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GREEN INFRASTRUCTURE FOR URBAN CLIMATE RESILIENCE: MAKASSAR AND ENSCHEDE

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Green Infrastructure for urban areas
Case studies Makassar (Indonesia) and Enschede (The Netherlands)

Master Thesis, Water Systems and Global Change Group in partial fulfillment of the degree of Master of Science in Environmental Science at Wageningen University, The Netherlands

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As cities have grown rapidly across the nation, many have neglected infrastructure projects and paved over green spaces that once absorbed rainwater.

Charles Duhigg

ABSTRACT

Makassar (Indonesia) and Enschede (The Netherlands) are two cities which have been developing Green Infrastructure (GI) in response to flooding experienced in the past years. GI has been seen in parks, gardens, or green buildings for both case studies which has a benefit for rainwater absorption, climate change adaptation, and well-being improvement. This thesis focuses on understanding the GI implementation to enhance community resilience for flooding. A literature review, semi-structured interview, and policy analysis have identified the flooding risk, GI benefits, and the challenges for future GI implementation. The research has revealed that both case studies have different GI implementation approaches from policy enforcement until stakeholders' participation.

Keywords: Green Infrastructure, GI, Makassar, Enschede, flooding.

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List of abbreviations

GI	Green Infrastructure
PU	Public Works (in Indonesia)
BPBD	Regional Disaster Management Agency (in Indonesia)
WALHI	Wahana Lingkungan Hidup Indonesia (WALHI)
BNPB	National Coordination Committee For Disaster (in Indonesia)

Chapter I

Introduction

From the last decade, Makassar has been hit by flooding. One of the biggest flooding was in 2019, which I experienced by myself. The weather at the time was terrible, and there was heavy rain for several hours. My neighborhood was instantly silent and empty because people evacuated themselves (Author's note)

Figure 1 flooding in Makassar 2019 (Author's picture)

1.1 Introduction

Flooding is a serious hazard that can cause severe problems such as damage to infrastructure, loss of human life, and destruction of agricultural production. It occurs in determined areas, such as rivers, floodplains, coast, most commonly with long periods of heavy rainfall. According to the World Bank, 90% of flooding occurs due to heavy rainfall and low infiltration capacity of the soils, especially in urban spaces (Jha et al., 2011). It is particularly devastating in highly populated and densely built areas because of the damage it causes to economic and societal sectors. Consequently, this topic has gained importance towards building effective flood management strategies.

Urban flooding is a major problem and has become an annual disastrous event that takes place yearly in many parts of the world. Flooding in urban areas has resulted from the interplay of natural and human actions. Natural factors include meteorological and hydrological factors, such as groundwater levels, tidal impacts on runoff, rainfall intensity, storms, and changes in temperature. Human actions include land-use changes, poor management and maintenance of drainage systems, and solid waste disposal in water canals that do not function properly. The direct impacts of flooding are evident, such as inundation, infrastructure damage, injuries, financial damages, and life loss. Fortunately, these negative impacts can be prevented or managed by proper flood mitigation planning and adaptation.

Over centuries, the government in flood-prone countries have implemented engineering solutions to mitigate flood risk, aiming to (1) reduce the inundation area of floodplains, (2) reduce flood and peak discharges, (3) reduce flood durations. However, these traditional

solutions adversely decrease floodplain areas, sedimentation, and floodwater capacity (Benito & Hudson, 2010). An example of this case can be seen from the dike construction in the Rhine River, which has over time reduced the floodplain area from 1,400 to 950 km^2 and decreased water storage during flooding. Due to this, flood management has shifted towards more adaptive and integrated flood risk management systems by creating climate-proof cities using Green Infrastructure (GI) (Murti & Mathez-Stiefel, 2019). GI can be seen as a solutions for urban areas because it has a role in climate change adaptation. It can help reduce high urban temperatures, restore the natural environment, and provide flood mitigation (Araos et al., 2016).

The Netherlands and Indonesia are exemplary flood-prone countries that have worked on flooding management. Climate change influences high precipitation and heavy rainfall, resulting in extreme events, such as floods. This situation will more visible in the future. Therefore, both countries need to take aggressive and committed action to tackle these hazards.

Makassar and Enschede focused on policy implementation that enforces Green Urban Infrastructure (GI) to mitigate floods. GI offers benefits to livelihoods in social, health, environmental, and economic terms (Nazir et al., 2015). Those benefits are mitigating environmental impacts of future development surrounding the community. However, there is still little information about how effective this new development is in enhancing flood resilience for residents.

Both cities are developing concepts to make the city greener and more sustainable. Open green areas and green buildings have become one of the concepts for smart and resilient cities for Indonesia's urban areas, including Makassar. The concepts have used several policies for future implementation, such as green open spaces policies and environmental protection policies. Makassar's government launched the spatial planning draft "*General Design of Regional spatial Planning 2010-2030,*" where the city is projected to be greener and achieve a 30% greener area in the future. Similarly, as s pioneer of green policies, the Netherlands, particularly Enschede, shows a lot of development for this greener project. Enschede has green buildings to support the city more sustainably and created many open areas such as parks, public and private gardens to manifest the dream of becoming a resilient city.

Unlike Enschede, flooding in Makassar occurred due to the limited capacity of the existing drainage system to drain water, especially during the rainy season. Land-use change associated with urban development has reduced drainage capacity. This situation causes Makassar to experience extreme rainfall from December until February, with bursts of more than 150 mm on average, causing flash floods (Patandean, 2020). Furthermore, the fluvial floods from the Tallo and Jeneberang Rivers, which are the two main rivers in the city territory, are forecast to occur frequently in Makassar. The two rivers cannot accommodate the rainwater; therefore, some areas remain flooded even after rain stops (Prabhakar et al., 2014).

On the other hand, flooding in Enschede city caused by the heavy rainfall. The city is located in the eastern part of the Netherlands and lies close to Germany. Enschede has faced groundwater and precipitation changes making the city experience higher rainfall during winter and dry conditions during summer. In 2010, Enschede already encountered a problem related to flooding, such as the disappearance of the natural water system caused by land-use change, groundwater abstraction, and soil depletion rainwater infiltration from industrial activities (van Dijk, 2010). Considering future scenarios, the Dutch government made a delta decision in 2010 for the entire country, with solutions such as building and increasing the dikes' capacity to

reduce the fatality of flooding by 50% in 2050 (van Dijk, 2010). Thus, assessing stormwater management in both cities can give an insight into GI implementation for community resilience.

1.2 Problem Description

Despite many differences in geography, climate, governance, urbanization, socio-economic development, and types of floods experienced, both Makassar and Enschede have implemented GI to various extent. It is interesting to compare the various factors that influence GI and its impact on community resilience for climate change. In this Master's thesis, the research focuses on knowing how GI measures in Enschede and Makassar contribute to the local policy goals of increasing the population's resilience against stormwater flooding.

1.2.1 Scientific and Social Relevance

This research will contribute to new knowledge about GI and flood resilience by filling the gap of information and lack of understanding about GI itself. For instance filling the gap by applying a different framework to look at the GI implementation both in Makassar and in Enschede.

Furthermore, the implementation of GI as a flood management system has been implemented in Enschede, and the city has transformed from grey to green-blue infrastructure. The well-established GI is used for stormwater and flood mitigation measures. Meanwhile, Makassar has committed to shifting its development planning towards a greener city in 2030 by using GI (Jamaluddin, 2018). As for societal relevance, the thesis's results can contribute to policymakers developing the better adaptation of GI in social needs and social relevance to villages by enhancing community stormwater resilience.

1.3 Thesis structure and Research Questions

In order to unravel the GI implementation for flood resilience in Makassar and Enschede, this research first builds a theoretical framework that integrates action, learning, resources, and capacities as three core domains in shaping community resilience in chapter 2. Action in this study considers civil protection and social protection, such as resilience action taken by stakeholders and the community. Resources and capacities in this sudy are seen as the benefit of GI in Enschede and Makassar. Lastly, learning is defined as knowledge building, which integrates multiple knowledge sources about GI from residents and relevant stakeholders. Subsequently, chapter 3 states the research questions to assess the contribution of Green Infrastructure in local policy goals of increasing stormwater flood resilience in Makassar and Enschede. In chapter 4, the research design is introduced, which consists of data collection methods and data analysis. Afterward, chapter 5 presents the information on case studies of Green Infrastructure and flooding resilience in Makassar and Enschede. The following chapter mainly discusses the findings from the interviews with relevant actors. In chapter 7, the sub-research questions are answered to formulate and discuss the answer to the main research question in chapter 8, followed by the conclusion and recommendations for future research.

Main research question

"How do the GI measures in Enschede and Makassar contribute to the local policy goals of increasing the population's resilience against stormwaters?"

In order to operationalise the main research questions, four sub-research questions were developed. The first sub-research question explores the risk of flood for the local people in Enschede and Makassar. The second sub-research question focuses on identifying the relevant actors involved in flooding management and GI implementation. The third sub-research question focuses on resources and capacities from GI that helps to enhance resilience. The fourth sub-research question focuses on identifying the remaining challenges for flooding management in Enschede and Makassar. By understanding all of those, this research aims to unveil how green infrastructure solutions operate and facilitate resilience in Enschede and Makassar.

Sub-research questions

1. What is the risk of stormwater floods to local people in the areas of Enschede and Makassar?
2. Who are the relevant stakeholders on water management, climate change adaptation, and green infrastructure development in Enschede and Makassar?
3. What are the resources and capacities exposed by green infrastructure that help build resilience against flooding, in general, and in Enschede and Makassar?
4. What are the remaining challenges in the case study areas related to stormwaters?

Chapter II

Conceptual Framework

Community resilience is defined as populations' capacity to enhance, anticipate, absorb or recover from a hazardous event (Patel et al., 2017). Enhancing community resilience needs cooperation between the government institutions, NGOs, and the local residents to shape how disaster risk reduction is organized and distribute the responsibilities between stakeholders. In both the Netherlands and Indonesia, resilience is assigned from the national to the local level. In this study, community resilience was assessed using community resilience framework, a combination of multi-level and multi-hazard framework to identify and measure resilience. It combines three interrelated domains that shape resilience within a community: Resources and capacities, actions, and learnings.

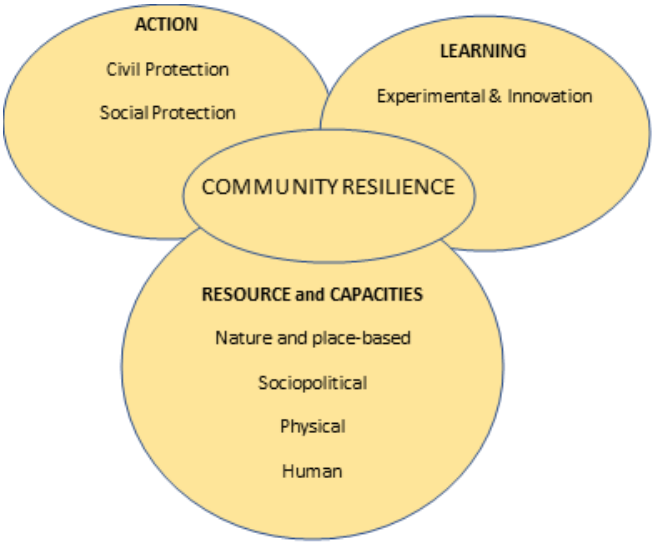

Figure 2 Community resilience framework adapted from (Kruse et al., 2017)*)*

2.1 Resources and capacities

In this context, the resources and capacities relate to the protection and development of ecosystem services to increase the community's well-being. GI applies services and functions provided by the ecosystem to achieve feasible solutions for flooding adaptation, such as creating wetland parks and gardens, re-naturalizing rivers and wetlands, and maintaining green areas inside and outside the cities for flood retention (European Commission, 2013). However, according to Kruse et al. (2017), low awareness and limited knowledge are barriers to planning GI. Therefore, socio-political and human capacities also need to understand the barrier better. The socio-political capacities include the rule of law, communication, and participation. Human capacities focus on the individual level, such as belonging to a community, previous hazard experience, and capacities for coping with hazards (Kruse et al., 2017).

2.2 Action

Action is defined in two parts: civil protection and social protection. In this context, the concept of civil protection refers to the protection of people, the environment, natural and human-made disasters. An early warning system is one of the elements of civil protection (Pursiainen & Francke, 2008), followed by disaster management cycles: preparedness, responses, recovery,

and mitigation. Meanwhile, social protection consists of policies and programs to diminish people's exposure to risks and improve the ability to recover after a disaster(Kruse et al., 2017).

2.3 Learning

Learning can be translated as an ongoing and adaptive process from individual to social interaction because people's interaction in the community may influence their risk assessment capacity toward hazard (Ahsan et al., 2016). This framework understands learning as the capacity of green infrastructure to approach individuals, communities, or states to achieve sustainability and resilience for climate adaptation. Furthermore, learning in this context can also be seen as how different policy management from a wide range of policy makers embed the same vision regarding green infrastructure and resilience development

2.4 Urban Climate adaptation

Urban design and structure have an important influence on flooding mitigation. Recent studies scrutinize the advantage of urban green space for climate adaptation, including cooling temperature, reducing rainwater run-off, flood mitigation, energy efficiency usage for buildings, and biodiversity preservation to prevent climate change problems (Arabadzhieva, 2016). Thus, cities need to act and tackle flooding problems by developing standards and methodologies for adaptation to climate change. Over recent years, significant advances have been made in policy, practice, and climate adaptation research. However, the lack of open and green spaces in urban development needs government attention to maximize the function of limited urban areas (J. G. Carter, 2018). Although the development of urban green space is relatively a new topic, it has made significant progress in policymaking and practices. Adaptation planning can be pro-actively undertaken by including hazard-based approaches, vulnerability-based approaches, policy-based approaches, and adaptive-capacity approaches. Hazard-based approaches explore the physical characteristics and structural capacities, such as building and strengthening infrastructure, projecting precipitation, and projecting water levels. T. R. Carter et al. (2016) stated that vulnerability is attributed to people and areas of hazard. Therefore, developing GI in urban areas for flooding and climate adaptation can help to vulnerable people become more resilient. Adaptation needs to be planned for the short and the long-term. The policy-based approach covers the long-term national/regional plan of action, such as cost-benefit education, emergency response, and spatial plans. This program aims to reduce the impact on vulnerability in the long-term and implemented it equally through community groups, civil society organizations, and private sectors. Lastly, cities undertake adaptive-capacity approaches to enable the community to adapt to flooding. Cities seek to create a better early warning capability for flooding and for communities to face extreme events. GI can be used as lenses to enhance community resilient. Implementing GI gives insight to people about climate problem.

2.5 Green Infrastructure

The term “green infrastructure” (GI) has gained traction around greening the cities (Haase, 2021). It offers spaces a strategic planning approach, nature-based solutions supported by natural processes, and improved ecosystem services. Haase (2021) defined it as "*the socio-spatial dimension of urban life*."

In this research, the focus is on the capacity of GI to enhance resilience for stormwater floods. GI utilizes the concept of artificially green spaces and natural ecosystems. It consists of urban green areas, publicly or privately (Wolch et al., 2014). GI includes green spaces, forests, water bodies, wetlands, parks, green roofs, natural or semi-natural ecological systems. A study by

(Benedict & McMahon, 2006) explained that GI is an interconnected network between natural and open spaces. It preserves the ecological framework for the environment, social and economic, and natural life-support systems. GI envisioned to offer social benefit to the community where it is implemented. Examples include existing infrastructure, such as buildings, parks, or gardens (Votsis, 2017). The physiological benefits, such as reducing stress, are given from nature to humans, which increases enjoyment, relaxation, comfort, and satisfaction (Alagumannan, 2019). This empirical evidence is supported by a widely accepted theory, which is called the stress reduction theory. The theory claims that observing natural elements (such as trees and green spaces) or experiencing the natural environment can activate our parasympathetic nervous system to reduce stress and arousal levels. Some studies have shown that green spaces can be used as a buffer to relieve the adverse health effects of stressful life events, thereby indirectly reducing stress levels (Bowen & Lynch, 2017).

Besides, having a community park encourages people to engage in physical exercises such as jogging and cycling that improves their physical state. Tzoulas et al. (2007) agreed that GI improves human health and healthy urban living. Apart from the above, it can be said that GI integrates both development needs and natural infrastructure conservation, which enhances ecosystem services, such as rainwater buffer, air purification, cooling temperature, save energy, and cope with another climate impact(European Commission, 2013). The well-being and health of citizens are improved. For instance, GI provides benefits for humans and biodiversity that are now rarely found due to urban density and hardened infrastructure in big cities (EEA European Environment Agency, 2004). “Green roofs” are one example of GI implementation in cities because it helps optimize limited space. Green roofs provide sustainable urban drainage and water retention. In the Netherlands, a green roof is a possible solution that helps build resilience against flooding. For instance, European cities have started to develop greener roofs to provide multiple benefits for the environment and human beings (European Commission, 2013). The opportunity to implement green vegetation is also possible in Indonesia. Some big cities, such as Makassar, start to build more green spaces and parks, increasing the feeling of well-being. As mentioned above, a green environment offers relaxation and reduces stress for city-dwellers.

However, several challenges hinder the progress of GI in cities. One of the challenges is the low awareness and limited knowledge of stakeholders, including the government and residents, on GI implementation and policy. Wright (2011) stated an abundance of definitions and perceptions of GI from environmental, political, social, and economic stimuli, which stimulated ambiguity of GI concept because of the lack of shared understanding on how it should be defined.

Chapter III

Methodology

This section elaborates on how this research was conducted. A literature study, policy analysis, and semi-structured interviews were done in this research to answer the sub-questions.

3.1 Literature Review

A literature study was conducted to answer the second research question: "*Who are the relevant stakeholders on water management, climate change adaptation, and green infrastructure development in Enschede and Makassar*?". Keywords used in the literature study were green infrastructure, flood risk, Makassar, the Netherlands, and Enschede. Case reports, congress papers, and scientific journals were used as primary literature. Some documents were in Indonesian and Dutch. Therefore this study first translated the documents into English. Later, the literature was utilized to identify the relevant stakeholders and understand their climate change role, water management, and green infrastructure implementation. Identifying stakeholders is done by looking into the existing policies that mentioned responsible stakeholders for the issues mentioned. Further, the implementation of policies enacted by stakeholders had been identified.

This thesis focuses on GI practices in Makassar and Enschede, with the primary goal to enhance community resilience. Thus, a second literature study was conducted to see the relation between GI implementation and resilience (sub-question 3). Due to the limited number of literature reviews, newspapers and websites were referenced as essential sources.

3.2 Policy analysis

Policy analysis was conducted to analyse the implemented policies that address the GI, climate adaptation, and flooding management in Makassar and Enschede. This research also identified power and interest for stakeholder position because decision-making does not depend on one single actor but rather on those who have partial power and responsibility. These decisions can affect numerous people, groups, organizations, and sectors positively or negatively. Therefore, policy planning and decision-making are moving toward a social actor perspective to identify power relations and conflicting interests. This study identified stakeholders within four clusters (See figure 2): (1) People who had decision authority over the program, (2) people who had direct responsibility for policy implementation, (3) people who were interested in the policy for their institutions, and (4) people were disadvantaged by the policy.

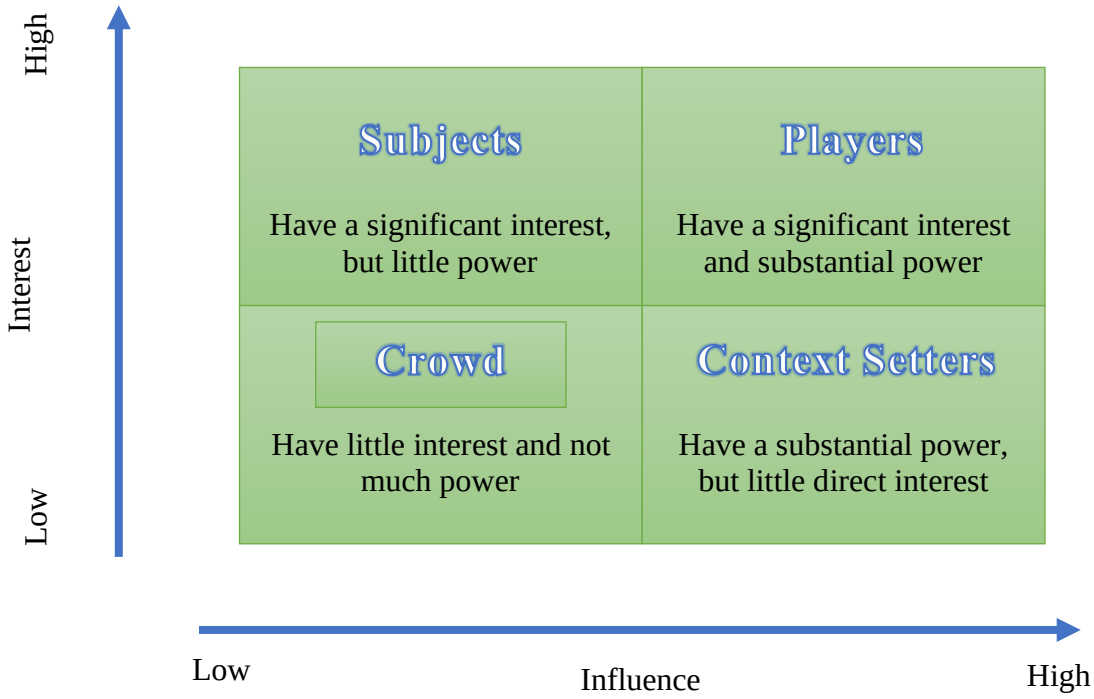

Figure 3 Power - Interest stakeholders (adapted from Bryson et al. 2011)

The identification of these clusters showed the capacity of each stakeholder to get involved in policy implementation. Despite the accuracy of these clusters, interest and variables may change over time. This research used a influence-interest matrix to identify Makassar and Enschede stakeholders'. The outcome of this research can be found in chapter 5.

3.3 Semi-structured interviews

Semi-structured interviews were held to analyse the risk of flooding in residents, capacities and resources of GI in relation to flooding resilience, and remaining challenges for GI implementation. The most important stakeholders to interview were selected through a literature study that was conducted beforehand. Interviewees are experts in their field of knowledge for both case studies. In the first study case (Makassar), the interviewees were seven residents of Makassar, Governor of South Sulawesi, Regional Disaster Management Agency (BPBD), Environmental Institutions, Public Works Services (PU), Spatial Planning Institution, Lecturer, Private Sector (Nipah Mall Management), an NGO (WALHI). In the second case study (Enschede), the interviewees were five residents from Enschede, the municipality from Enschede, Vechtstomen, and the lecturer (See Table 1). The interview questions covered different topics such as damage of flooding, governance, and technical supports for flooding management and GI Implementation (See Appendix).

A letter of permission was sent manually to environmental services Makassar, public services institutions, governor of South Sulawesi, Major of Sulawesi, followed by electronic mail three times. However, the institutions were unresponsive. Later on, in December 2020, environmental services were contacted via phone calls and briefly explained the institutional role of environmental services to the interviewer. Similarly, electronic mails were sent to the waterboard Vechtstromen of the Netherlands and the CATCH project's contact person, which is a transnational project to answer the challenges of extreme weather events, but they were not responding at all. Due to time limitations, the researcher stopped approaching interviewees when they remained unresponsive.

	Country	Sector	Status	Recording
Interviewee 1	Makassar	Local Resident	Responsive	Yes
Interviewee 2	Makassar	Local Resident	Responsive	Yes
Interviewee 3	Makassar	Local Resident	Responsive	No
Interviewee 4	Makassar	Local Resident	Responsive	Yes
Interviewee 5	Makassar	Local Resident	Responsive	No
Interviewee 6	Makassar	Local Resident	Responsive	Yes
Interviewee 7	Makassar	Local Resident	Responsive	No
Interviewee 8	Makassar	BPBD	Responsive	Yes
Interviewee 9	Makassar	Environmental Institution	Responsive via phone call	No
Interviewee 10	Makassar	PU	Unresponsive	No
Interviewee 11	Makassar	Governor of South Sulawesi	Unresponsive	No
Interviewee 12	Makassar	Spatial Planning	Unresponsive	No
Interviewee 13	Makassar	Private Sector	Responsive	Yes
Interviewee 14	Makassar	WALHI	Responsive	Yes
Interviewee 15	Makassar	Lecturer	Responsive	Yes
Interviewee 16	Enschede	Local Resident	Responsive	Yes
Interviewee 17	Enschede	Local Resident	Responsive	Yes
Interviewee 18	Enschede	Local Resident	Responsive	No
Interviewee 19	Enschede	Local Resident	Responsive	No
Interviewee 20	Enschede	Local Resident	Responsive	No
Interviewee 21	Enschede	The municipality of Enschede	Responsive	Yes
Interviewee 22	Enschede	Lecturer	Responsive	Yes
Interviewee 23	Enschede	Water Board	Unresponsive	No

Table 1 Overview of the interviews

In total, twelve interviews were conducted in Makassar and seven in Enschede. Although there were few interviewees, saturation was reached after five interviews did not yield any new information. In the case of Enschede, the few stakeholders did not influence the validity because the stakeholders revealed the same information. Furthermore, If the interviewee approved, the interview was recorded for further analysis. If the interviewees were not keen on giving the recording permission, written notes were taken. Out of nineteen interviewees, twelve were recorded. Seven interviewees were not recorded due to privacy issues. To protect the interviewees, privacy of individual interviewees was preserved in this thesis.

First, the interviewer briefly explained GI's concept to give some insight to the interviewees. The interviewer asked about the condition when flooding occurred, such as a feeling of loss from the resident's perspective (sub-question 1). Second, the question related to how GI could help enhance resilience for flooding (Sub-question 3). Third, the interviewees were asked about the governance system, flooding, and GI management practices from the Institutional government, private sector, and NGO perspective (Sub-question 2). All the questions given to interviewees offer a comprehensive and integrative approach to the remaining challenges for GI implementation in both case studies (Sub-question 4). The relations between different stakeholders and research questions are shown in the figure below.

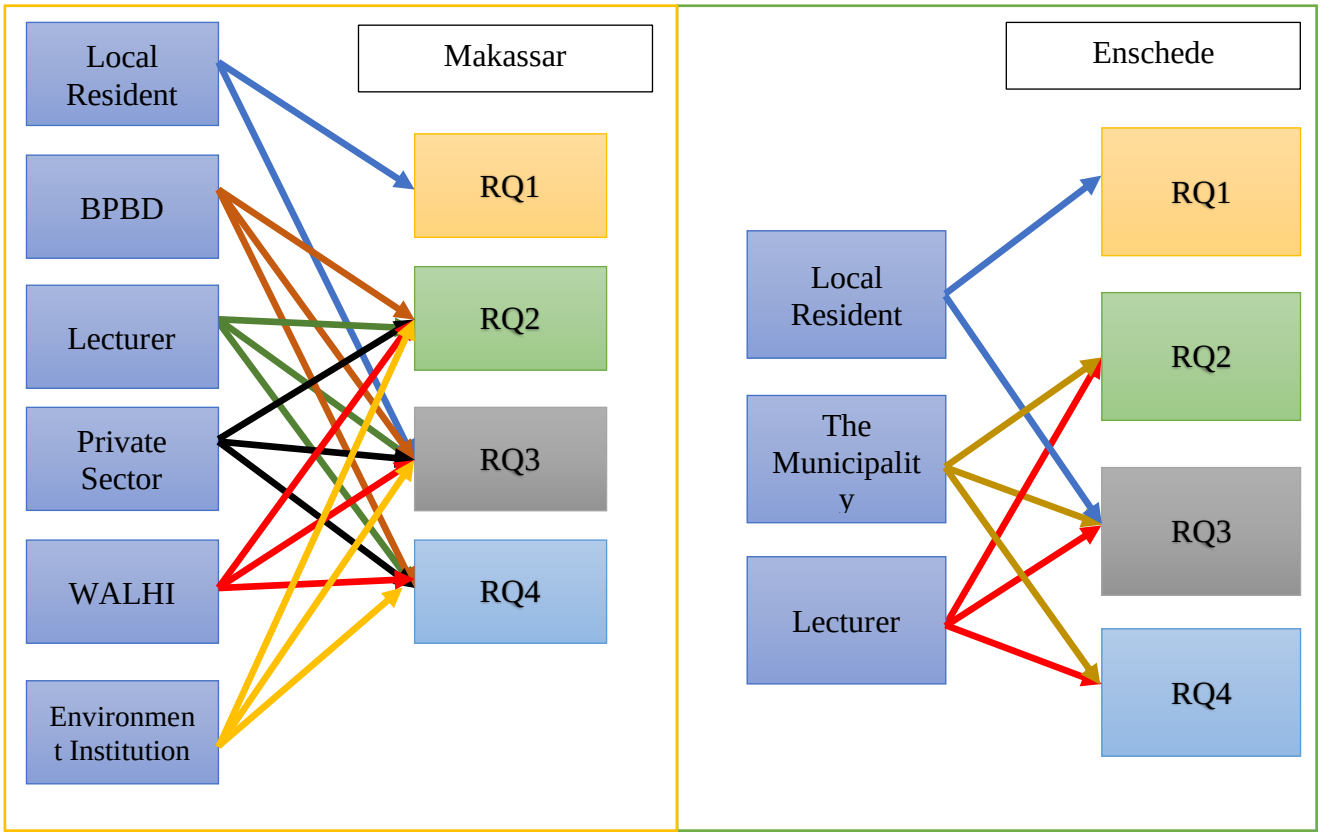

Figure 4 Relations between different stakeholder, Own elaboration.

3.4 Data analysis method

The data analysis was performed by Atlas.ti. It allowed managing, coding, and displaying the qualitative research data. The first step of the data analysis involved a detailed reading of the interview transcript, a review of documents and transcripts, listening to the interview recording, and reading notes taken during the interview. In the next step, all the data was reduced to the critical information, based on the data's key themes identified by developing open coding schemes using Atlas.ti software. The purpose of the interviews was to examine the perceptions of the respondents related to GI and flooding.

3.5 Ethics and Concerns

All the interviews were transcribed in MS Word documents. During the interview, ethics and data protection were applied.

a. Firstly, the relation between interviewee and respondent did not cover sensitive issues, nor did it cause conflicts of interest. Therefore, a neutral position was taken toward sensitive issues.
b. Secondly, the goal of the investigation, benefits, and potential risk were explained by the interviewee before agreeing to participate in this research (informed consent). The interviewees were notified that the outcome of this research would be published on public and scientific platforms. Therefore, three aspects required consent before conducting the interview: consenting and understanding that the interview concerns free participation; consenting to give personal information, and consenting to

a respectful recording. The interviewees had the right to decline their consent at any point during the research.

Thirdly, every respondent had the right to confidentiality and privacy. Essential information such as individual names, organization names, occupations, and quotes was only used with the respondent's consent. All the data gathered for this research was stored on a Microsoft One Drive share in the student's personal university account provided by WUR. The cloud folders were only shared with supervisors. All the confidential documents of non-published papers were not shared with people outside this research.

Chapter IV

Research Results

This chapter is divided into four sections. These are based on the sub-research questions: the risk of flooding, relevant stakeholders, resources and capacities of GI, and GI's remaining challenges. The result of interviewees presented in a simple bar chart in the form of horizontal bars.

4.1 Risk of flooding

This part explores the risk of flooding as perceived by the residents in Enschede and Makassar. Semi-structured interviews were conducted to get the resident's perception of risk. This part will answer the first research question, "What is the risk of storm water flooding to a local resident in Enschede and Makassar?"

Overall, the literature reveals that the Netherlands has proven to consistently make additional innovations for flood management, for example, creating green infrastructure in the city and providing open public risk-assessment maps that present all hazard information in the future (Klein Tank et al., 2002). Conversely, Indonesia's flood management is still lacking commitment from government. The reason for the lack of commitment by the provincial government may be related to the institutional structure of this period, because before 2002, the provincial government regarded itself as a representative of the central government, rather than a representative of its citizens. The assigned administrators are easily replaced, which makes them more interested in maintaining positions than in providing better public services. (Simanjuntak, 2010).

The figure 5 showed the results of the interviews showing that the risk of urban flooding is associated with heavy rain in both case studies, leading to flooding management to mitigate the risk of flooding. Flood risk management actors in both study cases included the municipality, disaster planning agency, and water board as key stakeholders.

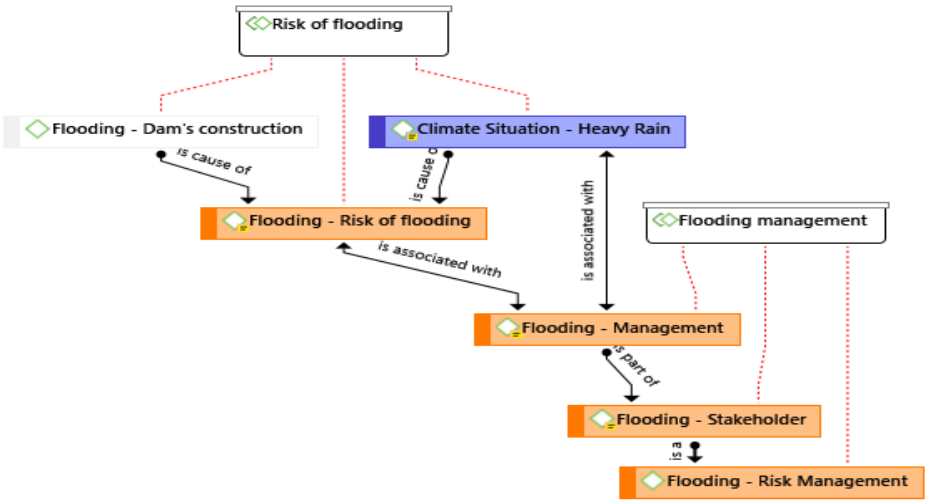

Figure 5 Linking concept

4.1.1 Makassar

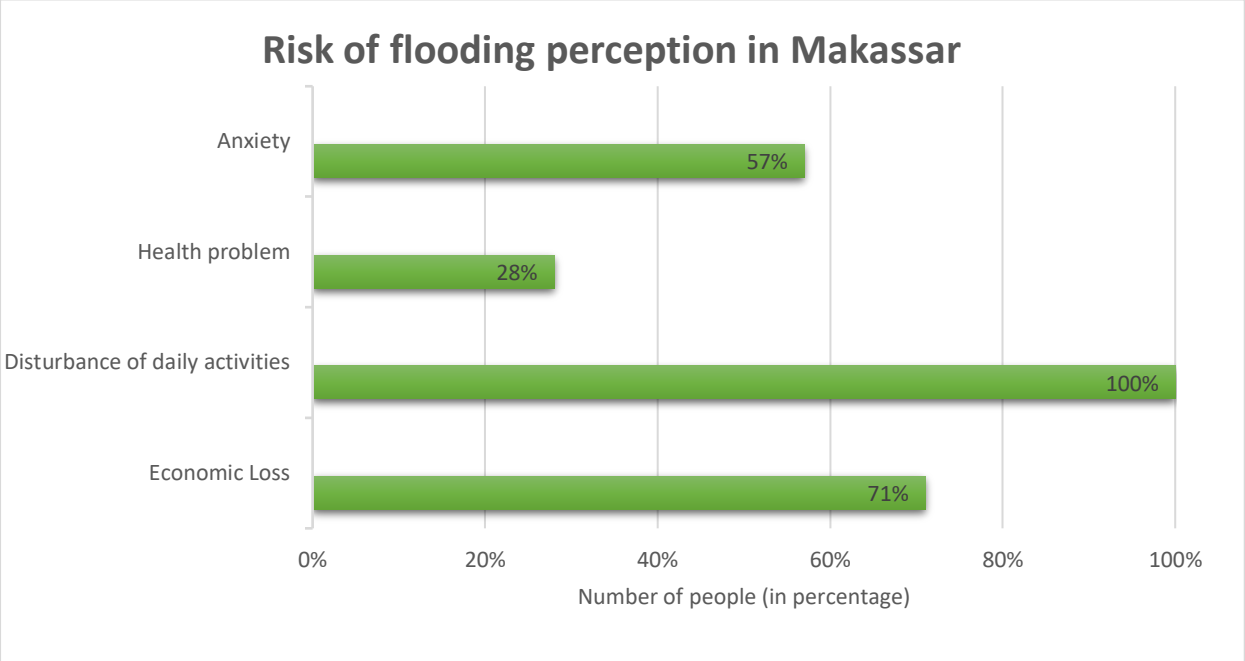

Figure 6 Risk of flooding from residents in Makassar

Flooding is regularly occurring in Makassar during the rainy season. The direct impact from floods is significant for inhabitants. Figure 6 Illustrates the percentage result from seven interviews in Makassar regarding the flooding risk. All of the interviewed residents stated that flooding caused a disturbance in their daily activities because it submerged the road. The water level rose to over one-two meters, resulting in leaving their house and staying in their relative's places. Conversely, some of them preferred to stay on the second floor of their house. One respondent described the experience:

> *"The road was full of water, and we need a rubber boat to move around. Everything was paralyzed" (Interviewee 3)*

The inability to move around when the water level was raised affected people's income. The result found that five out of seven (71%) of respondents addressed economic loss during the interview. Since most interviewees were businessmen and day laborers, they had to face significant income and occupation losses. They were impacted due to disruptions in transportation and retailing opportunities. Moreover, people also stated that the cost of repairing damage after a flood was expensive. It showed a clear indication of the severe economic impacts of flood.

The flooding took people by surprise. Four out of seven (57%) of the respondents described their anxiety levels went up every time it rains consistently. It was because their home had been flooded several times. They mentioned that rain caused electric power cuts in their area, which added insecurity. Furthermore, they also summarized that they were easily panicked when the rain did not stop for few hours and started to move some of their belongings to the higher place. In contrast, the rest of the interviewees indicated that they were familiar with flooding and became part of their lives.

"It was hard for me to sleep because I always woke up staring at the road watching the rain and the water level." (Interviewee 5)

A small number of respondents mentioned health problems during flooding. Approximately two out of seven (28%) respondents stated that flooding affected their health because the water was contaminated. The floodwaters carried sewage and pollutants from the nearby septic tank because Makassar has lots of impermeable surfaces, causing water challenges to infiltrate and flow into the river.

"The water turned brown for five days. We still used the water for taking a shower and cleaning the dishes because we did not have any choice." (Interviewee 1)

It is also interesting to note that all of the local residents in Makassar mentioned that constructing a new dam would help mitigate floods during the interview. The information about new dam was given by the government. It is an on-going project in the Nipah-Nipah area to mitigate future flooding around Bumi Tamalanrea Permai, Maros Regency, and Antang, known as highly populated urban areas.

4.1.2 Enschede

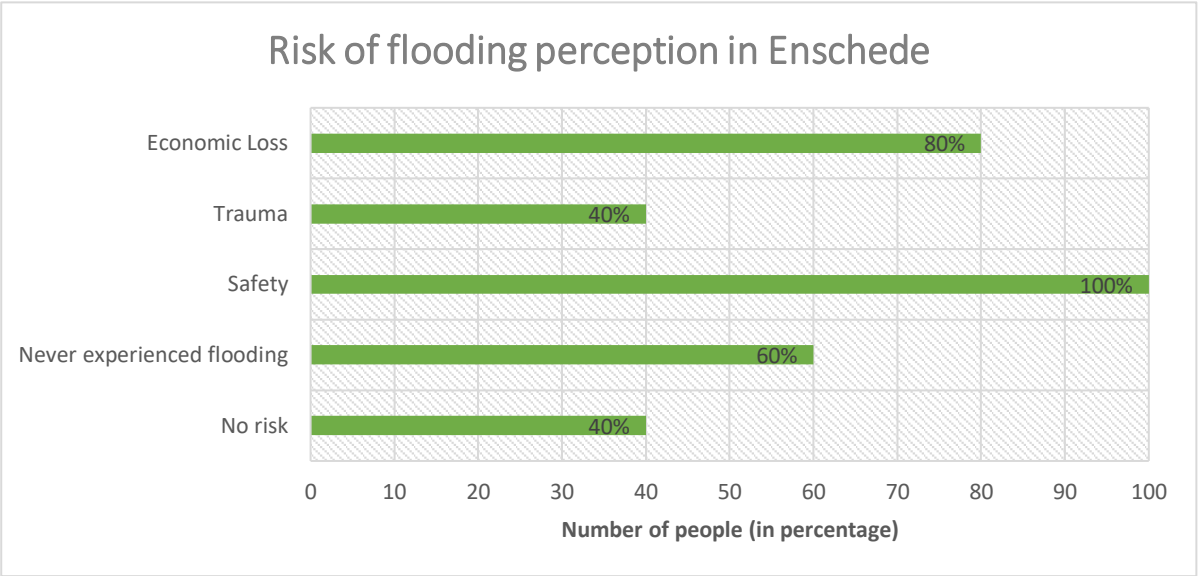

Figure 7 Risk of flooding for Enschede

In Enschede, the previous flooding was attributed to the water drainage system's inadequacy (Hielkema et al., 2019). All respondents stated that the precipitation was too much for the public sewer's capacity, causing the flooding of roads.

Figure 6 above represents the results from five interviewees in Enschede. It is interesting to highlight that three out of five (60%) respondents have never experienced flooding in Enschede. However, they could describe the situation and had a sufficient amount of information from the local newspapers. The photographs below (figure 4) show several occurrences of flooding in the city of Enschede.

*Figure 8 Flooding conditions in Enschede, 2010 Source: (*Tauw, 2017)

Two out of five of the respondents (40%) in Enschede experienced the 2010 flood. They stated that previous flooding did not pose a high threat to their lives. However, despite the result that flooding had no impact, two interviewees (40%) also assumed that there must be insecurity at the beginning of the first flooding. This assumptions' interconnectedness lies in the big explosion of fireworks in Enschede on 13 May 2000, which caused people in Enschede to become overly cautious until now. Two interviewees described their thoughts as follows:

"I could see the water in the road. However, it was only until my knee, and I did not feel insecure at all." (Interviewee 20)

"Some older people were frightened by the sound of thunder, which is similar to an explosion. Similarly, with flooding, some people may become more vigilant when heavy rain occurs". (Interviewee 19)

Based on the information on previous floods in Enschede, 80% of respondents speculated that flooding might lead to economic losses for individuals and the city. Flooding caused an interruption of daily financial activities and damaged infrastructures, such as houses, buildings, and roads. However, the interviews also revealed that all of the respondents feel secure living in Enschede because the government has implemented better flood management strategies in recent years, which provides safety for residents.

"I feel safe in Enschede. Our government has done an outstanding job in the water management." (Interviewee 16)

4.2 Role of Stakeholders in GI

This part explores the relevant stakeholders in Enschede and Makassar. It contained three methods which are policy analysis, literature review, and semi-structured interview.

Overall, during the interviews, the questions were asked about the institutional role on water management, climate change adaptation, and green infrastructure development in Enschede and Makassar. The relevant stakeholders were summarized in the table below (Table 2). This part addresses the second research question, *"Who are the relevant stakeholders on water management, climate change adaptation, and green infrastructure development in Enschede and Makassar?"*

Makassar	Role	Enschede	Role
BPBD	Green Infrastructure development and Climate change adaptation	Academia of Enschede	Green Infrastructure development and Climate change adaptation
Environmental Institution	Green Infrastructure development and Climate change adaptation	Water Board	Water Management,
Governor of South Sulawesi	Water Management, Green Infrastructure development, and Climate change adaptation	The municipality	Water Management, Green Infrastructure development, and Climate change adaptation
Public Works (PU)	Water Management	Rijkswaterstaat	Water Management for big river and sea
Private Sector	Green Infrastructure development and Climate change adaptation		
Academia of Makassar	Green Infrastructure development and Climate change adaptation		
Spatial Planning	Green Infrastructure Development, Water Management		
Local Residents	Green Infrastructure development	Local Residents	Green Infrastructure development

Table 2 List of stakeholders

Overall, the table explained that multiple stakeholders could address the same role in Indonesia. For example, GI development is a responsibility of all institutions, except PU. Similarly, water management also is a role for multiple stakeholders. The implementation of stakeholders' roles remains unclear. Meanwhile, for Enschede, the job desk for each stakeholder is clear. For example, the municipality is responsible for the drainage of wastewater and excess rainwater through the sewer systems. At the same time, the big river is the responsibility of Rijkswaterstraat. Academia has a similar role in this case study. However, interviews with

academia in Makassar highlighted that their research did not put into the decision-making process. In contrast, academia in Enschede is working together with the municipality by providing research before starting GI development.

4.2.1 Makassar

Indonesia, particularly Makassar, has formulated several policies to address flooding and GI. This section gives insight about policies which are implemented at multiple levels, for instance, national, regional, and local.

Policy analysis & Literature Review

Firstly, Law No. 7/2004 regulates water resources principles, including the right to use water and permissions; governance in managing water resources; water conservation; control of water resources; water management and planning. This law also emphasized that each region has the authority to establish water management regulations according to the government's level. Water management is controlled by three levels of government: national, provincial, city/regency level.

In connection with flooding, the flood management in Indonesia consists of National Coordination Committee (BNPB) at the national level, the Executor Coordination Unit at the provincial level, the Executor Unit at the city level, and the Flood Hazard Mitigation Unit at the site. Each unit consists of different institutions. Overall, BNPB is a non-department government institution that is equal to the national ministries. As a coordinating institution, BNPB consists of several ministries with main responsibility in hazard management and resilience at the national scale. The existence of BNBP was formulated based on Law No. 24/2007. The law allowed the government of Indonesia to create the National Disaster Management Agency. The law also regulated Indonesia's government to protect citizens' lives and livelihood pre-and post-disasters, including natural and non-natural disasters. Furthermore, to take any action at the provincial and regional level, BNPB created a regional agency known as BPBD (CFE-DMHA, 2015).

Secondly, apart from disaster management, several government institutions are involved in the context of water management. For instance, PU and Spatial Planning are responsible for the development of piped water distribution. PU has also shared responsibility for constructing the urban drainage system with the provincial office and public works ministry at the national level.

Thirdly, significant effort has been made by the Indonesian government towards developing the climate change issue. It is written under Presidential Regulation No. 16/2015, which regulates emissions reduction and guidelines for preparing climate change adaptation action. The law includes environmental protection and management, spatial planning, renewable energy, and coastal management. This regulation became the establishment of the National Action Plan on Climate Change. Specifically, National Action Plan on Climate change has been translated into regional action by the Makassar authority. The action contains seven strategies to combat climate change, including improvement and expansion of Green Open Space (RTH), improvement of infrastructure, economic welfare, public participation, improvement of institutional capacity and NGOs, environmental conservation, and strengthening and enforcement of regulation and law (Rosalina, 2017). Nonetheless, although all written regulation exists, the impact and future planning has not been fully addressed in Makassar (Tjandraatmadja et al., 2012).

Apart from that, building a sustainable green cities is seen as a long-term plan for Indonesia. Therefore, Law Number 26, the year 2007, regulates Spatial Planning and Development. This law address climate issues with the green city concept. This concept aims to promote an eco-friendly city to cope with the impacts of high-speed urbanization. Under this law, the government launched the Green City Development Program (GCDP). It has eight green city attributes: green building, green energy, green water, green transportation, green waste, green open space, green planning and design, and green community (Kirmanto et al., 2012).

Concerning the green city plan, law No. 32/2009 regulates environmentally sustainable development. It includes environmental planning policy, exploitation, development, maintenance, restoration, supervision, and control of the environment. This law implementation is a responsibility of the Provincial Environmental Agency.

Interviews

Interview with the NGO, Wahana Lingkungan Hidup Indonesia (WALHI) and the private sector visualized the non-government institution's role. Firstly, an interview with WALHI addressed the NGO's role in environmental problems and insecurity of natural resources management issues in Makassar. WALHI is actively involved in water and environmental problems such as flooding and limited green space areas in Makassar. Recently, WALHI published a red report which is a warning for the governor for the inconsistency of solving the green open space problem. Secondly, an interview with Nipah Mall management in Makassar highlighted the importance of the public sector to build resilience and adapt to climate change. Nipah Mall became the first green building in Makassar, which used a green roof to reduce heat and decreased Albedo value by four. The green roof is planted with some vegetations such as bougenville.

> *"The owner got the inspiration after visiting one of the green building in Bandung, West Java. Amidst the urban population, the green roof gave him a sense of relaxation."*
> *(Interviewee 14)*

The interviewee also emphasized that the project manager, engineering team, and management team followed some training in Bandung before the construction of Nipah Mall. Nipah Mall provides a concept to mitigate rainwater by using rainwater retention concepts.

4.2.2 Enschede

The Netherlands takes action on climate change based on its climate agenda. The agenda aims to design a resilient and well-prepared society for the consequences of climate change. The implementation integrates various stakeholders from the national or international business community, national or international organizations, local authorities, NGOs, academia, and residents. By working together, the Netherlands believes it can transform the country into a strong and sustainable country (Ministry of Infrastructure and the Environment, 2014).

On 22 December 2009, the Dutch government integrated the various aspects of water management within a single Water Act. It aimed not only facilitating integrated water management but also to enhance transparency in Dutch law. The water act set several responsibilities from various government bodies, namely central government, provinces, district water boards, and municipalities. The central government is responsible for national policy and measures, i.e., standard for flood protection from significant rivers. Provinces have

the responsibility of translating national water policy into regional measures. District water boards in charge of water quality issues within the district formulate management plans, i.e., regional flood defence systems. Lastly, municipalities are responsible for groundwater in urban areas, e.g., drainage of wastewater and excess rain in the sewer system (Government.nl, n.d.). Interestingly, this law also integrates with Environmental Planning Act (Havekes et al., 2011).

Regards to flood risk management, the Netherlands uses an adaptive delta management approach. Underpinned this adaptive plan, the central government, provinces, district water boards, and municipalities work together to actualize climate-proofing countries. Hence, the Netherlands can prepare for a future threat such as drought, heat, and urban flooding (Dutch Ministry of Infrastructure and Water Management; Dutch Ministry of Agriculture, Nature and Food Quality; Ministry of the Interior and Kingdom Relations, 2018)

In 2000, the Dutch Cabinet introduced "Give the water room" as the new policy approach to flooding to raise public awareness for climate change impact. Several government entities were involved in the project, namely the Ministry of Transport, Public Works and Water Management, the Association of Provincial Authorities (IPO), the Association of Water Boards (UvW), and the Association of Netherlands Municipalities (VNG) (Environmental Protection Department, 2007). Moreover, collaborative action is undertaken by The Ministry of Transport, Public works and Water Management (V&W), the water boards, provinces, and municipalities in the concern on water quality improvement in the rivers, lakes, canals, ditches, and waterways (Environmental Protection Department, 2007).

Interviews

The municipality addressed the collaboration between private and public institutions in Enschede for climate adaptation. Similarly, the academia also stated good practice of governance in Enschede as all people being allowed to export knowledge.

> *"We work together with the water board for flooding, and with private sectors for green infrastructure implementation. We never had a conflict so far". (Interviewee, 21)*

> *"I work together with the government in Delta Management Program." (Interviewee 22)*

4.3 Resources and Capacities

This part of the result addressed the third research question, "What are resources and capacities exposed by Green Infrastructure that help build resilience against flooding in Enschede and Makassar?"

4.3.1 Makassar

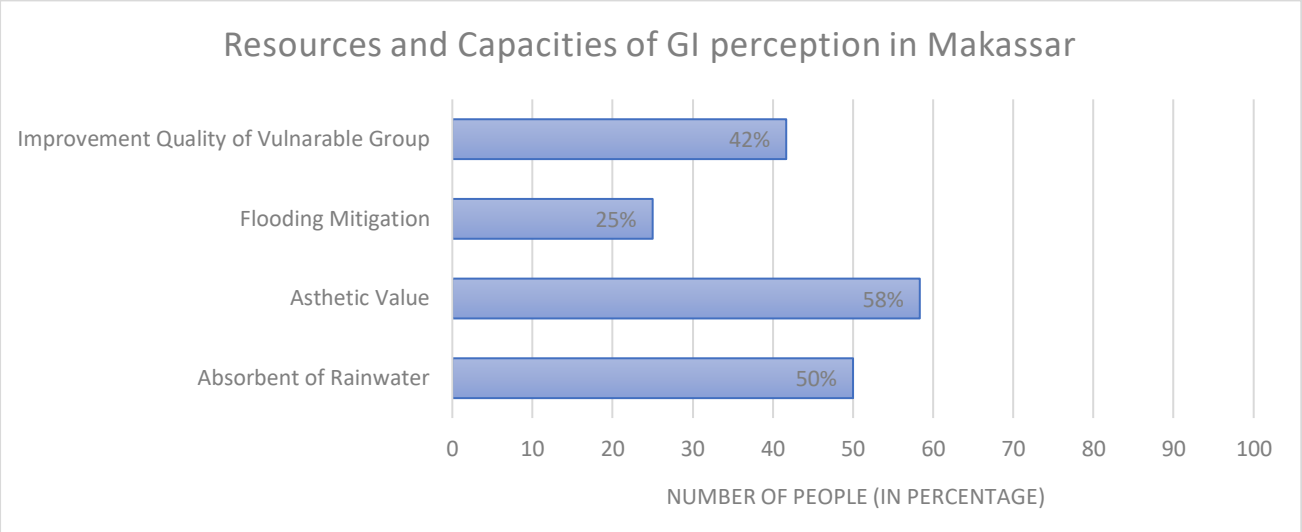

Figure 9 Resources and capacities Makassar

Figure 8 above represents the percentage result from twelve interviewees Makassar concerning resources and capacities for GI.

Five out of twelve (42%) respondents mentioned GI's function as an absorbent of rainwater. Three interviewees explained the green roof function for rainwater retention and mitigate water run-off in Nipah Mall building. With the implementation of a semi-outdoor concept with a roof garden on the top, the building has its rainwater shelter with 50m3 capacity. Thereby, the mall can reduce a load of rainwater runoff into the city drainage. The existence of a rain garden using several vegetation reduces 85% of the puddle in the area surrounding the building after rain (Amalia et al., 2018). Planting the grasses help stormwater infiltration by allowing water to enter the soil. Additionally, 10% of the building is using permeable pavements to reduce runoff. Grasses play a major role because their root system enriches the soil and increases infiltration (Kingsford, 2000).

Furthermore, seven out of twelve (58%) of respondents thought of GI as an aesthetic value. Interviewees mentioned the Lorong Garden program (Longgar) from the local authority during the interview. The program aimed to change Makassar to be clean and green. Among all the respondents, only three out of twelve (25%) respondents considered GI for flooding mitigation. However, people still questioned the capacities of GI to solve the flooding problem in Makassar. Interestingly, five out of twelve (42%) of respondents stated that GI can improve vulnerable people's quality of life. This statement appeared after the interviewer mentioned community parks as one example of GI.

4.3.2 Enschede

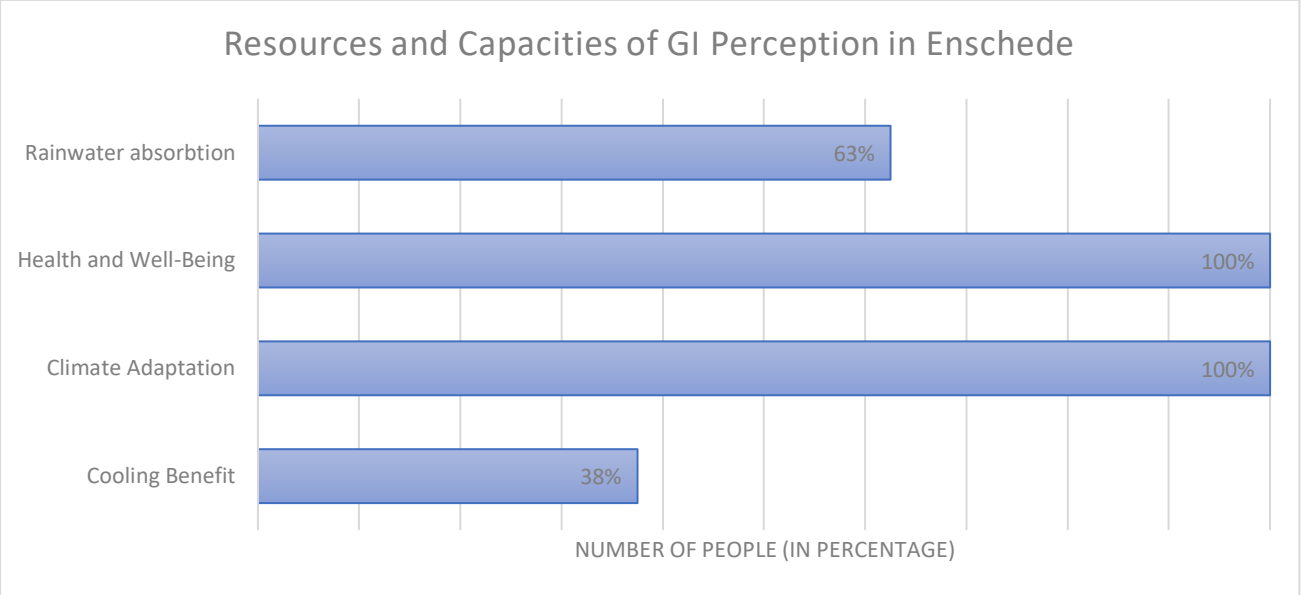

Figure 10 Resources and capacities Enschede

In Enschede, all respondents agreed that GI provides benefits for climate adaptation, health, and well-being. They mentioned the park, which allowed them to enjoy walking and cycling. Five out of eight (63%) of respondents also explained that GI could be used as rainwater absorption. They introduced the Neighbour's day program the last September, where they planted a green plant in the street, allowing the road to absorb rainwater. Furthermore, three out of eight (38%) respondents considered GI as a cooling system because it used trees and vegetation.

Notably, interviews with local stakeholders in Enschede figured out that many people in Enschede are considering building their green environment. Recently, the municipality of Enschede launched Groen-Blauw Enschede. It is a website to facilitate and inspire residents and professionals to involve in climate change adaptation and eco-friendly infrastructure. One of the municipality programs was "*Green your schoolyard subsidies*" to bring children closer to a healthy environment and as an excellent way to introduce GI's function for people. Developing parks in urban areas helps retain rainwater and create possibilities for recreation (Beumer et al., 2012). Therefore, more opportunities for climate adaptation can be achieved by the programs.

4.4 Remaining challenges

This part of the result addressed the fourth research question, "What are the remaining challenges in the case study areas related to storm waters?"

4.4.1 Makassar

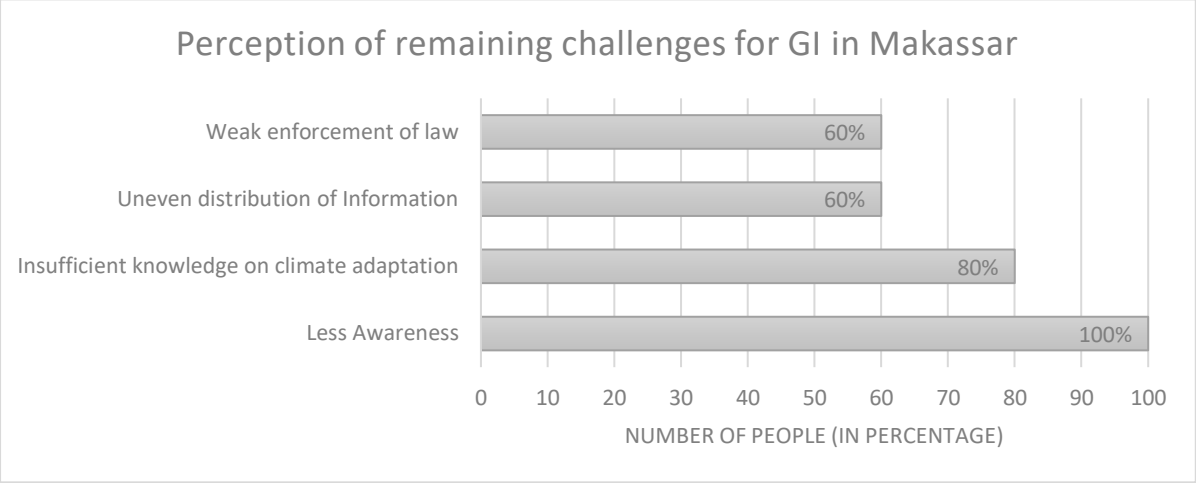

Figure 11 Remaining challenges for GI Makassar

Figure 11 represented the percentage result from twelve interviewees in Makassar concerning the remaining challenges for GI implementation. All of the respondents agreed that low awareness was a key challenge. Ten out of twelve (83%) respondents mentioned that climate change mitigation only reached scientists and policy makers. The respondents realized that they had been suffered from flooding, but they could not cope with climate impacts. Eight out of twelve (66%) of respondents recognized that the uneven distribution of information became a real challenge in Makassar. The majority of interviewees said they were not familiar with the word "Green Infrastructure."

"There was socialization in 2009 from some experts including environmental institutions, but only certain people were invited" (Interviewee 7)

In addition, the interviewee emphasized that socialization only reached the middle to the upper class with a high education level. Related to GI's implementation, eight out of twelve (66%) of respondents mentioned weak enforcement of the environmental law remained a significant challenge.

"Although we have had environmental law and lots of innovative action, but compliance with and enforcement law remain relatively weak for us." (Interviewee 15)

Conforming to the interview data, some literature studies mentioned that spatial planning regulation is becoming an issue to integrate GI into urban climate resilience in developing countries (Mathey et al., 2011). Matthews et al. (2015) give a holistic review of several barriers found for GI implementation: limitation on detailed knowledge, political intervention and planning regulations, and managing risk and uncertainties related to GI implementation. One interviewee, a local resident stated that the government provided seminars and training about GI in 2009. However, due to uncertain reasons, it stopped.

4.4.2 Enschede

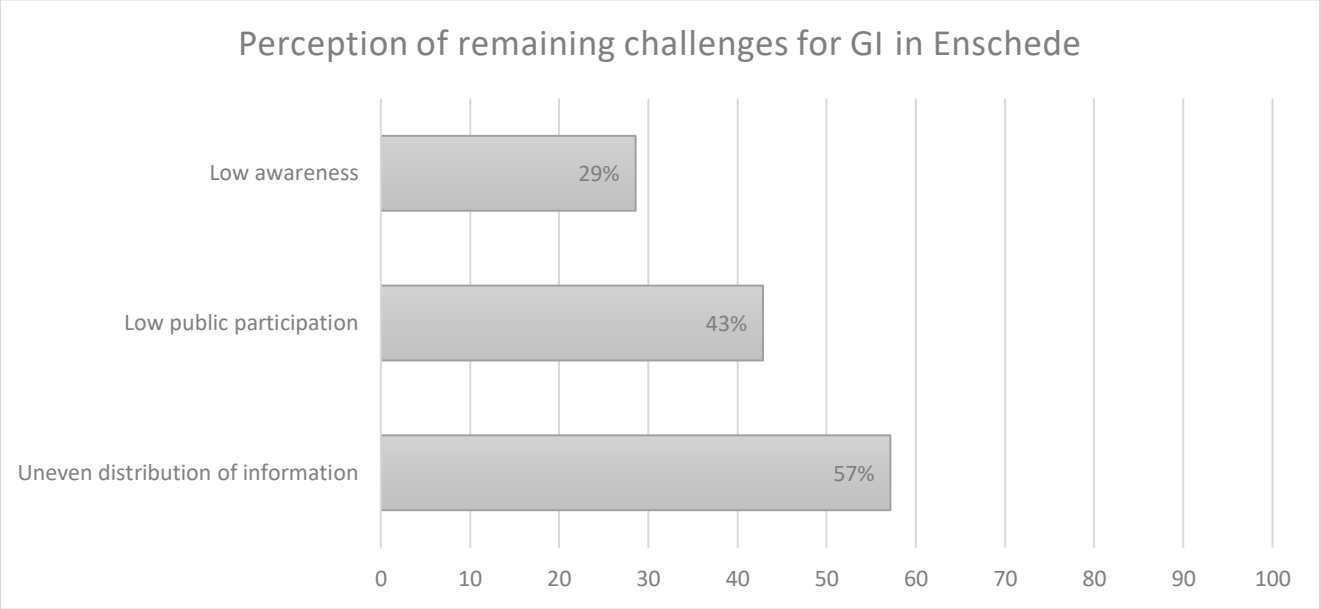

Figure 12 Remaining challenges for in Enschede

Figure 12 represented the percentage results from seven interviewees in Enschede about the remaining challenges for GI implementation. This study discovered four out of seven (57%) respondents stated that the distribution of information was not optimal, for instance, information about GI cost and maintenance. The respondents believed that the cost of GI implementation is expensive. Furthermore, three out of seven (43%) respondents agreed that low public participation became an obstacle for future GI execution. As mentioned, the municipality organized a "climate café" as an initiative. However, according to the interviewee, the program was not optimal to cover all different levels of society. Two out of seven (29%) respondents also indicated low awareness could be a future challenge. One interviewee assumed that people were not pro-active because they have put their trust in the authority.

Chapter V

Result Analysis

5.1 Conceptual Framework

The understanding of GI implementation by using the conceptual framework in chapter 2 has helped the researcher to see different actions and new learning process to enhance community resilience. This framework emphasized the current policies to mitigate the flooding problem to enhance community resilience. Understanding the policies help to explored the action taken by the government. The experience of GI implementation in both cities provide ability to learn for future GI implementation. By focusing attention on flooding and GI, this research offers innovation that Makassar can learn from Enschede.

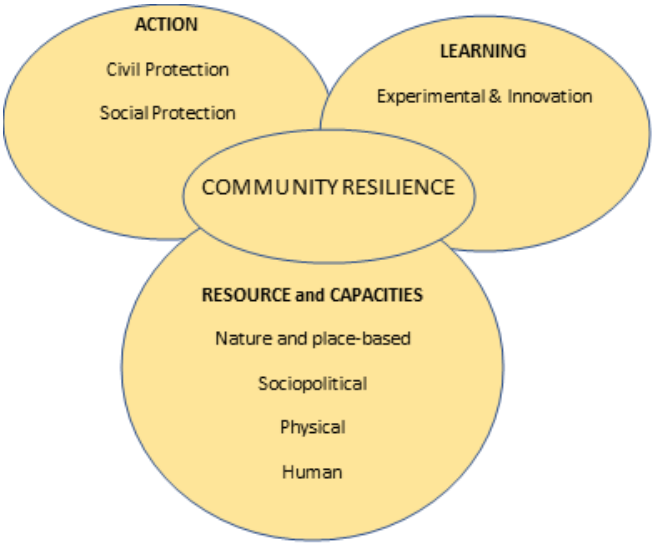

Figure 13 Community resilience framework (adapted from Kruese et al., 2017)

5.1 Result: The significant risk of flooding in Makassar and Enschede

Flooding will happen if the rainwater has no space to be collected because the infiltration capacity of the ground is low (Hofman & Paalman, 2014). In addressing the first research question, this study shows the risk of flooding in Makassar and Enschede. From the result, there is a growing risk of flooding in Makassar. To manage the risk, people take action on their behalf rather than waiting for the government action. Therefore, people gain community resilience through their actions. In Enschede, the risk of flooding is almost not seen by the people who have experienced it. The government took action to enhance the community's resilience by expanding the capacity of sewer system for flooding prevention.

Overall, this study shows that flooding causes loss of life and significant destruction to property and infrastructure. Although the intensities of flooding risk in Makassar and Enschede are different, it still affects inhabitants. For example, flooding 2018 in Makassar displaced 445 people (BNPB). The number of inhabitants affected by flood were higher than those whose homes or businesses were directly inundated during that time (Kingsford, 2000). Flooding also

damaged private properties in Makassar because floodwater carried enormous amounts of silt which damaged walls or floors (Twigger-Ross, 2006). Dano (2020) addressed the probability of property loss during a flood event in Makassar at 35.7%, followed by 1.1% of productivity loss. In some cases, people are forced to leave their house, leading to disruption of their daily life.

By contrast, flooding in Enschede resulted in no one being displaced. The water only flooded the gardens and roads (Jonkman, 2007). The differences in flood risk in Enschede and Makassar lie in their flooding management. Prior to the historical record of flooding in 1953, the Netherlands lists 1795 fatalities (Jonkman, 2007). Centuries of floods have left Dutch people inventive about flood risk management. The Netherlands changed flood risk policy, introducing a scientific approach to mitigate flooding, assigned The Delta Committee to solve the current and uncertainties about future flood problems (Tol, 2014). There is enough information to believe that Delta Programs has been successful in carrying out individual responses to flooding. Delta plan is considered as an essential policy lesson for Makassar, who sees the Dutch experience for flood risk reduction programmers.

Apart from that, assessing flood damage is the key to reduce the risk of flooding and as a window to implement flood protection measures (Green, 2003; Wijayanti et al., 2017). One solution offered by the regional government for flood mitigation was developing a new dam construction for dense areas. Engineering and technical contributions to clearing canals are undoubtedly needed. For instance, dams retain floodwaters before they reach flood-prone areas (Change & Strategy, 2010). Typically, dams' principal use manages the floodwaters in the reservoir and gradually releases them downstream (Ma et al., 2012). Nevertheless, dam construction usually has a high upfront cost and can be overtopped by an event outside their design capacity. For instance, the big flood in 2018 was caused by the opening of the floodgates in the Bili-Bili dam. It is because the dam was almost exceeding its capacity. In some circumstances, recent studies believe that technical solutions may only reduce flood risk in one location by transferring the risk into another location, also causing environmental impact (Van Alphen & Lodder, 2006). In the Netherlands, semi-open dams were designed after public protest against full closure. The construction allows tidal fluctuations and closes during storm conditions.

5.2 Policy Evaluation

In comparison with the Netherlands, policies in Makassar are more descriptive but low in enforcement and implementation. By contrast, in Enschede, where the Water Act and Delta Plan can be seen as measures at the national level and supporting regulation for the regional level, it helps to guide the realization on a regional level.

5.2.1 Makassar

Overall, decentralization allows a transition in Indonesia's disaster management from central government to a local institution. However, a lack of coordination is still found between the central and provincial governments. Moreover, policy analysis showed the different capacities of each stakeholder in the decision-making process in Makassar. The implementation of policy depends on the power and interest of actors. As shown in the figure below (See figure 11), actors, which are private sector and local resident, have interest in climate issues related to GI and flooding, but they have limited power in the decision-making process. For the "players", they have considerable powers to influence the decision. Context setters are local governments who can set or influence the rules of flooding and GI. Therefore Major of Makassar plays a

role in this context. The NGOs also are considered context setters because they can assess government action and policy but are not directly affected by the water problem. Academia can evaluate environmental issues, but they realized their research sometimes does not consider by the government. There is no crowd found in this research.

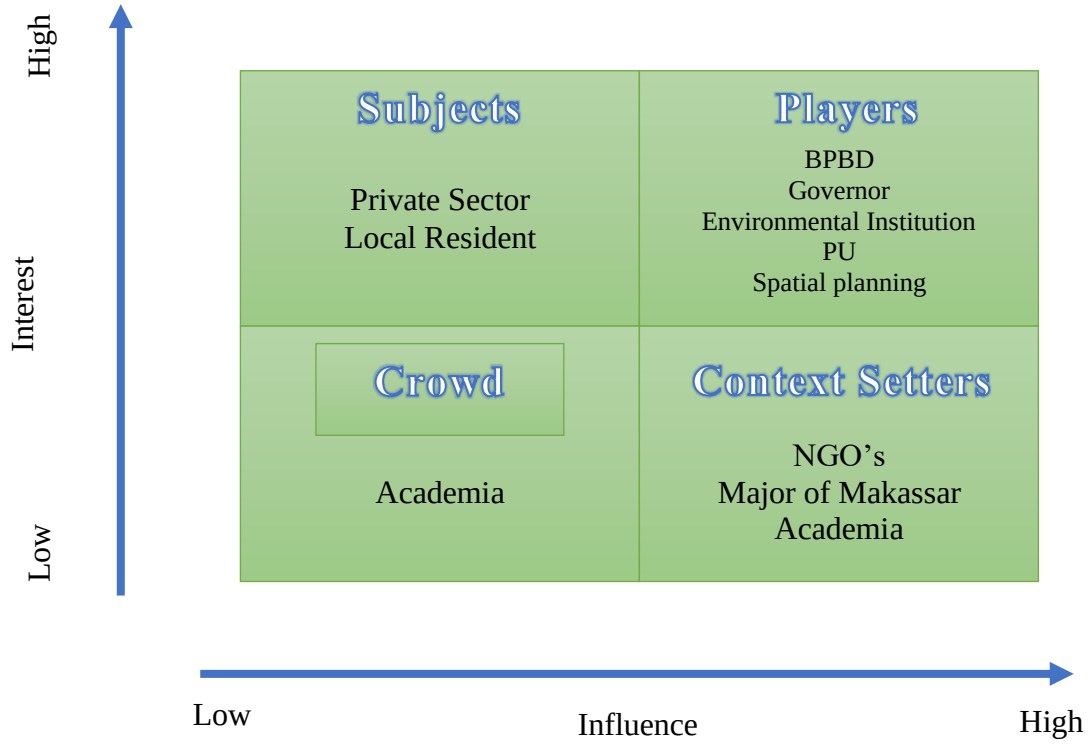

Figure 14 Influence-Interest stakeholder in Makassar, Own elaboration

Firstly, the implementation of Law No. 7/2004 confronts difficulties at the national level because of overlapping jurisdictions between ministries. This law aims to become Integrated Water Resource Management (IWRM). However, each ministry sets its regulation and has different ways of thinking. A recent study stated that stakeholder collaboration and cooperation are not prioritized because the management patterns overlap (Ariyanti et al., 2020). Furthermore, changes of policy at the micro and local level created difficulties for the implementation. But this change is necessary for a local authority to translate the substantial message into familiar terms for local citizens and the authority itself (Ariyanti et al., 2020)

Secondly, Law No. 24/2007 regulates disaster relief and governs. It includes preparedness to respond and recover. This law is a foundation for Indonesia to have a solid and comprehensive legal framework for disaster management (International Federation of Red Cross and Red Crescent Societies & Palang Merah Indonesia, 2016). However, a recent study explained that disaster management has not been effective in Indonesia due to the lack of policy and regulation at the national level to handle the disaster (Kartika, 2017). There were some overlaps and inconsistencies of legislations governing natural resources. For instance, disharmony legislation found between Law No 24/2007 and Law No. 26/2007 within overlapping authority

and lack of inter-institutional coordination, procedures on working at disaster management, and disaster funding (Kartika, 2017).

Furthermore, some discussion gives more legitimacy power to the National Disaster Management Agency (BNPB), which is not one of the cabinet members. However, it has a direct coordination with the president. Lassa (2013) believes that giving BNPB more legitimacy can strengthen Indonesia's disaster management like Sri Lanka or Bangladesh. However, there has been no further decision about it.

Environmental protection in Indonesia is regulated by Law No. 32 of 2009. This law gives autonomous power to the regional government at the regional level to protect and implement this law. This law also grants everyone the right to access data or information related to environmental protection and management. Furthermore, this law also requires transparency from the provincial and regional governments, including an opportunity for public participation. Under regulation number 32, Year 2009, about protection and environmental conservation, the government of Makassar tried to protect several in-built lands from investors. But, in reality, this implementation is hardly visible because two interviewees described foreign investments in the coastal area of Makassar as leading to environmental degradation. Likewise, the regulation from the Mayor of Makassar, Number 69, Year 2016, concerning permits for utilization, arrangement, and management of green areas also developed are not managed well by the city council. Ideally, the national level sets GI principles, which need to be understood at the regional and local levels. These principles include national strategies focusing on long-term targets on GI maintenance. Thus, the national government's monitoring activities should be carried out at the national and regional level to ensure policy implementation on GI is well-implemented.

5.2.2 Enschede

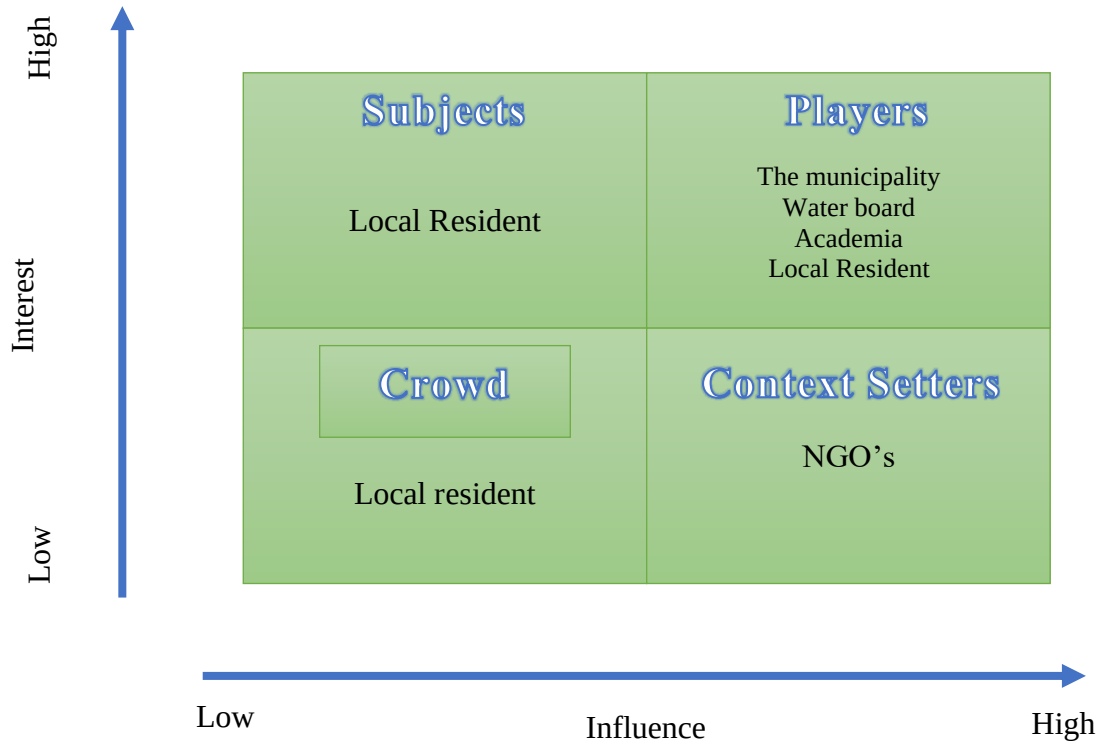

Figure 15 Influence-interest stakholders in Enschede, Own elaboration

Figure 13 shows the level of influence and interest of stakeholders in Enschede. The local resident was put in almost clusters because the Netherland uses a participatory approach which major efforst are needed to boost participant participation.

Policy and legislation are established at the national level in the Netherlands, whereas operational responsibilities and implementation are regional and local. According to De Heer et al. (2004), water management in the Netherlands is already highly decentralized in the water board's hand. On the one hand, this has resulted in a firm water policy in the Netherlands because it creates strong central leadership at the local level. However, on the other hand, the system is often perceived as problematic. Water use licenses, such as water discharge, abstraction, and other uses, are different. The administration process to get water licenses is also arranged by various authorities (De Heer et al., 2004). For example, according to the legal view for water risks and the cost of drought and flooding, municipalities must consult with the water board to prepare land-use plans. The water boards have the power to specify the general command. In other words, this is an interactive process between municipalities and water boards but does not give a particular outcome because municipalities are not required to follow the advice of the Water Board (Jong, n.d.)

Delta Management plays a role in climate-proofing the Netherlands. The programs started in 2010 which involved central government, provinces, municipalities, and waterboards. It aims to improve flood risk management, vulnerability reduction to water scarcity, and spatial adaptation (Delta Program Commissioner, 2017). However, according to Bloemen et al. (2019), there is a political intervention, such as commitment of actors, in the process of planning and implementation. The Delta Management Program is still in its early stages of

development. Therefore the effectiveness of implementation needs to be proven (Zevenbergen et al., 2018).

5.3 GI capacities

5.3.1 Makassar

Lorong Garden was mentioned during the interview, which is a project to improve green public spaces in the dense population in Makassar. Using plants, such as flowers, the government aims to improve the quality of life for vulnerable urban groups and environment quality in the slum area (Sataloff et al., n.d.). Additionally, in green buildings, GI also considers health benefits and well-being because of air quality and materials used for the building, vegetation, and the natural light that can support well-being. Some hospitals have proven this benefit, such as the Royal Children's Hospital in Australia, which brings together nature and vegetation around the building (Brierley, 2015). Furthermore, GI will increase rainwater penetration into the ground and decrease water run-off (Hui et al., 2020), as shown in the Nipah Mall concept. The green roof concept in Nipah Mall has the potential to reduce city dwellers' stress.. However, the embracing of green building concepts in Makassar is still low. According to M. Tahir et al. (2017) policies implementation and environmental conditions in Makassar are still becoming the primary constraint to optimize GI capacities.

5.3.2 Enschede

Concerning the main objective, the result shows that respondents acknowledged GI's capacity to mitigate climate adaptation, whereas its function for cooling systems is less acknowledged. Likewise, Madureira et al. (2015) found cooling services to be the least important in France; however, many others found the cooling system to be perceived as highly important (Derkzen et al., 2017; Shackleton et al., 2015). The different insight may be related to the way the question is given. People in Enschede currently recognize the climate problem as general rather than specify it into urban heat. The benefits of the ecosystem-based approach in the Netherlands to community resilience have been reviewed by various authors (Gill et al. 2007; Foster et al.; 2001). Investments in GI as alternative flood regulation become a long-term plan in the Netherlands (Brouwer & Van Ek, 2004). However, the explanation and evidence of GI to human health and well-being, also for hazard mitigation in general, are still limited (Sudmeier-Rieux et al., 2013).

Another finding is the potential of information to create public support for adaptation measures. The residents are willing to participate in adaptation measures when informed, such as greener your school program. Other studies found similar effects (Derkzen et al., 2017) but stress the need for communication policy (Lo & Jim, 2010). Capacities of GI can also increase when GI designs are promoted on a neighborhood level to influence people so that people accept the installation of a rain garden or green roof (Uren et al., 2015).

5.4 Remaining Challenges

5.4.1 Makassar

Lack of motivation and willingness to include GI in development on the part of the government are key issues in developing countries (Alves Beloqui, 2020). Public participation happens partially in the implementation process. The implementation is problematic due to governance issues, such as corruption (Stoyanov et al., 2014). Furthermore, the limits of data and cost analysis in GI implementation also become the remaining challenges for GI (Green Nylen &

Kiparsky, 2015). A study by Hui et al. (2020) indicates that the implementation of green buildings can help to raise awareness of GI, as can be seen in the example of Bandung, the capital of West Java. Bandung has established a public policy of green buildings at the regional level and investing more in green building for infrastructures. Therefore, Makassar, which is also one of Indonesia's (regional) capitals, wants to copy the green building implementation from Bandung.

The function of GI is not evenly distributed in Makassar due to education and financial gap. The low-income and low-educated people do not realize the benefit of having GI around them regarding flooding or cannot afford to live in such neighbourhoods surrounded by GI or parks. This is in line with the study by (Biesbroek et al., 2011), which explained that developing countries' utmost priority is with social issues such as poverty, hunger, and health care rather than taking action on climate change. Biesbroek et al. (2011) suggested that solving climate change issues should be transdisciplinary approach. Meanwhile, in Makassar, the governance structure is a top-down approach, whereas the government has a prominent role in policy implementation. The local resident becomes the object of implementation. By changing the political perspective, all actors can share knowledge about GI. It will not only come from the government.

5.4.2 Enschede

Considering the benefit of GI, the municipality of Enschede subsidizes the implementation of GI on private land, aiming to increase awareness. However, it still does not fulfill the municipality's expectations. From the interview result, the information about subsidies remained unclear. Therefore, the municipality is still working on how to communicate with residents about the GI project. The interview results also indicated that people find heat stroke is more threatening in the future rather than flooding.

CHAPTER VI

Discussion

6.1 Findings

The findings of the research are categorized into important themes. The first themes describe the finding for different flooding risks in both case studies. Then, the policy implementation that had been taking place in the area. Thirdly, the Green Infrastructure that has been implemented. Finally, building to the remaining challenges that still need to be overcome to provide good flooding management.

6.1.1 Differential risk of flooding

The first research objective investigated the risk of flooding in Makassar and Enschede. Although the sample from which data gathered is small, this research still provides meaningful findings and insights into the cities' normal practice for urban flood management.

As presented in the previous chapter, the result indicated different perceptions regarding the risk of flooding. Both case studies revealed that flooding affecting the life of inhabitants, social, and economics. However, the consequences of flooding vary depending on the location and government action to tackle the risk. Lower risk is found in Enschede compared to Makassar. As mentioned in the result section, flooding in Enschede caused due to the overcapacity of the sewer. The sewer system in Enschede cannot handle storms resulting in 30 properties having sewage water in the resident home (RTV OOST, 2014). Although the flooding caused residents at a loss, observation by (Pilarczyk, 2007) noted that in general, the strategic planning for mitigating the risk of flooding seems to be more frequent in the Netherlands because about a quarter of the country is below sea level. Hence, protection against flooding is an important task for the Dutch government, resulting in almost no flood risk experienced by local residents. In the case of Enschede, the municipality works with residents, companies, and other stakeholders to ensure Enschede is safe from flooding and withstand climate extremes in the future. This is in line with recent findings that higher municipal flood protection standards are provided to the household (Slomp, 2012). Therefore, the government has the responsibility for the safety of citizens. From the explanation, the first research question is answered for the Enschede case study.

Furthermore, as mentioned in Sections 4.11 and 5.1, higher risks of flooding revealed in Makassar. It is because the city is not equipped with proper and efficient flood management. The lack of planning and law enforcement related to spatial planning caused uncontrolled urban population growth, thereby triggering the decline of water catchment areas. Recent studies show that some drainage systems have not been connected to the gutter system in residential and government offices (Sudirman et al., 2019). Furthermore, the lack of bottom-up involvement in crafting well-implemented flood risk management creates problems in execution and action. Makassar's institutions are aware of the risk of critical;climate change, but planning to mitigate the risk is hard (GFDDR, 2021). With proper involvement and communication, local residents can better understand the planning of the government.

6.1.2 Policy implementation

There are major concerns about policy implementation in Indonesia. For instance, there are gaps between different sectors and responsibilities distribution (i.e., water management, climate change, and green infrastructure). The issues of implementation of laws and lack of coordination in the previous section can undermine the extent to which the input of stakeholder role is meaningful and effective to local policy goal when addressing GI, climate change, and water management.

As lots of laws and regulations related to environmental problems are addressed in different institutions in Indonesia, assessing effective coordination is needed because implementing every policy's goal requires collaboration and cooperation from all levels of stakeholders. This is problematic because the law's lack of definition of ministries and other stakeholders' roles tends to affect particular stakeholders and hinder capacity building for others. The results from the previous section revealed that disaster management should be carried out only by BNPB and BPBD. Every district must consolidate and coordinate with BPBD to adopt precautionary measures against natural disasters. However, in some areas, BPBD lacks the technical capacity for risk assessment (UNISDR, 2015). Overlap and unclear policy also can occur within BNPB and the Minister of Environment. Both institutions can address the same policy about the environmental problem without giving limitations. Similarly, an environmental assessment can be issued by Minister for home affairs. Furthermore, GI policy is addressed by Spatial Planning, but the guidance is preparing by PU.

Coordination and collaboration can avoid overlap and clashes of interest, but without clear responsibilities for stakeholders governing climate, water management, and GI in Indonesia is no easy task. Indonesia policymakers remain stagnant in utilizing the different institutional contexts for environmental management. Identification of interest, power, resources, and capacity of each stakeholder should be recognized in advance to know the extent to which stakeholders can be involved (Simanjuntak, 2010). Therefore, legal clarity is needed to clarify which institutions have the right to take decisions when addressing environmental problems (Glover & Schroeder, 2017).

This research highlights that Enschede has better coordination and collaboration for policy implementation. Its clear measures for flood risk management, adaptation, and long-term plan include and integrate many actors. Although every large-scale project related to water management, such as flooding, also has some conflict potential. In the Enschede case, flood safety is a responsibility of the national government in collaboration with the water management board. It also involves many parties, such as local residents and private sectors.

This result should be interpreted with caution because multi-stakeholder participation is very limited in Makassar, even though several stakeholders are involved. Despite differences between the two cities, Makassar can learn from Enschede in the context of policy implementation, coordination, and collaboration.

6.1.3 Resources Capacities of GI

Through the Lorong Grade program, the expansion of Green Open Space helps create gardens along the alleys in limited open spaces in Makassar. Although this program contributes to making Makassar cleaner and greener, this research argues that Lorong Garden's capacity cannot be counted for rainwater absorption to mitigate the stormwater problem. The program

tends to achieve the economic purpose for the community. The vertical gardens in Lorong Gardens are planted with agricultural plants which can be consumed and sold at harvest time (Mustanir et al., 2020). However, Lorong Garden's application can improve living conditions and improve the quality of slum areas in Makassar. Meanwhile, capacities of GI to reduce surface runoff are found in the Nipah Mall building.

In the case of Enschede, the green roof is becoming a sustainable and environmentally friendly neighborhood. Capacities of green in Enschede are not only for water management but also for heat stress, biodiversity, and amenity value (*Green Roofs | Urban Green-Blue Grids*, n.d.).

6.1.4 The remaining challenges

The research findings from this study show some similarities with regard to the remaining challenges of GI implementation. As mentioned in section 5.4, communication seems to be carried out to give clear GI information in both cities.

In the case of Makassar, overall, the city is not ready to become a green and sustainable city. There are lots of people who do not understand GI's concept (See section 5.4.1). The citizen is still questioning what GI is, why the city is needed for GI implementation and the benefit of GI for their environment. There are barriers to implementing green infrastructure include lack of performance information, lack of awareness, and socialization about GI from those who have expertise in GI development (Drosou et al., 2019). People still abandoned the value of having green spaces to improve environmental conditions and increasing the quality of life in Makassar (Mungkasa, 2020). The research traces that local residents, who experience quite intense floods, have a high probability of loss during flood events (Section 5.4.1). The communication approach could give the perception about GI for the environment. However, it is not the residents that lack awareness of GI. Policymakers also often lack a basic understanding of GI's benefits (Drosou et al., 2019).

While Makassar is still struggling with integrating communication from stakeholders and residents, the city of Enschede is at the forefront of the climate dialogue. Still, it is not enough to make people more aware of climate issues. This study found that strong campaigns that increase public awareness on GI implementation are still needed to strengthen basic communication. Unclear information may lead the citizen's organizers themselves to create and manage their own garden in private land without considering some of environmental aspect or protest against the municipality's subsidy policy (Mattijssen et al., 2018). For example, garden vegetation in urban areas is still not clear, such as the garden size, detail planting, and the plant types. Different neighborhoods have different capacities for rainwater absorption or cooling systems (M. O. de Jong, 2015). Proportion of garden size and permeable areas are correlated, meaning that the bigger permeable surfaces, the bigger the garden. The residents may perceive the green product to be expensive. Therefore, emphasizing the importance of private gardens and how the subsidy works will create a better understanding of the practice. A joint approach is necessary for overcoming these communication barriers (*Klimaateffecten Voor Twente in Kaart Gebracht | Gemeente Enschede*, n.d.)

6.2 Reflection on the methodology of the research

This research intended to evaluate GI's contribution in Enschede and Makassar to how local policy goals can increase the community resilience against stormwaters. The answer to the research question has been given. However, some aspects are still taken into limitations in this

research. For instance, firstly, the covid-19 situation prevented on-site fieldwork in both case studies. All data collection had to be conducted online, including the interviews. However, some people were unfamiliar with an online interview. Some institutions were not fast to respond with online meetings. Therefore, the research results may be different if field observation can be carried out. Secondly, most of the literature about Enschede flooding was in Dutch. Therefore, language became a limitation for the researcher to gain some information about previous research. Thirdly, the scope of discussion is also limited. Recent studies were very general about flooding, and only a few discussed a specific case related to GI to stormwater and the flooding in Makassar and Enschede.

6.3 Reflection on the conceptual framework

This research desired to understand the community resilience by using GI for the flooding problem. The community resilience framework was useful for highlighting the different actions taken by both cities to solve flooding problems. The framework has unraveled that Makassar can learn from Enschede for GI implementation. As has been described, the municipality of Enschede showed better flood management by using GI compared to Makassar. A short overview of each concept is provided in this section. Additionally, action in this research is understood as one of the GI elements to provide social protection within communities. It belongs to policies regarding urban spaces and flooding management, which both case studies already have. Learning is understood as an adaptive process of GI to create climate resilience. Resources and capacities are related to the ability of GI for flooding adaptation. These three aspects assess GI to enhance community resilience in Makassar and Enschede.

Overall, the utilization of the concepts has been challenging since the conditions of both case studies are different in relation to GI development, implementation and response from resident. Furthermore, each case study has a different GI implementation and process, however, integrating all of them into one brief explanation adds value and overview. Henceforth, this thesis's attempt to assess two locations with different GI experiences proved valuable and helpful in analysing urban green infrastructure development.

CHAPTER VII

Conclusions and Recommendations

7.1 Conclusions

The benefits of GI has enticed both cities to establish a green policy for climate adaptation. GI can contribute to the effective policy implementation of a range of domains, including climate action, water problems, and disaster risk management. The existence of GI in the neighborhood can take the form of parks, gardens, and green roofs both in the private and public land. However, some remarks were found in this study to ensure the effectiveness of the policies. For instance, the enforcement of policies and collaboration from many actors are still needed. The role of academia for example is almost not seen in the decision-making process in Makassar. Furthermore, this study also highlights that stakeholders' involvement needs proper collaboration. The involvement of stakeholders in Makassar created confusion about GI implementation. There are unclear definitions and responsibilities related to each stakeholder's job when addressing water management, GI, and climate change in the legal framework. To conclude, this situation weakens the GI implementation.

This study also found that flooding affects inhabitants more in Makassar and Enschede. Flooding occurred in Makassar due to complex problems, such as urbanization, weak policy enforcement, spatial planning regarding land-use change, also climate change. These factors affecting the social and economic life of inhabitants. In comparison, the flooding problem in Enschede occurred due to the lack of capacity of the public sewer system. With this study, Makassar can learn from Enschede (taking account of significant differences between the cities) about flood management.

The benefits of GI for increasing well-being, rain water absorption, and climate adaptation have been revealed in this study. The capacity for rainwater absorption to improve citizens' well-being is seen in the Nipah Mall building which is the only green building in Makassar. This research also argues that the government program, Lorong Garden, is primarily seen as serving economic purposes and not as green infrastructure for stormwater infiltration. Meanwhile, in Enschede, GI's capacity is already acknowledged as urban climate adaptation, such as a cooling system, rainwater absorption, and improved well-being. However, to reach GI implementation's potential, more information for the advantage of GI capacities is needed. Although this research concludes that GI has capacities for flooding mitigation, the communication approach and spreading of information are still barriers for further implementation. The mechanism of subsidy remains unclear. Authorities play an important role in relation to this barrier.

Lastly, an effective communication approach is needed for future implementation. The information about GI is still not well-spread into society, especially information about GI subsidies in Enschede. A well-spread information help to give insight to the resident about GI function for stormwater mitigation.

7.2 Recommendations

- Social media have become a new form of public participation, especially for the young generation. Social media such as Facebook, Instagram, and Twitter are great opportunities to disseminate GI information. Therefore, the authorities can use social media to reach the younger generations and talk about climate issues.
- This research recommends that the city of Makassar's authority increase GI implementation by learning from different countries' experiences. Furthermore, several workshops related to climate adaptation can be conducted to improve participatory processes. Local stakeholders can arrange workshops in the café or *warung kopi* to attract many participants.
- Both case studies need transparency regarding the responsibilities and tasks of the government in GI implementation. Furthermore, the cities also need to evaluate the existing GI to give some insight and a better understanding of GI implementation.
- Given the decentralization in Indonesia, stakeholders' interest in a top-down approach is not compatible anymore. The involvement of academia, residents, NGOs, and the private sector in the decision-making process must be considered.

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Annex I

Jeneberang River is one of the main rivers in South Sulawesi Province and flows through the province from east to west. It originates from the mountain Bawakaraeng (2,833 m) and flows to the Makassar Strait. The river is 90 kilometers long and has a drainage area of 727 square kilometers. The drainage area of the Jeneberang River is 727 square kilometers and is located in South Sulawesi Province. Ujung Pandang (now Makassar) is the capital and economic center of South Sulawesi itself and eastern Indonesia. The population growth rate in this area is 2.93% per year. The fresh water of the Jeneberang River has been used since 1926, and the water from the Kampili Dam has irrigated 17,600 hectares of rice fields. In order to protect Ujung Pandang City from floods, the government built a flood control structure in the lower reaches of the Jeneberang River in 1978, built the Bilibili Dam between 1988 and 1998, and finally built the Jenelata Dam in 2000.

Floods are usually caused by heavy rains in the rainy season, and flash floods often occur. Two reservoirs are under construction in the basin, the Bilibili Reservoir on the Jeneberang River and the Jenelata Reservoir on a tributary of the Jenelata River. The annual precipitation in the basin varies along the main stream. The average annual rainfall in the upstream basin is about 3,700 mm (3,707 mm at Malino station), and the annual average in the downstream basin is about 2,160 mm (2,166 mm at Bontosunggu station). The climatic conditions of the basin are affected by the monsoon. There are two seasons each year, the dry season is from March to August, and the rainy season is from September to April. The annual average emissions of Patalikang station is 43.5 m^3/s, while the average annual emissions of Jenelata station is 12.8 m^3/s.

APPENDIX I

Interview Questions

Academia

1. Could you tell me about what you are doing and how long you have been as researcher?
2. What comes to your mind when you hear the phrase “green infrastructure”?)
3. What is your opinion about annual flooding in this city?
4. In your opinion, is there any better solution to mitigate floods without changing the natural ecosystem?
5. As one of the researchers in flooding mitigation, do you think green infrastructure is a possible solution for future flooding adaptation?
6. From your perspective, how will society cope with the upcoming flooding hazard?
7. In your opinion, do you think GI implementation can enhance community resilience?

Government

1. Can you describe how you became a part of a Green Infrastructure project?
2. What is the mode of communication or coordination among different stakeholders?
3. Were there any knowledge gaps in the early stages of implementing Green infrastructure in Enschede?
4. What is your institutional goal for green infrastructure with respect to flooding?
5. Does your institution have specific policies regarding green infrastructure which are different from other institutions? If yes, why is it different?
6. How effective is Green Infrastructure towards flood management? Probes: Which Factors contribute to the success of Green Infrastructure?
7. How does your institution encourage people who are at risk from the detrimental effects flooding to participate in green infrastructure projects?
8. How would your institution prepare for a flood event?
9. How does your institution mitigate the effect of the stormwater flood (e.g., post traumatic stress) on local people in Enschede?
10. How will your institution maintain the GI?
11. What recommendations would you have for future GI projects?
12. Is there any financial incentive from your institution for implementing GI project?

Local Resident

1. Could you tell me about yourself and how long you have lived in this area?
2. Do you remember any year where there was heavily rain? And how was the situation at the time?
3. How is the condition when there is heavy rain in those years including the household, school, and public spaces?
4. What effect did the flooding have on you and people around your neighborhood? (Financially, emotionally, and socially?
5. Has the government always done enough to address your concern during and after flooding?

6. Do you have any people who experienced the same situation as you that I could talk with?
7. What do you do when the flooding occurs?
8. What do you think is the cause of the flooding? And why do you think that is the cause?
9. Are you aware of green infrastructure around you for flooding adaptation? If yes, how?
10. What is going well with the green infrastructure implementation in your city/region?