacity and community resilience. Community resilience is the capacity of the community to learn from past failures, crises and disasters and to transform towards reducing the social pre-conditions of disasters and hence community wellbeing. (Imperiale and Vanclay, 2021).

Flood risk is a function of the flood hazard, the exposed values and their vulnerability. (Wolfgang, 2005). The flood hazard; the occurrence frequency and magnitude of high flows can be attributed to human activities, even the ongoing shift in the hydrologic regime due to climate change (Wolfgang, 2005). Also in Zeeland, climate change affects the flood hazard (Eenvandaag, 2018).

### 2.1.3 DRR

Disaster Risk Reduction is in this research equal to flood prevention. Disaster Risk Reduction is broadly understood to mean the development and application of policies, strategies and practices to reduce vulnerabilities and disaster risks throughout society (Twigg, 2015). Disasters are a result of a combination of factors: the nature of the particular hazard or hazards; the extent to which people and their possessions are exposed to them; the vulnerability of those people and assets; and their capacity to reduce or cope with the potential harm. The Disasters where we are interested in are the natural hazards of floods (Twigg, 2015). Pursuing inclusive social learning from past failures, crises and disasters and integrating DRR is crucial to reverse ongoing degradation and make sure the Delta Region becomes stable and disaster-free. It is important to integrate DRR and community resilience into development 4P and change the mindset of ‘Managing the impacts’ to “reduce risks and build resilience” (Imperiale and Vanclay, 2021). To this date, most Dutch flood-risk assessments have focused on physical risk, for example, the comprehensive disaster impact assessment ‘Flood Risk in The Netherlands’, which takes into account environmental factors such as mean elevation and sea-level rise, along with the likelihood of failures of flood protection structures (VNK2, 2012). A fine-scale social vulnerability assessment could provide additional insight to support disaster planning at a local level.

More on Disaster Risk Reduction, Zeeland joins the European Project FRAMES (Flood Resilient Areas by Multi-Layered Safety). The province of Zeeland, together with FRAMES, looks at how Zeeland can be secure on three different layers. Layer 1: How to prevent floods. Layer 2 is about how to reduce damage and victims, by a detailed investigation of how to plan the province of Zeeland the best. The spatial adaptation of the area. Research in layer 3 investigates where and how people evacuate, also known as the emergency response. And at last, layer 4 is about resilient recovery. Be already prepared on how to recover from a disaster. (Zeeland.nl; FRAMES, 2021)

### 2.1.4 Community Resilience

One main concept to define community resilience is the definition used by Imperiale & Vanclay (2016a): “Community resilience can be understood as “the social survival processes that occur within a place that is put into action by local communities to address the negative social and economic impacts they perceive as common problems during a crisis.” Community Resilience is the self-organizing nature of communities, comprised of skilful people who possess resources and organizational capacities that can provide services to people at risk (Coles and Bucke, 2004; Imperiale, 2016).

Hazard exposure and susceptibility are reduced by local capacity and community resilience (Imperiale & Vanclay, 2021). The extent, intensity and frequency of the risk of a hazard becoming a disaster is inversely proportional to the extent of local capacity and community resilience.

Community resilience consists of two dimensions. The cognitive dimensions orient their intentionality toward reducing local vulnerabilities, risks and impacts and enhancing community wellbeing, whilst at the interactional dimension individual and collective actions and behaviours represent which resilience comes into action and the local community level. (Imperiale and Vanclay, 2021). Improving community resilience in Zeeland is something that should be taken into account. In 2007, the European Union Floods Directive encouraged member nations to pursue a more integrated view of flood risk and management strategies, taking into account the social vulnerabilities of residents (Kirby et al., 2019) To date, most flood-risk analyses conducted by the Dutch government have focused on physical risk. The study conducted 25 factors of social vulnerability in Zeeland, however, 7 of these explained roughly 66% of the total variance. The factors of social vulnerability in Zeeland are: Urban

density, low-income households, recent population change, female gender, train access, and self-employed and service-sector employment. The most vulnerable districts are located in South Zeeland(Kirby et al., 2019).

### **2.1.5 SIA Framework for Action**

There are already some frameworks used regarding resilience in both infrastructure and community. The SIA Framework for Action is used in the article of Imperiale and Vanclay (2016) to improve community development outcomes. The SIA Framework for Action considers the social dimensions of risk reduction. How community resilience can be strengthened to enhance DRR. SIA focuses on the impacts of climate change on local communities and how people cope with climate change and contribute together to improve DRR along with the resilience of infrastructure. The SIA Framework for Action will especially focus on the recognizing part of the framework. Recognizing takes for example 'Informing key local actors about the proposed intervention' and 'Recognizing local knowledge and capacities' into consideration.

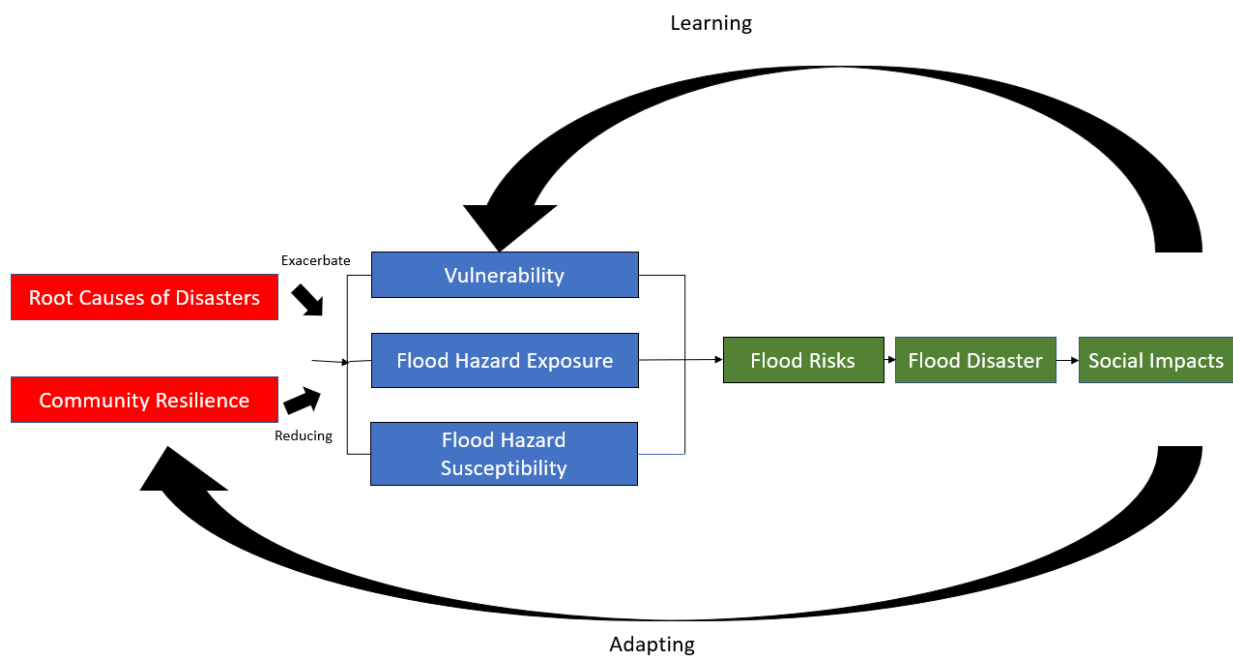
The scope of the SIA Framework For Action is a set of actions that social practitioners can implement together with local communities to help decision-makers, development agencies, and local communities achieve improved social outcomes through enhanced understanding and better management of the social issues associated with development projects (Imperiale and Vanclay, 2016b). The SIA Framework for Action helps in codesigning "transformations towards sustainability" and has 4 different phases. Understanding the local context, recognizing local concerns and capacities, engaging local communities and empowering sustainable transformations. Or in short: understanding, recognizing, engaging and empowering. (Imperiale and Vanclay, 2016b). Addressing the SIA Framework for Action on the local community flood-prone areas, promoting collective feelings such as solidarity and social responsibility. When a disaster strikes, the local community can be more prepared.



## 2.2 Conceptual model

Figure 5 shows the conceptual model based on the literature review. The conceptual model is based on the model of Imperiale and Vanclay (2021). The conceptual model shows the multiple dimensions of risk based on floods. Vulnerability, capacity to flood hazard exposure and flood hazard susceptibility combined with the root causes of disasters and community resilience form together with the multiple dimensions of flood risk. These flood risks can eventually lead to flood disasters. Learning from previous flood disasters (Social impacts) cause improved community resilience, combined with a better vulnerability. This will decrease flood risks in the long run.

Figure 1: Conceptual Model



Source: Author

## 2.3 Hypotheses

To answer the main research question, combined with the sub-questions, several hypotheses are tested. The hypothesis are based on the theoretical framework, combined with the conceptual model as you can see in figure 1. Hypotheses are tested using the questionnaire,

Hypothesis 1: There is no correlation between community resilience on the cognitive level compared to the interactional level in Zierikzee.

Hypothesis 2: Past flood prevention measures did engage resilience of the residents in Zierikzee.

### 3. Methodology

#### 3.1 Mixed-method approach

This case study aims to investigate to which extent climate change risk and community resilience-building strategies are integrated into the flood risk prevention measures. This will be done using a case study of the village Zierikzee in Zeeland. Zierikzee is used as an example because it was hit by previous floods, where for this reason flood prevention measures are installed. Contributing to the project 'Zeelandleeftmee', where different towns in Zeeland become more sustainable to prevent climate change and in addition flood risks. Zierikzee already adjusts the local petting zoo to a more sustainable city farm. Using Zierikzee as a case study, I try to answer the main research question: *"What Disaster Risk Reduction and community resilience-building actions have been, are being or will be undertaken in the flood-prone Delta region of Zierikzee, The Netherlands, to cope with climate change risks and impacts?"*

To answer the main question, a qualitative data research method is used. This research will use a semi-structured interview, based on residents of Zierikzee. In corona times it is harder to get in contact with residents. Using a Facebook group called 'Zierikzeenieuws', support for answering questions based on their villages is asked. The questions are based on DRR and community resilience-building actions in Zierikzee. Using a semi-structured interview it possible to engage with the participants on the relevant topic and keep it centralized, whilst also making sure that the participants are not limited in their story (Clifford et al., 2016; Longhurst, 2016). The interview and the survey will be in Dutch, as all the interviewees will be Dutch. The interviewees will be explained what the exact context is and terms will be defined if they are unable to comprehend. Using a coding tree which can be seen in Appendix 2, answers are linked to either community resilience or social impacts if relevant.

An old director of the Watersnoodmuseum helped to find relevant interviewees in Zierikzee. He found 4 other relevant participants. All these participants are called or video called and recorded.

Combined they are; 5 people from Zierikzee. Two of them are old directors of the Watersnoodmuseum and very active in the community. One is a former archivist in Zierikzee and two interviewees are currently a member in water boards in The Netherlands. All received questions about community resilience in Zierikzee, whilst the two members of the water boards got additional questions regarding planning. All of these interviewees were alive during the Watersnoodramp in 1953.

The questionnaire makes use of various statements where participants answer on a 5-point scales basis, ranged from totally disagree (1), disagree (2), neutral (3), agree (4) and totally agree (5). The statements are grouped based on themes 'cognitive level' and 'interactional level'. At the cognitive level, empathy, social responsibility, perception of shared needs, local knowledge, values, beliefs and narratives are grouped on a point scale. At the interactional level, the actions and behaviours of the residents of Zierikzee, such as memorials and other collective actions are grouped together. It also includes boxed questions about what kind of community resilience they see in Zierikzee.

##### 3.1.2 Representativeness of the sample

In the Facebook group 'Zierikzeenieuws', there are 6300 active members. The current amount of inhabitants in Zierikzee is 11.460 in May 2020. Of these 6300, 26 answered the online questionnaire. Primary data was collected by distributing a questionnaire between inhabitants. With corona measures in place, the questionnaire was distributed via the Facebook group 'ZierikzeeNieuws'. This active Facebook group with 6.300 members as of April 2021. The full questionnaire is provided in Appendix 1. and gathered data on inhabitants' view on community resilience and opened. Because of the small sample, it is only used as additional supporting data.

### 3.1.2 Ethical Considerations

During data collection, it is necessary to take into account that I'm an outsider in the region. It is useful to have contact with locals beforehand to see if they are interested in an interview and be willing to participate. The interviews will be completely anonymous and privacy is first. It is useful to be as diverse as possible whilst interviewing locals, to see how community resilience takes place and who contributes the most and/or least.

Also, the interviewees will be told what his /her rights are. They are not required to answer each and every question and can stop the interview when they want. The participants are asked if the (video) call could be recorded.

## 3.3 Case Study

### 3.3.1 Zierikzee

Zierikzee (Figure 1 & 2) is chosen because of certain criteria. First of all, it was affected by past flood events, namely the big Watersnoodramp in 1953. The island Schouwen-Duiveland, where Zierikzee residences, was almost completely overflowed (Figure 3). To adapt to future floodings, flood prevention measures took place. Within a year, the start of the Delta Programme began. This massive physical flood prevention measure consists of 5 storm surge barriers, 2 sluices and 6 dams and was finished in 1997 (Rijkswaterstaat, 2021). Rijkswaterstaat has an extraordinary event scenario for floods in the Netherlands. Figure 4 shows Zierikzee when primary flood defences which can withstand flooding with a probability of once every 10,000 years or less should still fail. As you can see on the map, Zierikzee will be flooded with 2 to 5 meters of water. If the Delta Programme is indeed not suited for climate change, as stated before, this primary flood defence will fail and Zierikzee will overflow.

At last, Zierikzee also has future flood prevention measures taken place. Zierikzee is slowly starting to be more sustainable. The local petting zoo is turning into a sustainable city farm. The main goal of this farm is to show how residents of Zierikzee can help in becoming a climate-adaptive village. Stimulating to turn garden tiles into green and the use of rain barrels will slowly contribute to climate adaption (Zeelandverandertmee.nl, 2021).

This study is about Zierikzee, however Figure 3 shows the whole island Schouwen-Duiveland. Every interviewee explained implicitly that Zierikzee is part of Schouwen-Duiveland and that this area can also be seen as a whole. *"People talk about 'the island', instead of an area-specific" (Interviewee 2, 2021).*

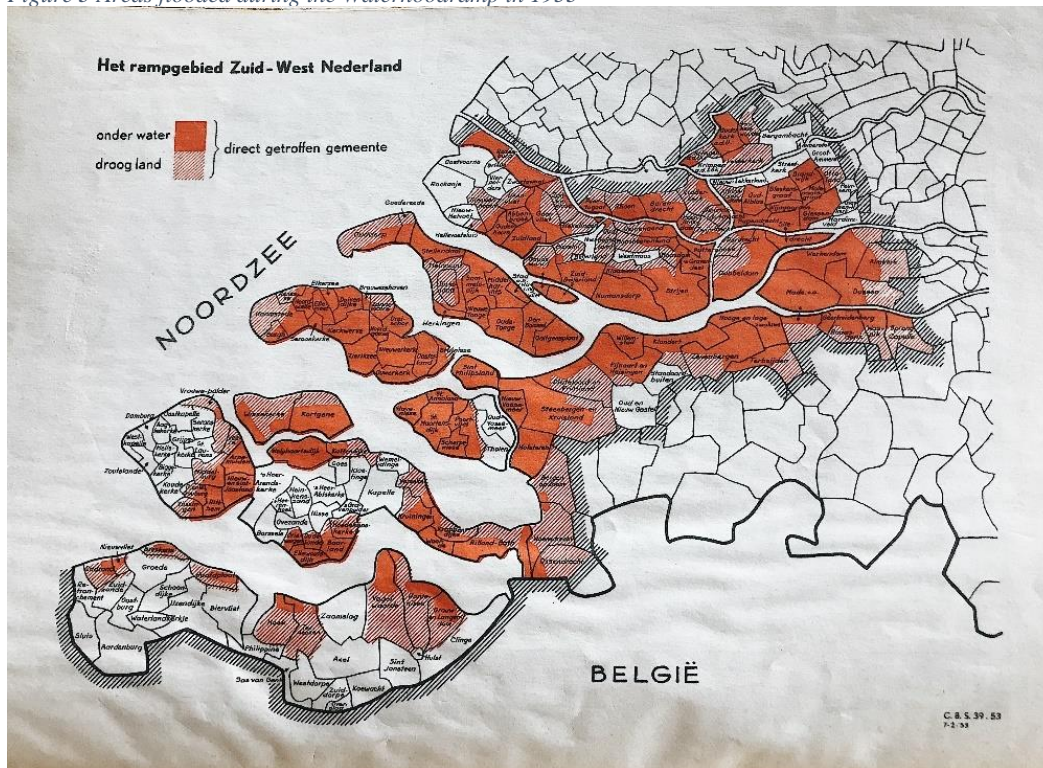
Figure 2: Zierikzee, Zeeland



## Borders of Zierikzee in the Netherlands

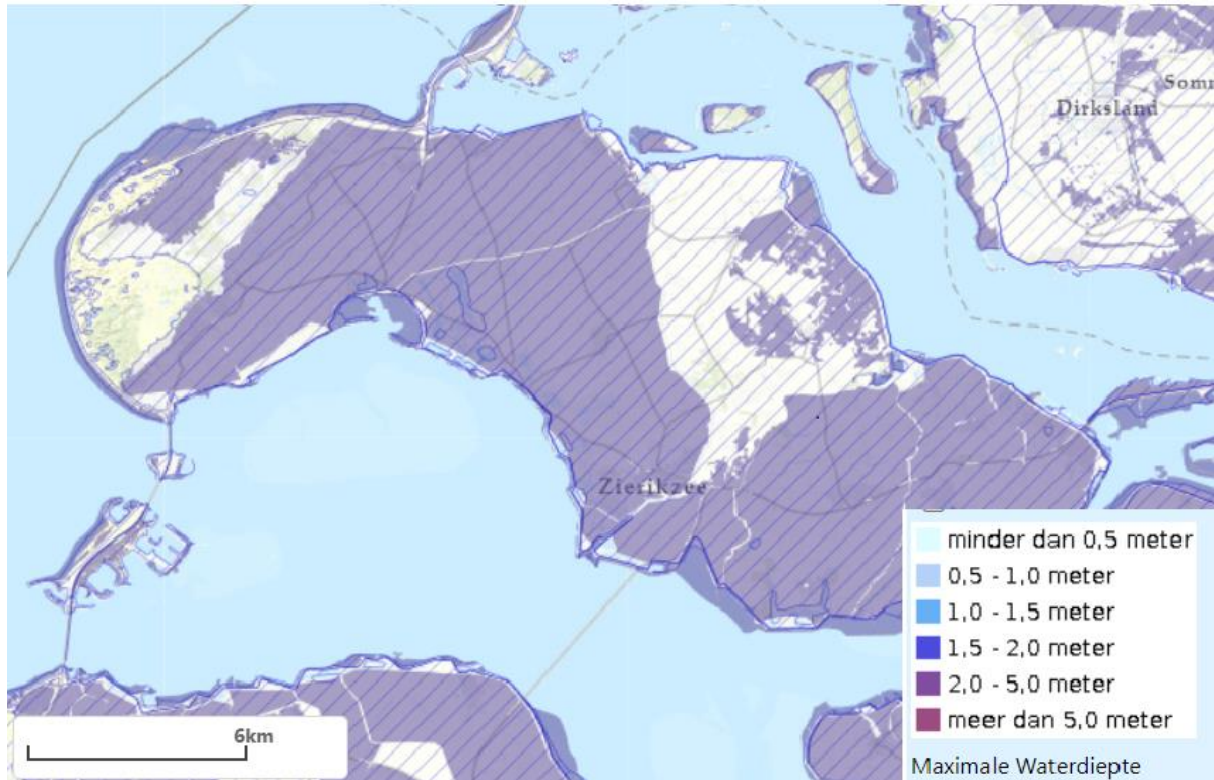
Source: Author

Figure 3 Areas flooded during the Waternoodramp in 1953



Source: cbs.nl (2019).

Figure 4 Flood risks during extra-ordinary events in Schouwen-Duiveland



Source: Author

Potential flood hazard could lead to a disaster if no flood prevention measures and community-resilience building strategies are implemented and if local people and their localities keep being vulnerable and exposed to flood risks and impacts.

### 3.3.2 Flood Risks In Zeeland

As said before, the European Union Floods Directive encouraged member nations to pursue a more integrated view of flood risks and management strategies. Zeeland has a primary physical focus on flood prevention and could benefit from looking at the social vulnerabilities of residents (Kirby et al., 2019). Which district in Zeeland has the highest social vulnerability is determined by the index by the study of Kirby et al, 2019. Zeeland was divided into 147 districts and the highest score was 0.64 in Oudelandse Hoeve of Terneuzen. South Zeeland has the most vulnerable districts, with 8 out of the top 10 most vulnerable districts were located in Terneuzen. The majority of less vulnerable districts are in the centrum of Zeeland (Kirby et al., 2019). Dealing with the physical side of flood risk, there are many uncertain factors, such as maximum loading and strength of structures (VNK, 2012). The social preconditions of flood disasters are the number of social vulnerabilities, combined with the flood risks which can be determined by the flood hazard, exposure and susceptibility. (Imperiale and Vanclay, 2021).

## 4. Results

### 4.1 Community Resilience and Social Impact

During the interviews, the social dimensions of a flood disaster were kept in mind. Social impacts and community resilience differed between different periods.

#### 4.1.1 Watersnoodramp in 1953

When a flood occurs, the whole country of the Netherlands comes into action. An example can be seen during the latest massive flood in the Netherlands including fatalities, the Watersnoodramp in 1953. Zierikzee, located on the island Schouwen-Duiveland is hit. Community resilience arose, for example a story about a Zeelander, Wim Schot. When the flood occurs, Wim and a friend of his sail through the water to save dozens of people (Omroepzeeland, 2013). Whilst this is one story, more known are fisher ships from Urk. They saw the storm coming in 1953 also helped people on the island to evacuate. During the interviews, there was a big difference in how the ramp was perceived. The centre of Zierikzee is built on high ground, just like some other farms. These people evacuated to the attic and had to wait it off. An example: *“Then we were picked up by Urk fishermen, who took us to the village to an aunt. There we were told that our grandmother and another aunt with their family had drowned”*. However if your house was outside the city centre, it could completely be wept away.” (Interviewee 1, 2021). *The only reason we survived is that the walls of our house did not break, otherwise it was completely wept away”*. (Interviewee 2, 2021). During the disaster, there was a lot of mutual aid and cooperation. The whole area was flooded and evacuated. Social impacts are huge, houses and family members are lost, the land is destroyed and everything has to be rebuilt.

#### 4.1.2 After the disaster

After the disaster, Schouwen-Duiveland and Zierikzee became a wasteland of water and mud. However this time was used to change the planning of the island. *“Farms were scattered at first, but then they had to be closer to the farm. Actually, it has been a blessing, newer farms. A more efficient environment. If you want to repair dykes, the water management also had to be right, all the ditches were no longer efficient.”* (Interviewee 4, 2021). Not only the relocating of farms and ditches changed the safety of the island, but more drastic measures were taken. The Delta Programme started as a flood prevention measure. The Oosterscheldekering (1986), part of the Delta Programme, is responsible for the safety on the island and Zierikzee. Also a sluice in 1958 and closing a final dike hole of the Watersnoodramp are all measures taken to combat flood hazards.

Whilst physical measures were taken to make the area flood-proof, the population suffered. The social impacts were huge: *“First the Second World War, then the Marshall Plan and then another blow (Watersnoodramp). There was a lot of austerity in those days...there was no time for initiatives (Musea, or big memorials)... people had to work hard.”* (Interviewee 3, 2021).

After the disaster, every 1<sup>st</sup> of February during the church service there is a small memorial, but the disaster was more a thing in the past and the survivors did not express their feelings. The cognitive dimension of community resilience, such as feelings, actions, knowledge and narratives was not discussed. Physical flood prevention measures were implemented and the disaster is officially over.

#### 4.1.3 1990 to now

*"There must be vigilance. You can distinguish three generations. Those who experienced the disaster, those raised by the delta works and the generation that is now coming up"*(Interviewee 1, 2021). Those raised by the Delta Programme are in the 1990s 40/50 years old. Those raised by the Delta Programme started to get interested in the Watersnoodramp. After the 40th anniversary of the flood in 1993, a working group was formed under the leadership of Ria Geluk, who succeeded in getting the museum project off the ground in 1997. First, the museum was solely for the disaster itself, but a couple of years later the human side of the disaster is addressed. As stated before, the generation who experienced the disaster did not cope cognitive dimension. But the Delta Programme generation started to make the disaster more accessible. Jaap Schoof, ex-director of the museum started his project: *Oral History*. Schoof: *"Those who experienced the disaster want to tell their story now before it is too late.."* During this project, Jaap Schoof talks with survivors and aid workers of the disaster. *"Is comparable to the war victims, it was waved away and not talked about"*. (Interviewee 1, 2021) The last big memorial was on 1 February 2018. 65 years after the disaster. The commemoration was followed by a symposium on the theme: 'Tales of Water'. Surviving relatives, eyewitnesses and representatives of the government and organizations such as the Red Cross by assisting during the disaster on a large scale by receiving victims, providing food and drinks, distributed clothing and beds etc. (Watersnoodmuseum.nl, 2021). The UK141, the boat which saved Jaap Schoof during the disaster returns for an exposition to the Watersnoodmuseum (OmroepZeeland, 2021).

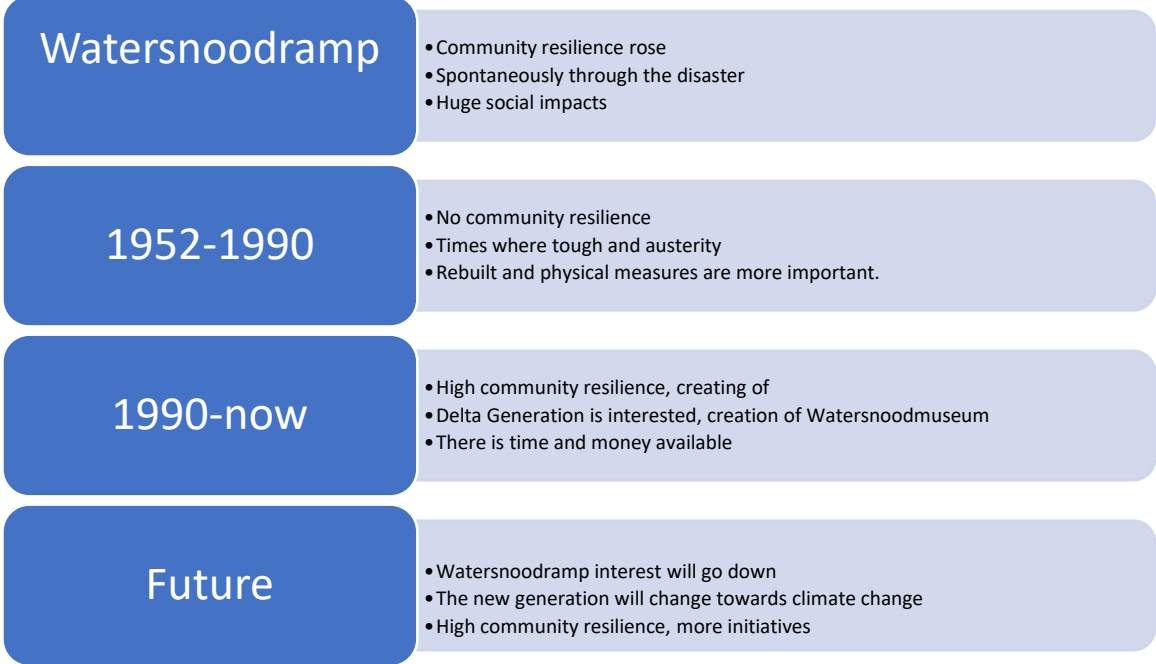
#### 4.1.4 The Future

In the last 30 years, volunteers from the delta working generation have ensured that the disaster was talked about and that the future should be thought about. The museum, which is located next to Zierikzee, ensures that cognitive people are involved in the disaster. At the moment, everything regarding the disaster is at its peak in terms of community resilience, but this area is still flood-prone. This is why the disaster still needs to be thought about in the future. The newest generation knows at most the stories but has never actually experienced a flood risk. Water authority: *"People completely trust the dikes at this point and so do I"*. (Interviewee 5, 2021). Water boards have the task of protecting the dikes, but if the primary flood prevention measures fail there still needs to be a plan B. Figure 4 shows that Zierikzee is still in trouble if the dikes break. Water boards are currently working on plans in case something does happen. *"At one of our meetings an escape window was proposed in each roof for new houses (...) For plans, they are looking at raising new motorways to 6 meters above sea level so that there are escape routes."* (Interviewee 4, 2021). Water boards currently working on extra flood prevention measures, but the same member of the Water Board also says: *"Too much attention is paid to making plans but the implementation is not there yet. A bit more attention could be paid to that."* (Interviewee 4, 2021)..

Small changes such as an evacuation plan and escape windows are relatively small measures on local change which can be used to lower the risk of extraordinary events.

As summarized in Figure 5, Zierikzee can be categorized in 4 different phases. Community resilience is not always straightforward, because many factors are necessary. Huge social impacts will increase the community resilience during the disaster, however in a austerity period in a poor area the focus can decrease. This is why keeping track of the perspective of the community is necessary.

Figure 5 Community Resilience in Zierikzee ordered in time periods.



Source: Author

**4.2 Climate change**

In Zierikzee, local community resilience is rising. ActAsOne will paint a gauge on a grain silo, combined with a video addressing a message using drone footage. Their goal is the present this during the climate change conference in Glasgow in 2021 (ActAsOne, 2021). This is however an initiative from the primary schools in Schouwen-Duiveland. Older generations are not actively busy with climate change. Different reasons were named during the interviews. Floods will probably not happen during their lifetime, combined with the effect of climate change. During a small questionnaire, 19 out of 26 people in Zierikzee saw Climate Change as a hazard for flood risk. However, during both interviews with two people from the water boards explained that there is no danger for floods. *“Every few years, the dikes are inspected again. Zeeland has just been completed. Dikes are reinforced if necessary. (...) Zeeland is perhaps the safest of all regions when it comes to floods.”* (Interviewee 5, 2021). Every dyke is checked if it is sustainable enough for the upcoming 5 years with the estimated sea-level rise. People are not scared of floods because they trust in the system of the Waterschappen. *“There is a shift of responsibility from individualism to the collective. Young people are trying to ensure that measures will be taken.”* (Interviewee 2, 2021). Young people in particular are actively organising initiatives against climate change.” Other small initiatives, such as the sustainable farm in Zierikzee, are also prevention measures against climate change.



Safety for Zeeland is maintained by the water boards. Both interviews emphasised that a great deal of testing is taking place and that flooding will not be caused by climate change in the coming years. What could be more of a problem is intermittent rainfall flooding the streets. *"If you want to have dry feet in 2050, things have to change. Now everyone has tiles and everything goes straight into the sewers. That now has to be pumped away, so get a maximum number of tiles fixed in your garden". (Interviewee 4, 2021).* Climate change will not be the cause of flooding, but in the big picture, it will have an impact.

## 5. Conclusion

Zierikzee and the entire island of Schouwen-Duiveland have experienced various phases of community resilience and social impacts regarding floodings. After the disaster, immediate measures were taken to make the area safe again. The entire island is protected by the Oosterscheldekering, but in Zierikzee specifically, a sluice was built and the hole in the dike was closed.

Zierikzee did not start talking about the disaster until later. The generation that lived through the disaster ignored it for a long time and it was only the Delta Generation that took an active interest. The aim was to learn and inform about the past and show what the future looks like. Coming back to the Conceptual Framework, one can see that there have been drastic social impacts during the disaster. The whole island Schouwen-Duiveland was destroyed and had to be rebuilt. Many lives were taken. Community resilience only really came from the next generation, because directly after the disaster it was not the time, due to poor economic status. After the disaster, flood prevention measures have reduced vulnerabilities, but community resilience is needed to ensure that people are better prepared for upcoming floods and that was not the case yet. This only happened in 1990s, with the start of the Watersnoodmuseum.

Returning to the main question *"What Disaster Risk Reduction and community resilience-building actions were undertaken in the flood-prone Delta region of Zierikzee, The Netherlands, to cope with climate change risks and impacts?"* The following can be concluded.

In Zierikzee, no one is afraid that their area will be flooded. The water authorities keep a close eye on everything and the inhabitants of Zierikzee have no fear of flooding. People recognize that climate change has an impact and the youth in particular are actively engaged in initiatives regarding climate change. There are indeed community resilience-building actions, such as the ActAsOne initiative in Zierikzee.

What can be done for Zierikzee? Everyone relies on the dikes, but as Figure 4 shows; an extraordinary event can happen and there is no plan.

To cope with climate change and impacts there currently are Disaster Risk Reduction and community resilience-building measures, however there is not yet a concrete second safety measure. Recommendations such as evacuation plans, escape roofs and flood safe infrastructure are advised. Don't rely on 1 source of protection but have additional fail safes.

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## **Appendix 1: Interview**

### **Semi-structured interview for locals**

#### **Blok 1: Introduction**

- 1) Can you tell a little about yourself?
- 2) How long have you lived in Zierikzee?
- 3) Why did you move/stay to/in this area?

#### **Blok 2: Past Floods**

- 4) What did your community learn from the Watersnoodramp?
- 5) Did the sense of risk increase in Zierikzee?
  - a. Did perception of shared needs increase in relation to future flood risks?
  - b. Did the perception of the vulnerabilities increase after the Watersnoodramp?
  - c. Did social cohesion increase in Zierikzee?
- 6) Are you aware of disaster prevention measures that have been implemented in the area? (Keersluis 1958).
- 7) Are there still initiatives carried out by people to enhance flood risk prevention in your area (Meetings, Talks, Memorials, Stories)?
  - a. → Do you partake in these, what do they mean to you?

#### **Blok 3: Community Resilience**

- 8) During a flood or flood-scare, how did your community react?  
Does solidarity and mutual support emerge among people, in which way?
- 9) Does the community of Zierikzee already has a plan for a future flood, taken premediate measures?
- 10) Does Zierikzee contribute to local climate resilience actions? (Zeelandverandertmee is a site dedicated to these actions).

- 11) Should Zierikzee get additional social flood prevention measures? for example ...
- a. Are you aware of climate risk?
  - b. Are you aware of flood risks?

### **Additional questions towards planners**

- 1) Can you describe your job?
- 2) What do you have to do with flood planning?

### **Past floods**

- 3) What flood prevention measures were implemented after the Watersnoodramp in relation to Zierikzee?
- 4) What did change in Zierikzee on a planner level after the disaster?
- 5) What did you/planners learn from the Watersnoodramp?

### **Future Floods**

- 6) Is climate change a threat for this area? If so,
- 7) How well is Zierikzee prepared for climate change? (Zierikzeenieuws)
- 8) What are current vulnerabilities in Zierikzee?
- 9) What are future planning goals in Zierikzee?
- 10) Is climate change risk reduction included in future prevention planning in the area? If so, in which way?

## **Quantitative data**

**On a scale from 1 to 5 (Completely disagree – Disagree – neutral – Agree – Completely agree)**

### **Flood risks**

- 1) Do you see climate change as a treat in Zierikzee?
- 2) Do you see flood risks as a treat in Zierikzee?
- 3) Are you aware of flood risk because of climate change?
- 4) Are you aware of flood risk prevention measures?
- 5) There should be more physical flood risk prevention measure (e.g Keersluis)

### **Past disasters**

- 6) Do you join in activities in relation to the Watersnoodramp? (Memorials, Gatherings)
- 7) To what extent is the Watersnoodramp still a subject among the people in Zierikzee; are you still talking about it in current conversations
- 8) Is the Watersnoodramp still a subject in your life?
- 9) Did you join in activities in relation to the Watersnoodramp?
- 10) In Zierikzee there is a strong social cohesion

### **Personal info**

- 11) What is your age (<18) (18-30) (31-50) (50-68) (68+ *These are watersnoodrampsurvivors*)
- 12) Do you live in Zierikzee? Yes/No
- 13) How long have you lived in Zierikzee? Open Question

## Appendix 2

Coding table during interviews

Social dimensions of a flood disaster	
<b>Community resilience</b> Shared needs Desires Sense of place / community / risk Knowledge Beliefs Empathy Caring	<b>Social Impacts:</b> Health Community Culture Livelihoods Infrastructure Housing Environment Infrastructure



### Appendix 3

Relevant outcomes of the questionnaire

Do you see climate change as a danger to Zierikzee in terms of flooding?

Ziet u klimaatverandering als een gevaar voor Zierikzee wat betreft overstromingen?

26 antwoorden

