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都市水患的社區韌性: 臺北社子島的例子

**Community Resilience to Urban Flooding: A case study of Shezidao,
Taipei**

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摘要

在氣候變遷引起的極端天氣威脅和全球暖化引起的海平面上升威脅之下，河口區域應立即採取應對威脅的措施。自 1970 年以來，位於基隆河和淡水河匯流處的社子島，因保護台北市不受洪水威脅而被宣告為禁建區域。這一禁令，導致社子島成為快速發展的台北市中，相對低發展的社區。然而，社子島被排除在政府防洪計劃之外，當地居民認為為了保護台北市的其他地區免受到洪水的侵害，社子島被犧牲了。在洪水威脅和居民對發展的需求之間的衝突中，社子島正在挑戰台北市對於氣候變遷的調適策略。在此之下，本研究選擇社子島作為案例研究，以研究和描繪一個地方社區的韌性，和社區對於洪水調適的因應機制。本個案研究，將研究區域的在地居民視為調適的基本單位，以更好地了解在氣候變遷的負面影響的下的韌性都市生活。

本研究分析社子島人與環境之間的互動和關係，以對於災害和洪水風險管理的不同階段中的社區洪水韌性有全面性的瞭解。本研究收集了有關洪水及其他氣候相關災害對社區的影響的資料，並分析了他們的社區韌性和調適策略。接著，從專家和當地居民的角度，本研究分析了對於災害的韌性，以及政府的洪水風險管理措施。強大的社區韌性使居民在日常生活中對氣候變遷的威脅有著周全的看法，同時支持當地的調適技術和知識。然而，居民對政府對社子島的再開發計劃表示不同意，並擔心該計劃可能抹去他們的文化生活和友善的社區環境。

關鍵詞：都市洪水、社區韌性、社子島、水災管理

Abstract

Under the threat of extreme weather caused by climate change and the rising sea level induced by global warming, response measures for the river-mouth region should be taken immediately. Since 1970, Shezidao, a sandbar area situated at the confluence of the Keelung and Tamsui rivers, has been declared a construction-forbidden area for the conservation of Taipei city. This ban led to Shezidao becoming a low-developed community situated within the growing and rapidly developing city of Taipei. However, Shezidao was excluded from the government flood prevention plan for protecting Taipei City from the recurrence of 200-year floods. Thus, residents think that Shezidao has been sacrificed in order to protect the rest of Taipei city from flooding. With the conflict between the threat of flooding and the demand for development from residents, Shezidao is challenging Taipei City's adaptation strategy for climate change. As a result, Shezidao was chosen as a case study to study and portray a local community's resilience and coping mechanisms to adapt to flooding. Local peoples of the study area are shown as the fundamental units for adaptation in this case study in order to better comprehend resilient urban life within the context of the adverse impacts of climate change.

This thesis analyzes the interactions and relationships between humans and their environment in Shezidao in order to have a holistic understanding of their community resilience to flooding through the different phases of disaster and flood risk management. This study collected data about the impact of flooding and other climate-related disasters on the community and analyzed their community resilience and adaptation strategies. Next, studies on disaster resilience as well as the government's initiatives for flood risk management were analyzed from the perspectives of experts and local residents. Strong community resilience results in residents having a thoughtful perspective of the threat of climate change in their daily lives while supporting local adaptation technologies and knowledge. However, residents disagree with the government's redevelopment plans for Shezidao and fear that this plan may erase their cultural life and community-friendly environment.

Keywords: Urban Flooding, Community Resilience, Shezidao, Flood Risk Management

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1 Introduction

1.1 Urban flooding

Urban flooding has become a significant global challenge in recent years, exacerbated by climate change and rapid urbanization (Miller & Hutchins, 2017). Dramatic land-use changes have occurred in the majority of cities as a result of rapid urbanization and extensive climate change. Rapid urbanization has led to an increase in concrete surface area and a reduction in the infiltration or absorption of stormwater runoff into the soil. Grey infrastructure has largely taken the place of blue-green landscapes, such as forests, grasslands, and wetlands, which naturally control coastal tides and waves and capture rainfall. Urban areas are more vulnerable to floods as extreme weather events occur more frequently and severely, having a considerable negative impact on the economy, society, and environment (Lau et al., 2010). Nature-based solutions (NBS) have emerged as an innovative and sustainable approach to managing urban floods while also providing additional co-benefits such as improved water quality, biodiversity conservation, and recreational opportunities (Oral et al., 2020).

Urban flooding also includes floods that don't merely affect cities or cause rivers to overflow. Instead, it occurred as a result of inadequate space for the runoff of stormwater, an insufficient oldest sewage system, and a lack of permeable surface (Weber, 2015). Furthermore, even very little precipitation can clog the drainage system and flood city streets. Urban flooding can also be defined in a variety of ways, including flooding caused by heavy rainfall, flooding brought on by impermeable surfaces, flooding caused by aging sewage systems with limited capacity, flooding brought on by rapid urbanization, and flooding caused by inadequate infrastructure (Asiedu, 2020).

Although most of the studies about flood hazards mainly focus on monetary loss and fatality loss, it is equally important to shed light on the losses suffered by both individuals and communities. On a smaller scale, urban flooding has an impact on the city by obstructing traffic, lowering the frequency of public transportation, obstructing the supply chain, closing institutional buildings, and many other things (Weber, 2015). In addition, most low-income residents live in places that are vulnerable to flooding. Or, to put it another way, individuals are relocating from rural to urban areas in pursuit of better living and employment opportunities. These migrants were forced to live

in temporary colonies by the river or underneath the bridge since they could not afford to afford a home in a developed town. Therefore, it is clear that urban flooding poses a serious threat to many low- and middle-income people.

Urban flood risk management (FRM) must be a part of urban planning and management that intends to minimize the impacts of flooding on urban areas, especially in dense cities where flood risks are usually severe (O'Donnell & Thorne, 2020). Floods can seriously harm human life and health in addition to causing damage to buildings, houses, and businesses. To protect urban people's safety and well-being as well as to avoid financial losses brought on by flooding, it is crucial to reduce the vulnerability of urban flooding. A multidisciplinary strategy including cooperation between urban planners, engineers, policymakers, and community members is necessary for effective urban flood risk control. In their development plans, urban planners must carefully take into account flood-prone locations and make sure that the built environment can sustain plausible floods (Ibeanu et al., 2023). Engineers are essential in the design of flood barriers such as levees, floodwalls, and stormwater infrastructure (Ibeanu et al., 2023). Regulations that lower the danger of flooding must be created and implemented by policymakers, such as zoning laws and building codes. At the same time, local communities play an essential role in flood management, as their perceptions, attitudes, and behaviors can greatly impact the success of flood management strategies (Atanga, 2020). By evaluating the community perceptions of flood risk and their planning and implementation for effective flood management, this thesis aims to further knowledge and understanding of urban flood risk management. To ensure that community members' wants and concerns are taken into consideration, they must be included in the planning process (Han, 2023).

1.2 Community resilience

Resilience may be understood at several spatial scales, including individual, home, community, and beyond (Dewulf et al., 2019; Rodina, 2019). According to Keating "The community level is where flood impacts are felt most viscerally, where much action on flood resilience needs to be taken and are the focus of many flood and development activities" (Keating et al., 2017, p.80). The community level was also chosen because "there is acceptance that development and disaster preparedness interventions must operate at the level of the relatively small entities that are commonly called "communities," in addition to being a practical and well-liked choice for unit of

analysis in the social-ecological systems literature" (Rodina, 2019; Van Aalst et al., 2008, p.168). The community unit is still in use even though it is recognized that, in practice, it is difficult to separate a community from its inhabitants and the larger (city, country, or global) environment in which it is located (Dewulf et al., 2019; Keating et al., 2017). Additionally, it is acknowledged that communities do not consist of a homogeneous group of people, but rather are made up of a variety of individuals, each of whom may experience flooding differently and have varying degrees of vulnerability depending on their gender, level of education, health, and social capital (Dodman et al., 2022; Taeby & Zhang, 2019). Dewulf et al. (2019) also point out that, after a system's limits have been established, it is necessary to determine what needs to be supported to maintain its resilience or what needs to be made more robust. Due to the frequent lack of the (financial) ability to make every component of a system robust, (Dewulf et al., 2019).

In order to adjust to a disturbance or adversity, a community must first develop a network of adaptive capacities (resources with dynamic qualities). Population wellness, which is characterized as high and uniform levels of mental and behavioral health, functioning, and quality of life, is a sign of community resilience. Economic development, social capital, information and communication, and community competence are the four main adaptive capacity sets that together constitute the basis of community resilience and offer a plan for disaster preparedness (Dückers, 2017; Norris et al., 2008). Communities need flexibility, decision-making abilities, and reliable information sources that work in the face of uncertainty if they are to reduce risk and resource inequities, involve locals in mitigation, build organizational links, strengthen and protect social supports, and plan for not having a plan.

1.3 Background of the study area

Taiwan's Taipei City has a district called Shilin. Shezidao, a small peninsula located at the northeastern tip of Taipei, precisely at the mouth of the Tamsui River (Figure 1 and 2), is one of the famous sites in the Shilin District. These 323 hectares in northern Taiwan, Shezidao is located at the confluence (Figure 2) of two main rivers (Chou, 2012). In this region, about 11,000 people reside in houses that are primarily built of tin. These homes are vulnerable to power outages during floods. The majority of the structures were erected around 1970 or before. A few of the structures can accommodate about 7–15 households (Liao, 2022). As a result, the majority of the Shezidao people are housed in structures with poor flood resistance. In this location, the Taipei government

classifies a lot of buildings as unlawful development. According to a 2018 report by the Taipei City Government, only a few projects are permitted in this region (Liao, 2022).



Figure 1 Shezidao, a confluence of Tamsui River and Keelung River.

The Shezidao peninsula is a dune area situated at the confluence of the Tamsui and Keelung rivers in Taipei. The Taipei City Government declared the tip of Shezidao a flood-prone region and forbade construction. Major parts of Taipei cities were protected against a 200-year recurrence of flood and reserved a 1.5 m levee height as a margin. However, Shezidao's 6-meter-high levee system barely offers to protect recurrence of 20 years of flooding. Shezidao has thus been intentionally ignored to protect Taipei City's strategic location from a 200-year recurrence interval of flooding (Liao, 2022; Shih et al., 2014).

Flooding problems in Shezidao were a major concerning issue in the 1970s. However, the frequent flooding problem has mostly been resolved (Su, 2023). Future climate uncertainties and sea level rise could provide additional difficulties. Raising the flood wall's height as it is now suggested would simply create more risk during typhoons. In reality, the existing condition, which has a high amount of farmland and a low building density, is already an adaptive approach. Here, local stakeholders have developed effective disaster resilience and self-adaptation strategies to lessen the effects of unfavorable climatic circumstances including flooding and typhoons (Su, 2023).

1.4 Research objectives

As a result of rapid climate change and a rise in environmental hazards like floods, there are more losses and disruptions as a result throughout the world. In most flood-prone areas, flood risk management by the government is a widely accepted method for reducing flooding-related losses. However, there are a few localities where, in comparison to the capital city, the government gives considerably less importance. Tragically, Shezidao was sacrificed to keep Taipei, Taiwan's capital city, safe from the recurrence of 200 years of flooding.

Shezidao was a significant producer of vegetables for Taipei City in the 1960s and 1970s. In the 1970 report, Shezidao was designated as a "development restricted zone and it shall remain agricultural land use and be restricted from any urban development" (WRPC-MEA, 1970). Therefore, Shezidao has not developed much since the 1970s. After decades of flood control work, the Taipei Area is currently protected against a 200-year flood recurrence, except for Shezidao. This is because Shezidao's physical development is legally prohibited as it is considered a "flood-prone area". Thus, the quality of Shezidao's living environment has declined. The people of Shezidao generally perceive that they are being unfairly sacrificed in order to keep the rest of the city secure from flooding (Liao, 2022).

The research objective of my thesis is to generate context-specific knowledge on how community resilience to flooding (CRF) in Shezidao mitigates natural disasters, especially typhoons and tidal flooding, by capturing stakeholder perspectives. This thesis also covers the challenges they experienced on a regular basis, specifically in the event of a natural disaster, when residing in a region where building reconstruction is prohibited by government decree. In particular, the study analyzes the coping mechanisms they adopted to control or get over the hazard situations. Simultaneously, it measures the factors that help to enhance the community's resilience to flooding and to better reduce hazard risks. The further goal of this study is to find out stakeholders' perspectives on the CFR of the local people and the Government's future development plan in Shezidao.

1.5 Research questions

The following research questions will be the main focus of this thesis.

1.5.1 Main question

How do Shezidao residents' coping mechanisms to flooding shape their community resilience to the adverse impacts of climate change and government flood risk management initiatives?

1.5.2 Sub questions

- 1) What are the coping mechanisms of the Shezidao residents to flooding and flood risk?
- 2) How do these coping mechanisms shape their community resilience to flood mitigation and other adverse impacts of climate change?
- 3) What strategies have the Shezidao people adopted in recovering from natural disasters like flooding?
- 4) What are the stakeholders' perspectives, including experts and residents, on the government's initiatives for flood risk management in Shezidao?

1.6 Chapters distribution

This chapter has provided an overview of community resilience to urban flooding and functioned as the introduction of this thesis. The second chapter provides a review of the literature on community-based disaster resilience and adaptation, flood risk management, and nature-based solutions for flood risk management. Highlighting the research questions, the third chapter outlines the research methodology, including the research design, data collection, and analysis approaches. The fourth chapter presents the findings of the empirical research, including the results of the interviews and data analysis. Finally, the conclusion summarizes the key findings and contributions of the thesis and suggests areas for future research to further advance our understanding of urban flooding, flood risk management, and the roles of residents in shaping disaster resilience.

2 Literature Review

This chapter presents the literature review, which is followed by the conceptual frameworks and theories that the research is based on.

2.1 Resilience

Holling (1973) first used the term "resilience" to describe a system's ability to sustain and preserve its structure and connections in the presence of external disturbance or changes (Holling, 1973). The concept of resilience has expanded to many other disciplines including Flood Risk Management (McClymont et al., 2020; Walker et al., 2004). Fekete et al. illustrate, "resilience is both a term and a concept: broad, contested and yet mushrooming" (Fekete, 2020, p. 2). There is not just one way to describe resilience, more than 70 distinct definitions present in the scientific literature (Fisher, 2015; Liao, 2012; McClymont et al., 2020). An easy way to describe resilience is "the capacity of a socio-ecological system to continually change and adapt" (Folke et al., 2010).

There are many different definitions of resilience (see Table 1). There has been a lot of multidisciplinary research on resilience definition, including but not limited to (Holling, 1973; Timmerman, 1981; Masten, 1990; Adger, 2000; Buckle, Paton & Waller, 2001; Bodin, 2004; Longstaff, 2005; Resilience Alliance, 2006; IPCC, Twigg & Pelling, 2007; Cutter, 2008; UNISDR, 2009; PPD, 2011) as well as resilience evaluation and assessment. The majority of definitions emphasize the ability to successfully adapt in the face of stress, adversity, or disturbance.

Table 1 Definition of resilience

Author	Definitions of resilience from a hazard perspective
Timmerman, (1981, p. 21)	Resilience is the measure of a system or part of a system's capacity to absorb and recover from the occurrence of a hazardous event.
Masten, (1990)	Resilience is the process of, capacity for, or outcome of successful adaptation despite challenging or threatening circumstances.

Adger, (2000, p 347)	Resilience is the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change.
Buckle, et al., (2001, p. 8.))	Resilience is broadly the capacity of a group or organization to withstand loss or damage or to recover from the impact of an emergency or disaster.
Paton, (2001)	The capability to bounce back and to use physical and economic resources effectively to aid recovery following exposure to hazards.
Waller, (2001)	Resilience is positive adaptation in response to adversity; it is not the absence of vulnerability, not an inherent characteristic, and not static.
Bodin, (2004)	Resilience is the speed with which a system returns to equilibrium after displacement, irrespective of how many oscillations are required.
Longstaff, (2005)	Resilience is found in systems that are highly adaptable (not locked into specific strategies) and have diverse resources.
Resilience Alliance, (2006)	Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change to still retain essentially the same function, structure, and feedbacks-and therefore the same identity.
Pelling, (2007, p. 48)	Resilience to natural hazards is the ability of a person to cope with or adapt to hazard stress. It includes the planned preparation and spontaneous or premeditated adjustments undertaken in the face of natural hazards including relief and rescue.
IPCC, (2007)	Resilience is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.
Twigg, (2007)	Resilience is the capacity to manage or maintain certain functions and structures, during disastrous events.

Cutter, et al., (2008, p. 598)	Resilience is the ability of a social system to respond to and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate the ability of the social system to re-organize, change, and learn in response to a threat.
UN/ISDR, (2009)	The ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.
PPD, (2011)	Resilience is the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies.

2.2 Community resilience

For this chapter, I searched articles on community resilience to urban floods. During my literature review, I only considered the articles on community disaster resilience from the social science, environmental science, earth and planetary science, and arts and humanities fields. Some of the literature from 174 articles is pointed out here. For our work, the following findings from those studies are especially important.

2.2.1 What is community resilience?

The concept of "community resilience" raises the same issues as resilience in general, but it is complicated by the variety of interpretations of what makes a community. A community is often, but not always, a geographically constrained group of people who share a common fate. Built, ecological, social, and economic environments make up communities, and they all interact with one another in intricate ways (Brown & Kulig, 1996). Writings on community resilience from the past have covered a wide range of topics, from grassroots organizations and neighborhoods to intricate combinations of formal institutions and sectors in more extensive geopolitical units. Resilience may be understood and managed at several levels of analysis; therefore, this is not inappropriate. The term "whole is more than the sum of its parts" is frequently used in discussions

about community resilience to indicate that a group of resilient people does not automatically result in a resilient community (Doll et al., 2007; Rose, 2004). As Brown and Kulig noted "People in communities are resilient together, not merely in similar ways," (Brown & Kulig, 1996, p. 43).

The definition of community flood resilience (CFR) is "the ability of a community - and all of its socio-ecological and socio-technical networks across temporal and spatial scales - to maintain or rapidly return to desired functions in the face of flood events, to adapt to change, and to transform systems that affect the current and future adaptive capacity" (Bulti et al., 2019). A socio- network among the community peoples strengthens the interaction between two peoples by sharing experiences and transferring knowledge, for example, early warning systems that transmit flood information to people via communication and social activities.

According to Plough, building a community's ability for disaster management is essential to effective response and recovery, and this is the primary goal of the research on community resilience (Plough et al., 2013). Marasco's observation for the advancement of modern civilization is that it is crucial to ensure that infrastructure and communities are resilient against both natural and man-made calamities and the wellbeing and success of our society depend on protecting against potential hazards (Marasco et al., 2022).

According to Ostadtaghizadeh (2016), the concept of resilience emphasizes a community's ability to resist and adapt to the effects of disasters more than just reducing its vulnerability to risks. The term "community disaster resilience" (CDR) describes how a community adapts to a disaster or knows how to deal with it (Ostadtaghizadeh et al., 2016). Community disaster resilience can be achieved by following disaster risk management mechanisms such as preparedness, response, recovery, and adaptation. With community disaster resilience people can avoid or significantly reduce the losses due to natural disasters typhoons or flooding.

The design of infrastructure systems and how I operationalize them are at the core of the adaptability characteristic. When ecological, economic, or social elements render the current system unworkable, transformability refers to "the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable" (Walker et al., 2004, p. 5). Transformation or transformability in social-ecological systems is defined as the capacity to create untried beginnings from which to evolve a fundamentally new way of living

when existing ecological, economic, and social conditions make the current system untenable (Folke et al., 2010; Gunderson & Holling, 2003). In other words, it is accomplished by fundamental adjustments to relationships, functions, and infrastructures.

2.2.2 Urban flood resilience and preparedness

Improving preparedness and the ability to respond to threats with precautions is one of the key aspects of building community resilience and reducing fatality rates. Several UFR and preparedness issues fall into various subgroups.

2.2.2.1 Enough resources:

The work of Mashi et al (2020) describes reducing flood risks in Nigeria's Katsina township, where there have been more floods recently as a result of climate change and rising urbanization. Most members of the local communities are from low-income households. Lack of resources prevents respondents from investing in rainwater drains, transferring to flood-free areas, or building flood-resistant structures. The work emphasizes how depending solely on structural flood protection methods is becoming unworkable and calls for new strategies centered on better planning for land use, relocation, proofing, forecasting, warning, and insurance. Respondents in Katsina had a strong overall understanding of the nature, causes, and effects of floods, but institutional stakeholders in charge of local physical planning, waste management, and emergency management lacked effective coordination (Mashi et al., 2020).

Urban regions in Malawi experience frequent and severe disasters as a result of unplanned and unorganized informal settlements, insufficient basic urban amenities, and weak law and order enforcement. These locations have poor infrastructure that is not disaster-resistant. The current scenario has been exacerbated by the government's inability to provide sustainable and resilient urban development as well as the absence of important stakeholders in disaster risk reduction and management (Phiri et al., 2019).

2.2.2.2 Supply of clean water:

The study by Parvin et al evaluates how rural populations in Bangladesh's southwest coastline region dealt with various catastrophic events and their present disaster-related problems. The main issues were insufficient access to clean water, poor infrastructure, poverty, unsanitary conditions, and health issues. The study discovered that the community still experiences significant pain after

disasters, with infrastructure-related issues serving as the primary culprit. It is important to keep in mind that the southwest region, which has mangrove forests, is more stable than other areas since it is less susceptible to sea flooding (Parvin et al., 2023).

2.2.2.3 Knowledge and education

The United Nations' World Disaster Reduction Campaign in 2000 placed a strong emphasis on developing a culture of prevention via education, especially among children who are more able to learn and share concepts with their families. Through risk awareness and disaster preparedness, the campaign aims to empower kids to actively contribute to making the world a safer place. Schools play a crucial role in educating kids about disaster preparedness and risk reduction so they may grow up to be productive members of society. Future generations may be more resilient if disaster awareness and mitigation are taught to children. As kids get older, they may teach the following generation how to take similar precautions for both themselves and the environment (Izadkhah & Hosseini, 2005).

A study conducted by Mishra and Suar (2007) in Orissa's flood-prone and heat wave-affected areas revealed a strong relationship between prior disaster experience, education, risk perception, and preparatory behavior. According to the study, those who had greater disaster preparation knowledge and experience did much better in both floods and heat waves. Personal catastrophe experience and disaster education offered important knowledge from reliable sources to assist individuals in understanding the nature and effects of the danger (Mishra & Suar, 2007).

2.2.2.4 Social and economic aspects

Climate change is a major factor driving migration from Mexico. Communities are developing strategies to adapt to the impacts of climate change and migration, such as building more resilient infrastructure, developing new agricultural practices, diversifying the local economy, strengthening social networks, and increasing access to education and healthcare.

An article by Wells et al (2013) discusses how a community resilience program in Los Angeles County was planned using a participatory research method. To check the effectiveness of community resilience and individual preparedness, intervention toolkits have to be developed, along with a pilot demonstration. To gain trust, identify community resilience barriers and solutions, and modify the community resilience toolkit and demonstration design, extensive

stakeholder feedback and community engagement exercises were performed. In order to improve public health policy and practice, the necessary steps are to create agency alliances, boost community stakeholder awareness, and produce evidence for effective approaches. (Wells et al., 2013).

The physical, social, economic, and institutional systems that make up the City of Makassar all vary in how susceptible they are to flooding, with certain districts being less resilient than others. Despite substantial community involvement, the city's ability to recover fully from floods is restricted by the existence of many economically disadvantaged households (Thoban & Hizbaron, 2020).

A study conducted by Sim et al (2018) evaluated Hong Kong's preparedness for disasters. Hong Kong is a megacity with a population of over 7.5 million. According to the study, Hong Kong has a high level of disaster resilience in terms of social and economic aspects as well as risk management. In the regions of the built environment and environmental variables, the city is less resilient. Hong Kong has a thorough structure in place for managing disaster threats in terms of risk management. Disaster risk mitigation is the responsibility of several government entities, and the region has strong public-private collaboration and educated residents. Additionally, the city has a solid track record of putting disaster risk reduction strategies into action. The study also suggested several areas where Hong Kong might reinforce its physical infrastructure, enhance its catastrophe readiness, and raise public knowledge of disaster risks to increase its resilience to disasters. The study found that while Hong Kong is a city that can resist disasters, there are several places where it might become more robust (Sim et al., 2018).

2.2.3 Urban flood resilience and response

In order to analyze urban flood resilience (UFR), three key responses— the social response, the economic response, and the natural response—are taken into account.

2.2.3.1 Social Response

The indicators in the response dimension consider how people respond to flood-related changes, including natural and social responses that indicate urban growth and recovery skills as well as social and economic responses that show social learning and recovery abilities. Regarding the social response, Gawith, Liu, and Zheng show how the government has strategically responded to

catastrophes caused by urban flooding (Gawith et al., 2016; Liu et al., 2019; Zheng & Huang, 2023). Dewa and Guo demonstrate the public's capability to develop their own opinions, carry out rescues, and recover from flood disasters (Dewa et al., 2023; Guo et al., 2023), whereas Ro's group symbolizes the city's capacity for learning and creativity as well as its capacity to consider flood catastrophes (Ro & Garfin, 2023).

According to Gawith et al (2016), policymakers think building community resilience is crucial to minimizing loss and damage from climate-related disasters. Researchers create a composite indicator of community resilience in Fiji using survey data, after which they assess the degree to which community resilience lessens loss and harm. Their findings indicate that community resilience may reduce effects since it is inversely connected with damages that human intervention may be effective in limiting, but not with damages over which it is less effective. They also discover that this conclusion is true for typhoons, for which communities received a warning in advance, but not for flooding for which the communities received minimal prior notice, indicating that early warning is essential for community resilience to become responsive. (Gawith et al., 2016).

Zheng and Huang (2023) evaluated that climate change and urbanization raise the danger of flooding, despite established disaster prevention strategies. As a result, concern about flood resilience has grown internationally. The author noted that to reduce flood risk, it is unquestionably crucial to understand the similarities and distinctions between flood resistance and risk. In this work, they used the Pearl River Delta to investigate the relationship between flood resistance and risk. From their finding, the authors suggest that places with low (high) flood resilience (risk) are mostly located inside highly urbanized areas and that the total flood resilience (risk) in the research area is larger (lower) than that in the highly urbanized areas. Flood resilience is a concept that complements flood risk and may be used as an indicator in risk analysis. Additionally, after assessing flood risk (resilience), pre-disruption (post-disaster) actions should be implemented, and flood risk management should incorporate tactics that promote flood resilience. This research offers resources for reducing risk and enhancing flood resistance (Zheng & Huang, 2023).

2.2.3.2 Economic Response

Regarding the financial reaction, Luthar et al (2000) illustrate the robustness and redundancy of urban infrastructure in catastrophe recovery (Luthar et al., 2000). Xiao shows the adaptability and

flexibility of the urban economy (Xiao & Drucker, 2013), whereas Gall reflects investments made in catastrophe avoidance and the city's capacity for social response (Gall et al., 2011).

The work by Luthar et al (2000) presents a critical evaluation of resilience, a concept that refers to people's ability to maintain adaptive strengths in the face of severe hardship. The author stated that resilience has a great deal of promise to improve their comprehension of the factors that influence people who are at risk. Without continuing scientific attention to some of the severe conceptual and methodological flaws that have been identified by both supporters and detractors. (Luthar et al., 2000).

Hurricanes, floods, and severe storms account for over three-quarters of all direct losses from natural disasters in the United States. Hurricane and flood losses have increased over the previous fifty years, whereas losses from severe storms have remained steady. The fact that impacts outstrip population increase is demonstrated by the fact that per capita losses are also rising, with the Southeast and Midwest suffering the greatest per capita losses. To capture trends in both overall losses and per capita losses, loss statistics are adjusted for inflation, population, and wealth. The loss information is then contrasted with the federal government and commercial insurance expenses associated with disasters. (Gall et al., 2011).

Using the Midwest flood as an example, Xiao et al (2013) investigate whether economic variety helps regional economies under normal conditions and during the recovery period following a natural disaster. The Authors isolate the impact of variety on employment and income in both typical conditions and following a significant shock by comparing counties in the nine flood-affected states to control counties. In typical situations, they discovered that economic variety had conflicting relationships with employment and income. Compared to less varied locations, economically diverse counties often had greater increases in employment but slower increases in per capita income. They isolated the impact of variety on employment and income in both normal conditions and following a significant shock by comparing counties in the nine states impacted by the flood to control counties. They discovered that, under normal situations, economic variety had conflicting relationships with employment and income. Economically diversified counties often had higher job growth but slower per capita income growth than less varied regions.(Xiao & Drucker, 2013).

2.2.3.3 Natural response

According to Chandra and Haapio natural reactions are primarily concerned with the availability of emergency resources, such as water, transportation, power, and medical assistance (Chandra et al., 2013; Ha'apio et al., 2019).

Chandra et al noted that community resilience, or the capacity to withstand and recover from a disaster, is a national policy expectation that pushes health departments to integrate community health promotion and disaster preparedness, as well as to forge stronger partnerships with non-governmental organizations. For employees of health departments and community-based organizations (CBOs), they identified obstacles to and facilitators of community resilience development. Despite serving numerous populations that might benefit, the majority of health department employees and CBO members spent little time on community disaster preparedness. Respondents saw only a few community resilience activation procedures in action. The research guided the creation of a community action plan and toolkit and identified the potential for involving communities in disaster preparedness (Chandra et al., 2013).

Haapio et al examine two case studies of indigenous communities in the Solomon Islands to determine the trends and variables that account for households' reactions to extreme environmental events (EEEs). Among the key elements of household reactions, the social cooperative system, the government's participation in disaster response, and household net worth they noted. The author revealed that the community's amenities and household net worth allowed them to survive the disasters, despite the great poverty shown and the absence of government aid. According to their opinion, these elements are essential for long-term adaptation to EEEs and climate change threats. The author thinks it is also possible for other communities to successfully adjust to rising climate change risks by studying how these groups and families handled such EEEs (Ha'apio et al., 2019).

2.2.4 Urban flood resilience and recovery

The process of recovering after a flood occurs in phases, requiring careful planning, resources, and coordinated efforts at each stage. These stages, which frequently overlap, are:

2.2.4.1 Immediate recovery

The initial phase of reaction occurs both during and soon after the flood occurrence. Its main objectives are to save lives, offer emergency aid, and set up makeshift shelters for displaced people

and families. During this phase, the distribution of food, water, and basic supplies, as well as search and rescue activities and medical assistance, are the main objectives.

The area impacted by erosion, the yield of sediment, and the connection between hillslopes and channels all significantly decreased as a result of reforestation, which also resulted in a quick recovery of vegetation (Dixon et al., 2016).

2.2.4.2 Short-term recovery

This stage, which often lasts many weeks to months, starts when the floodwaters recede. Restoring vital services, evaluating the damage, and starting the recovery process are its main goals. The rehabilitation of vital infrastructure, such as utilities, roads, and bridges, as well as damage assessment and debris clearance are among the activities.

In order to help local communities recover from disasters or adapt to environmental challenges, social cohesiveness plays a significant role in enhancing community resilience. The research found a relationship between social cohesiveness and the rate of recovery in the four communities, which served as a representation of Puerto Rico's natural disaster-prone regions. The results showed that cohesiveness has a significant influence on community adaptation and recovery in the immediate case of a natural disaster, when communities are most in need (Sobhaninia, 2023).

Ostadtaghizadeh in 2016 comprehends the idea of community disaster resilience (CDR) in the context of Iranian people who have experienced several natural hazards and man-made disasters. According to the study, hazard coexistence and the capacity to respond to their difficulties and effects are crucial elements of CDR. The research investigated the viewpoints and experiences of disaster specialists, offering insightful information about the relevance of CDR in the nation. Here the author suggests that disaster prevention, planning, response, and quick recovery all work together to increase community resilience. The study also highlights the importance of social and cultural aspects in enhancing CDR in Iran, which is impacted by a variety of factors, including social, managerial, economic, cultural, physical, and environmental aspects. As a result, improving CDR in Iranian society may be done successfully and efficiently by targeting social and cultural parameters. (Ostadtaghizadeh et al., 2016).

2.2.4.3 Long-term recovery

Long-term recovery focuses on restoring communities, increasing resilience, and lowering the likelihood of floods in the future. It involves working to improve construction regulations, enhance disaster preparedness, and put flood mitigation plans into action. Changes in urban design, the development of green infrastructure, and community-based disaster risk reduction activities are examples of long-term recovery projects.

The recovery of agricultural terraces and stonewalls is very expensive but offers social and cultural benefits by reducing hydrological connectivity, peak flows, and runoff. However, it has environmental consequences as they are significant sources of ecosystem services, such as the regulation of floods. NBS in abandoned areas should soon be focused on long-term, affordable measures to reduce flood risk. The NBS should be affordable, guarantee a longer lifespan than gray infrastructures, and be adaptable to various local goals and global conditions (Dixon et al., 2016).

The built environment in a town has a significant impact on its ability to recover after a flood. How soon a town may recover from a flood depends in large part on factors including the terrain, proximity to rivers, amount of building covering, availability of green areas, and number of building levels. Enhancing community resilience to upcoming flood disasters may need an understanding of and attention to these built environmental factors. According to research, resilience can be improved by high topography, low building density, and an abundance of green space. Innovation in drainage facilities and management systems, as well as proper integration of blue, green, and gray infrastructure, are also crucial. Interdisciplinary urban planning should take resilient community design elements like connection, biodiversity, and self-organization into consideration (Chen et al., 2020).

2.2.4.4 Resilience building

All stages of rehabilitation include a continuous process called resilience rebuilding. Its main goals are to increase community resilience to floods in the future by implementing legislative reforms, better land-use planning, public education programs, and updated infrastructure (Birkmann et al., 2023).

In order to help local communities recover from disasters or adapt to environmental challenges, social cohesiveness plays a significant role in enhancing community resilience. The research found a relationship between social cohesiveness and the rate of recovery in the four communities, which served as a representation of Puerto Rico's natural disaster-prone regions. The results showed that cohesiveness has a significant influence on community adaptation and recovery in the immediate case of a natural disaster, when communities are most in need (Sobhaninia, 2023).

2.2.5 Urban flood resilience, nature-based solutions, and adaptation

Adaptation refers to the process of adjustment to actual or expected climate and its effects, to moderate harm or take advantage of beneficial opportunities (IPCC, 2018). Ecosystems and ecosystem services can also contribute to adaptation and mitigation of floods, and the remainder of this subsection focusses on how the natural environment could shape community resilience and adaptation.

2.2.5.1 Nature-based solution (NBS)

The International Union for Conservation of Nature (IUCN) and the European Commission (EC) proposed the most widely used NbS definitions (Cohen-Shacham, 2016; European et al., 2015). According to the EC, NbS refers to "activities inspired by, supported by, or copied from nature, that aim to help societies address a variety of environmental, social, and economic challenges in sustainable ways" (European et al., 2015, p. 5). Alternatively, NbS is defined by IUCN as "activities to protect, sustainably manage, and restore natural or modified ecosystems that confront societal issues effectively and adaptively, giving benefits to human well-being and biodiversity at the same time" (Cohen-Shacham, 2016, p. 2).

Open green spaces (such as urban parks), green/blue infrastructures (such as wetlands, river parks, and rain gardens), and building-level features like green roofs or green walls are all ways that Nature-based Solutions (NbS) are bringing advantages to the public (Stovin et al., 2012; Thompson et al., 2022; VanWoert et al., 2005; Zhang et al., 2021).

2.2.5.2 Green infrastructure

Green Infrastructure (GI) is an effective method to use in urban areas to minimize the impacts of flooding, as demonstrated by a case study from the region north of Rosario, Argentina

(Zimmermann et al., 2016). Green infrastructure is valued even more because it provides several co-benefits in addition to providing the key opportunity to decrease flood and water dangers (Hoang et al., 2018). The Portland research was concerned with adapting long-term methods to cope with climate change because of its location near the base of the Tualatin Mountains, where the Columbia and Willamette Rivers confluence. The study showed how an interdisciplinary GI approach can be a viable strategy for preparing for climate change disasters (O'Donnell & Thorne, 2020).

Green infrastructure has the potential to be a beneficial tool for promoting sustainable development in urban environments, even if more research is necessary to fully understand its role and impacts (Mell, 2009). In order to analyze the effectiveness of GI, the City of Houston case study uses different combinational approaches. Each tool's shortcomings in the context of land use are discovered via research. However, GI is advantageous for the environment and has widespread support (Newman et al., 2022).

Green roofs in particular can lower the danger of urban flooding. In an Italian study, scenarios with green roofs evenly spread throughout metropolitan regions outperformed those with green roofs concentrated upstream (La Rosa & Pappalardo, 2019).

2.2.5.3 Wetland restoration

As a long-term, sustainable reaction to climate change, Albufeira's biophilic urbanism plan worked to improve the city's river using natural ways and to establish a green and blue infrastructure (Blau et al., 2018).

Recent studies show that spending time in blue areas, such as vast, low-elevation wetland forests, improves the health and well-being of people in urban areas (Li et al., 2022).

2.2.5.4 Street side swales

In comparison to utilizing simply permeable pavement or only grassed swales, combining all of them in a combined system is the greatest approach to reduced runoff, lower peak flow, delayed runoff yielding time, and delayed peak-flow occurrence time(Xie et al., 2017).

2.2.5.5 Urban trees

The flow of floodwater can be reduced with the help of trees. By examining their capacity to accumulate litter, the article (Zhai et al., 2022) examined the usefulness of several forest tree species in reducing urban flooding. For each forest, sample plots larger than 20m x 20m were set up to examine the results. The study emphasizes the significance of forest waste in water conservation and surmises that bigger trees with thicker canopies create more trash, which improves the capacity to store and intercept water. For the avoidance of urban flooding, QM (*Quercus mongolica* Fisch. ex. Ledeb) and BP (*Betula platyphylla* Sukaczew) forests shine due to their high-water absorption rates in the un-decomposed layer. The research provides useful guidance for choosing tree species for urban flood prevention.

Trees may reduce urban stormwater runoff in many ways, including by collecting rainwater in their canopy and empowering water infiltration into the soil (Berland et al., 2017).

2.2.5.6 Land use management

The engagement of stakeholders in land use is crucial. The case study from the Laver and Skell catchments, located west of the town of Ripon in North Yorkshire, represents the development of flood risk management with the participation of stakeholders. According to this report, farmers gave landscape maintenance the greatest priority, followed by environmental protection, lowering diffuse pollution, and managing soil erosion and runoff (Posthumus et al., 2008).

Cities require fresh, creative approaches to increase their capacity for adapting to a more unpredictable future. In order to fight the problems brought on by urbanization and climate change, many cities are turning to NBS. While not a panacea, NBS is an essential tool for climate adaptation and resilience (Frantzeskaki & McPhearson, 2021).

The benefits of using nature-based solutions to reduce disaster risks, help people adapt to climate change, and promote community resilience are becoming more generally recognized. By preventing or reducing the effects of possible dangers, they can overcome all aspects of the risk factor.

Many residents in Semarang City, Indonesia preferred to stay and adapt to the *Rob* (a local term for flooding caused by sea water overflow) hazards than to leave their current residential places.

Here the individual house owners elevate the houses above a potential water level to mitigate to the *Rob*. Social variables, such as being comfortable with their group interaction in the community, were the major factors (Buchori et al., 2018).

In a study from India, the disaster resilience of two Chennai neighborhoods is compared. According to the study, people who live close to rivers and canals are more likely to experience the negative effects of flooding, but because of their poor adaptive capacity, they have not been able to improve their capability to deal. The study's findings suggest that to make communities more resilient to upcoming climate-related disasters, more efforts by diverse stakeholders are required to address issues at the micro-level of a community. Additionally, disaster survivors have much poorer English proficiency, showing that less affluent citizens are less resilient, which raises the possibility that education and resilience are related (Joerin et al., 2012).

Another case study demonstrating the effectiveness of nature-based solutions (NbS) for disaster resilience indicated coastal communities in Jamaica can benefit from them. NbS may serve to improve the quality of life for coastal communities and safeguard the environment, and they are frequently more affordable and environmentally friendly than conventional engineering solutions. The study discovered many NbS that might be employed to increase coastal Jamaica's disaster resilience (Lee et al., 2022).

2.2.6 Urban flood resilience and mitigation/prevention

Hazards and vulnerabilities together result in risk. While vulnerabilities are inherent predispositions that raise a system's vulnerability to harm, hazards are exterior threats. Hazards and vulnerabilities both need to be addressed to lower risk. The efficiency of risk mitigation methods can be improved by using a comprehensive, interdisciplinary approach based on various theories to evaluate the non-linear interactions of environmental factors (Cardona, 2004).

Urban infrastructure, layout, building lifespans, and future growth plans all affect a city's ability to withstand flooding. The resilience and flood vulnerability of cities may be increased while attaining sustainable growth via sound urban planning and design (Gao et al., 2022).

According to a study by Chen et al. (2020), a community's resistance to flooding can be increased by having a wide variety of land use activities locally, such as office, commercial, and educational

space all within one kilometer. This could be the case because locals have greater resources available to them during emergencies. Diverse communities' preparation, emergency readiness, and post-disaster recovery initiatives influence their resilience. Urban planners and decision-makers may find this material useful when planning and designing communities to increase their resilience to floods and other natural disasters (Chen et al., 2020).

A study on Can Tho City, Vietnam highlights the significance of incorporating local knowledge and the indigenous landscape system into urban design to develop a flood-resilient model. By using a flood-resilient strategy rather than flood control, the city may be able to retain its identity as a water-based city and ensure long-term flood protection. The resilience and historical character of the city are threatened by the struggle between industrialization and the natural system. Thus, the article promotes the incorporation of indigenous resilience into urban design as a sensible and sustainable strategy for CTC to address ongoing environmental issues, like as climate change (Van Long et al., 2020).

The ability of a city to resist and adapt to flooding disasters, as compared to trying to prevent them, is referred to as urban resilience to floods. These mandates attention on enhancing community flood resilience, making quick adaptations after each disaster, and incorporating backup systems (Liao, 2012; Long et al., 2020).

Exploring the role of religion in fostering resilience might offer a unique perspective on how communities can better prepare for and reduce the effects of catastrophes, even if the relevance of community resilience in disaster risk management has been addressed. Indonesia is a nation that values religion immensely. Schoolchildren believed that natural disasters are caused by natural phenomena, according to the study on preliminary investigation into the role of Islamic teachings in disaster risk reduction in Banda Aceh, Indonesia. However, most residents and some students believe that disasters are caused by God and are a test of human reason (Adiyoso & Kanegae, 2013).

In a study, Ranjan and Abenayake (2014) underline the need to identify the distinctive characteristics—such as social networks, access to resources, expertise, and education level—that make a community resilient to disasters. The study emphasizes the significance of knowing local

community views and attitudes in fostering resilience and the demand for customized strategies that give priority to the needs and goals of the community (Ranjan & Abenayake, 2014).

The ToKaili community in Central Sulawesi, Indonesia has been capable of maintaining environmental balance and reducing the effects of calamities like earthquakes, landslides, liquefaction, and floods because of their customary laws and spatial planning concepts (pengataa). The 2018 Nalodo tragedy in Palu, Indonesia serves as proof that these ancient traditions have been neglected in modern times, with serious consequences for the lives, possessions, and environment of the ToKaili people. This study emphasizes the value of local wisdom and indigenous knowledge in reducing the effects of disasters (Siradjuddin et al., 2022).

2.3 A paradigm shift of adaptation in dealing with floods

In recent years, the concept that Nature may provide insightful guidance for attaining urban sustainability has gained ground. Ecological knowledge is necessary for flood management, and a paradigm change from flood control to flood adaptation might pave the way for a day when urbanites can safely coexist with flooding and even benefit from it (Liao et al., 2016).

2.3.1 Knowledge from past experiences

Numerous studies have demonstrated the essential importance that knowledge from past experience plays in enhancing community resilience to disasters, particularly when it comes to helping individuals, groups, and organizations make the best decisions (Fujieda & Kobayashi 2013; Oktari et al. 2015, 2018). It is crucial to transfer local and indigenous knowledge—along with values and skills—across generations since it can save lives during disasters (Oktari et al., 2015). Weichselgartner and Pigeon (2015) emphasized the significance of knowledge in disaster risk reduction and went on to suggest more studies to analyze the formation of new and existing disaster knowledge and turn it into wisdom. However, as a foundational paradigm for information management, its use has recently broadened in the public sphere, especially when it comes to tackling social issues and empowering communities (Nonaka & Nishihara 2018). Improving performance in disaster management is one area where applying knowledge-based management may have a big impact (Oktari et al. 2020). Therefore, to support decision-making and guarantee

the generational transfer of disaster knowledge, it is vital to create a knowledge-based community resilience framework (Oktari et al. 2021).

Enhancing disaster preparedness requires making good use of past disaster experience. Four categories of disaster experience were identified by Becker et al. (Becker et al., 2017): direct, indirect, vicarious, and past life events. Participating in hazard events allows individuals to get direct experience. An individual gains indirect experience from small events that did not directly impact them. One can get vicarious experience by learning about other people's personal or media-reported disaster experiences. A person's personal bad experiences with disasters, criminal activity, and other dangerous circumstances are referred to as life event experiences.

The risk perception or motivation to prepare for future risks of an individual who has experienced loss or injury in a disaster is influenced by hearing their stories (Helweg-Larsen, 1999; McClure et al., 2011; Turner et al., 1986). When the 2004 Indian Ocean tsunami struck, locals on the Indonesian island of Simeulue were reported to have used their traditional knowledge of the tsunami tragedy to assist in minimizing deaths (Rahman et al., 2018). There are different levels of involvement among them in terms of sharing disaster experiences. While many survivors simply participate in informal chances, such as family get-togethers, some actively participate in official opportunities to disseminate lessons learned from their experiences. To convey the experience to outsiders, inhabitants who were not there during the tragedy might gain vicarious experience via their regular lives and serve as mediators (Kato & Endo, 2020).

Studying Taiwan's distinct ecology and complicated history of colonialism, this research emphasizes the significance of indigenous and local knowledge in fostering resilience. Indigenous resilience is a critical element of the future in dealing with tragedy. It is managed and directed by local communities and is defined by place-based knowledge, social learning, collective action, and empowerment. According to the essay, the democratic participation of locals, particularly Indigenous peoples, is essential for developing creative practices and alternatives for management (Berkes et al., 2021).

In another study, two Indigenous Tayal groups in northern Taiwan were explored to see how culture and local perspectives affected coping mechanisms and adaptations to climate change. Indigenous peoples shouldn't be represented as victims of climate change, according to the

researchers, and neither should their Traditional Ecological Knowledge (TEK) systems. According to the study, Tayal communities are more prepared to handle climate-related disasters because they have greater traditional support structures and cultural traditions. They also receive more help from their communities. As a result of climate-related calamities, non-Tayal people of Nan'ao frequently rely on finding new occupations in the tourism industry (Bayrak et al., 2020).

It is necessary to portray the real and individual impact of climate vulnerability to include and empower local stakeholders in climate adaptation activities. It is important to also include caring and educational organizations, as well as the municipal agency, in the implementation of adaption measures. Vulnerability assessments can therefore help in the selection and application of suitable actions, resulting in a community that is more resilient and sustainable (Opach et al., 2020).

2.4 Conclusion

This chapter provided the key theories related to resilience, specifically community resilience; and disaster risk management mechanisms, such as preparedness, response, recovery, and adaptation, towards flood mitigation and prevention. These components guide the structure of the results section of this thesis.

3 Methodology

3.1 Case study area

In Taiwan's hectic past, there have been several devastating floods many of which have had a significant effect on the Taiwan people. Taipei is one of the places where this trend has had a particularly negative impact (Li et al., 2016). Taiwan's capital city is Taipei. The amounts of precipitation in Taipei have risen consistently over the past century, with an average increase of 3-4 mm every year (Hsu & Chen, 2002), and has strongly risen from 1897 to 2006 (Chang et al., 2013; Wang et al., 2008). This had a substantial impact on the region's frequent and severe floods. In Taipei City, the Tamsui River basin has been the location of several catastrophic flooding incidents, most notably in 1987, 1997, and 2001 (Teng et al., 2006). Typhoon Gloria produced severe floods in Taipei and New Taipei on September 11, 1963, which led to the deaths of many animals, 200 deaths, and huge property damage. Waters rose to a height of two meters in the lower-lying areas of the city, covering them for 30 hours and flooding more than 21,000 hectares of land.



Figure 2 Google Map of Shezidao.

In order to reduce the impact of natural disasters, a pivotal decision was made in 1970 to establish flood prevention programs for the greater Taipei province (Lean & Wu, 2005). The projects have, however, had some unexpected consequences, such as disturbing the residents of Shezidao. A comprehensive strategy to protect the Taipei city against a 200-year flood was approved by the Government in 2010. With an emphasis on building levees, drainage systems, diversion systems, and land acquisition, the TMFMP (Taipei Metropolitan Flood Management Project) was initiated. Numerous advantages of the project include lowering the Tamsui main channel's flood stage and enhancing flood protection for the whole basin. Despite these initiatives, Taipei still faces a high danger of flooding, and certain people are more at risk than others (Chang et al., 2013). Some residents of Taipei are more in danger than others from floods, which is still a serious threat. To ensure the security of the local populations and prevent such disasters, there is still more work to be done. However, the actions taken up to this point have greatly influenced the growth and administration of the city. Many migrant and immigrant workers who migrated to Taipei from rural areas of Taiwan or the Chinese Mainland in favor of a good salary now reside in Shezidao (Lean & Wu, 2005).

Since Shezidao is a flood-prone area declared by the government, residents have tried to reduce the risks by constructing temporary structures, but their efforts fall short of an actual solution (Liao et al., 2019). Due to government flood prevention projects, the local community in Shezidao feels distinct from other communities in Taipei. Due to its geographic position, this region is vulnerable to typhoons and other natural disasters like floods. In this location, there have been improvised residential and industrial areas. For 52 years, no new development has been allowed in this region (Yang, 2016). Since the 1970s, minimal development activity has been done in this low-lying region due to flood concerns as a result of the limits on construction surrounding the islet, which were implemented and led to concerns associated with river dredging. Shezidao was not included in any of the appropriate plans since it was still a part of Taipei City until the community raised objections. Although there is much discussion and finger-pointing about it, the Shezidao region is sacrificed in order to protect Taipei City's highly developed areas (Liao et al., 2019).

In order to secure Taipei City, the Taipei Area Flood Control Plan (TAFCP) was formed, however Shezidao was the exception. The main goal of the TAFCP's first phase (Chang et al., 2013) was to construct a floodway to address the flooding problems in Taipei City's Luzhou and Sanchong. By then, the concept had been enlarged to include all of Taipei City's key areas. The 6-meter-high

levee surrounding Shezi Island currently offers residents protection against 20-year floods that have been constructed and strengthened following public pressure. However, this level of protection remains inadequate in comparison to the rest of Taipei, where flood walls are engineered at a 200-year flood standard. Restoring wetlands and converting former irrigation or river channels into drainage canals are types of additional infrastructure. Shezidao has therefore intentionally neglected to secure Taipei City's main area from 200 years of recurrence interval of flooding. The Taipei administration accelerated the development project in 2014 out of fear of losing votes after the Shezidao residents protested this unfair protection and ongoing demands (Liao, 2022).

The government proposed a so-called “Eco-Shezidao plan”, in which all residents would be temporarily resettled in order to make Shezidao more flood-resilient. This is a major redevelopment plan, which includes an almost complete restructuring of Shezidao. In this development plan, the government proposed that the Shezidao area be fully reconstructed and developed into an ecological city where a central city park and a light rail system would be built. Because of several severe concerns and issues, the residents were opposed to the Eco-Shezidao plan. Due to concerns about losing land local people are unwilling to accept the Eco-Shezidao the new development plan. While the plan itself may use up some land, it also has advantages, including housing in Taipei City while it is being built and new structures in Shezidao if the plan is successful. The government will only provide one living apartment in exchange for one house, so residents need to be aware of the project's potential outcomes and the possibility that they won't receive as much land as they decided to give the government. This is because many families (Liao, 2022) have multiple households in one building. During a protest against the Taipei city government's environmental impact assessment for future construction on the island, Shezidao residents and police were involved in a physical fight (Hioe, 2021). The clashes between the island's pro- and anti-development factions are not the first. While some locals support the possible future economic advantages of development, others worry that it may force them out of their homes. The Taipei city government continues to promote growth despite accusations of not seeking input from locals.

Community resilience is a measure of the sustained ability of a community to utilize available resources to respond to, withstand, and recover from adverse situations. This study will specifically analyze the community resilience of the residents in Shezidao to mitigate/tackle flooding risk. The main method being used to answer the research question will be qualitative research. The literature

review would focus on the topics and issues that aligned with the case study area. In this qualitative data would be collected through conversation/interviews about community resilience with professors who have experiences working in the case study area, stakeholders, and self-help group leaders. In addition to the opinions of experts and residents about community resilience in Shezidao, the study will focus on resilience and adaptation strategies towards natural disasters like floods (Figure 3).

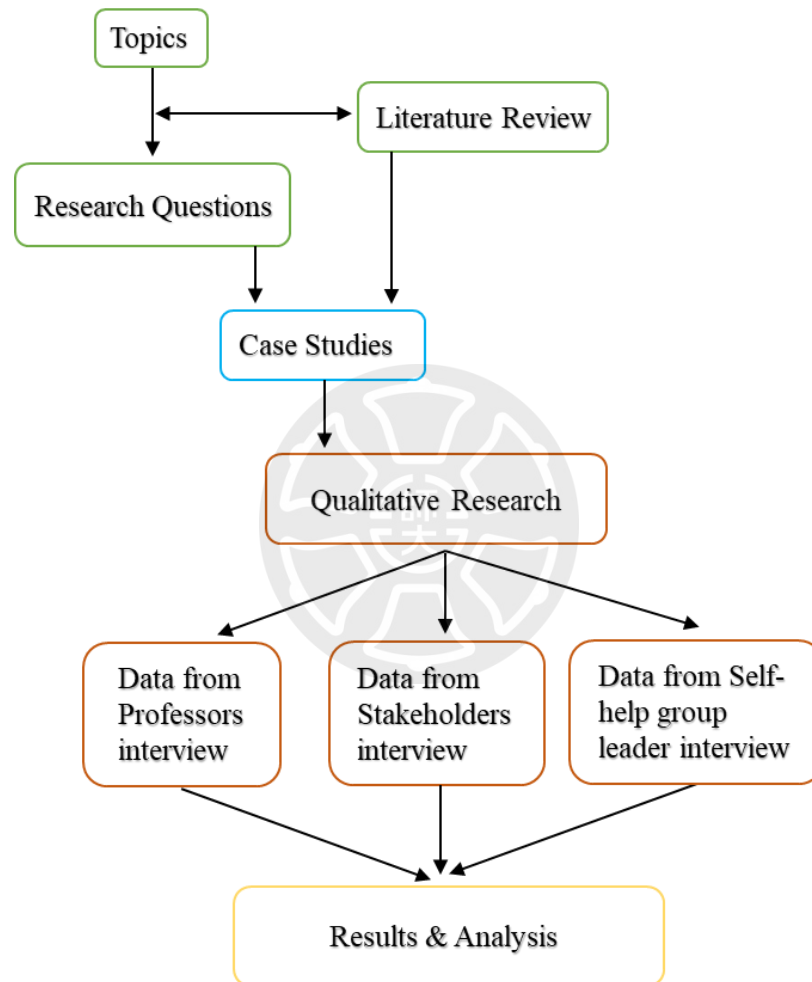


Figure 3 Flow diagram of research methods used in the study.

3.2 Research framework

The research framework (Figure 4) allows working with the ultimate goal of the project and is applied to decision-making processes. Thus, the proposed framework is designed to be flexible and can be tailored accordingly.

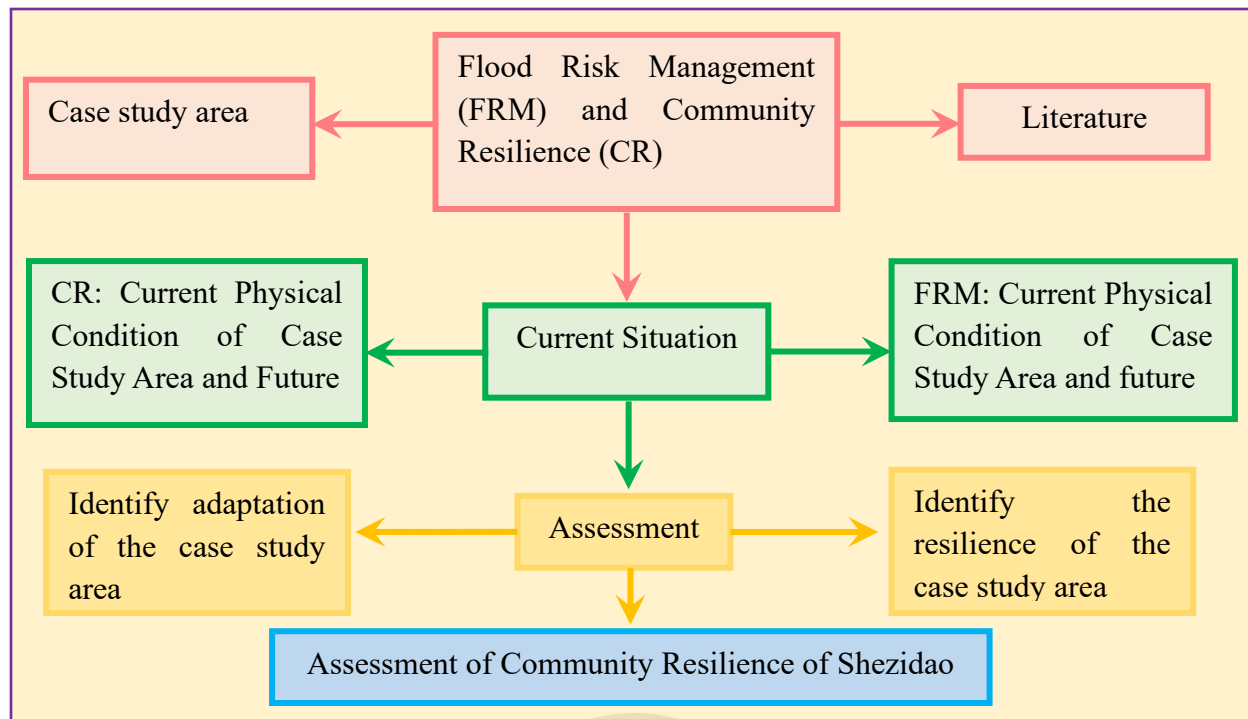


Figure 4 Flow diagram of the research framework.

The flow diagram above demonstrates how utilizing a framework of community resilience might help lower the risk of flooding in the target area. The first step is to evaluate the community resilience of flood risk assessment activities in the target area. However, it is essential to fully understand the benefits of community resilience to manage flood risk in the case study area. The long-term impacts of reducing flood risk via community resilience have been carefully examined. Finally, a full assessment of the community resilience and adaptation to mitigate flood risk in the case study area has been undertaken.

3.3 Participants

The data collection was conducted from August 2022 to July 2023, spanning 12 months. Before data collection, I conducted a preliminary survey (August 2022 and March 2023) to become familiar with the general situation of the study area. A survey was done for the research proposal from August 2022 to September 2022. I conduct interviews with experts in March 2023. In April 2023 I visited the place again for a field observation of flood risk management and the community situation. I began conducting individual' interviews in June 2023. The initial interview started with the snowball method used for conduct with people from the Shezidao community.

After having discussions with experts individually on the topic of flood hazards in Shezidao and the community's ability to survive in a flood situation, I used the snowball method initially to interview 15 residents in Shezidao and got similar answers from several people. Then to avoid data saturation, I chose interviewees randomly from Shezidao. In this method, I took interviewees of more than 14 residents from the case study area. Interviewees ages ranging from 24 to 90. I conduct face-to-face in-depth interviews with all my interviewees.

Table 2: List of local people in Shezidao who participated in our discussions

CODE	GENDER	TYPE	CHARACTERISTICS
R1	Female	Organizations member	She has been living in Shezidao for 30 years
R2	Male	Worker	He has been living in Shezidao for the past 31 years
R3	Male	Farmer (own farm)	He has been living here for 68 years
R4	Female	Farmer (Own)	She is now 85 years, came to Shezidao over 50 years ago
R5	Male	Farmer (Own)	He has been living here for 63 years
R6	Male	Temple care member	He lived here in rent for 31 years
R7	Female	Housewife	She lived here for 35 years since married
R8	Female	Farmer (Own)	She lived here for 55 years
R9	Male	Grocery owner	He has been living here for the last 72 years
R10	Female	Grocery owner	She came after married in Shezidao 40 years ago
R11	Male	Motorcycle shop worker and owner	He has been living here for 52 years
R12	Female	Farm owner	She has been living here for 60 years
R13	Male	Fisher	He has been living here for the past 75 years
R14	Male	Temple care member	He rented here in the last 30 years
R15	Female	Worker	She has been living here for 70 years
R16	Female	Farmer	She has been living here for the last 50 years
R17	Female	Restaurant worker	She moved here in the past 30 years ago

R18	Female	Restaurant worker	She moved here after married more than 43 years ago
R19	Male	Farmer	He has been living here for 75 years
R20	Male	Fisher and Agriculture business person	He has been living here for the last 90 years
R21	Female	Fish and Agriculture Business	She has been living here for 70 years
R22	Male	Bus driver	He moved here 64 years ago
R23	Male	Farmer	He has been living here for the past 70 years
R24	Female	Business person (give apartment for rent)	She has been living here for 63 years
R25	Female	Business person (give apartment for rent)	She has been living here for 70 years
R26	Male	Agriculture business	He has been living here for the past 68 years
R27	Male	Student	He has been living here for the last 18 years
R28	Female	Landowner	She has been living here for the last 70 years
R29	Female	Farm owner	She has been living here for 76 years

This study focused on the community resilience to urban flooding in Shezidao. I have gathered feedback on the government's current development plan, community preparedness, and adaptability during and after disasters, and the perspectives of 29 people (Table 2), and 4 experts (Table 3) who have been working for several years in Shezidao.

Table 3: List of Experts I interviewed who are working in Shezidao

Code	Current Position	Expertise	Working in Shezidao
E1	Professor	Architect, Urban Development	>10 years
E2	Professor	Architect, Urban Development	>10 years
E3	Professor	Architect, Urban Development	>2 years
E4	Journalist, Magazine Editor	Social Issue	>5 years

In order to collect sufficient information, I first consulted with experts followed by stakeholders from Shezidao. The data itself was collected by grouping the viewpoints of professors and resident

experts. I have a total of 33 participants in my data set, which is adequate to describe the community resilience of Shezidao. It is however important to note that these 33 participants do not necessarily represent the entire Shezidao community, but qualitative insights allow us to have an in-depth understanding of community resilience.

3.4 Measures

In the interview, I ask residents about their opinion regarding the government initiative on flood risk management. How is their daily life, with their experiences of early natural disasters; what they did do to avoid flooding and flood risk? This interview also includes views from experts and professors about several issues that are the biggest concerns of the Shezidao residents.

3.5 Research Design

The purpose of this study is to get a general resident of various ages about their daily lives, risk adaptation strategies, preparedness for floods, and initiatives related to flood risk management. Additionally, to find out if they have the same opinions on flood risk management regardless of age or government initiative. The study would focus on gathering qualitative data from residents as well as experts and professors who have spent more than 2 to 10 years working on Shezidao.

3.6 Procedure

The qualitative data was gathered through one-on-one interviews with residents, experts who have been working on Shezidao for several years, and stakeholders in the case study area, Shezidao. After the initial conversations with professors who are working on Shezidao, four days of field interviews were conducted in Shezidao. I interview 4-6 stakeholders each day from the case study area. My advisors arranged for two Taiwanese students to accompany me considering that I am not fluent in Chinese. They worked as interpreters between me and the inhabitants. Additionally, they made transcriptions of those conversations. It should be noted that I used the online transcription site to translate the professor's conversations and local community interviews to make sure that none of the statements were altered.

3.7 Conclusion

This chapter provides Shezidao's community resilience to urban flooding, is guided by a research framework. The qualitative data were collected through face-to-face interviews with 29 residents of Shezidao and 4 experts who have worked in this area for a long time. As I conclude, these

narratives will shape the forthcoming findings and analysis, providing insights into flood risk management in Shezidao.



4 Finding and Analysis

The study was conducted at a plethora of stakeholders' viewpoints and answers to find out their motivation for resilience to future flood risk in Shezidao. I categorized the data into topics to evaluate it from the perspectives of the stakeholders. The main sections are the study area, common hazards, community support and resilience, and the government initiative for flood risk management. The general hazards are further subdivided into vulnerability to natural disasters and the experience of the stakeholders from their past. Community support and resilience are also divided into awareness and adaptation whereas the government initiative for flood risk management is divided into several groups. As Shezidao has several structures and temples that hold sentimental value the residents' concerns should come first when developing any strategy for flood risk management in this region.



Figure 5 Temple as traditional heritage in Shezidao (source: author).

The everyday routine of a Shezidao resident is very different from that of an urban city resident. Although living in a big metropolis is always busy, Shezidao is one such area where most of the residents continue to cultivate their food and keep hens at home. Several restaurants (Figure 6) provide substantial meals at significantly lower prices than in Taipei's city's other areas. There is a local temple or traditional heritage (Figure 5) that they still maintain on every corner of the street.



Figure 6 Restaurant in Shezidao (source: author).

Vegetables from Shezidao used to be imported into Taipei's city markets for a very long time. In Shezidao there are many farmlands where farmers cultivate vegetables that provide food for their daily needs. The residents enjoy a rural-like lifestyle despite being city residents since they have increasingly separated from Taipei's daily rush lifestyle. There are not big shopping malls luxury shops and modern houses like Taipei's main city. A few years ago, they didn't have convenience stores but currently, there are found both 7-Eleven and Family Mart-like shops. There are bi-cycle routes on the on the dykes surrounding Shezidao.

4.1 Natural hazards and past experience

In Taipei City, typhoons and floods are general hazards. However, I found from my research interviews that Shezidao's river overflow has become low nowadays. This is a relief from the serious concern that existed a few years ago. Shezidao was flooded during Typhoon Gloria in 1963 and by Typhoon Herb in 1996. Typhoons and river overflow were the two main causes of the floods in Shezidao. Shezidao is surrounded on the west by the Keelung River and on the east by the Tamsui River. Additionally, this location is low-lying and where two significant Taiwanese rivers meet. Nonetheless, the people of Shezidao discovered that their farmlands act as efficient natural rainwater absorption systems during floods.

One responder (R29) says, *“Although the location of Shezidao is a little disadvantageous for us during rain, our farmlands help to absorb water. We have lots of farmland which works great during rain.”*

This remark shows that farmland in Shezidao works as water infiltration during rainfall. In a study, Basche et al., explore the importance of continually growing plant roots and the beneficial soil

changes. They also found that by applying alternate methods that increase water infiltration rates, there may be an opportunity to mitigate the effects of extreme weather, which is expected to occur more frequently due to climate change (Basche & DeLonge, 2019).

4.1.1 Flooding impacts and response

Shezidao had to deal with frightening conditions during Typhoon Gloria in 1963 and Typhoon Herb in 1996, which caused vulnerable floods. Floodwater overflowed into residential areas in both cases. The interviewees who experienced these typhoons and floods described how the water level sometimes reached their necks and their chests for those of ordinary height. Because the lowest portions of the houses were entirely submerged, residents in Shezidao took shelter on the higher floors or old houses (Figure 7). Those without upper compartments had to rely on their neighbors who lived in multi-story buildings. Items were held in half-stair chambers that were linked to the rooftop. One interviewee (R3) shared their experience during Typhoon Gloria:

"I remember when Shezidao faced flooding during Typhoon Gloria, I was a teenager. My family and my pregnant sister were in our house. Everyone was worried and stored things in the half-storage compartment of our house. We sought shelter in heritage houses or neighbor's houses. I found comfort in that half storage section until the water subsided."



Figure 7 Old heritage house in Shezidao (source: author).

Another interviewee (R21), who was a farmer, mentioned, *"After getting married, I came here, and we built our own house. We experienced Typhoon Gloria, and after that terrifying experience, we decided to build our house at a higher level."*

Another interviewee (R27) said, *"I faced Typhoon Herb. Later, I built a temporary zinc wall room (Figure 8) on the rooftop to survive during flooding."*

An old farmer (R19) shared his experience of typhoon Gloria, *"During typhoon Gloria, we faced floods massive, that time we sheltered on a higher floor, during typhoon Herbs, the situation of Shezidao became terrific due to up to neck flood water, to manage the situation we placed sandbags near the houses and our shops, and community people gather and dig into the road to reduce water flow."*



Figure 8 One of the residents' settlements with a zinc wall covered on the top floor in Shezidao (Source: author).

Transportation was practically impossible during Typhoon Gloria (1963), when Shezidao was nearly underwater, and people had to stay on higher floors until the water started to drain. For individuals who lost their loved ones or their houses, the government promised financial help and provided food. However, some of the fishermen had boats, and they utilized them to reach out to the people and help them. One local person (R9) said,

“We had a small rooftop house when typhoon Gloria hit Shezidao. The street was fully in under water. I found not only river overflow but also. drainage clogging is a problem in Shezidao. The government has not taken any action to clean the drainage, but local community groups have taken the initiative to address this issue.”

These remarks show how residents' past experiences have influenced their ability to adjust to the current circumstance, building a higher floor is a great process of adapting to a flood. The experiences of Typhoon Herb and Gloria served as significant experiences for the interviewees. It helps people see how vulnerable they are to flooding and motivates them to build homes at higher elevations, demonstrating a process of learning and adaptation within the community. In the flood-prone districts of Odisha, Mishra, and Suar's (2007) study found that those with more experience prepare for disasters and do better during floods.

4.2 Community resilience and coping mechanism

The majority of interviewee commented on the adaptive strategies that they implemented during their agriculture work. They learned from their past experience and later implemented it to overcome food security during natural hazards. One interviewee (R4) said, “I plant a variety of crops in the same field and I rotate them seasonally, this method helps me to harvest my crops at any season.” He also added “Before harvesting I store seeds from the current crops that are used for the next planting season. This is how we keep seeds available for a whole year to harvest.”

In a study Wu et al. (2022) mentioned similar kinds of adaptive strategies used by the Cinsbu and Smangus communities in agricultural production, seed conservation, and food storage techniques, especially taking into account the fault condition effect. Additionally, the communities use TEK as a basis for integrating the environment, agriculture, and social capital in building community resilience.

Through mutual learning, these communities use a variety of food preservation methods. Granary, a warehouse made of bamboo was one kind of storage system used for grains and coarse cereals like millet, rice, corn, beans, wheat, and seeds. Sweet potatoes were hermetic, or airtight, and provide insulation against heat, allowing them to be stored for at least 6 months in storage cellars. Taro was buried in its original location with dry grass (Wu & Chen, 2023).

Based on the aforementioned comments, I believe that most of the people I interviewed learned various adaptable techniques from their past experiences that are effective in disaster management. Adaptive agricultural methods enhance their food security. Moreover, stronger community bonds increase a community's ability to withstand hazards. Furthermore, the community uses TEK to the development of preparedness and response strategies for hazards.

4.2.1 Awareness and preparedness

Most senior residents of Shezidao who were born there have been affected by typhoons and floods. I interpret from the majority of the interviewees' statements that they have been passing down their knowledge of how to survive and what to do in the event of a natural disaster for approximately 300 years at this point. But these days, all that is taught in schools is how to use fire extinguishers and how to survive an earthquake. Classes on how to cope during and after natural disasters are not offered by any other organization or government. Government representatives do visit the area in the aftermath of natural disasters to convince residents that Shezidao has to develop immediately to better prepare for future floods. However, once the government declares the region a flood-prone area, leaders and a group of community members inform the residents about the probability of future floods and offer sandbags as well as other needs.

According to a restaurant owner (R18) *“Sometimes community leaders or groups of people come to us to talk about near years risks, they told us they will provide sandbags to us and we should not panic.”*

A university student (R27) said, “I was born here, but my original family was not from Shezidao. We learned from neighbors that Shezidao has faced several floods in the past. However, I have never witnessed any natural disasters or major floods. People say it's because of the river embankment, which has been useful. If floods were to occur in Shezidao in the near future, I believe the community members would help each other survive better than people in other cities. The community relationships in Shezidao are very strong.”

The residents of Shezidao are in contact with several researchers who help them in sustaining the weather. News about these events is also provided by the government. Residents in Taiwan are sufficiently aware of recent weather changes and sea level rise threats. In a study by Izadkhah et al. (2005), children were taught about disaster awareness and preparedness. The school plays a crucial role in educating young minds about disaster preparedness and risk reduction so future

generations can be aware when they grow up. As children get older, they might pass on to the next generation the knowledge of how to take similar safety precautions for the environment and themselves (Izadkhah & Hosseini, 2005). Similarly, in Shezidao elders transfer their knowledge through strong community bonding to prepare and aware young people from disasters.

According to the local Shezidao business owner (R26) *"Shezidao is not only at risk of floods; the whole of Taiwan is in danger of future flooding due to sea level rise. I don't have any concerns about this now. In recent times, I have been living a happy life, and I want to continue living in my original place as it is."*

Predictions and past experiences made the Shezidao people situation-aware. During floods, the residents of Shezidao have an acute sense of environmental awareness. Finding plants with the ability to absorb water is a wonderful resilience and a natural way to reduce the risk of flooding.

Research on Odisha shows that sharing personal disaster experience and education on disaster provide important information from reliable providers to aid communication about the nature and impact of risk (Mishra & Suar, 2007).

Residents in Shezidao have a strong sense of community and solidarity. Through participant observation, I observed how individuals get together every morning and evening to socialize and spend some time together. This reflects the community's bond with each other. The majority of the people I interviewed had comparable past experiences in which neighbors were crucial in helping them cope with the risk of flooding. Social integration is evident in the fact that individuals in Shezidao are actively seeking as well as using resources from different sources and found shelter at a neighbor's home until the water flow quieted down. Their common belief that they would support one another in times of need inspires them and gives them the self-assurance they need to defend their territory on their own in the event of a disaster. Strong community connections and support are important components of a community's disaster resilience.

The findings show that inter-generational knowledge transfer, educational gaps, knowledge gaps, government agents and community awareness, strong community relationships, and awareness of climate and weather are all components of community resilience.

Many interviewees believed that their Gods and deities would protect Shezidao from natural disasters. When I asked some temple community members from Shezidao on my second interview

day why they thought God would protect them from any natural disasters, about four to six people made similar statements. They highlighted for instance that while in other parts of Taipei there would be heavy rain, Shezidao would often be spared from this due to their religious beliefs. Therefore, when discussing community resilience and awareness of natural disasters, religious beliefs often play a key role.

Religious people believe that natural disaster happens because of the unhappiness of people's own deeds. One interviewee (R2) said, *"We worship a god who is known as a sea god. I am not superstitious, but I believe, God protects us from natural disasters."*

Another person (R5) said *"I believe that disasters happen because God may be angry with people, we have to face, and we worship a god, although I know if we say sorry, God surely, will help people. We are strong enough, and we try to protect our Shezidao, community people also get together to help each other to overcome disaster situations and we always take precautions before happen anything. We worship to make our god cool down, and we try to do good with everybody so that God won't get angry with us."*

Another interviewee (R28) said, *"Not every time but, I experienced several times, just a little pass in the Shezidao area, I saw there is raining but our Shezidao did not. Maybe our sea god protect us."*

These quotes indicate that a part of the population indeed thinks that their deities or gods possess supernatural powers to protect people from disasters. This is consistent with a case study of Banda Aceh, Indonesia where most residents believe that disasters are caused by God and are a test of human reason (Adiyoso & Kanegae, 2013).

Indeed, I do think that their strong confidence in God and some of their observations have led them to believe this, rather than simply describing it as superstition. In addition, I saw during my fieldwork in Shezidao that while not every member of the community practices a particular religion, they do have faith in several religious. It was also evident from the interviewees' remarks that they ignore superstitions in favor of their faith in God. The belief is that when a god becomes displeased, bad things would happen. However, they don't just rely on worship to keep themselves safe; they also come together and take the necessary precautions on their own. In Shezidao, several temples are maintained by the residents. My interviewees think that with God's help, they can protect their community from these kinds of occurrences. Well, planning and taking precautions

might occasionally assist individuals from becoming seriously harmed during natural catastrophes. Even though they may have had faith in God, they are not depending on his power to keep them safe in this situation. Some residents of Shezidao use this concept as inspiration to be resilient to disasters. Religious beliefs could thus motivate people to participate in preparedness to avoid flood risk (Reale, 2010).

4.2.2 Vulnerability and adaptation towards natural hazards

Although the embankment in Shezidao can resist the intrusion of water from the Keelung River it is often flooded due to the heavy rains. The area is relatively low and lacks a rainwater sewer system. Later, the Taipei City Government set up a water pump station (Figure 9) to alleviate the flood water. The situation of flooding occasionally happens due to torrential rain during typhoons.



Figure 9 Water pump station in Shezidao (source: author)

According to the expert (E2), despite being in a low-lying area and being at the confluence of two major rivers, Shezidao is not highly vulnerable to natural disasters. The announcement that this area is prone to flooding was issued by Taipei City Government intentionally:

"Most of Taipei City's areas are prone to flooding even with minor rainfall, despite having advanced flood protection measures in place. Shezidao is not an exception in this regard."

The major impact of the flooding on Shezidao residents' means of survival and accommodation. Typhoons caused agricultural damage for farmers, which cost them money. The lack of available land and homes as well as the demand for social housing for migrants were cited as urgent issues. According to the experts, Shezidao's residents, especially those impacted by floods and land acquisition laws, have a substantial need for inexpensive and safe housing adoptions. Due to construction bans local people cannot reconstruct their houses in high altitudes to survive during flooding. Here residents apply their way to survive during flooding.

The supply of food is not a major concern because the majority of people own farms or grocery shops. When someone is hungry or even without electricity, neighbors will certainly assist by providing them with food, water, and flashlights. One participant (R12) shared their own experience:

"During a flood in Shezidao when I was a teenager, I don't remember the name of the typhoon that caused the flood. Our house was of relatively low quality, so we sought shelter in a neighbor's house with higher floors to avoid floodwater. Now I have built higher floors."

Additional respondents mentioned utilizing the lunar calendar, stating changes in cloud size, color, and tidal patterns, as well as learning to forecast weather conditions. They used this understanding to start harvesting their crops earlier, store their valuables upstairs or on higher levels, and spread the message to the neighborhood.

According to Grothmann et al. (2006) people in Cologne, Germany, who have previously experienced flooding are generally more prepared, such as having food supplies and keeping flood-prone places empty to minimize flood damage (Grothmann & Reusswig, 2006)

The majority of elderly Shezidao residents who were born there had seen floods and typhoons. Now, for around three centuries, they have been passing on their knowledge on how to survive and what to do in the case of a natural disaster. Their traditional knowledge is based on past experiences,

and this information assists in their ability to adapt themselves to forecast flooding disaster situations. In Shezidao, it also serves as a resilience building that shields residents from natural disaster threats. Having seen significant floods personally, which enables them to absorb water and gain experience, the person has gained an understanding of Shezidao. Their focus on situation awareness, survival skills, and preventive measures suggests a proactive readiness for flood scenarios.

Some interviewees expressed trust in their community's ability to protect their area in the event of a natural disaster. These viewpoints show the intricate interactions between Shezidao's strong community resilience, the government's recognition of the flood risks already there, and its acceptance of those risks. The locals, however, say they want to preserve their way of life and save the land's uniqueness, culture, and significance.

However, after conducting in-depth interviews, I learned that people are using some form of nature-based solution, whether consciously or unknowingly. However, when I asked them about nature-based solutions for managing flood risk in Shezidao, I found that they had a negative view of the term "nature-based solution" because of the government's Eco Shezidao development plan campaign, which will be described in the next section. During the Eco Shezidao campaign, I found that the government defined "Eco" as being related to nature and nature-based solutions.

The analysis's results suggest that the majority of my interviewees frequently use a range of tactics to predict flood time, typhoon seasons, and monsoon times to reduce damage. Additionally, living in higher houses and apartments until the water dies down, finding shelter in neighbors' homes, storing valuables in half-stairs storage areas, digging into the road, and putting sandbags close to infrastructure is an interesting adaptation strategy and using traditional knowledge, like keeping an eye on changes in cloud size and color and tidal patterns are effective preparedness tactics.

4.3 Government initiative on flood risk management

An initiative like building a river embankment was a successful implication for Shezidao to protect this area from flooding. This development was implemented in 1980 with the participation of residents of "Shezi Island". After the success of this development plan, the Taipei City government proposed a project that would be implemented in the future for Shezidao named Eco-Shezidao (Hsiao, 2018).

The local administration created three distinct projects for the urban development of the peninsula in 2015. The three projects are “Shezidao Canal,” “Our Shezidao” and “Eco-Shezidao.” The first project, called the “Shezidao Canal”, proposes the construction of four canals that would encircle the newly built public housing units and settlement buildings by connecting the Keelung and Tamsui rivers. The third project, "Our Shezidao," would see expropriations taken by rehousing efforts and a range of developments. The second proposal, Ecological Shezidao (Figure 10), would see the preservation of a canal that runs through the area city along with a waterfront park on each side of the canal by cultivating artificial wetlands. The three plans include 20 hectares of land reserved for businesses, a light-rail system, and ecological restoration areas. After that, the public was allowed to participate in those three proposals through i-Voting, which allowed them to vote both in person and online. On February 27 and 28, 2016, the Shezidao development project referendum was held by physical presence as well as online using the "i-Voting" platform of the Taipei City Government. Voting rights are dependent upon land ownership and building on Shizidao Island or a long-standing family registration (Lefèvre, 2017; TCG, 2016).



Figure 10 Future development plan for Shezidao area, taken from Urban Development Department, Taipei Government (source: Urban Development Department, Taipei Government).

The 5091 residents who used the i-Voting system to cast their votes for Shezidao's future had a voter turnout of 35.16 %. Out of the four development proposals, "Ecological Shezidao" received 3,032 votes, followed by "Canal Shezidao" (825 votes), "Our Shezidao" (617 votes), and "No Development" (617 votes). The second project, "Ecological Shezidao," has been selected with 60.4 percent of the vote (TCG, 2016).

In July 2018, the Urban Planning Review Committee of the Ministry of the Interior approved the Ecological Shezidao led by the Ko Wen-je Municipal Government. To plan, the plan intends to develop Shezidao by expropriating the entire district. As of July 2023, there are still procedures such as the second-level environmental impact assessment and section expropriation plan that have not yet been completed (Taipei City Government, 2023). Shezidao was planned to be a residential area, an agricultural area, and a waterfront development area, but it was terminated due to opposition from some public opinion.

According to the Taipei City Government, many mayors of Taipei had plans to develop Shezidao, however, due to disputes over the scope of protection, the flood control plan has not yet been revised, and the environmental impact assessment has not passed (Taipei City Government, 2016). The so-called development plan of "Ecological Shezidao" passed the main plan and detailed plan in 2018 and 2020 respectively. As of July 2023, there are still environmental impact assessments, section acquisition plans, and other procedures that have not yet been completed.

However, most Shezidao residents expressed dissatisfaction with the current proposal for the development of the ecological Shezidao plan, blaming insufficient and unclear communication of the plan's content, especially concerning the resettlement issue (Liu, 2020). After that, residents started to protest, and as of now, nothing much has changed. The primary agent in the Shezidao development case, The Taipei City Government, lacks general promise abilities and poor communication skills with other agents. However, the Shezidao development was forced by the Taipei City Government, which generated opposing forces, continuing disagreements, and delays in development projects (Chen, 2021).

4.3.1 Current situation

Construction of around 6-meter-high dikes and pumping stations with 15 water pumps close to the river bank has proven to be a successful strategy for lowering flood risks and accelerating the drainage of rainwater. The levee (Figure 11), however, can only provide 20-year flood protection. The 20-year flood return period protection on Shezidao and the. It is a distinctive region in the Taipei metropolitan area, presenting a range of dwelling designs. In terms of industry, there has been the establishment of vegetable professional areas and tin house manufacturers.

Therefore, despite Typhoons Gloria and Herb, substantial flooding has not affected locals. Residents rely more on their traditional detection techniques despite the government's supply of broadcasts alerting them about natural disasters. Offering food during disasters is also seen as an important action, as is providing financial help to flood and disaster victims.

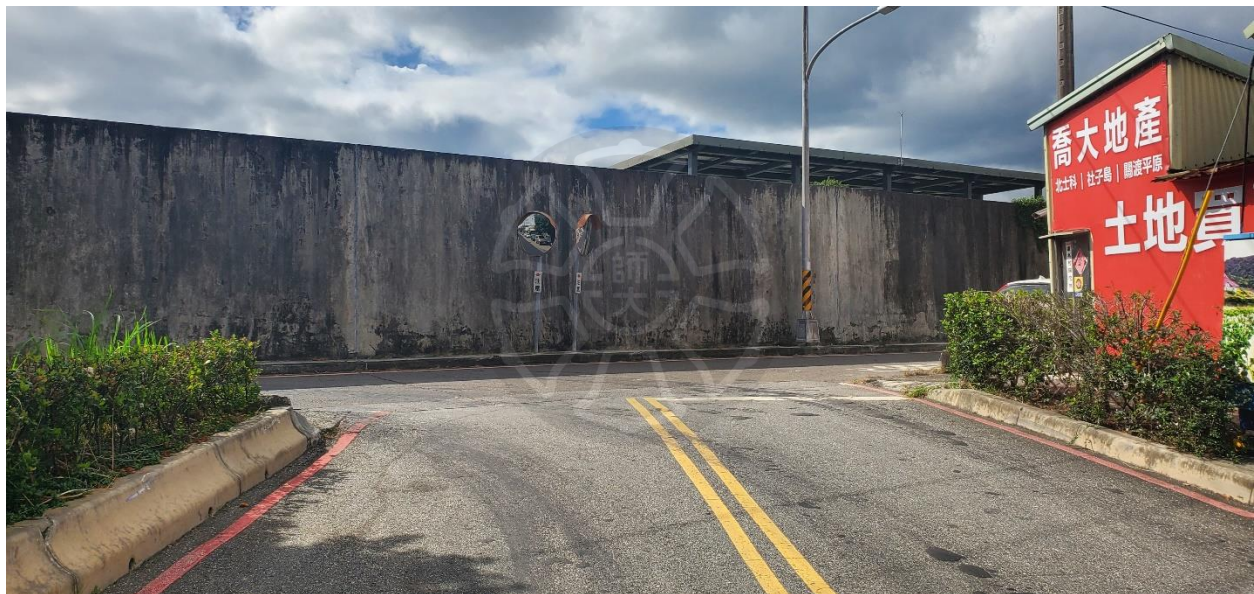


Figure 11 River embankment in Shezidao (source: author).

According to a motorcycle shop owner (R11) *“When I was young, I saw floods, but in recent times I did not see any huge clusters or floods. The water pumps work great to reduce clogged water. The embankment also works as a survivor for Shezidao. Both are located near Riverbank.”*

Furthermore, the government's and the community's collective efforts to minimize the effects of floods are emphasized by the acknowledgment of the effectiveness of pumping stations and embankments constructed by the government.

Although the residents currently practice development through the use of farms and farming methods, the strategy doesn't use a natural or nature-based approach.

According to an Expert (E1) opinion about the plan, *“First of all the Development Plan is misleading. There is nothing natural or nature-based about it, except that like a central park. Residents in Shezidao, in contrast, already practice eco-development through the use of farmland and diverse farming methods.*

Second, community support is essential for any transformation to succeed. The majority of people in this situation, whether they are homeowners or renters, are opposed to the plan. They are aware of how to handle natural disasters; thus, this strategy is not essential. It's also vital to keep in mind that this strategy prioritizes construction above improving flood protection.”

These comments demonstrate that people are comfortable preserving food as a precaution since they are well-known for their farmland and sand quality. Lack of resources is often a huge concern in disaster situations, however in Shezidao, owing to their resilience, this is not a big worry.

4.3.2 Experts’ opinion on the government’s proposed resettlement

According to experts, the primary problem with the future development plan is that it advances a political agenda and prioritizes development for show rather than taking the local community's concerns and originality into account. It is also a problem with the land losing its authenticity and identity, not just with legal and illegal land settlements.

According to the Expert (E4), *"It is a plan driven by political agenda and restlessness, designed to satisfy politicians and improve the city's appearance"*

“This is not merely a legal or illegal issue but a matter of losing the originality and identity of the land.”

According to an expert (E3) who worked on Shezidao the “government can enlarge the farmland instead of the development of buildings. Additionally, permeable road would be more valuable if flood risk is an issue”.

I also have a similar kind of opinion with E3. All of the stakeholders I interviewed from the Shezidao area have negative perceptions of NBS as they perceive the development plan to be some kind of NBS.

My views on the resettlement plan, the government should follow the recommended strategy when resettling Shezidao residents; the issue should be resolved without relocating them. Reconstruction after a disaster vulnerability by the government is common but full deconstruction

may face severe community backlash. In Shezidao, the eco-Shezidao development faces several major issues.

The first is that most of the interviewees think that Shezidao's cultural value will continue to disappear with urban development. I also think that with the development of a place, the old culture starts to change, the arrival of new people starts, and the old cultural values gradually disappear. It is almost certain that with this development the local groceries, local shops, local farmland, and old restaurants will slowly disappear with the new construction of buildings and modern shops, and people will have to find new livelihoods to survive.

The second issue is that this area became a flood risk zone because of Taipei City's past flood management policies. This development thwarted Shezidao's own development and now when the local community becomes resilient by themselves, the government wants to completely restructure their physical and social environment.

The third major issue is that people are already resilient to flood risk and flooding is no longer a major issue in Shezidao. This community resilience strengthens their community bond and increases cultural value and love for their environment. The residents realized that a reconstruction of Shezidao, would destroy their community environment and they would get a new Shezidao which could feel like an unknown place for them.

4.3.3 Stakeholders' perspectives and concerns

The levee and water pump work efficiently at Shezidao to avoid flood situations during typhoons and heavy rain. The majority of interviewees said that there have been no major floods in happens last 50 years due to the construction of the embankment, and if water clogs due to torrential rain, then the water pumps work efficiently to release the stormwater runoff.

The majority of residents are opposed to the government's current plan to buy their land for a development project (Jiabao, 2020). Their land would be completely taken by the government for the development project. However, when the project is finished, the government will give the landowners back 60% of the land together with new housing and land development.

Residents' opinion on the government's land purchase policies and the development plan for Shezidao varies. While some residents supported the development, the majority expressed concerns about losing the land's natural beauty and the perceived injustice of the government's

policies. The development prohibition, among other new government regulations, made some residents' houses vulnerable, but they also taught them how to survive in their existing homes, according to several people who shared their experiences with these occurrences. One local person (R1) said,

"Government wants our land, and in return, the landowners will receive <60% of its value. I don't have a problem with the percentage, but I am concerned about losing Shezidao's originality. Shezidao has its essence of living, with people gathering on every corner to chat, farmlands, grocery stores, and the beauty of the river, and if you're lucky, you might spot some rare birds near the riverbank (Figure 12). Our biodiversity is really good, and we will lose all of that if the government rebuilds this place."

While the majority of my interviewees reject the government's new development plan, a small minority support it because they are worried about the poor condition of the local public schools which are often flooded during heavy rain and the lack of earthquake-resistant buildings. One of the locals (R9) said they had no opinion on the proposed development plan, saying,

"I have my shop, and I have faced floods before. We can survive floods. However, if a major earthquake occurs in the near future, my house may not withstand it. The government has banned construction, but I have my family, and I want them to have a better life. The government says they will provide homeowners with earthquake-proof houses."

Another resident (R10) observed, *"During small and heavy rains, water accumulates in the middle of the school grounds. In my opinion, education is important, and if schools are flooded, children will be distracted from their education. I believe the government should focus on rebuilding schools."*

Concerns about losing originality, perceived unfairness of land acquisition, opposing views on development, and neutral stance on development were included in this analysis.

According to expert opinion, the majority of the people in Shezidao are conscious of natural phenomena and impacts because they have either personally experienced them or have heard about them. This area already has resilience to natural hazards like flooding and adaptation strategies are in place, therefore there is no need for a plan to make it more floodproof.

While they have not witnessed major disasters recently, the elderly people are aware of the potential consequences of floods or significant typhoons which they convey to others. They do not have a knowledge gap regarding what could happen during natural disasters. Shezidao's residents are now capable and aware of how to handle comparable situations in the near future.

4.3.4 Community demands and feasibility

Residents and several academics are quite concerned about lifting the development ban. The infrastructure of this location may be improved to survive in the future by allowing construction. They are afraid to loosen the originality of the land and its essence.

According to the experts (E1 and E2), If the government wants to preserve Shezidao's originality and beauty, it should listen to the people's demand for no development.

The Expert (E2) think *"The demand is very simple: they want the government to allow them to live on their land as they wish, preserving its originality. The construction ban imposed by the government should be lifted."*

According to Expert (E1) *"Majority of people in Shezidao have sufficient financial resources; they are neither poor nor jobless."*

One of the stakeholders (R9) who runs a grocery store in Shezidao said *"We want a social house that would be earthquake-proof"*

"When the earthquake happened in Taipei city, I realized earthquake-proof houses are much more needed, we are in rented houses if the government can only focus on social housing buildings in Shezidao that would be a more beneficial development for me and my family at least."

Another interviewee (R14) was concerned about the plan and said *"Social housing is the cheapest rented houses, my income is very low, rent a house in Shezidao is not higher, and after development may the price be high, so, if the government decided to develop this area, I want social houses where people like me can rent the room"*.

The Shezidao people are demanding social housing because they are concerned about price hikes. Despite being in a prime location for growth, they continue to make demands that are appropriate for their current situation. After that, it should be mentioned whether there is a government plan or a social housing plan to fulfill this demand.

In the current situation, it is not possible to meet the demand for social housing only, because to build social housing, land will also be needed. And that is under reconstruction, which will require land. Lifting the construction ban on Shezidao the current development plan must pass four review stages (ensuring compatibility with both flood control policies and master urban plans, Environmental Impact Assessments (EIAs), and managing the land acquisition process) (Salmon, 2022). However, the demand for drainage system improvement is possible within the project of Just Urban Maintenance.

4.3.5 Concerns for the ecosystem and environment

With the success of wetland ecological construction and the implementation of environmental education activities, Shezidao has become a representative scenic spot of Shezidao. Shezidao has also become one of the bird-watching spots in northern Taiwan. In 2017, the artificial wetland on Shezidao implemented a dredging project to reconfigure the beach area of the wetland to increase the area of the beach above the water surface, so that the birds still have a resting space when the tide is high. The excavation project and follow-up maintenance work have brought results as scheduled and successfully attracted transiting migratory birds such as Pacific golden plovers, sandpipers, field sandpipers, green-footed sandpipers, and ring-necked plovers come to live in the wetlands of Shezidao. At the same time, there are also well-known species such as black-faced spoonbills and four-spotted scorpions. However, people are afraid to loosen the originality of the land and its ecological environment as new buildings or infrastructure in the development plan would destroy the ecosystem in Shezidao.



Figure 12 Riverbank in Shezidao (source: author).

The development project has raised doubts about damaging the ecological environment, affecting the flood control safety of Taipei City, threatening the livelihood of vulnerable residents, and erasing settlement texture and cultural assets. In addition, Liao, Chan, and Huang (2019) pointed out from the perspective of "environmental justice" that the current flood control infrastructure did not eliminate the flood itself, but redistributed it so that some regions face greater threats. This will make already relatively marginalized communities more vulnerable (Liao et al., 2019). In the "Taipei Area Flood Prevention Plan", Shezidao is designated as a "flood zone" as well as a "restricted development area". Currently, there are many agricultural and illegal factories in the Shezidao area.

4.4 Discussion on the development plan

After Shezidao was declared a zone where new construction was banned in 1970 its land usage was substantially restricted for development. Some of the inhabitants also left the island due to a lack of job opportunities, and the island's total growth was stopped, resulting in apparent signs of degradation and deterioration. Shezidao lacks the fundamental construction of houses, utilities, and common infrastructures since no specific plan has been made public for the region. It is the least developed neighborhood in Taipei City in terms of infrastructure.

In the "Shezidao Embankment Protection Project", the height was raised, and the flood control intensity of Shezidao was raised to the 20-year flood control standard. In this view, "Taiwan Flood

Control Plan for the Northern Region, in addition to hard times such as dikes and floodways, people living in the "floodplain". The residents themselves have also become a part of this flood control infrastructure system that needs to be drawn and controlled. However, the political government did not forcefully relocate the residents of Shezidao, nor did it strictly enforce the ban on construction, but let Shezidao develop vegetable development areas, and unregistered factory clusters.

The situation of Taipei City and the situation of Shezidao can also be seen in the two sets of defenses that are related to each other, "Taipei Metropolis" and "Shezidao". In addition, the situation of Shezidao is also related to the fact that the "city" must exclude "floods". On the one hand, discussions on the development of Shezidao after 1993 all included Shezidao in the 200-year, high protection against flood standards as a prerequisite. On the other hand, the reappearance related to the flood control construction of Shezidao is considered relatively. Shezidao, which is prone to flooding, represents backwardness, dilapidation, and a waste of time, and Shezidao is regarded as a place that was "sacrificed" by Taipei.

In Shezidao, there's a group of landowners backed by developers and politicians. They very strongly support the government's new development plan. They want the government to develop such that as soon as possible, there's another group, the self-help group, protesting against this plan. So, some of these people did very respectable things to some of the members of this opposing group.

Many Shezidao residents do not meet the criteria for identification as persons with a relevant interest in the area, such as residents registered in Shezidao, owners of legal buildings and lands in Shezidao, or residents living in Shezidao but citizens of Taipei City registered in areas outside Shezidao, according to conversations with experts and stakeholders in the area. They are also the inhabitants or interested parties who will be required to migrate as a result of the Shezidao development because many of the citizens have come in from other counties and cities to live and work in Shezidao. However, the Taipei City Government does not give these citizens the chance to vote and express their expectations; as a result, the principles of open government and participation by all citizens are not being accepted, and the human rights of those who might be forced to relocate are not being taken seriously.

However, Shezidao, it is planned to use the zone expropriation method to carry out the overall development of the whole area at one time (Hsiao, 2018, 2021). The residents of Shezidao emphasized that they are not refusing to develop, but are worried that the section expropriation will displace most people, close factories, affect the livelihood of hundreds of families, and destroy the original ecological and cultural monuments.

The residents who own a very small piece of land according to the rule according to the expropriation rule of the government, after redevelopment, won't be able to get enough pieces of land they rebuild their house. So oftentimes they will end up having to sell the land and get the money. And that money is not enough for them to stay in Shezidao or anywhere. Then they have to just go somewhere else. Have to go to a more fringe area of the city. But there are also people in the anti-development group. They're against this plan purely for value reasons. They are against inappropriate development. They want to preserve their current lifestyle.

The residents want to retrofit their houses. But they can't do it due to the construction ban imposed by the government. They have the money and want to rebuild the house. But if they use any permanent material, then your house will be qualified as illegal. That's why people put up something rather temporary because they are not sure about their future. There's a lot of uncertainty about whether their investment could last forever. In addition to the old houses left by the ancestors, many traditions and cultural practices have been preserved for almost a century in Shezidao. These include things like the dragon boat culture in the settlements and the nighttime land fair, which brings the locals' emotions together.

It's not like everyone in Shezidao supports the Shezidao development plan, some do express certain concerns that they believe should be addressed. For example, parents are concerned about the school redevelopment case, and clogged drains are a vicious condition that affects the entire community. Both of these issues, in my opinion, can be resolved without the government acquiring any additional land. There is a clear distinction between development and care; the government can undertake a project to maintain this area. However, while some believe that social housing is important, this idea cannot proceed without land. Based on my interviews with experts, the Shezidao community, and a review of the literature, I have concluded that the development of Shezidao is currently becoming a political issue. Shezidao is part of the Taipei city government's

goal to develop Taipei city. Through my research, I was able to learn about the opinions and perceptions of the local inhabitants on this development as well as how they prepare for flooding.

4.5 Conclusion

With an emphasis on community resilience, this chapter explores the basic concepts that explain resilience. It also analyzes the mechanics of disaster risk management, including, preparedness recovery, response, and adaptation. Moving on to coping mechanisms and community resilience, a deeper understanding of the community's adaptive strategies in the face of challenges is illustrated.



5 Conclusion

My main research question was “how do Shezidao residents’ coping mechanisms to flooding shape their community resilience to the adverse impacts of climate change and government flood risk management initiatives?” The answer I found to this question is that the majority of the interviewees of the study area have developed various coping mechanisms to deal with natural hazards such as floods after Shezidao was declared flood-prone by the Government long ago. Although Shezidao is flood-prone they continue to deal with natural hazards through their community bonding with residents. They have a strong community relation with each other and they shared their past disasters experiences about how disasters have developed in the past. This practice is validated by several researchers and it enhances awareness and preparedness for natural hazards. For resilience, they use their traditional ecological knowledge and some adaptation techniques on their own. Like being able to determine the timing of their tides by looking at the lunar calendar, the amount of rain by looking at the shape and color of the clouds, etc. As they realize natural disaster situations, they are prepared in advance so that disasters won’t affect their area significantly.

Shezidao was declared flood-prone by the Government long ago and proposed a resettlement plan. However, as shown by Kane (2018) and Liao, Chan, and Huang (2019), flood protection methods that aim to divert floods from a specific location can simply redistribute floodwaters and often have a negative impact on some other places that are not inside the flood control plan's protected area. As a result, the flood protection paradigm of "flood" must be discarded if crossing the "urban" is not possible, and the paradigm of "flood resilience" (Liao 2012), which includes Shezidao, which is symbiotic with water and adapts without floods, must be further promoted (Liao2012). There is probably still no clear solution to the problem of space being "sacrificed" for flood prevention. The majority of my interviewees believe that Shezidao must lose their cultural values and land originality which they have been carrying from their ancestors for so long. Moreover, they are afraid of land expropriation rules that will be applied after the development plan.

6 Research Limitation

As my study was qualitative research on community resilience to urban flooding, I faced several limitations that is found considered in interpreting the findings. This research was conducted within a relatively short timeframe of 1 year, the study may not have fully captured the dynamic nature of community resilience in response to urban flooding.

One significant limitation was the language barrier, despite I had two research assistants to assist with the interviews. This raises the possibility of difficulties in precisely capturing complexity and ambiguities when gathering data. Furthermore, a rather small sample size of only 30 interviews was used in the research to reflect the case study region, which has over 11,000 residents. The small number of interviews may not accurately reflect the diversity and complexity present in such a large population, even though they were attempts to capture a cross-section of experiences and perspectives.

Additionally, the research was conducted in a case study region that was characterized by a variety of religious beliefs peoples. But just a portion of these communities were interviewed because of time restrictions. Because of this, there is a chance that sampling bias will occur and the results may not accurately reflect the variety within the case study region.

The primary method of data collection was through interviews, which is acknowledged as fundamentally subjective. While interviews provide valuable qualitative insights, relying just on this technique might restrict the research's overall scope and depth. Furthermore, the exploration of cultural influences on community resilience was restricted by the limited examination of different religious communities within the case study area.

Given these constraints, it is proposed that future studies use a longer time to enable a more in-depth study of community dynamics. To improve the study's external validity, researchers should also work to successfully overcome language barriers and include a wider range of people. To properly understand and use the results, it is imperative to acknowledge the limitations imposed by the relatively small sample size. This highlights the necessity of exercising caution when extrapolating the results to the larger context of urban floods and community resilience.

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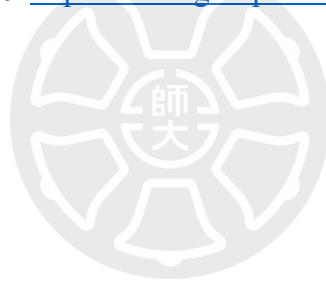
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Appendixes

Appendix A: List of questions for the interview

1. May I know your name?
2. Are you a local of Shezidao?
3. What is the name of your community?
4. How long have you been in Shezidao?
5. Did you see any changes in your locality because of natural disasters?
6. What types of natural disasters are common in Shezidao? How has the community prepared for them?
7. How did you communicate with other members of your community during and after the disaster? (what effective communication methods do you use?)
8. Have there been any challenges your community faced in accessing resources during and after natural disasters?
(For example, food, water, medical supplies, shelter, transport, electricity, network, etc) if so, how did your community overcome these challenges?
9. What other non-natural disaster-related challenges does your community face?
10. How does your community stay informed about potential natural disasters in the area? Do you get any warnings before disasters?
11. How do schools in Shezidao prepare children for disasters? (If the person has a kid in the house)
12. Have you been able to participate in any programs in your community that teach people about natural disasters and how to prepare for them? If yes, how often are these programs organized?
13. What are the specific challenges that your community faces because of the two rivers Shezidao has? Do you have any use of this river water?
14. What are some important resources or assets in your community that may be at risk during natural disasters, and how does the community try to protect the risks associated with them?
15. What are the challenges or barriers to scaling up or maintaining your house?

(I'm interested in learning more about your knowledge of the government's declaration of Shezidao as a flood-prone area.)

16. How has the government said Shezidao is prone to flooding affected the community? (what problems and chances have it brought?)
17. What are the key advantages or strengths of Shezidao that help the community cope with natural disasters, such as easy access to resources, effective communication and coordination systems, or unique geographical features?
18. What are the main concerns of communities that currently need to be taken into account for betterment in Shezidao in terms of disaster resilience? How government can help you in this matter?

