The Role of The Bottom-Up Approach in Flood Risk Management: Case Studies in Thua Thien Hue Province, Central Vietnam

洪水リスク管理におけるボトムアップアプローチの役割：ベトナム中部のトゥアティエンフエ省における事例研究

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ABSTRACT

More frequent and severe natural disasters are inevitable repercussions in the 21st century due to global environmental and climate and change. Greatly touched at both the social and individual levels, flooding is one of the most devastating natural hazards in Vietnam. Over the last 20 years, floods killed at least 14,927 people, injured 16,829, and caused tangible damage amounting to 3.7 billion USD. Annual damage caused by natural hazards is equivalent to 1 to 1.5% of the country's GDP. Reducing flood risks, hence, is considered a central task of the Vietnamese government.

This has been demonstrated through an institutional framework that requires the involvement of many levels of government and concretized through many specific measures and interventions. However, flood risk reduction currently remains a big challenge despite the unremitting efforts of the authorities at all levels. The government's strategy of popularizing massive dams and reservoirs seems insufficient to reduce floodwater levels. Major floods in recent years clearly demonstrate the limitation of this approach. In central Vietnam, the 2017 flood was equivalent to the historic one in 1999, while the 2020 flood reached extremely dangerous disaster classification, set a new flood level record, and caused far-reaching impacts entire the region. This fact implies the need of a more integrated flood risk management system to replace the purely technical-oriented defense. Besides, since the hierarchical structure of the administrative system reveals limitations in risk management, there is a transition underway to more resilient approaches such as bottom-up initiatives, which emphasize local actors' protective measures. Local actors' preparedness, though explored by a number of researchers, was only examined at the time of the survey. Its progression over time, however, was overlooked. Also, studies examining barriers to the implementation of protective measures between social groups are still rare despite compelling evidence of the link between their socioeconomic disparities and the implementation of precautions.

In addition to preparedness, rapid recovery is also critical because the delay is often the root of other types of risk, which may lead flood victims more vulnerable to future events. It is evident that flood victims, after suffering severe damages, usually face difficulties to recover due to lacking resources. While government formal support is still inadequate, the recovery of households is considered to be more dependent on informal sources from social networks. In relation to this, most recent studies focused on their positive outcomes to post-disaster human physical-mental health, well-being, and

especially satisfaction with the recovery process. However, households' post-disaster recovery rapidness, an equally important issue, has not been given due attention. Examining this matter is meaningful since sluggish rehabilitation will increase social costs and make households' economic pain and deprivation deeper and longer-lasting. Besides, there are relatively few studies exploring how the roles of social connections vary in different recovery sub-phases. Examining this aspect in the recovery process is indispensable to understand the dynamics of social supports over the course of time.

The aim of this dissertation, therefore, was to provide a deeper insight into the potential effectiveness of bottom-up approaches in the practice of flood risk reduction in Vietnam. This aim was concretized through two case studies: the first one investigated the long-term improvement of flood protective measures by local actors and potential barriers to different social groups, and the second one focused on the contribution of social connections to post-flood recovery rapidness and their dynamic in different recovery sub-phases. Thua Thien Hue Province was decided to be our study site on the basis of its exposure to hydro-meteorological-related disasters as manifested through consecutive major floods in recent decades. Huong Tra and Quang Dien districts were selected for the survey.

A mixed method was employed to collect the data and information. The quantitative data were collected through interviews with household representatives using semi-structured questionnaires, while the qualitative information was obtained through key informant interviews and focus group discussions. We then used the Statistical Package on Social Science (SPSS) to design the data entry template through which we entered the raw data and made a database for 120 households (first case studies) and 164 households (second case study). The data, after being entered into the datasheet, was rechecked to avoid errors made during data entry. After validating the data, we carried out simple frequency analyses and created some graphs to get an overview of available variables. We then examined the interrelation between these variables and outcome variables that were designed based on the specific objectives of each case study.

The results first point out limitations in the government's risk reduction approach and the preventive measures implemented by local authorities. The government intervention through structural works has made flooding more irregular. Anticipating flooding by conventional approaches, therefore, has become ineffective. Floodplain residents tend to be skeptical of the results of this top-down approach in reducing risks and focused more on precautionaries. At the local level, the authorities have taken a number of

measures to strengthen the defense capacity of households facilitate their rehabilitation process. These measures, however, were under-appreciated by most locals. The lack of resources, which leads to disproportionate and unsynchronized investment in public preventive measures, is the primary cause making government efforts less effective. The delay in responding to emergencies such as supporting evacuation, providing essential supplies immediately after floods, and inadequacies related to resource distribution for post-flood reconstruction were also the principal reasons making the government's efforts to be underestimated. The above limitations are believed to stem from the top-down flood risk management institution that follows the administrative decentralization applied by the government. Although not yet touching the needs of the majority of the population, the government's interventions have been effective in supporting some social groups to overcome their limitations. In this regard, the top-down approach has contributed to promoting the bottom-up approach.

To respond to the government's limitations, floodplain residents have developed their own strategies to minimize risks from flooding. This has been clearly demonstrated through the long-term efforts of households to improve protective measures and the ways they establish and mobilize resources from social connections to rehabilitate more effectively after floods.

Most households, nearly 20 years after the disastrous flood of 1999, improved considerably precausionaries both in structurally and non-structurally to actively deal with flood hazards. The reducing of flood damage is an undeniable proof of the effectiveness of these efforts. Through this finding, the central role of households in the bottom-up approach, especially in developing countries, is confirmed. Some social groups, nonetheless, seem to be lagging in this struggle against nature. Poverty was a major bulwark constraining household improvement in both rural and suburban villages. Poverty eradication, hence, should be prioritized and integrated into flood risk management strategy. Additionally, the external reliance was found as a psychological barrier negatively affecting the households' motivation. Breaking down this psychological barrier is required to enhance households' initiative, but this should be done by thoroughly considering this difference between rural and suburban areas. Besides, the households living in the suburb riverine was further identified as vulnerable because of their inability to improve structural measures. This matter was primarily attributed to inadequacies in planning and implementing projects to preserve the old town landscape. This, on the one

hand, indicates the additional complexity of coordinating projects in urban areas, while on the other, requires a smoother blend of development policies to limit adverse implications.

Regarding households' recovery efforts, our findings emphasize the more important role of social connections compared to other types of tangible assets. The crucial role of relatives and informal groups is revealed as they contributed significantly to shorten the recovery. While blood-based relations were crucial among relatives, small scale, diverse membership, and formation grounds of informal groups were believed to be helpful. In addition, the geospatial differences between social connection types, which allow flood victims to access more abundant resources outside the village, are also seen as potential causes for the considerable effect of relatives and informal groups on the post-flood recovery speed. However, the contribution of other connections is not therefore negated. Since speed is only one aspect of the recovery process, the contributions by friends, neighbors, formal groups, and local authorities can be manifested in other aspects of household recovery such as ensuring survival during urgent cases or relieving the victim's mental pain in the long run. In addition, we, through the subdivision of the recovery process, further exhibit the variation in the role of social connections over time. The substantial role of relatives and neighbors in the urgent period after the flood and the short-term recovery sub-phase was accentuated as they were key providers in almost all phases and categories. Neighbors are believed to play a greater role in providing urgent assistance due to their proximity. Households' long-term recovery efforts relied on the leadership of the local government. This, however, also notes the limitation of the local government and community-based organizations in assisting affected communities, especially during the immediate crisis. Besides the lack of resources as normally found in developing countries, slow administrative procedures were further identified as a challenge that authorities need to improve.

Through the two empirical case studies, this dissertation, in addition to highlighting the limitations of current top-down approaches by the government, demonstrated the key role of floodplain residents in the bottom-up approach of flood risk mitigation. Therefore, integrating this approach more extensively into the government's current strategy is crucial to be more effective in mitigating flood risks in the context of Vietnam.

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LIST OF ABBREVIATIONS

IPCC	**Intergovernmental Panel on Climate Change**
CRED	**Centre for Research on the Epidemiology of Disasters**
GDP	**Gross domestic product**
ADB	**Asian Development Bank**
WHO	**World Health Organization**
WB	**World Bank**
FRM	**Flood Risk Management**
MARD	**Ministry of Agriculture and Rural Development**
DRR	**Disaster Risk Reduction**
DRM	**Disaster Risk Management**
CSCNDPC	**Central Steering Committee for Natural Disaster Prevention and Control**
CCFSC	**Central Committee of Flood and Storm Control**
MOET	**Ministry of Education and Training**
MOC	**Ministry of Construction**
CFSC	**Committee for Flood and Storm Control**
NGO	**Non-governmental organization**
PMT	**Protection Motivation Theory**
TPB	**Theory of Planned Behavior**
DFID	**Department for International Development**
UNDP	**United Nations Development Programme**
VND	**Vietnam Dong**
GSO	**General Statistics Office of Viet Nam**

CHAPTER 1: INTRODUCTION

1.1. Background

Natural disasters are anticipated to escalate in both frequency and severity in the 21st century due to global environmental and climate changes (IPCC 2014). About 60,000 people were killed by natural disasters on average each year, equivalent to 0.1% of global deaths (H. Ritchie and Roser 2014). Aside from that natural disasters were the cause of more than 180 million people falling into the urgent need of assistance on average each year during the 1980-2019 period (CRED 2020). In economic terms, damage caused by natural disasters accounts for 0.29% of global GDP. Nearly 80% of these damages resulted from weather and climate-related disasters, equal to 0.23% of the total GDP (Pielke 2019).

Flooding, among natural hazards, is viewed as one of the most widespread devastations, resulting in loss of life and damages to personal properties and critical public infrastructure. Major flood-related calamities have tripled in almost three decades since the 1980s (ADB 2013; Hoeppe 2016). On average, floods resulted in roughly 6,000 deaths and 19 billion dollars in damage worldwide annually over the past four decades (CRED 2019). The total number of people affected by floods in the last two decades (1998-2017) was estimated at 2 billion worldwide (WHO 2018). Accounting for more than 60% of those who have experienced disasters, suffered more than two-thirds of the total deaths, and carried half of the world's disaster-related economic losses, Asia seems to be the hardest region hit by natural disasters (ADRC 2016). In 2018, Asia accounted for 45% of disaster events, 80% of deaths, and 76% of people affected. In which, flooding affected the highest number of people, accounting for 50% of the total affected, followed by storms which accounted for 28% (CRED 2019). Hydrological-related disasters, hence, is probably one of the largest fatal disaster in Asia (Shaw 2006b).

Vietnam, with nearly two-thirds of the population at risk, is viewed as one of the most vulnerable countries to natural hazards. Based on the 2018 Global Climate Risk Index, Vietnam lined fifth among the countries most harshly impacted by extreme weather events, three levels higher than the average order of the 1997–2016 period (Eckstein et al. 2017). Additionally, this is also one of five countries with the highest population proportion exposed to river-flood risks worldwide (Luo et al. 2015). The high flood risk[1] in Vietnam

[1] There are two essential elements in the formulation of risk: flood hazard and flood vulnerability (UNISDR 2004). Flood hazard is the probability of the occurrence of potentially damaging flood events. Potentially damaging means that there are elements exposed to floods that could, but is not necessarily, be harmed.

may arise out of its tropical monsoon climate, a long coastline, dense river system, and dense population along rivers and coastal areas (Chau et al., 2014; Razafindrabe et al., 2012). Additionally, excessive human interventions such as deforestation (McElwee 2004) or inconsequential land-use management (Chau et al., 2013) have exacerbated the probability of these types of risks in Vietnam. Over the last 20 years, floods killed at least 14,927 people, injured 16,829, and caused tangible damage amounting to 3.7 billion USD (Luu 2017; CRED 2013). According to the estimation of the World Bank (WB 2010), about 1 to 1.5 percent of the country's annual GDP in the aforementioned period was evaporated due to natural disasters, and this significantly hinders the socio-economic reorganization process.

Flood risk mitigation, therefore, has become a central task of Vietnamese government. Different measures and instruments have been applied to mitigate risks. While measures refer to physical interventions, instruments mention interventions based on mechanisms, which either directly or indirectly improve the behavior of floodplain residents. There are different terms to refer to interventions. Among them, the terms "structural measures" and "non-structural measures" are the most widely accepted (Hooijer et al. 2004). This may be derived from the traditional engineering perspective of flood risk management. The social perspective, which may be indispensable in examining the dynamics of interventions, calls for a more detailed specification of non-structural measures. The term "instrument", meanwhile, has been quite common to refer to activities in different areas of financial and legal policies. Measures can be distinguished as permanent or temporary. The permanent measures are direct physical interventions leading to an enduring change in the physical conditions, while temporary measures are direct physical interventions to lessen risks during ongoing floods (Schanze 2006). Permanent measures refer to engineering works aiming at controlling flood, improving flood resistance, and intensifying infrastructure resilience. Activities that aim to increase water retention capacity, and thereby reducing material loss from the landscape in upstream catchments and on floodplains, are also part of permanent measures. Temporary measures, meanwhile, include highly movable flood protection, easy to install and dismantle. Besides,

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Damage by flood hazards depends on the "vulnerability" of exposed elements. The term vulnerability refers to the inherent characteristics of these elements which determine their potential to be harmed (Schanze 2006). Vulnerability is a combination of various factors, including human and physical. The main variables illustrating variations of the vulnerability include a social class (e.g., wealth difference), gender, caste, occupation, ethnicity, disability, and immigration (legal or illegal), scope and extent of social networks (Wisner et al. 2003; Adger et al. 2004).

the evacuation of people and possessions out of flood-prone areas is also considered a temporary measure. This category also covers activities to overcome immediate flood damage such as cleaning up rubble.

The government's interventions have been implemented at all three key phases of the floods: flood preparedness[2] (before flood), flood response (during flood), and flood recovery (after flood). Each phase includes different intervention measures and certainly plays different roles in reducing risk. It is obvious that an effective flood risk management strategy requires good implementation of measures, activities, and appropriate interventions of stakeholders at all three phases. In which, the effectiveness of the response phase is mainly determined by the quantity and quality of the measures taken in the previous preparedness phase. Therefore, the implementation of protective measures before floods can be considered as a key factor to reducing risk. In addition, it is also important to have a specific plan for flood recovery as there is no way to completely neutralize the damage caused by floods. Failure to recover from floods will be a premise for the raising of other type of risks, which may lead flood victims more vulnerable to other future flood events.

The construction of an increasing number of reservoirs, hydropower dams, and other structural works, apart from serving national economic development, definitely demonstrated the determination of Vietnamese government to reducing flood risk. According to the Department of Water Resources - Ministry of Natural Resources and Environment, Vietnam currently has more than 7,169 reservoirs and dams arranged along the length of the country (MNRM 2020). These structural works, although significantly contributing to reducing flood frequency, were sometimes failed to prevent floodwater and related damage (Musiake 2003; Pilarczyk and Nuoi 2002). Major floods befalling in recent years are clear evidence of the aforementioned structural measures' limitations. The 2020 flood in the central region reaching alarming level IV (extremely dangerous disaster category), for instance, set a new flood level record and caused far-reaching impacts and damage to the entire region. This fact implies the need of a more integrated flood risk

[2] The concept of flood preparedness is quite straightforward. It is defined as measures taken before floods that ensure the availability of resources to respond effectively to emergencies (Bradley and Bautista 2010). These measures, in general, aim to minimize the adverse effects of flood hazards and to ensure timely, appropriate, and efficient organization and delivery of emergency response following the impact of a disaster. Preparedness is a continuous and integrated process resulting from a wide range of risk reduction activities and resources rather than from a distinct sectoral activity by itself (Douglas Paton 2003).

management (FRM)[3] strategy to replace the purely technical-oriented defense. Furthermore, since the hierarchical structure of the administrative system reveals limitations in risk management, there is a transition underway to more resilient approaches such as bottom-up initiatives. In such approaches, precautionary measures implemented by local actors are highly emphasized (Duc et al. 2012; Chinh et al. 2016; Luu et al. 2018; Atreya et al. 2017). It can be argued that local actors' preparedness is foremost to mitigate flood risks. Local actors' preparedness, though explored by a number of researchers, was only examined at the time of the survey. Its progression over time, meanwhile, was overlooked. Besides, studies examining barriers to the implementation of protective measures between social groups are still rare despite compelling evidence of the link between their socioeconomic disparities and the implementation of precautions.

In addition to risk reduction efforts, supporting flood victims to quickly recover is also an important duty of the government as delayed rehabilitation often raises other types of risk which are likely to make flood victims more exposed to future events, and thereby increase the social burden. However, despite incessant efforts, post-flood recovery remains a major challenge for both locals and governments, especially in developing countries like Vietnam. It is evident that victims of natural hazards, after experiencing severe damages, usually face difficulties to recover due to lacking resources (Chan et al. 2018; Opdyke et al. 2017). Recent studies indicated that government resources are finite, thus less effective in major floods (Aldrich et al. 2015; Chan et al. 2018). It is evident that most households tend to be neglected with their losses after natural hazards (Osberghaus 2015). While formal support is still inadequate, households' recovery probably depends more on informal sources obtained from their social capital (Hernández-Plaza et al. 2004; Sadri et al. 2018). In relation to social capital, most recent studies focused on its positive outcomes to post-disaster human physical-mental health, well-being, and especially satisfaction with the recovery process (Elgar et al. 2011; Maass et al. 2016; Bubeck and Thieken 2018; Dai et al. 2016). Households' post-disaster recovery speed, however, has not been given due attention. Examining this matter is important because sluggish rehabilitation will increase social costs and make households' economic pain and deprivation deeper and longer-lasting. Besides, there are relatively few studies exploring how the roles of social

[3] Flood risk management (FRM) is an integrated strategy to reduce the likelihood and impacts of flooding. By engaging stakeholders, coordinating public and private efforts, and employing a diversity of policy instruments, FRM can strengthen societal resilience, achieve greater efficiency, and enhance the legitimacy of decisions and actions to reduce flood risk (Thistlethwaite and Henstra 2019).

connections vary in different recovery sub-phases. It could be said that examining this aspect of recovery is indispensable to understand the dynamics of social supports over the course of time.

1.2. Research objectives and Research questions

Recognizing the importance of local actors' preparedness in flood risk mitigation (FRM) and the potential effect of social networks on the households' recovery process; and through exploring knowledge gaps of previous works, this dissertation aims at examining two main objectives as follows:

(1) The long-term improvement of protective measures by local actors

For this objective, we look at flood risk reduction practices at the local level through two key actors: the commune-level local authorities and individual households. Specifically, we focus on analyzing these local actors' long-term improvement in implementing flood protective measures and their damage-reducing effectiveness through two major and magnitude-equivalent floods. Apart from that we also consider associations between household characteristics and implementation of protective measures to identify potential barriers to social groups' improvement.

The detailed research questions corresponding to the first objective are:

- *How have flood characteristics changed under the influence of the dam system? What are the attitudes of villagers towards implementing preventive measures in the face of change?*

- *How have local governments improved preventive measures? How effective were they in helping flood people?*

- *How have floodplain inhabitants improved preventive measures in the long term? How effective were they in the actual flood?*

- *Who is plodding in the struggle against floods? And what factors are hindering them?*

(2) The contribution of social connections to post-flood recovery speed and their dynamic in the sub-phases of recovery

As for the second objective, we aim to reveal how social connections contribute to the post-flood recovery of rural households. Particularly, we examine household recovery

speed in relation to their demographic characteristics and social connections. We also investigate how social connections' role varies in different recovery sub-phases. In other words, we focus on identifying the dynamic of social connections over time.

The detailed research questions corresponding to the second objective are:

- *What factors affect households' recovery speed? Do social connections accelerate the household's post-disaster recovery?*

- *How different roles do social connections play in different recovery sub-phases?*

These two objectives will be separately examined in two case studies in central Vietnam.

1.3. Research methods

1.3.1. Data collection

Our research employed a mixed method to collect the data and information. The quantitative data were collected through interviews with household representatives using semi-structured questionnaires, while the qualitative information was obtained through key informant interviews and focus group discussions. In both case studies, the pilot trials were carried out to search for appropriate study sites and to check for the appropriateness of the questionnaire before conducting the official interviews.

- *Household survey with semi-structured questionnaires*

Based on research objectives, the content of semi-structured questionnaires was differently designed in the two case studies. While the first case study focuses on exploring local actors' flood preparedness, the second one analyzes the determinants of post-flood recovery.

For the first case study, the main contents were interviewed in the following order: We first explored information regarding the demographic characteristics of households, followed by participants' perceptions of changes in flood risks, the potential causes for these changes, and their attitude toward implementing preventive measures. We then requested key information on the preparation and damages of both floods (1999 and 2017) to understand the improvements in their precautions and their effectiveness in reducing damages. The cross-sectional data of 120 households, divided equally between two selected villages, were collected.

For the second study, a total of 164 households in four selected villages were interviewed. Since this study targets the post-flood recovery phase, only households who experienced damage in the 2017 flood were visited. To avoid bias or discrimination, these households were randomly selected from the household list provided by the village leaders. The interviews usually began with information regarding household demographic characteristics, followed by their social networks with friends, neighbors, relatives, formal groups, and informal groups. Then, the 2017 flood was recalled to understand households' damage, time to full recovery, and contribution of social connections to households' rehabilitation process.

- Key informant interviews and group discussions

Through informant interviews and group discussions, we collected qualitative information to further explain the implications of numerical data.

To answer the first study research questions, we interviewed those responsible for flood and storm control at the commune level to understand local socioeconomic characteristics and flood trends, and flood prevention activities. This information, after that, was further discussed with the village leaders as they are considered an essential link in the implementation process. For the second case study, we directly interviewed the people responsible for agricultural and rural development and disaster prevention at both district and commune levels to understand the flood damage in recent years and formal supports from local governments. Similar to the first case, we also validated these qualitative data through meeting with the village leaders.

Besides, we also conducted group discussions in both case studies. In general, one group discussion was held in each village where the survey was conducted. A group discussion includes 10 to 15 villagers with different demographics such as gender, age, education, and occupation. Although checklists were developed to guide the discussion, we, in most cases, could not properly follow the order of the questions. As a researcher, I act as a moderator for the discussion, debate among people about how flood disasters are affecting them, coping strategies of households, and the types of support they received from different stakeholders before, during, and after the flood event.

The explanations during the focus group discussions were helpful in getting insights about flood risk management and mitigation approaches in relation to flood preparedness and

post-flood recovery. The conversations were not recorded because there were sensitive issues during the discussion including the cultural and political aspects of the disaster.

1.3.2. Data analysis

As aforementioned, we used both quantitative and qualitative approaches for data collection and analysis. The quantitative data has obtained through semi-structured questionnaires. We used the Statistical Package on Social Science (SPSS) to design the data entry template through which we entered the raw data and made a database for 120 households (first case studies) and 164 households (second case study). The data, after being entered into the datasheet, was rechecked to avoid errors made during data entry.

After validating the data, we carried out a simple frequency analysis and prepared some graphs to have an overview of variables. We then examined the correlation between these them and target variables in case studies. In the process, we occasionally change the way variables are classified to better reflect their own value. For example, the number of labors was replaced by the dependence ratio since it better reflects the household's resources. In the first case study, we mainly used quantitative comparative and qualitative descriptive methods to observe the trends and cohesion between variables. Besides examining the correlation between variables, we also calculated Phi and Cramer's V coefficients to understand the association strength between pairs of variables. In the second case study, meanwhile, we further apply the linear regression model to examine the potential effects of explanatory variables on the dependent one. Based on the objectives, we considered recovery time as the dependent variable. Meanwhile, variables related to demographics and socioeconomics were inserted for explanation.

1.4. Justification for site selection

Thua Thien Hue Province was decided to be our study site on the basis of its exposure to hydro-meteorological-related disasters as manifested through consecutive major floods in recent decades.

Located in central Vietnam, Thua Thien Hue Province is one of the most vulnerable areas to natural disasters in Vietnam. The province is characterized by the short distance between the mountains in the West and the East Sea in the East, is associated with a variety of geographical features such as mountains, hills, rivers, paddy fields, coastal lagoons, and marine areas. Two large rivers pass through the province, fed by numerous smaller rivers

from the mountains. Bo river flows through the northern part of the province flows into the Cau Hai lagoon. Huong river is the largest and flows through Hue city, ending in the Cau Hai lagoon. These river systems play a crucial role in aquatic and riparian ecosystems, contributing to the biodiversity in the region. Tam Giang-Cau Hai lagoon adjacent to the estuary is the largest coastal lagoon in Asia, is recognized as a particularly valuable water body system, and plays a crucial role in the livelihoods of surrounding communities. However, due to the geographical and climatic conditions, this locality has suffered from different types of natural disasters, especially those related to hydro-meteorological ones, such as storms and floods (IUCN Vietnam 2005; Tran and Shaw 2007). It is estimated that approximately two-thirds of the population in Thua Thien Hue has been exposed to flooding during extreme rains (NCAP 2008).

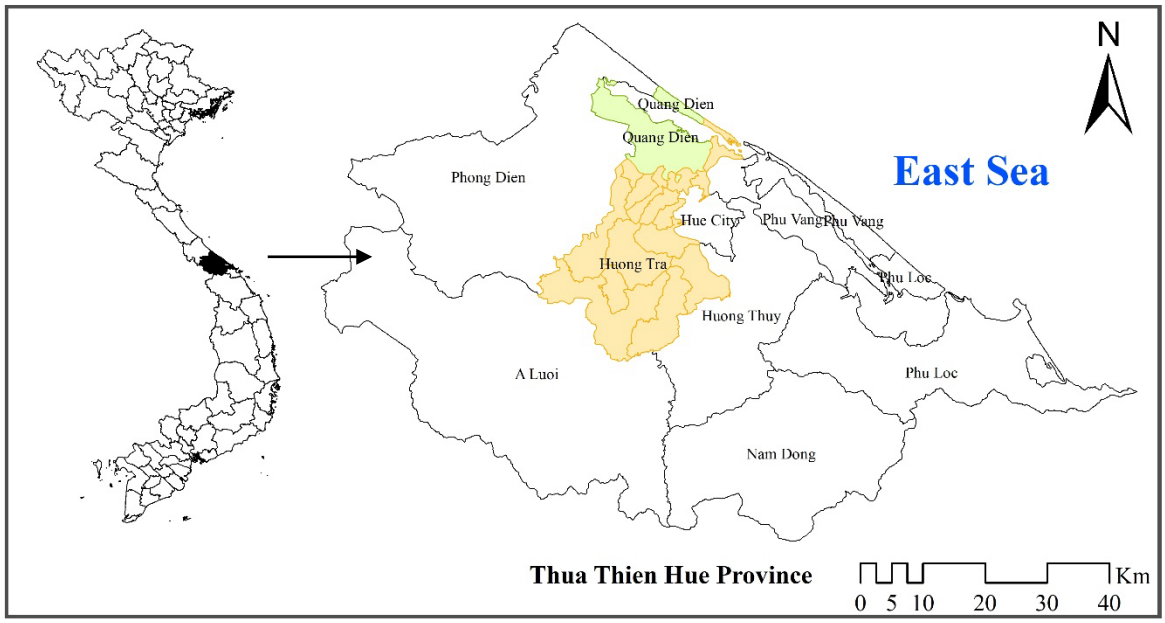


Figure 1: Map of Thua Thien Hue Province

Source: Authors

Based on the attack time, floods in Thua Thien-Hue Province can be divided into four different types. First, the main winter season floods, which usually occur from October to December, are high magnitude, prolonged, and high peak. Second, the late floods appear in late December and rarely exceed the dangerous threshold. Third, the early floods occur mainly from May to June, often rapidly recede. Fourth, the summer floods, which occur from mid-July to mid-September, are usually limited to moderate peak and intensity (Shaw 2006a). For farmers, winter main floods are usually less dangerous because they usually occur at the end of the harvest season. However, the high flood

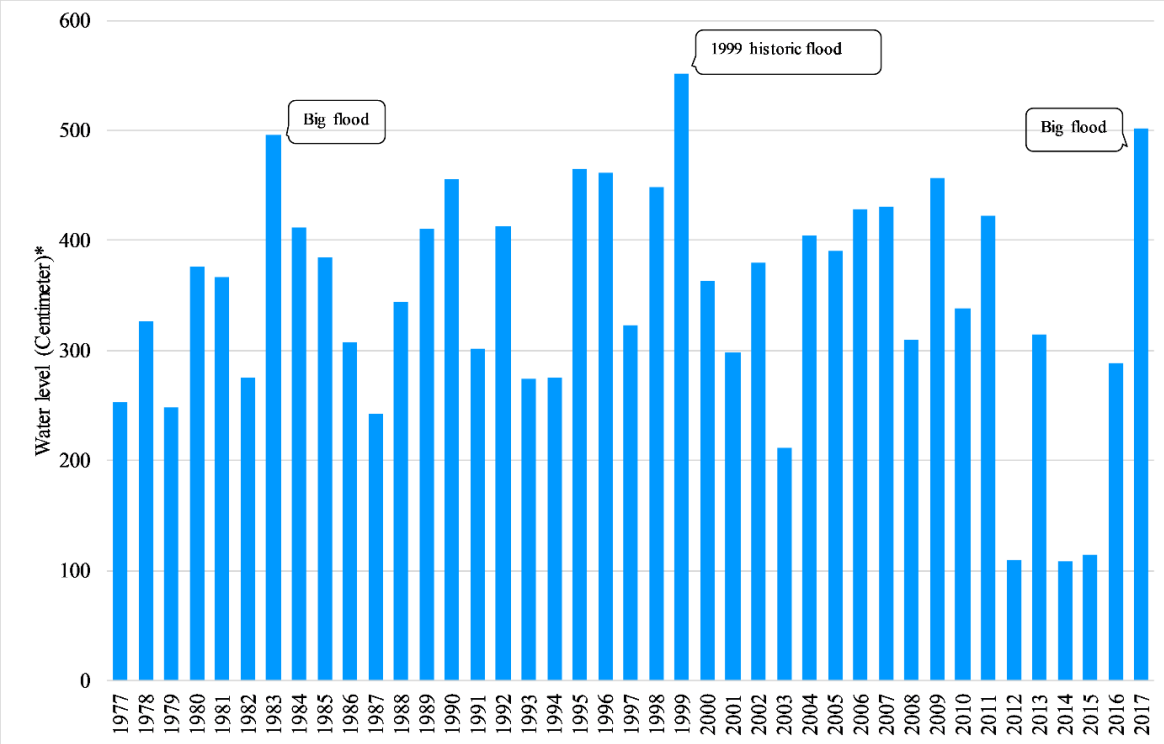
intensity during this time can destroy houses, assets, and belongings, which may sometimes be more valuable than crops. These floods often befall suddenly, and therefore put locals in danger as they have insufficient time to implement necessary precautions. Summer floods, meanwhile, are considered dangerous for agriculture-related livelihoods because they occur during the farming season.

The vulnerability to floods of Thua Thien Hue Province has been clarified through past events. In the period between 1801 and 1888, this area was severely kicked by about 40 severe floods. Heavy rainstorms and high floods also befell in September 1953 and October 1975. Major events have also continued to hit this area in recent years. Indeed, the major floods of 1983, 1989, 1999, and 2017 exceeded the level III flood alert level, which represents very dangerous conditions. In November 1999, the worst floods in a century occurred in central Vietnam including Thua Thien Hue. It is estimated that about 90% of the lowlands were flooded, of which many areas were inundated from 2 to 3 meters deep. The water level in the Huong river measured at Kim Long station reached 5.81 meters above the mean sea level, causing heavy inundation of most of the Province's coastal area. About 630,000 houses were destroyed or damaged. Floods lasted a week killed at least 547 people, left dozens missing, and caused tangible damage of approximately 200 million USD (Berchum et al. 2014; Valeriano et al. 2009).

The government has developed a disaster relief plan and constructed a number of structural works to prevent floods. Among them, constructing two enormous reservoirs named Ta Trach and Binh Dien in Thua Thien Hue Province is one of the dominant protective measures. However, big floods still occur frequently as the November 2017 flood. This flood occurred following severe storm No. 12 called Damrey. Heavy rains induced by this storm's circulation in combination with the water releasing from reservoirs and dams caused a big flood with the flood peak equivalent to the historical one in 1999.

Most recently in 2020, several consecutively major floods occurred in the central area of Vietnam, including Thua Thien Hue Province. The first flood, occurring from 6 to 13 October, severely affected central provinces in both infrastructure and human life. The second flood took place on October 16. In the central region, there was a new tropical depression that was in the process of turning into a storm, accompanied by cold air causing widespread flooding. The flood peak surpassed that in 1979 and 1999 events in some hydrological stations to set a new record of flood peak. The third flood occurred on October 25. This flood, coupled with the devastation of Hurricane Molave on 28 and 29,

caused enormous damage. The fourth flood that happened on November 6 induced upheaval in the whole central region. The 2020 flood in the central region is considered a new historic flood, reached alarming level IV (extremely dangerous natural disaster level), caused far-reaching impacts and damage in the entire region.



** Flood peaks measured at Kim Long station*

Figure 2: Flood peaks in the period 1977-2017

Source: Thua Thien Hue Provincial People's Committee

Flood history and its associated damages have demonstrated the vulnerability to flooding of central provinces. Local authorities and households, after enduring numerous continuous events and suffering heavy damage, may have improved their precautions to mitigate, cope with flood, and recover from flood more effectively. Thua Thien Hue Province, one of the most affected ones in central Vietnam, was chosen to consider the effects of flooding on individual households, the improvement in preventive measures by local authorities and households, the effectiveness of these measures, as well as the contribution of different actors in the households' post-flood recovery. Huong Tra and Quang Dien districts were selected for the survey because they well met our research objectives. Details on site selection will be clarified in the next chapters.

1.5. Dissertation structure

This dissertation is structured into 7 Chapters. These chapters' contents are briefly described as follows:

The content of **Chapter 1** first highlights the increasing trend of natural disasters and flood-related calamities globally and in particular in Vietnam. The associated damages caused by natural disasters and floods are also reflected to underscore the importance of risk reduction activities. This chapter also summarizes the existing literature related to the research topic that the author is interested in, thereby suggesting the knowledge gaps that need to be filled. Through that, the author determines the research objectives of this dissertation. Research methods and justifications for research site selection are also concisely presented in this chapter.

Chapter 2 briefly provides readers with an overview of the legal and institutional frameworks for Flood Risk Management and Mitigation in Vietnam. Some limitations related to these frameworks are also discussed.

Chapter 3 focus on establishing the theoretical framework, which plays as a basis for the process of analyzing case studies in this dissertation.

The centers of this dissertation are displayed in **Chapters 4** and **Chapter 5** through two case studies in Thua Thien Hue Province, central Vietnam. **Chapter 4** first looks at the long-term improvement in flood prevention measures. Local actors, including local governments and households, are considered in this research as they are important and inseparable components of the integrated flood risk management strategy. The level of improvement and their risk reduction effectiveness will be examined through a comparison of protective measure implementation and associated damages between the 1999 and 2017 floods. Besides, we also examine the relationship between the level of improvement of preventive measures and household characteristics in both rural and suburban areas to identify the most vulnerable groups in each area as well as their associated constraints. **Chapter 5**, meanwhile, concentrates on the post-flood recovery process of rural households. In the first half of the chapter, we examine the influence of household socio-economic and demographic characteristics, and social connection on their post-flood recovery speed. In the remainder, we examine the contribution of different social connections to each recovery sub-phases, including immediately after the flood, in the

short term, and the long term. This subdivision is meaningful in portraying the dynamics of social connection in the recovery process of households.

The entire space of **Chapter 6** is dedicated to discussing the results achieved through Chapters 4 and Chapter 5 with relevant existing documents, and from there conceptualizing findings achieved. **Chapter 7**, meanwhile, summarizes the main results of the dissertation.

CHAPTER 2: LEGAL AND INSTITUTIONAL FRAMEWORKS FOR FLOOD RISK MANAGEMENT IN VIETNAM

2.1. Legal Framework

Vietnam is recognized as one of the most disaster-prone countries in the Asia Pacific Region. Over the last 30 years, disasters have been a major contributor to fatalities, injury and economic losses totaling about 1.0 – 1.5% GDP. Flooding, as a dominant natural hazard, is a main cause of economic losses and casualties annually (Luu, Von Meding, and Kanjanabootra 2017b). With a coastline of 3,200 km conjoined with the high concentration of population (70%) and assets in the river basins and low-lying areas, the country has been exposing to many hydrological-related dangers such as sea level rise (SLR), high tides, storms, and river and coastal flooding (Bangalore, Smith, and Veldkamp 2019). Among them, floods and storm are the most frequent disasters (floods: 42%; storm: 52% of the total number of disasters) in Vietnam that caused 92% of the total affected people (flood: 33%; storm: 59%), 98% of total deaths (floods 30%; storm: 68%), and 92% of estimated cost (flood: 42%; storm: 50%). Floods and storm are the most notable disasters in Vietnam (AHA CENTRE 2015). These hazards are expected to be worsened by climate change and the impact of any change in hazard levels could be particularly acute in this region (Bangalore, Smith, and Veldkamp 2016). Rapid population growth, industrialization progress, and agricultural expansion in recent years have raised flood vulnerability, especially in riverine and coastal areas in Vietnam (Tran, Marincioni, et al. 2008). According to World Bank estimates, about 930,000 people in the country are currently at high risk of flooding, with total annual flood damage of about 2.6 billion USD (World Bank 2018).

The country is exposed to many different flood types such as river floods, flash floods, pluvial floods (surface floods occurring in urban areas) and coastal floods caused by tides, typhoons, and storm surges. In southern Vietnam, river flooding is most common due to slowly rise and fall of river levels, tidal influence, or sometimes a combination of both (Dang and Kumar 2017; Triet et al. 2018). The mountainous areas of the Northwest and Northeast of Vietnam, located in the tropical cyclone zone, suffer from extreme rainfall accompanied by storms, often leading to devastating flash floods as well as accompanying landslides (Bui et al. 2019). In Central Vietnam, river floods with high flow intensity and rapidly rising water levels following torrential rains can be disastrous (Casse, Milhøj, and Nguyen 2015). With rapid urbanization since Doi Moi in 1986, flood risk has

also increased in peri-urban and urban areas. This trend is exacerbated by population growth, economic development, and the expansion of buildings and infrastructure into flood-prone areas (Huong and Pathirana 2013).

This reality has made FRM to be one of the country's important goals as articulated in national-level policies. However, flood and Disaster Risk Reduction (DRR) laws and regulations in Vietnam remain diverse and expanded on a variety of regularly updated instruments. The Law on Natural Disaster Prevention and Control 2013 (effective on May 2014) is the first law on disasters in Vietnam rationalized this by bringing more areas of DRR regulation into one common law that provides the core elements of the country's disaster management system. The law was developed during the period 2010 to 2012 with the support of Ministry of Agriculture and Rural Development (MARD). The DRM Law maintains existing good practices and addresses a several gaps in the prior legislative framework for DRM. The main driving force behind the development of the DRM Law was to bring together the main elements of the disaster response and risk management system in Viet Nam, which was based on a range of different instruments. Focusing on natural hazards, the DRM Law provides, among other things, for:

- The establishment of a Central Steering Committee for Natural Disaster Prevention and Control (CSCNDPC) with a broader mandate than the current standing Central Committee of Flood and Storm Control (CCFSC)

- The expansion of early warning to other hazards and to mountain areas

- The zoning of natural hazards and references to resilient constructions

- DRR public awareness-raising and mainstreaming of DRR into school systems and socio-economic and sectoral development

- The construction of dual-purpose public buildings that can serve as shelter during evacuations

- Rights and obligations of individuals with respect to DRM

- And policies to offer incentives and promote the use of insurance to recover from natural disaster losses

According to the law, disaster management activities consist of prevention, response, and remediation of consequences. Although dispersed, and despite some gaps

such as inadequate focus on mitigation efforts, this legal framework has played a key role in Vietnam's remarkable achievements in the area of DRR. This law, for instance, reinforces the role of the Ministry of Education and Training (MOET) in integrating disaster risk knowledge into curricula at all levels of education, which has prospects for the future. Also, early warning legislation with clear responsibilities for different government agencies has contributed significantly to reducing storm and flood risks in coastal and delta areas. Besides, the law provides basic grounds regarding the compensation of individuals and households damaged by natural disasters, acting as a form of public insurance against disasters. The liability of government officials in disaster risk management (DRM) is included in the law, although sanctions are rarely applied in practices.

Besides, Disaster Risk Reduction (DRR) objectives are also featured in other related national level decrees such as: the National Strategy for Natural Disaster Prevention, Response, Mitigation until 2030 (issued in 2019), the National Target Program to Respond to Climate Change and Green Growth for the period 2016-2020 (issued in 2017), the National Climate Change Strategy (issued in 2011), Statutes on Dike Management, and Flood and Typhoon Mitigation such as Dike Management Law (issued in 2006), and the National Action Plan on Climate Change for the period 2012-2020 (issued in 2012). Other laws, though seemingly unrelated to DRR, also regulate DRR area in some perspectives. The Law on Construction (issued in 2014, updated in 2020) requires permits for construction in urban areas presenting an opportunity for authorities to ensure resistance to floods, storms, and earthquakes. However, the Ministry of Construction (MOC) does not have the capacity at the local level to conduct inspections of all construction works once they are licensed, so cannot always guarantee compliance with building codes. These codes also require detailed flood hazard maps from local authorities, which are not usually available in Vietnam. For example, the 2003 Land Law provides an opportunity to exploit land-use planning as a tool for DRR. However, the law to date has not been systematically implemented to support DRR partly because it does not require disaster mitigation to be included in land use planning at all levels. The current Environmental Protection Law (issued in 2020) also does not explicitly invoke DRR or require the inclusion of DRR in environmental impact assessments, so there is an opportunity to enhance the regulatory framework on this issue. Some challenges include MARD's limited resources (Ministry of Agriculture and Rural Development) to effectively implement the Forest Law, especially to protect mangroves. However, other policies, such as the Climate Change Strategy, make

DRR a core activity. Besides national-level regulations, provincial governments are also obliged to develop and implement local action plans to respond to climate change. Accordingly, information on risk assessment and management, as well as the causes and responses to flood risks, is important for providing information on adaptation and mitigation planning.

In general, the combination of the above-mentioned laws and decrees, though remain some gaps, have created a strict legal framework for achievements in disaster management in general, and flood risk management and mitigation in particular in Vietnam. Many effective DRR mechanisms in Viet Nam are supported by legal frameworks updated and developed over time, which detail the institutional framework, implementation methods, allocation of financial resources, and clearly defined roles and responsibilities of stakeholders. These laws and decrees have been concretized by many concrete measures in practice. The increased construction of reservoirs, dams, breakwaters, river embankments and other types of structural measures are clear examples of the government's efforts to reduce flood risks. Vietnam has built about 9,080km of dikes of all kinds (5,547km of river dikes; 1,343km of estuary dikes; 1,150km of sea dikes). Of which, there are about 2,727km of dikes classified from grade III to special grade. Additionally, according to the Committee on Science, Technology and Environment, Vietnam currently has about 7,000 irrigation reservoirs and hydropower dams in operation, significantly contributing to economic development as well as reducing flood magnitude and frequency. These structural works, however, also show certain limitations in practice as they were sometimes incapable to prevent flood water. This, combined with inadequate regulation of reservoirs and dams, can lead to major flood events. The major floods that occurred in central Vietnam in 1999, 2017, and most recently in 2020 demonstrated the limitations of these structural measures. These structural works, however, also show certain limitations in practice as they were sometimes incapable to prevent flood water. This, combined with inadequate regulation of reservoirs and dams, can lead to major flood events. The major floods that occurred in central Vietnam in 1999, 2017, and most recently in 2020 demonstrated the limitations of these structural measures. In addition, excessive dependence on structural measures at the national level may also lead to certain subjectivity, which reduces the incentive to implement protective measures at the local government and household levels. In addition, being regulated by different laws and

decrees can also cause overlaps in responsibility, enforcement among stakeholders, and potential lead to contractionary between decrees and policies.

2.2. Institutional framework

The institutional framework defines the positions and relationships of organizations and agencies responsible for disaster risk reduction. It identifies the reporting structure among organizations and institutions and establishes a mechanism for the coordination and implementation of tasks.

Government is a key part of the framework, but all stakeholders have their own role in planning, supporting, or implementing disaster risk reduction actions. The institutional framework is implemented through the Central Committee for Flood and Storm Control (CCFSC), which plays a central role in the coordination and mobilization of resources in case of floods or storms are forecast. The Constitution of Vietnam stipulates four administrative levels including national, provincial, district and commune. With committees established at national, provincial, district, and commune levels, this system provides an institutional framework, through which early warning information is routed to communities. At the provincial level, the organizational structure of disaster management is consistent with the national level. According to the DRM Law, each province is required to establish a Steering Committee for Flood and Storm Control (CFSC), headed by the Chairman of the People's Committee, and supported by representatives of relevant departments. Vietnam, at this level, is divided into 58 provinces and 5 municipalities, so there is a total of 63 CFSCs. Most activities of provincial CFSCs focus on setting up plans for disaster preparedness, response, and recovery. Each province includes many districts, and each district consists of many communes. Similar to the provincial level, a Steering committee for Natural Disaster Prevention and Control is also established at each district and commune but on a smaller scale and managed through the administrative hierarchy.

Figure 3 indicates that the institutional framework for FRM in Vietnam requires the involvement of the entire political system. However, this is obviously a top-down approach that highlights the responsibilities of various government agencies. Besides its advantages, limitations of this approach such as leading to unfair and unsustainable outcomes in disaster risk management have also been demonstrated (Luu, Von Meding, and Kanjanabootra 2018). Therefore, the combination of both top-down and bottom-up approaches that enables the participation of all stakeholders and ensures fairness should be

seen as an ideal model. Stakeholders here may include locals, government agencies, emergency management agencies, local authorities, NGOs, the media, and social scientists. Indeed, since the hierarchical structure of the administrative system reveals limitations in risk management, there is a transition underway to more resilient approaches such as bottom-up initiatives (Zevenbergen et al. 2008) and community-based systems (Aalst, Cannon, and Burton 2008). In such approaches, precautions implemented by local actors such as local authorities and private households are highly encouraged (Duc, Tanaka, and Kobayashi 2012; Chinh et al. 2016; Atreya et al. 2017; Luu, Von Meding, and Kanjanabootra 2018). For instance, Luu et al. (2018) suggested that since communes have a deeper understanding of their local conditions, empowering them in the planning and decision-making processes is necessary to improve the effectiveness of flood risk management activities. Duc et al. (2012), meanwhile, further underlined the crucial role of preventive measures at the household level in mitigating the adverse effects of natural hazard-related disasters. The institutional framework for FRM in Vietnam reveals that public administrations are wholly responsible for FRM activities. People's Committees at local levels from provincial to commune play a crucial role in implementing risk prevention and reduction activities. FRM follows the top-down hierarchy of the political system, where specific directives come from the upper levels. The decision-makers on the steering committees are government officials, who often have no expertise in disaster management (Luu, Von Meding, and Kanjanabootra 2018). It is obvious that the lack of consultation with experts, researchers, and scientists can affect the rationality of the decision-making output. Steering committees, besides direct their activities towards the administrative direction, should also refer to related mitigation and preparedness studies. The responsibility of the public administration in FRM alone seems insufficient because effective decision-making also requires a combination of the latest scientific knowledge and a deep sensitivity to the local context too. In addition, the limitations in decentralization and financial allocation to localities are also major barriers affecting the proactive and timely decision-making related to flood risk reduction (Garschagen 2016).

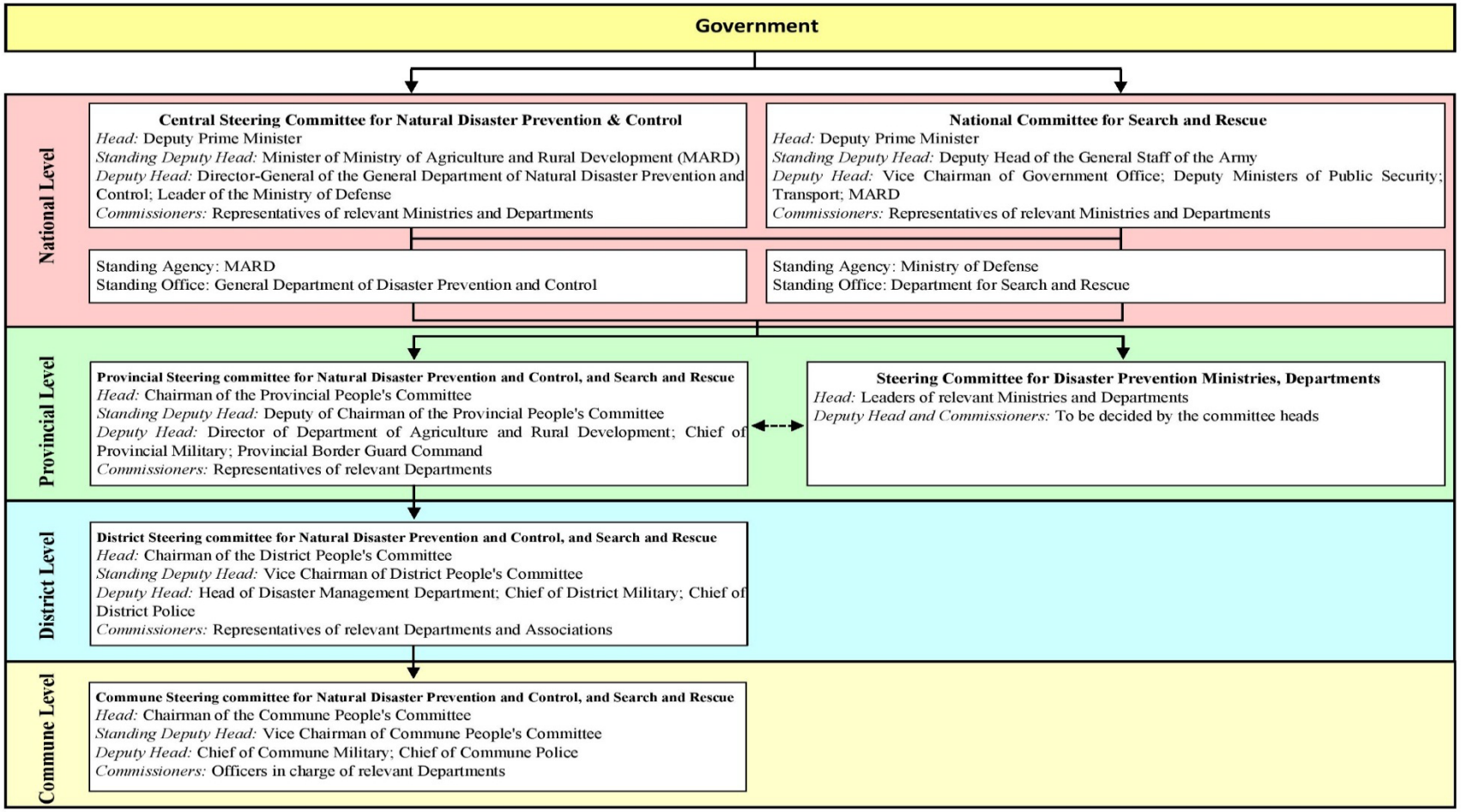


Figure 3: Legal and Institutional Frameworks for Flood Risk Management and Mitigation in Vietnam

Source: Vietnam Disaster Management Authority (http://phongchongthientai.mard.gov.vn/Pages/so-do-chung.aspx)

CHAPTER 3: THEORETICAL FRAMEWORK

3.1. Reviews of related theories

In the previous chapter, some potential limitations in the government's top-down approach have been indicated. A question raised is that whether these limitations can be overcome through the bottom-up approach? Therefore, in this chapter, we aim to establish a theoretical framework to examine the effectiveness of the bottom-up approach in practice based on the objectives presented in chapter 1.

A theoretical framework is a conceptual model of how one theorizes or makes logical sense of the relationships among several factors that have been identified as important to the problem (Sekaran 2000). In essence, it attempts to integrate key pieces of information especially variables in a logical manner, and thereby conceptualizes a problem that can be tested.

Our literature review has shown a number of factors affecting households' preparedness as follows: critical awareness (Lindell and Prater 2000; Douglas Paton 2003; McIvor and Paton 2007), risk perception (Armaş and Avram 2008; Jackson 1981; Miceli et al. 2008), preparedness perception (Lindell and Whitney 2000; Mulilis and Duval 1995), self-efficacy (Lindell and Whitney 2000; Duval and Mulilis 1999; McClure, Walkey, and Allen 1999), collective efficacy (Douglas Paton et al. 2010), fatalism (Miceli, Sotgiu, and Settanni 2008; Flynn et al. 1999), anxiety (Douglas Paton 2003; Ronan et al. 2008), previous disaster experience (Jackson 1981; Miceli, Sotgiu, and Settanni 2008), societal norms (Solberg et al. 2010), community participation and empowerment (D Paton et al. 2006), optimistic and normalization biases (Mileti and O'Brien 1992), social trust (Douglas Paton 2007), perceived responsibility (Mulilis and Duval 1995), , and available resources (Mileti 1995). Through this process, several theories that can be employed to examine households' capacity and behaviors toward implementing protective measures and actions were also revealed. They include Theory of Assets, Protection Motivation Theory (PMT), Person Relative to Event Theory (PrE), Protective Action Decision Model (PADM), Social-Cognitive Preparation Model, Social Capital Theory, and Theory of Planned Behavior (TPB).

Reviewing published documents was also helpful for us to understand factors driving the post-disaster recovery of households and communities. They include physical items or economic value lost (Kurosaki et al. 2012; Bubeck and Thieken 2018; Sadri et al.

2018), demographic characteristics (Kurosaki et al. 2012; Francisco 2014; Himes-Cornell et al. 2018; Sadri et al. 2018), income/financial capital (Francisco 2014; Himes-Cornell et al. 2018), Social capital/Social connection (Masud-All-Kamal and Hassan 2018; Casagrande, McLlvaine-Newsad, and Jones 2015; Van Krieken and Pathirage 2019; Aldrich 2012a), post-disaster decision-making (Platt 2018), political capital (Himes-Cornell et al. 2018), and building capacity (Van Krieken and Pathirage 2019). We also identified several theories that are relevant to examine households' recovery process including Theory of Assets, Social Capital Theory, Social Networking Theory, Social Support Theory, Theory of Reciprocity, The Theory of Planned Behavior, and Emergency Management Theory.

The above-mentioned theories, in general, comprehensively reflect the key factors that may affect/drive households' flood preparedness and recovery process. Each theory has its own approach to problems. However, there are certain overlaps in evaluation criteria between some theories. For example, the Protection Motivation Theory (PMT) and Theory of Planned Behavior (TPB) both include indicators related to perception and attitude towards threats, and the perception towards self-efficacy in implementing protective measures. Social Capital Theory and Social Networking Theory both focus on analyzing the interrelationships between actors in the network. The Theory of Assets, meanwhile, also covers indicators related to social assets, which is the key focus of the Social Capital Theory. Through the review process, theories best suited to our research in terms of generality, appropriateness, ease of application, and power of explanation have been chosen to create an academic context for the research as well as to underpin the analytical process. They include Theory of Assets and Protection Motivation Theory. Details on these theories are discussed in the next subsections.

3.1.1. Theory of Assets

The concept of the asset-based approach has commonly been discussed and applied in research topics related to resource management, community development, poverty, health, social risk, and natural disaster (Curtis and Lefroy 2010; Harrison et al. 2019; Siegel and Alwang 1999; Zhang, Zhao, and Pedersen 2020). Though there is no specific definition, most literature agrees that this approach underlines the fact that individuals, households, and communities control their lives with their own strengths, capabilities, and possessions.

The asset-based approach was initially developed to estimate structural poverty reduction interventions and livelihoods (Moser 1998). It was then applied to examine household vulnerability to disasters. This is also called the sustainable livelihoods framework, which views people's capacities as livelihood assets (Siegel and Alwang 1999). The more assets people have, the less vulnerable they are. And the greater the erosion of their assets, the greater their insecurity (Moser 1998). The assets framework has numerous benefits, including its incorporation of numerous aspects of these two concepts (assets and capitals). Modeling the effect of various capitals on household vulnerability helps policymakers to target and guide a recovery effort more efficiently. (Zhang, Zhao, and Pedersen 2020).

An asset can be seen as a stock of financial, human, natural, or social resources that can be acquired, developed, improved, and transferred across generations. It generates flows or consumption, as well as additional stock (Ford Foundation 2004). Assets can be tangible, such as real estate, houses, savings, jewelry, high education level, and special skills, or intangible such as social capital, proximity to markets, medical, and education facilities. The economic literature emphasizes productive tangible assets as they generate financial returns. Sociologists and anthropologists, meanwhile, often focus on intangible assets. However, there is a growing consensus that both tangible and intangible assets, and their interplay, are important in the context of risk management of vulnerable households (Siegel and Alwang 1999).

The assets framework was adapted from the Sustainable Livelihood Framework (DFID 1999). Assets can be classified in several ways based on the purpose and topic of research. In sociological research, however, assets are often classified into five groups, including natural, physical, financial, human, and social assets (Moser 2006; Grootaert and Bastelaer 2001).

Natural assets: are the stock of natural resources, which includes geology, soils, air, water, and all living organisms. Some natural capital assets provide people with free goods and services, often called ecosystem services.

Physical assets: is an item of economic, commercial, or exchange value that has a material existence, such as housing, land, machines, furniture, jewelry.

Financial assets: are diverse, but more commonly cash, savings, loans and gifts, regular remittances or wages, as well other financial instruments.

Human assets: are a measure of an individual's skills, education, competencies, and attributes that affect their productivity and earning potential.

Social assets: are a network of relationships between people living and working in a particular society, enabling that society to function effectively. It involves the effective functioning of social groups through interpersonal relationships, a common sense of identity, shared understanding, shared norms, shared values, trust, cooperation, and reciprocity.

Specifically, each category of assets has specific significance to households in different aspects. Natural assets, in addition to diminishing households' environmental stress, provide the necessary resources for the physical assets (for example, providing water for irrigation or through the pasture provide fodder for livestock). Physical assets can be pawned or mortgaged to be income or productive assets in times of need. Financial assets are indispensable for smooth consumption. They can be invested in various ways to enhance household income or use in urgent cases such as re-establishing livelihoods repairing houses after being affected by floods. Human assets form the basis for labor mobilization, a key strategy for coping with shocks and stress events. Social assets are a critical source of financial and non-financial support in times of need. Depletion of assets in a certain category may lead to a corresponding impact on the associated vulnerability.

3.1.2. Protection Motivation Theory

Protection Motivation Theory (PMT) is useful for discussing different aspects driving the self-protection behavior of households living in flood-prone areas in the long term.

PMT was founded by R.W. Rogers in 1975 to better understand the gravity of fear and how people deal with them. However, the theory was later expanded in 1983 by himself to be a more general theory of persuasive communication (Rogers 1983). The theory was originally based on the work of Richard Lazarus, who spent much of his time studying how people behave and cope in stressful situations. In his book entitled *Stress and coping: An anthology*, Richard Lazarus discusses the idea of the cognitive appraisal processes and how they relate to coping with stress. He showed that people differ in their sensitivity and vulnerability to certain types of events, as well as in their interpretations and responses (Monat and Lazarus 1991).

This theory was formerly developed for the health promotion and disease prevention field and illustrates how individuals are prompted to respond protectively

towards a perceived threat. The objective of PMT is to recognize and assess the danger, and then counteract this assessment with suitable and efficacious mitigation options. PMT, therefore, can be applicable to different social problems. In other words, the protection motivation concept can be applied to any threat that affected individuals can undertake suggested responses effectively (Floyd, Prentice-Dunn, and Rogers 2000). In fact, PMT was later employed beyond health-related issues such as injury prevention, political issues, environmental concern, and even disaster risk mitigation (Floyd, Prentice-Dunn, and Rogers 2000; Westcott et al. 2017; Tang and Feng 2018; Babcicky and Seebauer 2019; Grothmann and Reusswig 2006). This theory has first been applied in the field of flood preparedness in Cologne, Germany to observe the behaviors of the private households concerning the implementation of flood precautionary measures. The research aimed to address both physical and psychological barriers in implementing flood precautions (Grothmann & Reusswig, 2006). To conduct this research, Grothmann & Reusswig (2006) developed the initial model of Rogers (1983) by including the "threat experience appraisal" and "reliance on public protection".

The following are the details of the PMT after being developed by Grothmann & Reusswig (2006).

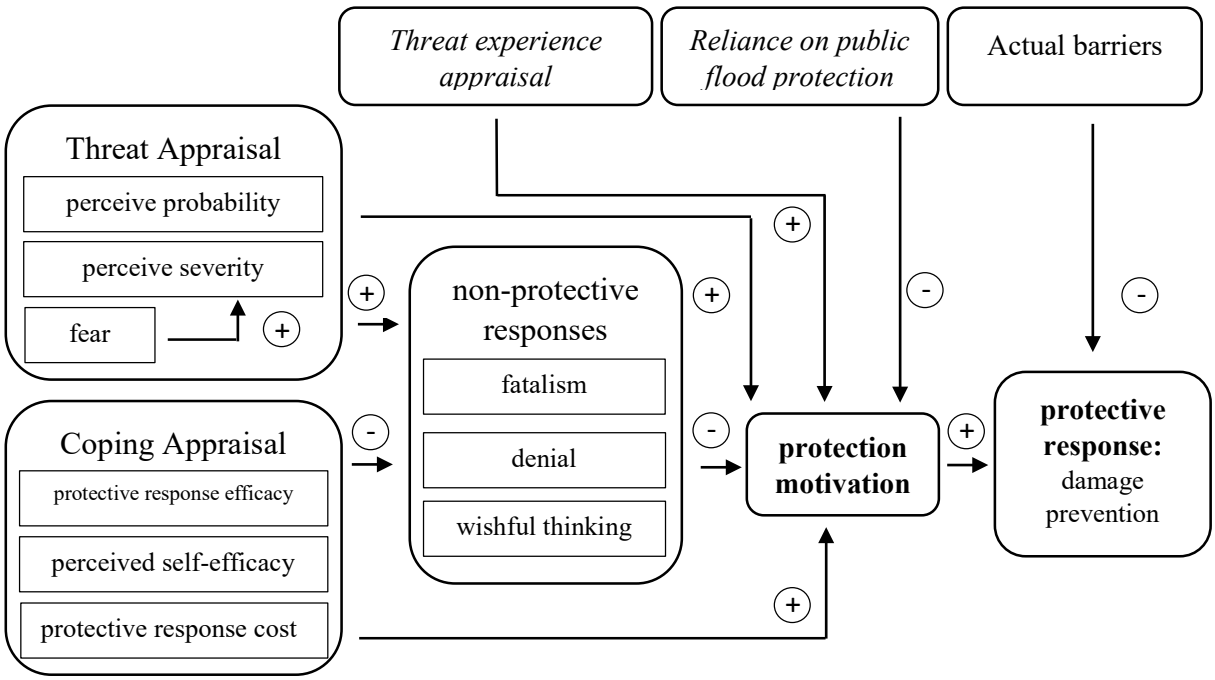


Figure 4: Protection Motivation Theory

Source: Grothmann & Reusswig (2006)

The first component of the PMT is "threat appraisal" (also known as risk perception), which describes how people assess a threat probability and its potential damage. The second category is "coping appraisal", which refers to how people estimate their own ability to respond to threats to avert being harmed, along with associated implementation costs. Threat appraisal is composed of three sub-components. Firstly, the "perceived probability" is the person's expectation of being threatened, such as by flooding. Second, the perceived severity is a person's estimate of how dangerous a threat's consequence is to things they value if a threat actually occurs (e.g., the judgment that a flood in the area will damage value things, such as home or belongings). Fear, the third component, plays an indirect role in threat appraisal by affecting the estimate of the severity of the danger.

The coping appraisal takes place directly after the threat appraisal process and is only being implemented if a specific threshold of threat appraisal is passed. The coping appraisal comprises three sub-components. First, it includes perceived protective response efficacy of people, the belief that protective actions will in fact be effective to protect them from being harmed by the threat. The second component is perceived self-efficacy which refers to the perceived actual ability to perform or carry out these protective responses of individuals. The third component, perceived protective response costs, is the assumed cost of taking the preventive response, including both monetary cost, time, and effort factors.

Protective responses are measures intended to prevent monetary or physical damage in the event of an actual event occurring and are taken if the threat appraisal and coping appraisal are high. Non-protective responses including denial of the threat, wishful thinking, and fatalism do not prevent monetary or physical damage, but only the negative emotional consequences of the perceived risk, such as fear. People would perform a non-protective response if their threat appraisal is high, but their coping appraisal is low. In contrast, in the case of choosing the protective response, people first form a decision or intention to take action, labeled protection motivation. Protection motivation does not necessarily lead to actual behavior due to actual barriers, such as a lack of resources like time, money, knowledge, or social support, not expected at the time of intention forming. The issue of actual barriers in the theory means circumstances that act as a barrier towards achieving a protective response goal. These are barriers that were not foreseen in the motivational stage of a protective response and can be either one of the aspects such as costs, knowledge, and physical capabilities.

Compared with the original Rogers model (Rogers 1983), Grothmann & Reusswig (2006) extended the PMT by including several additional indicators specific to precautionary flood damage prevention. One is "threat experience appraisal" which assesses the severity of a threat experienced in the past. Threat experience appraisal is expected to motivate people to take protective measures. The second one is "reliance on public flood protection". Private damage prevention by households will be redundant if public agencies successfully build levees to prevent floodwaters from reaching people's doorsteps; if the residents at risk rely on the efficacy of the public or administrative flood protection, they will probably take less precautionary action themselves.

3.2. General theoretical framework of this dissertation

By examining the selected theories in connection with research subjects, the general theoretical framework can be formulated as shown in Figure 5.

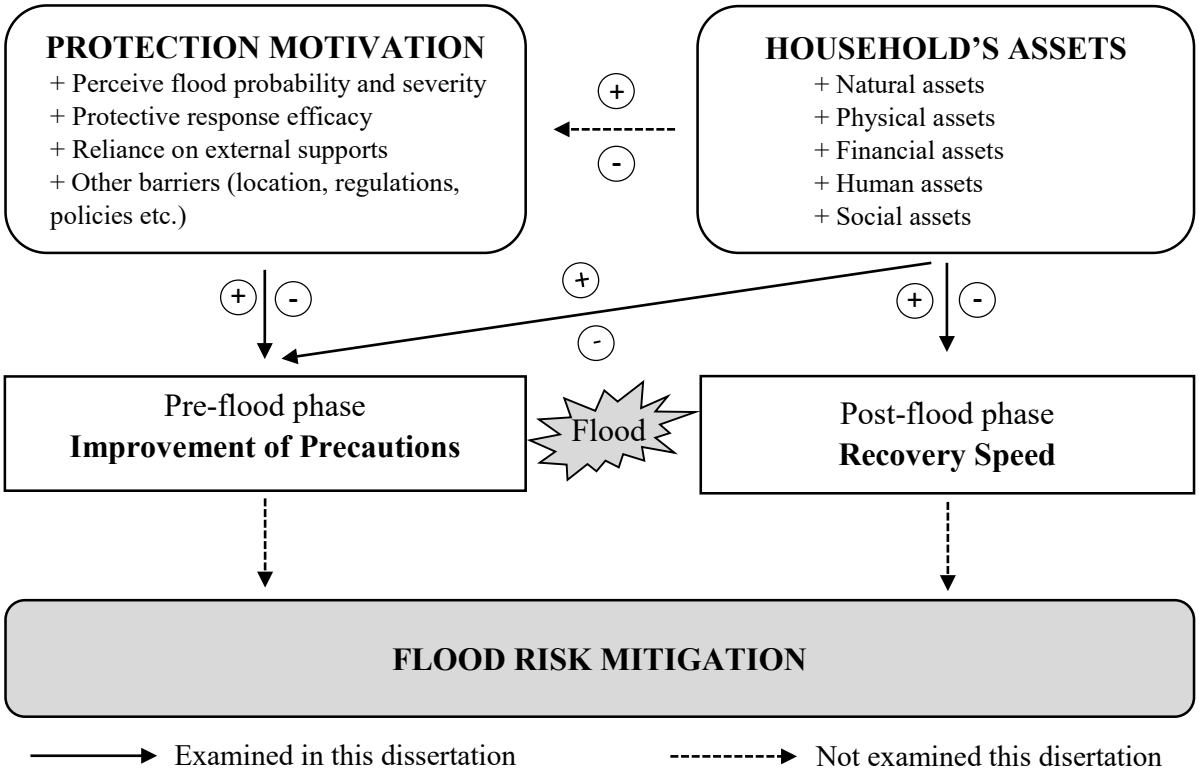


Figure 5: General Theoretical Framework

Source: Author

To achieve the goal of "Flood Risk Mitigation", this dissertation focuses on examining two specific topics in different flood phases: (1) the improvement of precautions before floods, and (2) the recovery speed after floods. Each topic is examined

in each different case study in Thua Thien Hue Province, central Vietnam. As shown in Fugure 5, the Theory of Assets are used to examine households' recovery process. Post-flood recovery speed is considered in relation to the types of assets of households. Household advantages in each type of asset are expected to speed up the recovery process after floods. Meanwhile, in addition to applying the theoretical basis as used in the post-flood recovery phase, households' pre-flood preparedness is further analyzed based on the Protection Motivation Theory. The impact of the key factors in these two theories on the improvement of protective measures is considered both positively and negatively. It should be noted that, due to the wide coverage of the above theories, only some of their components/elements are included in the analysis and interpretation. Additionally, these elements are examined either directly or indirectly in relation to the study subjects.

CHAPTER 4: LONG-TERM IMPROVEMENT IN PRECAUTIONS FOR FLOOD RISK MITIGATION: A CASE STUDY IN THE LOW-LYING AREA OF CENTRAL VIETNAM

4.1. Introduction

It is widely recognized that natural hazard-related disasters have been steadily increasing across the planet over the last several decades (IPCC 2014). Notably, the frequency of floods has accelerated faster than any other type of disaster, leading to a tripling of major flood-related calamities since the 1980s (ADB 2013). Asia is the most disaster-afflicted region, accounting for nearly 62% of those who have experienced disasters and bearing approximately 70% of the total deaths and 50% of the world's disaster-related economic losses (ADRC 2016). Of these, floods consisted of 31% of the total number of disasters, followed by 28% for cyclones and typhoons. Therefore, hydrometeorological-related disasters are seen as the most prominent in Asia (Shaw 2006).

Being considerably susceptible to climate change, Vietnam was ranked the eighth among 10 countries in the world most harshly influenced by extreme weather events in the last two decades (Kreft et al. 2016; Nguyen Duc et al. 2019) and was also listed as one of five countries with the highest population proportion exposed to river-flood risks worldwide (Luo et al. 2015). Over the past 20 years, natural hazards and disasters have resulted in 650 deaths, affected 340,000 ha of paddy fields, and destroyed 36,000 houses on average each year. The country has lost 1 to 1.5% of its annual gross domestic product (GDP) in the aforementioned period due to natural hazards and disasters, and this significantly hinders the socioeconomic reorganization process (WB 2010).

Over an extended period, conventional approaches to flood control have strongly relied on engineering works such as building dams and reservoirs. These approaches, however, were sometimes incapable of preventing flooding and associated losses (Pilarczyk and Nuoi 2002; Musiake 2003). It might be argued that flood threats continue to lurk regardless of the governments' ongoing efforts toward improving engineering works (Sayers et al. 2015; Chen and Lin 2018). This fact also implies the importance of being prepared to deal proactively with unforeseen events instead of putting full faith in the structural works.

Shifting from a purely technical-oriented defense toward a more integrated flood risk management system has been recommended in various countries (Hartmann and

Albrecht 2014). In Vietnam, the responsibility of local authorities and households in alleviating flood distress has been embedded into the national strategy for disaster prevention. It was further emphasized, especially after fateful disasters such as the 1999 historic flood in Thua Thien Hue Province, which flooded 90% of lowland areas in a week, and induced up to USD 120 million tangible losses (Tran and Shaw 2007).

Since the hierarchical structure of the administrative system reveals limitations in risk management, there is a transition underway to more resilient approaches such as bottom-up initiatives (Zevenbergen et al. 2008) and community-based systems (Aalst et al. 2008). In such approaches, precautions implemented by local actors such as local authorities and private households are highly encouraged (Duc et al. 2012; Chinh et al. 2016; Atreya et al. 2017; Luu et al. 2018). In Vietnam, for instance, Luu et al. (2018) suggested that since communes have a deeper understanding of their local conditions, empowering them in the planning and decision-making processes is necessary to improve the effectiveness of flood risk management activities. Duc et al. (2012), meanwhile, further underlined the crucial role of preventive measures at the household level in mitigating the adverse effects of natural hazard-related disasters.

These aforementioned studies, however, merely looked at the preparedness of the local actors only at the time the survey was conducted, overlooking its progression over time. In addition, there are relatively few empirical studies, especially in central Vietnam, that consider how villagers perceive the changes in flood characteristics, how local authorities and private households have improved precautions over the long term, and how coping capacities differ among social groups. Furthermore, studies examining barrier differences in enhancing protective measures between rural and suburban areas are still rare despite compelling evidence of the link between their socioeconomic disparities and the implementation of precautions.

To fill this gap of knowledge, this study, therefore, aimed to examine the long-term changes in precautionary measures for flood risk mitigation by focusing specifically on: (1) the changes in flood characteristics under the influence of the dam systems and the attitude of floodplain residents toward implementing precautions; (2) the precautions taken by the commune authorities and their effectiveness in supporting flood victims; (3) the long-term improvement in precautions of private households and their efficacy in reducing flood risks; and (4) the differences in coping capacities and constraints of social groups in both rural and suburban areas.

These issues were examined by comparing the two major floods that occurred in 1999 and 2017 in Thua Thien Hue Province, central Vietnam. Since floodwater depth is considered one of the determining factors of the damage extent (Thieken et al. 2005), the comparable water level caused by these two floods is crucial to ensure achieving the objectives of this study. This study may be useful to identify social groups lagging in the struggle against floods and recognize shortcomings in the design and implementation of flood-related policies.

4.2. Study site and methods

Thua Thien Hue Province, located in the north-central coastal region of Vietnam, was selected as the target region of this study based on its geographical features and flood history. A survey of local authorities and private households and quantitative and qualitative methods were used to collect and analyze the data.

4.2.1. Study site

With a 128 km long coastline and interlaced river systems, Thua Thien Hue Province has experienced many hydrometeorology-related hazards, such as floods and storms. It is considered among the most disaster-prone areas of Vietnam (Tran et al. 2008).

Flood-associated losses have trapped many households in the vicious circle of poverty. The 1999 flood was deeply implanted in the minds of many people as a fearful memory, which took hundreds of lives and caused economic losses estimated up to millions of dollars (Valeriano et al. 2009). Flood-related concerns appear to have been somewhat liberated since the construction of massive hydroelectric dams. However, these fears were again triggered by the 2017 major flood, which occurred after storm No. 12 named Damrey with wind speeds up to 135 km per hour. This was the most powerful storm impacting Vietnam since 2001 (UNDP 2018). Hydropower dams in Thua Thien Hue Province, under the influence of heavy rain due to the circulation of storm, had to release water, and thus caused widespread flooding in the downstream area. Although this led to a comparable floodwater depth, the damage was much lower than in the 1999 flood (Figure 6). This outcome may be due to various factors, but highly likely includes the improvement in precautions.

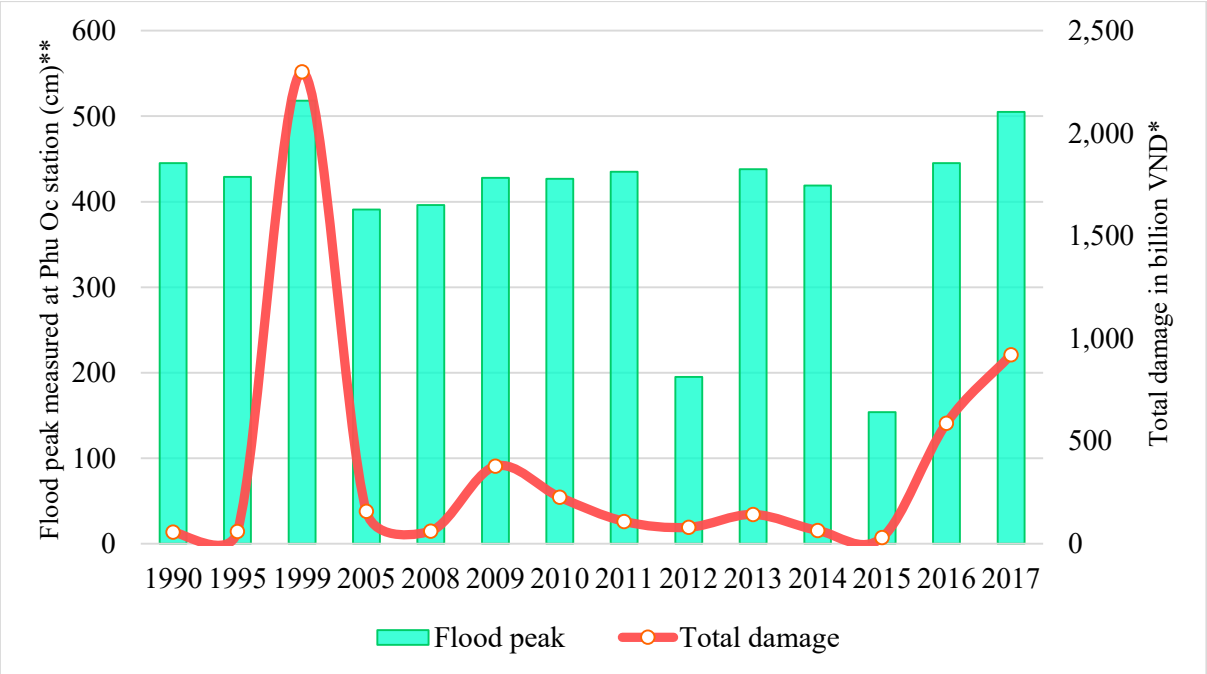


Figure 6: Flood peaks and tangible damages in Thua Thien Hue Province

** 1 USD ≈ 23,184 VND*

*** Phu Oc is a hydrological station located in Huong Tra District*

Source: People's Committee of Thua Thien Hue Province

The villages Trieu Son Nam and Bao Vinh in Huong Vinh Commune, Huong Tra District were selected for the survey (Figure 7). The population of these villages was 1,925 and 2,032, respectively, corresponding to 402 and 515 households. Although drawn from the same commune, the first village represents rural characteristics with more than half of households involved in agriculture, while the second village possesses suburban features where retail and handicrafts are more dominant.

Both villages are located near the intersection of the Huong and Bo Rivers where they merge before emptying into the sea, which causes the currents to be more powerful and dangerous during floods. This terrain, combined with its low-lying topography, makes these villages more susceptible to flood-related hazards. In reality, the communities in this area have suffered heavy losses due to floods, especially in 1999. However, annual reports affirmed a favorable indication that flood-related damages had decreased despite severe floods similar to the 1999 event occurring on occasion. This implies that greater attention was given to flood risk management in this locality.

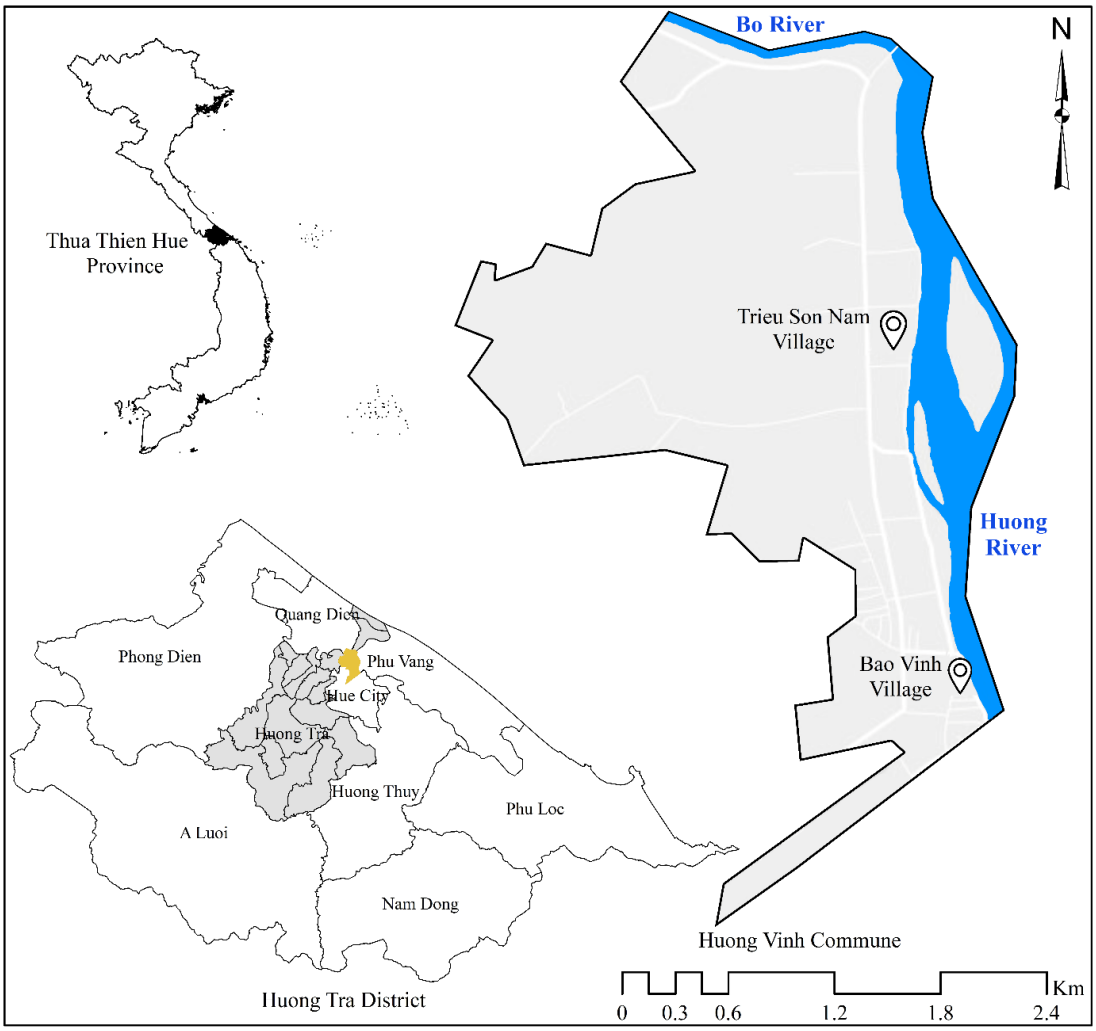


Figure 7: Map of the study site

Source: Authors

This site, therefore, was selected to explore the factors contributing to such achievement. Along with the comparison of rural and suburban villages, which have similar administrative systems but different socioeconomic characteristics, an indication of the limitations of social groups in coping with floods and their actual barriers is presented.

Figure 8: A normal flood in Bao Vinh village

Source: vnexpress.net

4.2.2. Methods

A pilot survey was performed to search for an appropriate study site before conducting the official survey in April and October 2018. The data were gathered from both local authorities and private households.

We obtained data on local socioeconomic characteristics and flood trends from the commune authorities. Flood prevention activities were also explored through direct interviews of those responsible for flood and storm control. These activities were further discussed with the village leaders since they are considered an essential link in the implementation process.

By using the face-to-face interview method, the cross-sectional data of 120 households, divided equally between the two selected villages, were collected. To facilitate the survey, a semi-structured questionnaire was developed after a thorough process of document review in combination with the consultation of specialists who are well-versed in both floods and village life. From the household lists provided by the village leaders, homeowners who met the following requirements were randomly selected for an interview: over 30 years old; experience of both the 1999 and 2017 floods; and direct involvement in the preparation of the flood defenses.

The interviews usually began with information regarding household demographic characteristics, followed by participants' perceptions of changes in flood risks, the potential causes for these changes, and their attitude toward precautions. As the beneficiaries, interviewees were then encouraged to express their views on the reliability of local authority actions, along with explanations for their assessment. Finally, key information on the preparation and damages of both floods was requested to understand the improvements in precautions and their damage-reducing effects.

This study adopted both quantitative comparative and qualitative descriptive approaches. The quantitative data were processed to observe the trends and cohesion between variables, while the qualitative information was used to further interpret the implications.

We first examined residents' perceptions of the changes in flood risks, potential reasons for these changes, and their protection behavior. In addition, preventive activities operated by local authorities and their reliability were revealed through practical experiences of the local people. We then focused on analyzing household measures and their effectiveness in reducing risks. In this study, the 1999 historical flood was seen as a powerful catalyst to drive households toward creating better defenses. Therefore, we expected significant positive differences in households' preparation and flood-related damages. Further to this, the indoor flood level between the two events was compared. From this, we expected lower levels of flooding as a direct result of upgrading structural measures.

Cross-tabulation analysis was chosen to explore the association between household characteristics and improvement in precautions. Popular protective measures were considered as dependent variables. Meanwhile, based on the literature review, income level, housing location, and external reliant psychology were included as explanatory variables. Higher-income households were reported to be better prepared for natural hazards (Hosseini et al. 2013; Ashenefe et al. 2017). Living in higher risk areas was found to be positively associated with households' preparedness (Hoffmann and Muttarak 2017; Wu et al. 2018). Reliance on external support was reported to be negatively correlated with protective responses (Grothmann and Reusswig 2006; Chen et al. 2019). In this study, household income was ranked by referring to the 2016–2020 living standard (Vietnamese Government 2015) and the 2017 report on the average income (GSO 2017). Households with a per capita income of less than VND 1.3 million were considered to be in the low economic class, while those that exceeded VND 4.5 million were regarded as a higher socioeconomic class. Location was classified based on distance to the riverbank with a

delimitation of around 30 m. Households' external reliant psychology was decided by taking into account their belief in emergency support. Those who had high trust in the availability of external support in urgent cases were viewed as the external reliant group.

We also included some additional variables, such as the number of laborers, occupational stability, dependency ratio, and living with disabilities, to gain insight into the constraints of the households. To better reflect household resources, the occupation that contributed the most to a household's income was chosen rather than that of interviewees and was further classified based on its stability. Dependency ratio was calculated as a fraction of the total number of individuals who are not working divided by those who contribute to the income, regardless of their age. A higher value of this ratio implies a greater strain imposed on the household. Similarly, living with disabled family members was also added as a barrier to the implementation of protective measures.

4.3. Results and discussion

In this section, the data obtained through household interviews are analyzed in the following order: sociodemographic characteristics of the surveyed households; changes in flood characteristics and household protective behavior; precautions of local authorities; changes in household precautions and damage-reducing effectiveness; and household characteristics and improvement of preventive measures.

4.3.1. Sociodemographic characteristics of the surveyed households

Main characteristics of the the study population are summarized in Table 1. The male household heads, who often have a great influence on household decisions, accounted for more than two-thirds of the total sample. The majority of respondents were in their middle age (43.3%) and older (41.7%). Investigating the elders were expected to obtain more valuable evidence through their long-term experiences.

Farming was the most dominant in the rural village, although this rate has fallen sharply in recent decades due to the lack of labor, and the strong penetration of the other careers. In contrast, retailers and handicrafts were the most well-known in the suburbs because agriculture was almost evaporated. In which, only about 40% of the total population was recruited with stable occupations, while up to one-third of families relied largely on precarious livelihoods. In terms of income, more than half of the surveyed households were classified as middle class, while about a quarter was defined as the poor.

Table 1: Socio-demographic characteristics of surveyed households

Characteristics		Rural (n = 60)	Suburb (n = 60)	Total
		n (%)	n (%)	N (%)
Gender	Male	46 (76.7)	40 (66.7)	86 (71.7)
	Female	14 (23.3)	20 (33.3)	34 (28.3)
Age group	30 ~ 45	10 (16.7)	8 (13.3)	18 (15.0)
	46 ~ 60	23 (38.3)	29 (48.3)	52 (43.3)
	> 60	27 (45.0)	23 (38.4)	50 (41.7)
Occupation	Unstable	25 (41.7)	14 (23.3)	39 (32.5)
	Self-employment	6 (10.0)	28 (46.7)	34 (28.3)
	Stable	29 (48.3)	18 (30.0)	47 (39.2)
Household size	≤ 4	33 (55.0)	37 (61.7)	70 (58.3)
	> 4	27 (45.0)	23 (38.3)	50 (41.7)
Number of labors	≤ 2	36 (60.0)	34 (56.7)	70 (58.3)
	> 2	24 (40.0)	26 (43.3)	50 (41.7)
Per capita income	< 1.3 million	25 (41.7)	7 (11.7)	32 (26.7)
	1.3 ~ 4.5 million	21 (35.0)	42 (70.0)	63 (52.5)
	> 4.5 million	14 (23.3)	11 (18.3)	25 (20.8)
Housing type	Temporary	6 (10.0)	2 (3.3)	8 (6.7)
	Semi-permanent	30 (50.0)	43 (71.7)	73 (60.8)
	Permanent	24 (40.0)	15 (25.0)	39 (32.5)
Housing location	Riverbank	10 (16.7)	23 (38.3)	33 (27.5)
	Non-riverbank	50 (83.3)	37 (61.7)	87 (72.5)
Dependency ratio	≥ 1	28 (46.7)	26 (43.3)	54 (45.0)
	< 1	32 (53.3)	34 (56.7)	66 (55.0)
Living with disability	Yes	21 (35.0)	12 (20.0)	33 (27.5)
	No	39 (65.0)	48 (80.0)	87 (72.5)

Source: Household interviews, 2018

In relation to human resources, the percentage of households with more than two labors in the suburban area was 43.3%, a little higher than that in the rural area. Semi-permanent houses were the typical style in the study area accounting for over 60% of the total survey. Only about one-third of households upgraded to permanent houses, while a small proportion (6.7%) still fastened with temporary shelters. Additionally, 27.5% of those dwellings were erected adjacent to the riverbank, which may lead their owners more vulnerable during the flood season. As regard to the dependency ratio, more than half of households had more labors than dependents. Besides, more than a quarter of those interviewed were living with elderly or disabled family members.

4.3.2. Changes in flood characteristics and household protective behavior

The extent of damages depends on how people prepare for encounters with potential risks (CMCC 2018). Their preparation is driven by the comprehension of changes in flood trends and risks (Reynaud et al. 2013). Therefore, the interviewees were asked to express their views on the changing nature of floods (Figure 9).

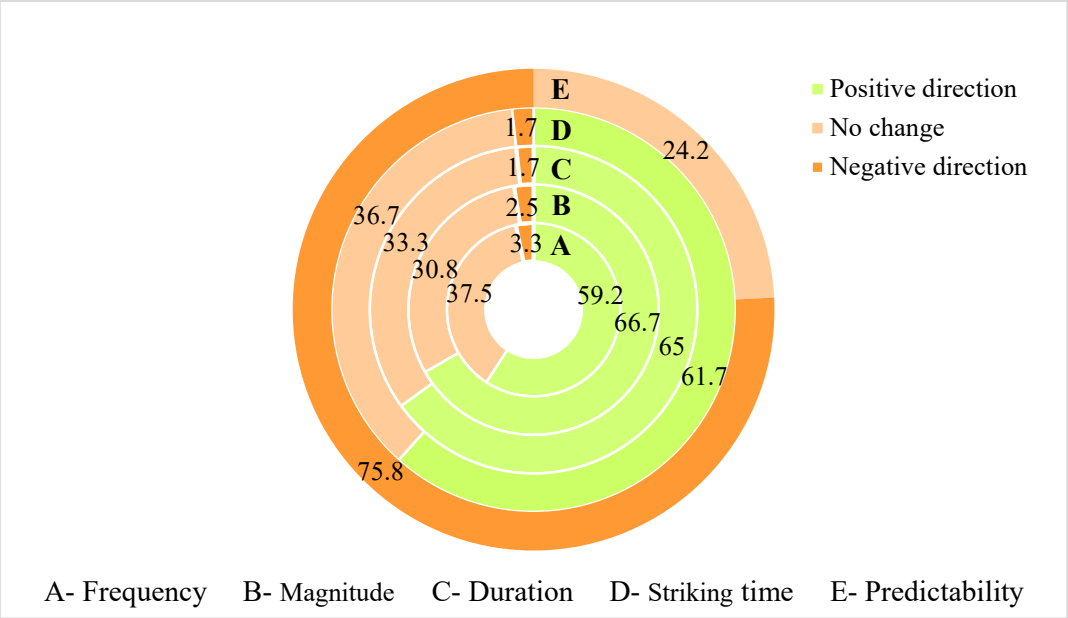


Figure 9: Perception of changes (%) in flood characteristics (N = 120)

Source: Household interviews, 2018

Most respondents asserted that floods are currently progressing in a favorable direction. In particular, less flooding was indicated by 59.2% of the informants, while only 3.3% signified the opposite. Nearly 67% of the informants confirmed less severity and faster drainage of floods, while its delayed appearance was clarified by almost 62%. In contrast, the majority of the interviewees (75.8%) complained about the increasing irregularity and unpredictability of floods. These changes were attributed to the increasing prevalence of dams. Currently, some 62 reservoirs for both irrigation and hydropower are being operated in the province. Alongside visible contributions, these massive structural works conceal many unanticipated dangers (Blöschl et al. 2015).

This fact inspired us to further explore residents' attitudes toward implementing precautions. Their responses are briefly shown in Figure 10.

Maintaining a similar preparedness level as previously was the response of one-third of the interviewees (33.3%). Meanwhile, more than half of the survey samples (54.2%) suspected the absoluteness of those structural solutions in reducing flood and concerned about abrupt calamities might tumble down at any time in the future. Most of them live in flood-prone areas such as adjacent to the river-bank or the deserted places that are easy to be isolated during the inundation, while others show less confident about the resistance of their dwelling. Hence, they believed that more attention should be paid towards flood preparedness. Attitudes of suburban residents towards dam uncertainty seem to be more precise than that in the rural area, but the difference is statistically insignificant ($\chi^2 = 2.91$; df = 2; $p = 0.233 > 0.05$). One villager said: *"It is certainly true that floods have decreased since operating the dams. However, it is impossible to anticipate future incidents. In case of the dams forced to release water, or worse when the dam failures, the consequences may be incalculable".*

In contrast, a small minority (12.5%) underestimated precautions, believing they were safeguarded by massive dams. This subjectivity probably stems from the fact that low-probability incidents related to natural hazards are often misjudged systematically (Faure, 2007). An elderly man asserted that *"I believe in advance of science. I put my faith in the authority ability in operating the dams for flood regulation. From now on, big floods will no longer present in this area".*

Although the government has made great efforts to erect structural works, they are just one part of the integrated flood risk management strategy. It should be recognized that flood damages can never be wholly mitigated by relying solely on these public defenses (Hoffmann & Muttarak, 2017; Osberghaus, 2015). Strengthening the role of local actors, therefore, is critical to compensate for the limitations of the engineering approach.

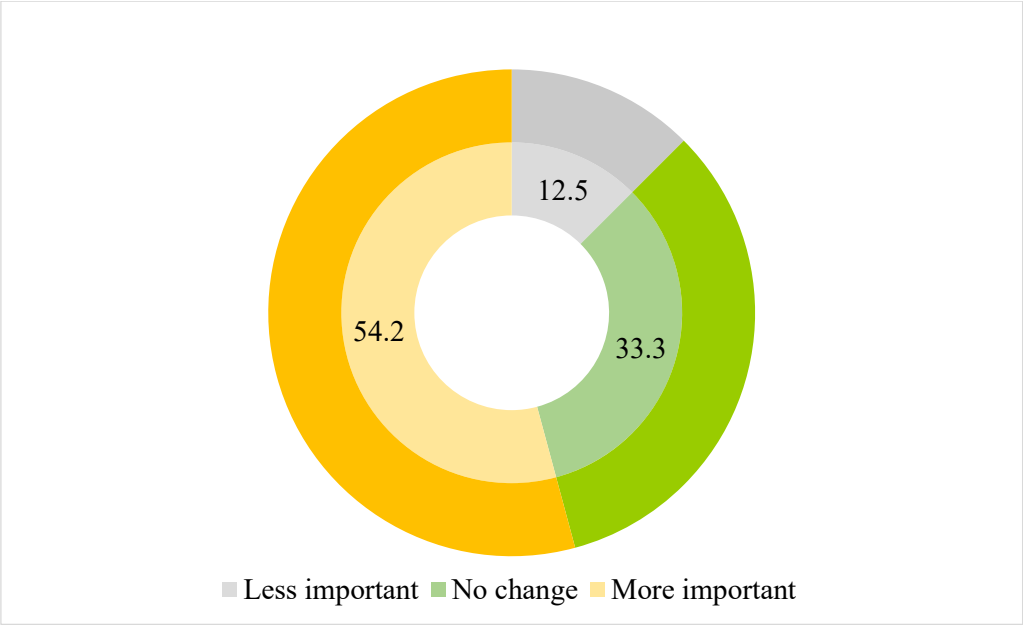


Figure 10: Dam protection and household protective behavior

Source: Household interviews, 2018

4.3.3. Precautions of local authorities

Two months before the flood season, the flood prevention committees are reorganized at both commune and village levels. These are permanent groups of nearly 20 members from various political, social, and economic organizations. They are established to support local communities to effectively work against floods. Support from these committees primarily relies on local resources and can be split into structured and non-structured forms. Structural measures aim to improve the quality of roads, strengthen riverbanks, and most importantly, prepare shelters for emergency evacuation. Schools and healthcare centers, which have already been solidified, are used as refuges during severe inundation. Meanwhile, non-structural measures include providing early warnings, emergency necessities, and means of escape. Warnings are spread through two main channels: a loudspeaker system operated by the local authority, and portable-speakers run by village teams. At the beginning stage of floods, villages are responsible for other supports, such as food and early evacuation, but due to a lack of resources, this applies only to some households living on perilous terrain. These supports are intensified by utilizing the commune's stockpile whenever extreme floods occur.

Nevertheless, it is neglectful to ignore the impressions of the population who directly benefited. Therefore, interviewees were asked to express their opinions on these supports (Figure 11). Of the study population, nearly three-quarters appreciated the

improvements to the early warning system, a quarter were doubtful, and only 2.5% were flatly unsatisfied. Conversely, 76.7%, 82.5%, and 69.2% of the respondents were dissatisfied with the support of basic necessities, emergency evacuation, and post-flood recovery, respectively. Besides the above-mentioned immediate supports, the current transportation infrastructure was much improved after several upgrades, which facilitated the flood coping process. The riverbanks, however, have not yet been fortified, leaving riverside households more susceptible during floods.

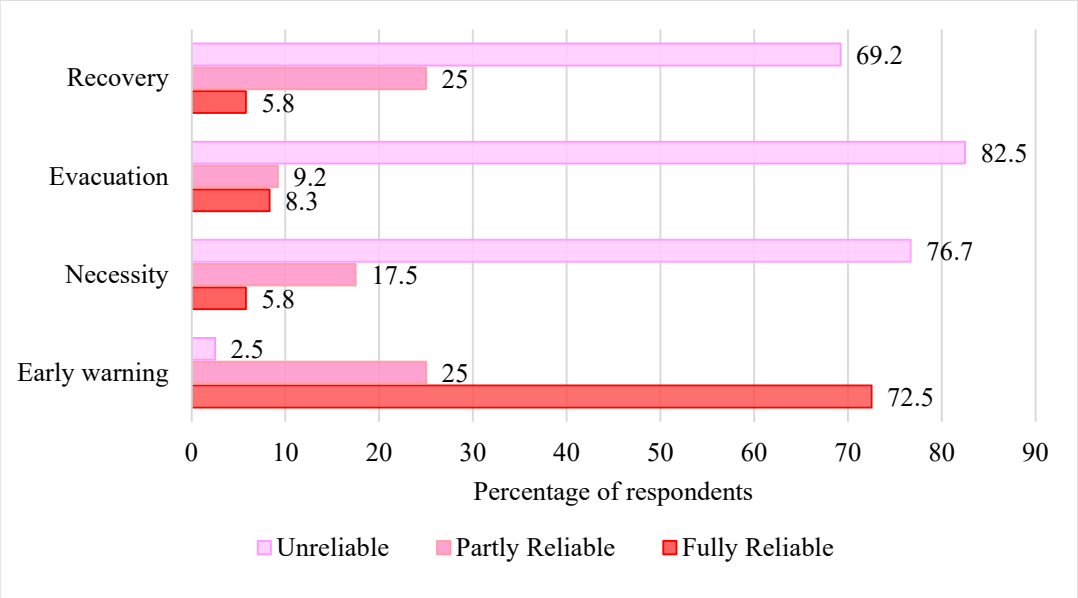


Figure 11: Perception of the public support reliability (N = 120)

Source: Household interviews, 2018

The beneficiaries were also required to disclose the main reasons governing their estimations. Absence of the village communicators was reflected by nearly 22% of those surveyed, while others disparaged the local broadcast system quality. Usually, the village board directly broadcasts warnings to every alley, and this process is repeated several times. However, this may be futile if residents are absent from their homes during the transmission. Regarding the loudspeaker, even with a wider range, this system is ineffective for those living far from radio stations, especially in tumultuous weather conditions. Likewise, the broadcast may be interrupted or deactivated due to power outages during heavy floods, which was mentioned by nearly 16% of the samples. The support of necessities was underrated due to negligible quantity (86.7%) or late distribution (75.8%). Food reserves were only deployed at the commune but disregarded within the villages due to financial constraints. Normally, relief goods were only distributed to victims after the

floods had begun to recede. This, in addition to the small support amount, led to the ineffectiveness of this effort.

Perception of failure in supporting emergency evacuation was due to the sparsity of shelters (78.3%) and suspicion about the authority's capacity (91.7%). Preparing emergency shelters and transport is obligatory to assure speed, timeliness, and safety in an evacuation. Recognizing these requirements, public infrastructures were reinforced by local authorities. These infrastructures, however, are scattered and far from most residential clusters. Approaching these shelters, therefore, becomes extremely arduous and perilous due to high floodwater level and swift-flowing currents. Most respondents were also skeptical of the authorities' ability to mobilize sufficient manpower and necessary facilities for evacuating an enormous number of households simultaneously.

Besides the above precautions, preparation for post-flood recovery is also important because neutralizing all flood impacts is impossible. However, once again the respondents lacked faith in the local authorities because of their limited financial resources (90%) and delays in implementation (55.8%). In fact, post-disaster supports were usually distributed to only a few households that had suffered major losses and took a long time to implement. In addition, the compensation amount was insubstantial compared to the losses and thus less meaningful for flood victims. It is undeniable that almost all damages suffered by residents tend to be neglected after disasters.

4.3.4. Changes in household precautions and damage-reducing effectiveness

This section focuses on analyzing the improvement of preventive measures at the household level and their effectiveness in reducing damage between the 1999 and 2017 floods.

4.3.4.1. Changes in household precautions

Most residents were aware of potential threats despite the protection of the engineering works, and they distrusted the support measures offered by local authorities. These findings raise the question of how floodplain inhabitants have improved preventive measures and how effective those improvements are during floods. To clarify these matters, the main measures implemented by households in the 1999 and 2017 floods were recalled (Table 2).

Table 2: Main measures implemented by households before 1999 and 2017 floods

Measures	1999 Flood		2017 Flood		*P*-Value[a]
	n	%	n	%	
Housing reinforcement	27	22.5	113	94.2	< 0.01
Raising ground	25	20.8	111	92.5	< 0.01
Install sub-floors	43	35.8	89	74.2	< 0.01
Access to official warnings	21	17.5	117	97.5	< 0.01
Store food for at least three days	71	59.2	115	95.8	< 0.01
Effective plan to compensate for energy loss	56	46.7	111	92.5	< 0.01
Effective plan to protect valuable assets	27	22.5	86	71.7	< 0.01
Specific plan for emergency evacuation	27	22.5	68	56.7	< 0.01

[a] *McNemar's Chi-square test by binominal distribution*

Source: Household interviews, 2018

Obviously, all measures have vastly improved after nearly 20 years. While almost all measures were implemented by less than 50% of the respondents in 1999, they were mostly greater than 70% in 2017 ($p < 0.01$). Households tend to solidify housing by using waterproof materials instead of fragile materials such as bamboo and thatch. Raising ground was also a widespread solution to reduce indoor flooding. Both of these solutions were deployed by over 90% of those surveyed in 2017, much higher than those in 1999 (below 30%). Additionally, the proportion of houses with additional floors doubled from 35.8% to 74.2%.

Similarly, the official warning was disseminated to almost all residents in 2017 (97.5%), as opposed to 1999 (17.5%). This may be principally due to the authorities' efforts but could also be achieved through proactive seeking of warning information by households. Storing sufficient food, though a simple task, is essential to uplift human endurance, especially for abnormally long-lasting floods. In 1999, nearly 60% of households stored food for at least three days. Meanwhile, the remainder believed that foodstuff could be easily replenished from peddlers when the floods retreated. However, this could be a dangerous misconception that could turn into unpredictable risk, since the 1999 flood lasted for a week, which led many households into food scarcity. In 2017, therefore, up to 95.8% of households accumulated enough food for a normal-length flood. Furthermore, up to

92.5% of households prepared alternative energy sources such as gas stoves or rechargeable lamps in case of power interruption, compared to just 46.7% in 1999.

In economic terms, floods are one of the costliest natural hazards and disasters (Saeed et al. 2018). In fact, 77.5% of households lost most valuable assets in the 1999 flood. Asset protection, however, was much better implemented by 2017 as most households (71.7%) successfully preserved their assets after the flood. Most of the respondents actively prepared more items such as bricks, wooden planks to lift up movables, or suspension systems to fasten water-sensitive objects to the ceiling. Highly mobile assets, such as motorbikes or agricultural machines, were shifted to safe places whenever imminent flooding was announced.

Drawing up a detailed evacuation plan is an effective way to minimize both human casualties and property damage (Na et al. 2012). While most households were passive in the evacuation in 1999, this was greatly improved in 2017. The proportion of households who prepared an evacuation plan doubled from 22.5% to 56.7%. Frail members are often evacuated before flooding, especially those living in hazardous areas, while others stay to protect belongings from thieves. Although currently less useful for livelihoods, some households still retain boats as a transportation means during floods. There was one boat for every five households, which was often used as common property in cases of emergency. However, this was mostly in the rural area and rare in the suburb. This was due to narrow living spaces and the lack of connection between suburban livelihoods. Those in better-off households simply moved to the second solid floor. Others planned to reach to and shelter in adjacent solid houses. Although dangerous, this may be feasible due to the dense housing. Although there has been a significant improvement, 43.3% of the households were still inactive in outlining evacuation plans, and mainly looked for external help.

4.3.4.2. Flood damage-reducing effectiveness

We first compared the actual indoor flood level, which is different from the land-surface flood depth, to understand the effectiveness of raising the ground (Figure 12). The 2017 indoor flood depth ($mean^{2017}$ = 0.776 m; $median^{2017}$ = 0.7 m) was much lower than that in 1999 ($mean^{1999}$ = 1.952 m; $median^{1999}$ = 2.0 m). The interquartile ranges further indicate that 75% of shelters were flooded to at least 1.7 m in 1999, while 75% of those were submerged below 1.2 m in 2017. This result is further affirmed by the equivalent flood peaks of the events in 1999 (518 cm) and 2017 (505 cm) (Figure 6). Such

comparison demonstrates the effectiveness of raising housing ground for reducing the indoor flood depth.

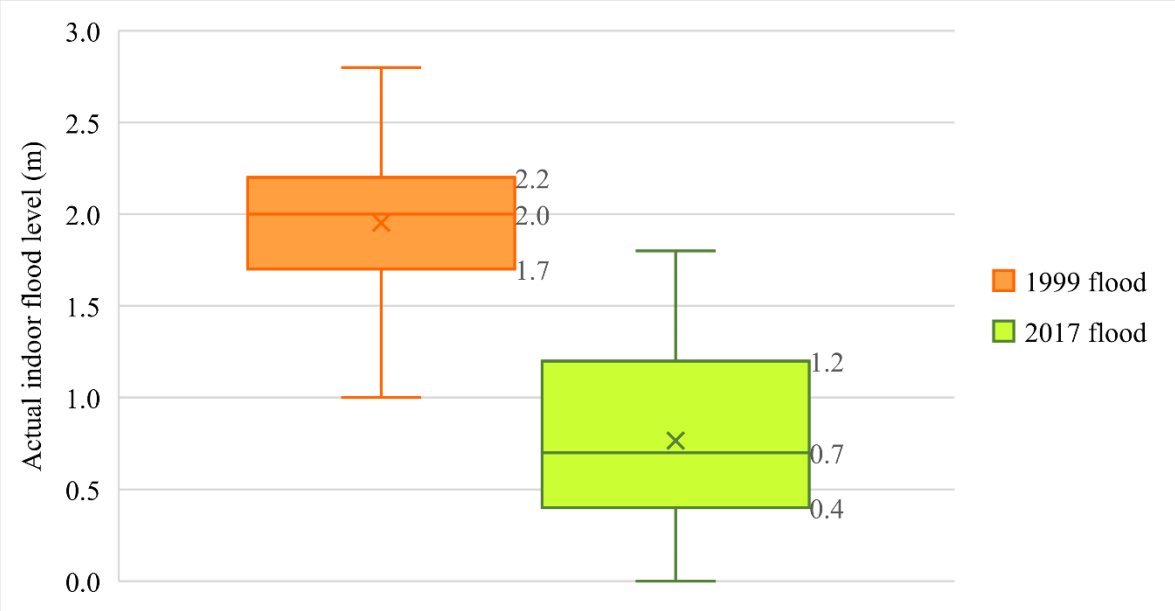


Figure 12: Comparison of actual indoor flood levels in 1999 and 2017

Source: Household interviews, 2018

Fewer damages were anticipated due to lower indoor floods experienced by most households in 2017. Due to the long interval between the two events, damages were recorded by category instead of the currency unit. Moreover, certain types of damage relating to injuries, food shortages, or evacuation may be impossible to convert into monetary units.

Table 3 shows that damages in 2017 were significantly lower than those in 1999. The percentage of people injured in 2017 (1.7%) was much lower than in 1999 (16.7%). People were normally wounded during evacuation due to the lack of supportive equipment. Therefore, the decline in the evacuation rate from 58.3% in 1999 to 8.3% in 2017 may have contributed to reducing the injured rate. Regarding physical losses, 65.9% of houses were damaged to varying degrees in 1999, but this dropped sharply to just 15% in 2017. This improvement may be partly due to a less severe flooding in 2017 but more likely stems from households' efforts to upgrade housing. Over 98% of the households reported that most of their assets were submerged by floodwaters in 1999. However, this rate dropped noticeably to 33.3% in 2017. Food security was also significantly improved, with only 3.3% of households suffering from food shortages, compared with 76.7% in 1999. It

can be assumed that households' efforts in improving precautions contributed significantly to reducing indoor flooding, thereby mitigating the associated damages.

Table 3: Percentage of households affected by the 1999 and 2017 floods (N = 120)

Damages	1999 Flood		2017 Flood		*P*-Value[a]
	n	%	n	%	
Members injured	20	16.7	2	1.7	< 0.01
House fully collapsed	8	6.7	1	0.8	< 0.05
House partly collapsed	71	59.2	17	14.2	< 0.01
Property damaged	118	98.3	40	33.3	< 0.01
Lack of food	92	76.7	4	3.3	< 0.01
Evacuated	70	58.3	10	8.3	< 0.01

[a] *McNemar's Chi-square test by binominal distribution*

Source: Household interviews, 2018

4.3.5. Household characteristics and improvement of preventive measures

Improving precautions has shown positive effects on flood risk mitigation, as found by Kreibich et al. (2011), Poussin et al. (2015), and Atreya et al. (2017). Who is plodding in the struggle against floods? And what factors are hindering them? These matters still need to be investigated for identifying the characteristics of the least improved groups.

The overall sample, therefore, was split into rural and suburban groups based on their socioeconomic disparity. The popular actions taken by the residents were also divided into different levels and regarded as dependent variables (Table 4). As mentioned in the method section, three characteristics of households, including income level, housing location, and external reliant psychology, are used as predictors. Some other demographic characteristics of households are also used to further explain their constraints.

Table 4: Classification of improvement level

Measures	Improvement Level	Descriptions
Housing reinforcement	Slightly	Minor or temporary reinforcement
	Significantly	Major or permanent reinforcement
Raising ground	Slightly	Raising the ground less than 1 m
	Significantly	Raising the ground by at least 1 m
Setting sub-floors	Unimproved	Not installing sub-floors; not reinforcing existing floors
	Slightly	Installing new temporary floors; reinforcing existing floors
	Significantly	Installing new solid floors; maintaining existing solid floors
Accessing warnings	Slightly	Receiving official warnings from a single source
	Significantly	Receiving official warnings from multiple sources
Food storage	Unimproved	Preparing food for three days
	Slightly	Preparing food for around five days
	Significantly	Preparing food for more than five days
Evacuation planning	Unimproved	Not knowing any shelter or way to access safely
	Improved	Knowing shelters and ways to access safely

Source: Authors

4.3.5.1. Characteristics associated with improvements in the rural village

Table 5 shows that the improvement in precautionary measures in the rural village is distinctly divided by income levels. Income creates significant differences in house reinforcement ($p = 0.00$), ground raised ($p = 0.00$), and sub-floor setting ($p = 0.00$). Further inspection of the Cramer's V coefficients suggests that the strength of these associations is moderately strong (V = 0.562; V = 0.546; V = 0.593). Accordingly, the lower-income group appears lower with regard to upgrading housing. This result is consistent with the finding of Kreibich et al. (2011), which underscores the crucial role of financial-related factors in implementing structural measures. Furthermore, lower-income earners are also less likely to improve non-structural measures, including accessing warnings, storing food, and planning evacuation. Cramer's V values indicate a strong cohesion between these relationships (V = 0.414; V = 0.610; V = 0.588).

It is easy to comprehend the connection between implementing costly measures and households in the lower-income bracket since it is closely related to their financial capacity. However, access to official warnings is also restrained by income, while it should be equally delivered to all residents as a free public service. Nearly half (44%) of the population who were characterized by meager income generally receive official warnings from a single provider rather than in a multidimensional manner. The wide rural residential area associated with inadequate equipment may partly result in the low coverage capacity of the warning transmission. Additionally, this may be ineffective if a household's members are at work and thus absent from their home when warnings are being announced. These hypothetical situations may apply to the low-income group, who are regularly away from home for livelihood. Missing warnings is, therefore, possible.

Besides indicating the links between low income and inferior improvement of measures, exploring the root causes of poverty is necessary if policy-related solutions are to be designed. We found that poverty in rural areas is strongly related to labor shortages ($\chi^2 = 15.27$; $p = 0.00$), high dependency ratio ($\chi^2 = 19.44$; $p = 0.00$), living with disabilities ($\chi^2 = 17.94$; $p = 0.00$), and precarious careers ($\chi^2 = 35.77$; $p = 0.00$). In this regard, sharing earnings that are already insufficient with more people, especially disabled members, may further restrict household budgets for investing in protective measures. This result, however, differs from previous findings that households with disabled or unhealthy members are more likely to participate in disaster preparation (Ablah et al. 2009; Eisenman et al. 2009). The healthier financial condition of residents in developed countries compared to those in developing countries is probably the reason for this difference.

Table 5: Rural household characteristics and improvements of precautionary measures

Improvement Level		Income Level				Housing Location			External Reliant Psychology		
		Low n (%)	Middle n (%)	High n (%)	χ^2 (df) *P*-value[a] [Φ/V]	Riverbank n (%)	Non-riverbank n (%)	χ^2 (df) *P*-value[a] [Φ/V]	Reliant n (%)	Non-reliant n (%)	χ^2 (df) *P*-value[a] [Φ/V]
Housing reinforcement	Slightly	19 (76.0)	7 (33.3)	1 (7.1)	18.97 (2) 0.00** [0.562]	6 (60.0)	21 (42.0)	1.09 (1) 0.32 [0.135]	12 (52.2)	15 (40.5)	0.38 (1) 0.54 [0.114]
	Significantly	6 (24.0)	14 (66.7)	13 (92.9)		4 (40.0)	29 (58.0)		11 (47.8)	22 (59.5)	
Raising ground	Slightly	22 (88.0)	10 (47.6)	3 (21.4)	17.89 (2) 0.00** [0.546]	8 (80.0)	27 (54.0)	2.32 (1) 0.17 [0.197]	12 (52.2)	23 (62.2)	0.24 (1) 0.62 [0.099]
	Significantly	3 (12.0)	11 (52.4)	11 (78.6)		2 (20.0)	23 (46.0)		11 (47.8)	14 (37.8)	
Setting sub-floors	Unimproved	16 (64.0)	4 (19.0)	1 (7.1)	42.18 (4) 0.00** [0.593]	3 (30.0)	18 (36.0)	0.389 (2) 0.82 [0.081]	13 (56.5)	8 (21.6)	9.12 (2) 0.01** [0.390]
	Slightly	9 (36.0)	11 (52.4)	0 (0.0)		3 (30.0)	17 (34.0)		7 (30.4)	13 (35.1)	
	Significantly	0 (0.0)	6 (28.6)	13 (92.9)		4 (40.0)	15 (30.0)		3 (13.1)	16 (43.3)	
Accessing warnings	Slightly	11 (44.0)	2 (9.5)	1 (7.1)	10.26 (2) 0.00** [0.414]	0 (0.0)	14 (28.0)	3.65 (1) 0.10 [0.247]	3 (13.0)	11 (29.7)	1.37 (1) 0.24 [0.192]
	Significantly	14 (56.0)	19 (90.5)	13 (92.9)		10 (100)	36 (72.0)		20 (87.0)	26 (70.3)	
Food storage	Unimproved	18 (72.0)	2 (9.5)	0 (0.0)	44.72 (4) 0.00** [0.610]	2 (20.0)	18 (36.0)	0.22 (2) 0.54 [0.143]	7 (30.4)	13 (35.1)	0.16 (2) 0.92 [0.051]
	Slightly	4 (16.0)	15 (71.4)	3 (21.4)		5 (50.0)	17 (34.0)		9 (39.2)	13 (35.1)	
	Significantly	3 (12.0)	4 (19.0)	11 (78.6)		3 (30.0)	15 (30.0)		7 (30.4)	11 (29.7)	
Evacuation planning	Unimproved	19 (76.0)	10 (47.6)	0 (0.0)	20.76 (2) 0.00** [0.588]	4 (40.0)	25 (50.0)	3.33 (1) 0.73 [0.75]	13 (56.5)	16 (43.2)	0.54(1) 0.46 [0.129]
	Improved	6 (24.0)	11 (52.4)	14 (100)		6 (60.0)	25 (50.0)		10 (43.5)	21 (56.8)	

*[a] Chi-square test for independence. * Statistically significant at 95% level, ** Statistically significant at 99% level, Φ = phi (applicable for 2 × 2 tables), V = Cramer's V (applicable for tables larger than 2 × 2)*

Source: Household interviews, 2018

In addition to finance, the improvement of precautions is also influenced by external reliant psychology, but to a lesser extent. Households with external reliant thinking appear to be less active in improvement measures. For example, 56.5% of households in such groups have made no improvements in setting sub-floors compared to just 21.6% of those in the non-reliant group ($p = 0.01$). In this regard, financial pressure should be seen as the primary cause since almost half (47.8%) of the members in the external reliant group were those living in poverty. Others argued that it is unnecessary to erect sub-floors because they trust their neighbors' support in the case of severe floods. The links between this psychological trait and the implementation of the remaining measures, however, are statistically insignificant. Housing location, which is frequently discussed in studies related to preparedness, is entirely separate from rural households' ability to improve preventive measures ($p > 0.05$).

4.3.5.2. Characteristics associated with improvements in the suburban village

With disparities in socioeconomic conditions, exploring the suburban village promised to reveal other valuable links. The results are summarized in Table 6.

The role of financial-related factors is further highlighted by their relationship with protective actions in the suburb. Similarly, fewer improvements in both structural and non-structural measures tended to be attached to the low-income group ($p < 0.05$). In this area, uncertain occupations ($\chi^2 = 29.19$; $p = 0.00$) and burdens from disabled members ($\chi^2 = 8.81$; $p = 0.01$) were found to be the causes of poverty.

Different from the rural village, housing location in the suburb had a significant effect on the improvement of structural measures. Families living adjacent to the riverbank appeared to be obstructed in reinforcing housing ($p = 0.04$), raising ground ($p = 0.00$), and setting sub-floors ($p = 0.00$). Only 34.8% and 26.1% of households belonging to the riverbank group reached considerable levels in reinforcing housing and setting additional floors, respectively, while none achieved that level in raising ground. This group is mostly small-scale retailers with a middle-income level. For most, housing upgrades are probably not a big challenge after saving for a long time.

The field survey revealed that these poor improvements primarily stem from the provincial policy for restoration of the ancient city. Accordingly, households located in the planning area will be restricted from major upgrades so as to control the clearance compensation cost afterward. Although major reconstructions are still possible without an

official license, those upgraded sections will not be compensated if the project is implemented. Furthermore, it should be stressed that, although initiated in the early 1990s, there has been no official decision made. This is the root cause constraining riverine households from upgrading structural measures.

Some households were prevented from raising the ground due to ancient housing architecture. Raising the ground excessively will make their habitable space significantly narrower. These families may also be more susceptible during the flood season since most have illegally encroached on the riverbed to broaden their residential space. The cramped housing has also prevented riverine households from purchasing boats for proactive evacuation. This is one of the reasons why nearly 40% have been unable to improve the evacuation plan. However, the relationship between housing location and making emergency evacuation plan is statistically insignificant ($p > 0.05$).

The influence of psychological factors is also emphasized by its linkage with non-structural measures. People who have trust in various external supports appeared to pay less attention to food storage ($p = 0.02$) and evacuation planning ($p = 0.00$). The strength of these connections ranges from moderate to fairly strong ($V = 0.369$; $\Phi = 0.585$). As an example, 37.5% of households in the external reliant group stored food for only three days, while up to 87.5% underestimated planning for an emergency evacuation. In contrast to the rural village, no connection between reliant thinking, poverty, and location was found. One possible explanation for the external reliant thinking of this type of residents relates to market functions in the area. Some residents believed that their shortcomings in preparation could easily be compensated by their neighbors, traders, as well as spontaneous services in the flood season. Living in the vicinity of the local market, where small retailers characteristically accumulate plenty of foodstuff for their daily business and there is a quite large number of boats passing during the flood season, may be the root of these passive ways of thinking.

Table 6: Suburban household characteristics and improvements of precautionary measures

Improvement Level		Income Level				Housing Location			External Reliant Psychology		
		Low n (%)	Middle n (%)	High n (%)	χ^2 (df) *P*-value[a] [Φ/V]	Riverbank n (%)	Non-riverbank n (%)	χ^2 (df) *P*-value[a] [Φ/V]	Reliant n (%)	Non-reliant n (%)	χ^2 (df) *P*-value[a] [Φ/V]
Housing reinforcement	Slightly	7 (100)	22 (52.4)	0 (0.0)	18.05 (2) 0.00** [0.548]	15 (65.2)	14 (37.8)	4.26 (1) 0.04* [0.266]	10 (62.5)	19 (43.2)	1.07 (1) 0.30 [0.171]
	Significantly	0 (0.0)	20 (47.6)	11 (100)		8 (34.8)	23 (62.2)		6 (37.5)	25 (56.8)	
Raising ground	Slightly	6 (85.7)	31 (73.8)	2 (18.2)	13.35 (2) 0.00** [0.472]	23 (100)	16 (43.2)	20.08 (1) 0.00** [0.579]	11 (68.7)	28 (63.6)	0.01 (1) 0.95 [0.047]
	Significantly	1 (14.3)	11 (26.2)	9 (81.8)		0 (0.0)	21 (56.8)		5 (31.3)	16 (36.4)	
Setting sub-floors	Unimproved	6 (85.7)	5 (11.9)	0 (0.0)	40.74 (4) 0.00** [0.583]	1 (4.3)	10 (27.0)	14.30 (2) 0.00** [0.488]	5 (31.3)	6 (13.6)	5.28 (2) 0.07 [0.297]
	Slightly	1 (14.3)	23 (54.8)	0 (0.0)		16 (69.6)	8 (21.6)		8 (50.0)	16 (36.4)	
	Significantly	0 (0.0)	14 (33.3)	11 (100)		6 (26.1)	19 (51.4)		3 (18.7)	22 (50.0)	
Accessing warnings	Slightly	5 (71.4)	8 (19.0)	0 (0.0)	13.43 (2) 0.00** [0.473]	2 (8.7)	11 (29.7)	3.69 (1) 0.11 [0.248]	6 (37.5)	7 (15.9)	2.08 (1) 0.15 [0.232]
	Significantly	2 (28.6)	34 (81.0)	11 (100)		21 (91.3)	26 (70.3)		10 (62.5)	37 (84.1)	
Food storage	Unimproved	6 (85.7)	4 (9.5)	1 (9.1)	42.61 (4) 0.00** [0.596]	2 (8.7)	9 (24.3)	2.94 (2) 0.23 [0.222]	6 (37.5)	5 (11.4)	8.16 (2) 0.02* [0.369]
	Slightly	1 (14.3)	30 (71.4)	1 (9.1)		15 (65.2)	17 (45.9)		9 (56.3)	23 (52.2)	
	Significantly	0 (0.0)	8 (19.0)	9 (81.8)		6 (26.1)	11 (29.7)		1 (6.3)	16 (36.4)	
Evacuation planning	Unimproved	5 (71.4)	18 (42.9)	1 (9.1)	7.40 (2) 0.03* [0.351]	9 (39.1)	15 (40.5)	0.01 (1) 0.91 [0.014]	14 (87.5)	10 (22.7)	17.90 (1) 0.00** [0.585]
	Improved	2 (28.6)	24 (57.1)	10 (90.9)		14 (60.9)	22 (59.5)		2 (12.5)	34 (77.3)	

*[a] Chi-square test for independence. * Statistically significant at 95% level, ** Statistically significant at 99% level, Φ = phi (applicable for 2 × 2 tables), V = Cramer's V (applicable for tables larger than 2 × 2)*

Source: Household interviews, 2018

4.3.5.3. Comparison of constraints between rural and suburban villages

Despite long-term efforts, some social groups remained less than impressive in improving preventive measures. There were similarities and differences in the constraints leading to these disquieting outcomes between rural and suburban villages. Poverty is an obvious obstruction in both areas since it is intricately linked to the improvement of all structural and non-structural measures. Labor shortages, high dependency ratio, living with disabilities, and precarious careers were the root causes of poverty in the study sites. This result strengthens the conclusion of Ahmad and Afzal (2020) that low financial status is the major obstacle of households to the implementation of risk reduction strategies. Other studies have also insisted that the poor are the most vulnerable to disasters and usually suffer greater damage than the wealthy (Fothergill and Peek 2004; Skoufias et al. 2011). This originates from their modest capacity to anticipate, respond, and recover from natural hazards (Wisner et al. 2003). The relationship between poverty and flooding is often seen as a vicious cycle. While floods cause or exacerbate poverty, poverty increases flood vulnerability (Dube et al. 2018; Kawasaki et al. 2020). Reducing poverty, therefore, should be a prerequisite in designing strategies related to flood risk mitigation.

Putting strong faith in external supports, besides implying strong cohesion within the community, should be considered a psychological barrier that leads to certain subjectivity. In particular, rural residents who had external reliant thinking were less focused on setting sub-floors while for those in the suburb it led to an underestimation of the importance of storing food and planning for evacuation. This result concurs with the findings of Chen et al. (2019) and Grothmann and Reusswig (2006) that relying on external support leads households to disregard self-protective measures.

However, it is likely that the causes for this association between the rural and suburban areas are different. In the rural area, this may reflect a more abundant social capital compared to urban areas as found by Sørensen (2014). This tight connection in rural society allows residents to firmly trust in their neighbors to convey them to safe places such as permanent houses and a well-built church, as well as sharing a small amount of food in case of severe floods. It is also possible that the poor have their own strategy to mitigate flood risks since almost half of those in the external reliant group were classified as poor. Due to lack of

financial capacity, the poor may prefer to invest in social capital to provide support in emergency cases. However, this reciprocal relationship can turn into external reliance since greater stocks of social capital were found to be associated with lower levels of risk perception and overestimation of self-capacity, which often undermine the intention to implement protective measures, making non-protective responses such as wishful thinking, denial, or fatalism more likely (Babcicky and Seebauer 2017).

In the suburb, on the other hand, the residents' external reliant thinking may be driven by specific functions in the area. It is said that urban areas are composed of different functionally diversified units, and these are interrelated through complex systems (Wilson 1984), of which market/commercial functions are an essential part. As the center of urban functions, the local market provides diverse commodities and services, including essential ones in the case of emergency. This may induce inhabitants within these systems to believe that it is less necessary to undertake precautionary actions.

Further, the improvement of protective measures in the suburb was restricted by housing locations. Households living along the riverbank were less likely to improve structural measures. This unexpected outcome, besides being directly influenced by the susceptible location, concurrently resulted from the ancient house architectures and the ancient town's preserving policy. For ancient houses, raising the floor was generally limited to a certain extent to ensure sufficient space for daily activities. Besides this, the policy of preserving the ancient town significantly affected the implementation of structural measures. Under the regulation of this policy, major housing-related upgrading will not be compensated when undertaking the project. This placed riverside residents, therefore, in a dilemma between ensuring safety and maintaining livelihoods. Although initiated in the early 1990s, this project is currently pending approval so residents were unsure when it would be implemented and whether the project implementation will be better for them or not. In this regard, project implementation will probably release riverside households from the potential dangers of flooding by relocating them to more secure areas. However, resettlement to another area may be a serious threat to their livelihoods. As retailers, their families' livelihood heavily depends on the current location, which is close to both the local market and the main road. Therefore, a change to housing location will potentially disturb livelihoods. Most households, meanwhile,

may not be ready to face this change due to a lack of occupational skills. From this result, we first reassert the previous findings of Tyas (2018) and Askman et al. (2018) on the binding between maintaining livelihoods and living in flood-prone areas. We also expose the inconsistency in designing and implementing development policies that may push residents into unfavorable and sometimes dangerous situations.

This overall comparison between rural and suburban villages underlines a more complex link between space, functions, and flood exposure in urban areas, as discussed by Sato (2006) and Ahmad and Simonovic (2013). One of the urban spatial characteristics—diversified and segregated settlements—and its functions, affects the long-term precautionary measures taken by individual households. It further emphasizes the additional complexity of coordinating projects in urban areas and exposes the adverse effects of incoherent policy mixture on improving protective measures of suburban residents, which could also be regarded as a product of the above-mentioned urban spatial characteristics.

4.4. Conclusions and policy implications

Mitigating flooding threats remains a major challenge for the Vietnamese government despite interminable efforts to expand engineering works. That context requires an integrated management strategy by incorporating bottom-up approaches. The main aim of this study, therefore, was to examine the extent of long-term improvements to flood precautions taken by local authorities and private households between the two major floods of 1999 and 2017.

The findings first emphasize the increasing irregularity and unpredictability of floods, thus making it more difficult to anticipate through conventional approaches since the increasing popularity of the dam system in Thua Thien Hue Province. The majority of residents, therefore, doubted the efficacy of this top-down approach in reducing risks and suggested that more attention should be paid toward flood preparedness.

Several public measures were implemented to enhance the defenses of local inhabitants. However, except for the early warning systems being regarded as much more effective operations after nearly two decades, other measures relating to food reserves, emergency shelters, evacuation supports, and resources for post-flood recovery were still considered scant and distrusted by most residents. The inadequate investment in preventive

measures due to limited financial resources and the authorities' delayed response to emergencies, as is often seen in developing countries, was one of the primary reasons for the inefficiency of the above-mentioned efforts. Household self-preparation, therefore, became the decisive factor in flood risk protection. Nearly 20 years after the disastrous flood of 1999, most households paid greater attention to both structural and non-structural protective measures to actively deal with flood hazards. The damage caused by floods since has noticeably diminished. This confirms the central role of individual households in the bottom-up flood risk management strategy, especially in developing countries.

Some social groups, nonetheless, appear to be lagging behind in this struggle against nature, which was evidently expressed through their underperformance in the long-term improvement of precautionary measures. Poverty-related barriers were the root causes restraining the improvement of households in both rural and suburban villages. Hence, poverty eradication is a prerequisite to mitigating risks and should be integrated into flood risk management strategy as a foremost priority. Furthermore, households' external reliant psychology, though less common in the communities, also created subjective attitudes toward improving some types of personal precautions. While external reliant psychology in rural areas was attached to residents' abundant social capital, in the suburbs this was likely to be attributed to specific functions such as local markets. Breaking down this psychological barrier is essential to improve precautions further, but this should be done by thoroughly considering this difference between areas.

The riverine suburb in the study area was further identified as vulnerable based on their limitations in upgrading structural measures. This matter, apart from being affected by the precarious location itself, was strictly regulated by the policy for preserving and restoring the ancient landscape along the riverbank. Their vulnerability to floods, meanwhile, potentially can turn into livelihood vulnerability if the project was implemented. This, on the one hand, indicates the additional complexity of coordinating projects in urban areas, while on the other, requires a smoother blend of development policies to limit adverse implications.

Besides revealing the connections between poverty, external reliant psychology, and potential flood risk susceptibility, this study, by comparing two villages in terms of vulnerability, emphasized the importance of space-function links in the suburban area and the

contradictions of different policy initiatives, such as landscape rehabilitation, disaster prevention, and livelihood maintenance. Therefore, besides considering social and geography differences, supportive solutions targeting vulnerable groups should be combined with effective public measures and a coherent mix of policies for further improvements.

CHAPTER 5: HOW DO SOCIAL CONNECTIONS ACCELERATE POST-FLOOD RECOVERY? INSIGHTS FROM A SURVEY OF RURAL HOUSEHOLDS IN CENTRAL VIETNAM

5.1. Introduction

More frequent and severe natural hazards are an inevitable consequence of environmental and climate change in the 21st century (IPCC 2014). Greatly impacted at both the social and individual levels, flooding is considered one of the most devastating natural hazards. In the last four decades, floods have resulted in approximately 6,000 deaths and 19 billion dollars of annual damage globally (CRED 2019). Therefore, post-flood recovery is seen as the biggest challenge to both residents and authorities, especially in developing countries (Aldrich 2012).

With nearly two-thirds of the population at risk, Vietnam is regarded as one of the most vulnerable countries to natural hazards. According to the 2018 Global Climate Risk Index, Vietnam ranked fifth among countries most severely influenced by extreme weather events, three levels higher than its average rank from 1997–2016 (Eckstein et al. 2017). Vietnam is also one of the places with the greatest population rate exposed to river flood risk worldwide (Luo et al. 2015). Over the past two decades, floods have killed at least 14,927 people, injured 16,829, and caused tangible damage amounting to 3.7 billion USD (Luu 2017; CRED 2013). Annually, damage caused by natural hazards is equivalent to 1 to 1.5% of the country's GDP, which significantly retards the socio-economic reform process (WB 2010).

Victims of natural hazards, after suffering heavy losses, face difficulties in recovering with their few remaining resources (Chan et al. 2018; Opdyke et al. 2017). Some studies indicate that formal support from the government is useful in facilitating the initial reconstruction of affected households (Consoer and Milman 2016; Gibson and Hayunga 2006). Recent literature, however, pointed out that government resources are finite, and thus less effective in major floods (Chan et al. 2018; Aldrich et al. 2015; Nguyen et al. 2021). In other words, most households tend to be neglected due to the extent of their losses after natural hazards (Osberghaus 2015). Further, delays in relief distribution made the government's efforts less effective. Alam and Collins (2010) reported that the first institutional relief goods normally take four to five days to reach the devastated areas. While formal support remains

inadequate, most assistance is achieved through informal personal connections known as social capital (Hernández-Plaza et al. 2004; Sadri et al. 2018).

Social capital, in general, reflects a group or an individual's ability to mobilize different types of resources, especially in urgent cases. It derives from social connections, shared norms, and mutual trust (J. S. Coleman 1988; Krishna 2016), and is usually viewed as a substantial element in post-disaster recovery (Munasinghe 2007). As the embodiment of social capital, social connection is viewed a key component that provides a common basis for empirical research (Bodin and Crona 2008). It is apparent that social capital can only exist within connections because it inheres in the structure of relations between/among actors (Coleman 1988). Social connections among individuals, groups, and organizations are supposed to be abundant information and resource reservoirs that are crucial for collective efforts and thus facilitate community post-disaster recovery (Ostrom and Ahn 2009). In addition to physical aspects, the efficacy of this invisible capital in the recovery phase also manifests through mental factors, such as alleviating psychological stress, depression, and other psychosocial symptoms (Bhandari 2014; Adeola and Picou 2014; Wind and Komproe 2012). There is no doubt that society progressively has to play a more comprehensive and active role in post-disaster recovery, rather than relying on the government budget to restore communities (Chan 2015).

Despite the increasing importance of social networks in disaster mitigation, its potential usefulness throughout the recovery phase of individual households has only been investigated to a limited extent. Indeed, most recent studies have focused on the positive outcomes of individual social networks in relation to post-disaster human physical–mental health, well-being, and especially satisfaction with the recovery process (Elgar et al. 2011; Maass et al. 2016; Bubeck and Thieken 2018; Dai et al. 2016). However, the household's post-disaster recovery speed, an equally important issue, has not been given due attention. Furthermore, we found no study looking at the household's recovery speed by using a regression model. Why are some groups able to recover quickly, while others lag in their return to normalcy? Do social connections accelerate the household's post-disaster recovery? Clarifying these matters is imperative because sluggish rehabilitation will increase social costs, deepen the emotional pain, and prolong of households' economic hardships.

Prior research has also explored the various support types that households gathered from different social networks. The whole recovery period in these studies, however, was either merely regarded as a continuous phase or vaguely split into consecutive phases without definite transition points. Instead, it should be separated into different sub-phases determined by explicit temporal interfaces, such as immediately after floods, in the short term, and long term. Despite some objections, splitting the recovery into different temporal phases is still in favor. Haas et al. (1977) in their pioneering work, presented a post-disaster recovery phase model consisting of four phases including emergency, restoration, replacement, betterment and redevelopment. The boundaries of each phase in this study, however, were not explicitly indicated due to their overlapping timeline and activities. As featured by Neal (1997), disaster phase models offer a heuristic method to develop research, organize dates and generate research findings. He further remarked that it also benefits disaster specialists in endeavoring to improve their capabilities through the phases. We, though admitting the natural overlap of recovery phases, still incline to separate them explicitly as this is a useful way to get into insight each phase. As argued by Davis and Alexander (2016), each disaster recovery phase bears its own activities led by different actors and different government levels working in diverse communities with different goals and objectives. In short, this segmentation may make sense in disclosing how the role of social connections varies through different recovery sub-phases. In other words, the subdivision of the recovery process is necessary for understanding the dynamics of social support over the course of time.

By acknowledging these knowledge gaps, this study aims to examine (i) the effects of social connections on post-flood recovery speed, and (ii) the differences in the role of social connections in the recovery sub-phases. These objectives will be examined by looking back on the recovery process of villagers after the major flood that occurred in November 2017 in Thua Thien Hue Province, central Vietnam. The outcomes of this study are expected to provide deeper insight into the contribution of various social connections to post-flood recovery.

The remainder of this chapter is organized as follows: Section 5.2 briefly summarizes some literature relating to the contribution of social connections in post-disaster recovery, followed by Section 5.3 describing the study site and applied methods. The main results, including flood damages, determinant factors of post-flood recovery speed, and the role of

social connections in recovery sub-phases will be presented in Section 5.4, accompanied by discussions in Section 5.5. Finally, Section 5.6 concludes the main findings of the study and their implications.

5.2. The role of social connections in post-disaster recovery

Although "social connection" is the key focus of this study, in this section, we also include the term "social capital" because of their close linkage, and as it was frequently mentioned in the previous literature.

Social capital is a multifaceted and ambiguous theory that has been widely applied across many disciplines, especially in disaster studies. Generally, it refers to the existence of social networks normally characterized by shared norms, trust, and reciprocity, which positively affect both individuals' and communities' goals (J. S. Coleman 1988; Bourdieu 1986; Putnam 2001). Coleman (1988) accented that social capital can only exist within relationships because it inheres in the structure of relations between/among actors. Krishna and Shrader (1999), meanwhile, revealed that social networks as a proxy to social capital refer to what has been known as “structural social capital”. It is deemed to be created through networks, linkages, and practices between individuals and organizations, within and between communities. This contrasts with “cognitive social capital”, which refers to values, beliefs, attitudes, norms, and behavior. It is thought that these dimensions together made up an aggregate indicator of social capital. Social networks are regarded as a center to the structural component providing an objective existence indicator, which contrasts to the intangible concepts such as trust and norms (White 2002). Portes (1998) also argues that analysis of social capital should focus on social relations and networks. As a principal incarnation of social capital, social networks provide common grounds for empirical studies related to social capital (Bodin and Crona 2008).

Based on connections with different actors, social capital is commonly differentiated into three types: bonding, bridging, and linking (Woolcock 2001). The term “bonding” is commonly used to reflect inward-looking or close relationships, such as family members, close friends, and neighbors (Szreter and Woolcock 2004; Scott and Liew 2012; Woolcock and Sweetser 2002). Bridging relationships, in contrast, are outward-looking, horizontal-direct relationships, and normally with similar entities. The term “linking” implies vertical-direct

relationships, particularly with individuals or organizations in the higher political, economic, or social hierarchy (Nakagawa and Shaw 2004). The conventional distinction between bonding, bridging, and linking social capital reflects the different roles that networks may play in shaping the development of a society (Sabatini 2009).

Greater stocks of social capital were found to be associated with numerous desired social targets, such as enhanced economic attitudes and outcomes (Hasan et al. 2020; Li 2004), improved public health (Ehsan et al. 2019; Nieminen et al. 2013), and more sustainable management of natural resources (Katz 2000; Pretty 2003). In relation to post-disaster recovery, the effectiveness of social capital was frequently manifested in studies at the community and household levels. At the community level, studies tend to focus on how social groups manage public resources and achieve collective efforts through mutual trust and social cohesion (Cagney et al. 2016; Joshi and Aoki 2014; Kim et al. 2017; Aldrich 2012b). Studies at the household level have mainly paid attention to how different types of connections translate into specific support efforts (Hsueh 2019; Masud-All-Kamal and Hassan 2018; Islam and Walkerden 2014; Chan et al. 2018).

In a case study in India's Tamil Nadu state, Joshi and Aoki (2014) indicated that the community-style prior to the disaster and the leadership of a strong village chief are both decisive for the success of a recovery program. In addition, social capital significantly affects successful policy implementation, which leads people to utilize government resources for disaster recovery. Kim et al. (2017), through a systematic review of the extant literature, underscored the specific role of bridging social capital in the long-term reconstruction of communities, recognizing it as a catalyst of co-production. Based on perceptions of preparedness and recovery, Cagney et al. (2016) found that people who live in communities with higher social cohesion, informal social control, and social exchange are more confident in preparation and quick recovery of the community. Aldrich (2010), after conducting a number of case studies (i.e., earthquakes in Tokyo and Kobe, a tsunami in Tamil Nadu, and Hurricane Katrina in New Orleans), concluded that communities with robust social networks coped with and recovered faster from disasters (Aldrich 2012b).

By surveying households in the island of Izu-Oshima after the 2013 typhoon, Hsueh (2019) indicated that bonding social capital results in various important forms of support after

a disaster. Bridging social capital complements supplies and provides partial psychological support, especially when bonding social capital experiences functional failure. In a case study of coastal communities in Bangladesh, Kamal and Hassan (2018) affirmed the importance of social capital in personal, household, and community recovery processes in the wake of the cyclone. Particularly, bonding and bridging social capital considerably assisted villagers from immediately after a disaster to long-term recovery; the benefits from linking social capital were trivial. In the context of Vietnam, Nguyen-Trung et al. (2020), through a case study in Tan Hung Rural District, Soc Trang Province, found that bonding social capital (family ties, relatives, close friends) plays a crucial role throughout the recovery phases; bridging social capital (input suppliers) only becomes important in the long-term recovery. Similarly, social capital is seen as a vital resource in flood disaster recovery in Malaysia. In particular, social capital builds collaborations among disaster organizations, mobilizes citizens as disaster volunteers, strengthens community resilience, and intensifies family cohesion. Social capital also builds self-reliance, enhances coping, and hastens recovery from floods (Chan et al. 2018).

Other studies prefer to investigate factors influencing specific aspects of recovery after natural hazards (Bubeck and Thieken 2018; Sadri et al. 2018). By examining the self-report of flood-affected residents in Germany on mental health recovery, Bubeck and Thieken (2018) found that damage extent and other flood-event characteristics, such as inundation depth, are less important than socio-economic characteristics and psychological factors. The recovery speed, another important post-disaster aspect, was explored by Sadri et al. (2018) in a case study of floods in Indiana. It was found that households with more damage experience had a slower recovery. Those with assistance from neighbors, stronger personal networks, and higher levels of social capital recovered more quickly.

The potential negative consequences of social capital have also been highlighted by several scholars. For example, the strong social capital of the elite can further marginalize people in the periphery (Aldrich 2011; Portes and Landolt 2000). Aldrich and Crook (2008), through analyzing the approved sites for trailer parks in New Orleans following Hurricane Katrina, discovered that areas exhibiting greater social capital were slated for fewer trailers. This is due to the civil society, besides working to bring citizens together, mobilized them against potential threats of trailer parks in their backyards. Also, through post- Hurricane

Katrina migration analysis, Elliott et. al (2010), emphasized that inequalities in social capital increase noticeably over the course of a disaster, leading the social security networks of less favorable residents to increasingly frayed and ineffective over time. This decline in social capital occurred largely because less favorable residents were unable to exploit transnational relationships in times of mass displacement. Bonding social capital which is deemed a crucial element to constitutes a kind of "sociological superglue", by creating strong intra-group loyalty, may also engender formidable out-group antagonism (L. A. Ritchie and Gill 2007). The above literature implied that social embeddedness itself does not always generate perfect outcomes. That is one of the reasons why strong in-group cohesion can, in some cases, pose implicit risks to their community such as more inequality (Aldrich and Crook 2008), high crime rate (Portes 1998), high suicide rate (Kushner and Sterk 2005), and more stress (Weil, Lee, and Shihadeh 2012).

The above literature, in general, sketched a vivid picture of social capital in the post-disaster context. Equally important segments, such as the link between "social connection and recovery speed" and the dynamic of "social connections in recovery sub-phases", meanwhile, were not given due attention. Indeed, there are relatively few studies, especially in Vietnam, investigating how social connections accelerate households' recovery speed, and how their roles change in the different recovery sub-phases. Therefore, this study, through examining post-flood recovery in central Vietnam, aims to expand these areas of knowledge.

5.3. Study site and methods

5.3.1. Study site

Located in the North Central Coast region of Vietnam, Thua Thien Hue Province was selected as a case study based on its low-lying terrain and flood history. With more than a hundred kilometers long coastline and interwoven fluvial systems, this province is a gathering place of various natural calamities, particularly floods and storms (Vo et al. 2021). About two-thirds of the province's population is exposed to floods during extreme rains (NCAP 2005). This province is also known as one of the most disaster-prone areas in Vietnam (Tran, Shaw, et al. 2008).

As mentioned in previous chapters, Thua Thien Hue Province has experienced many severe floods, such as events that occurred in 1953, 1975, 1983, 1989, and 1999. One of the

worst floods of the century occurred in November 1999 in central Vietnam. The daily rainfall was up to 1,422mm, equivalent to a total rainfall of nearly an entire year. The water level rose nearly one meter per hour. At Kim Long station of Thua Thien Hue Province, the flood level was up to 5.81 meters, equivalent to a 2-storey house. This flood killed at least 547 people, left dozens missing, caused initial damage of more than 200 million US dollars, and damaged 630,000 houses (Valeriano et al. 2010; VDMA 2019). Provincial authorities' efforts to erect massive structural works, although contributing significantly to reducing flood frequency, were sometimes incapable of reducing flood magnitude. In 2017, water release from hydropower and irrigation reservoirs resulted in flood depth equivalent to the 1999 historical flood in some rural areas, and thus caused heavy damage to villagers (C. D. Nguyen et al. 2021).

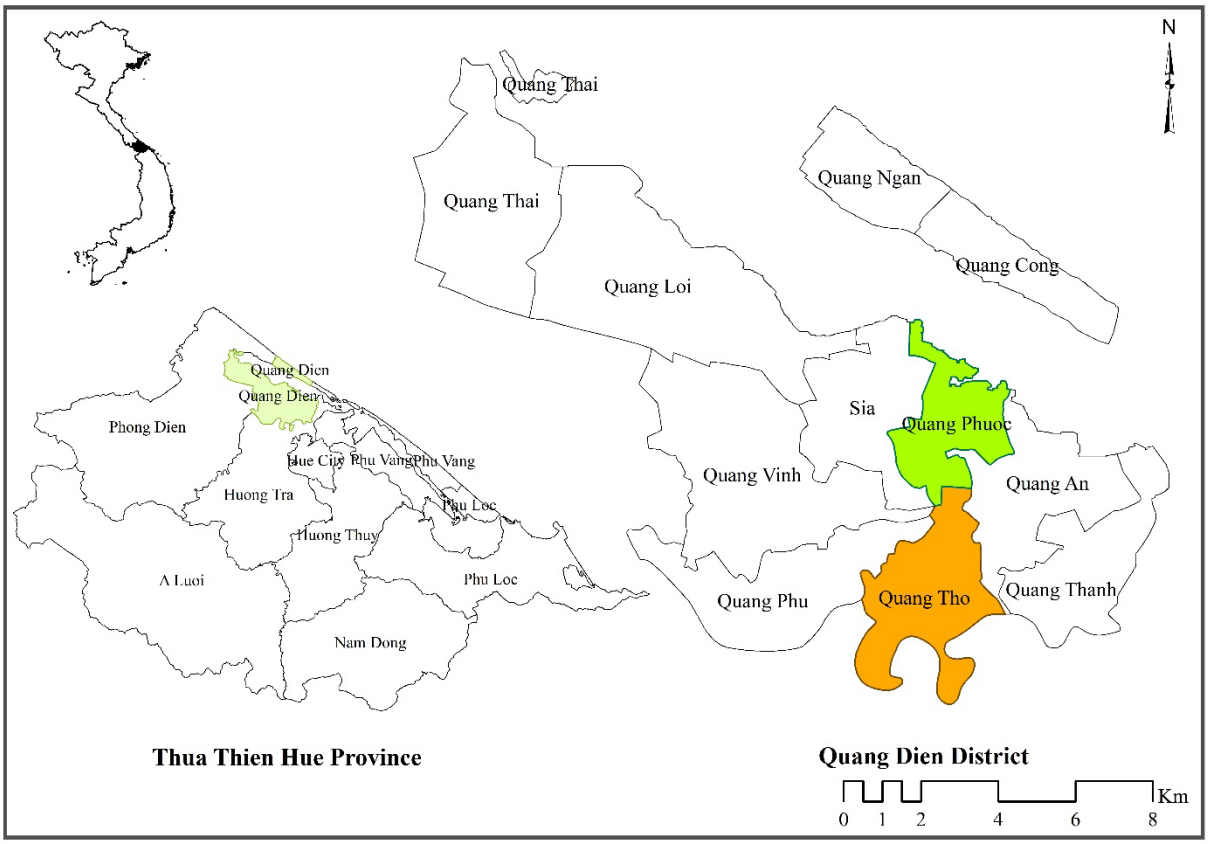


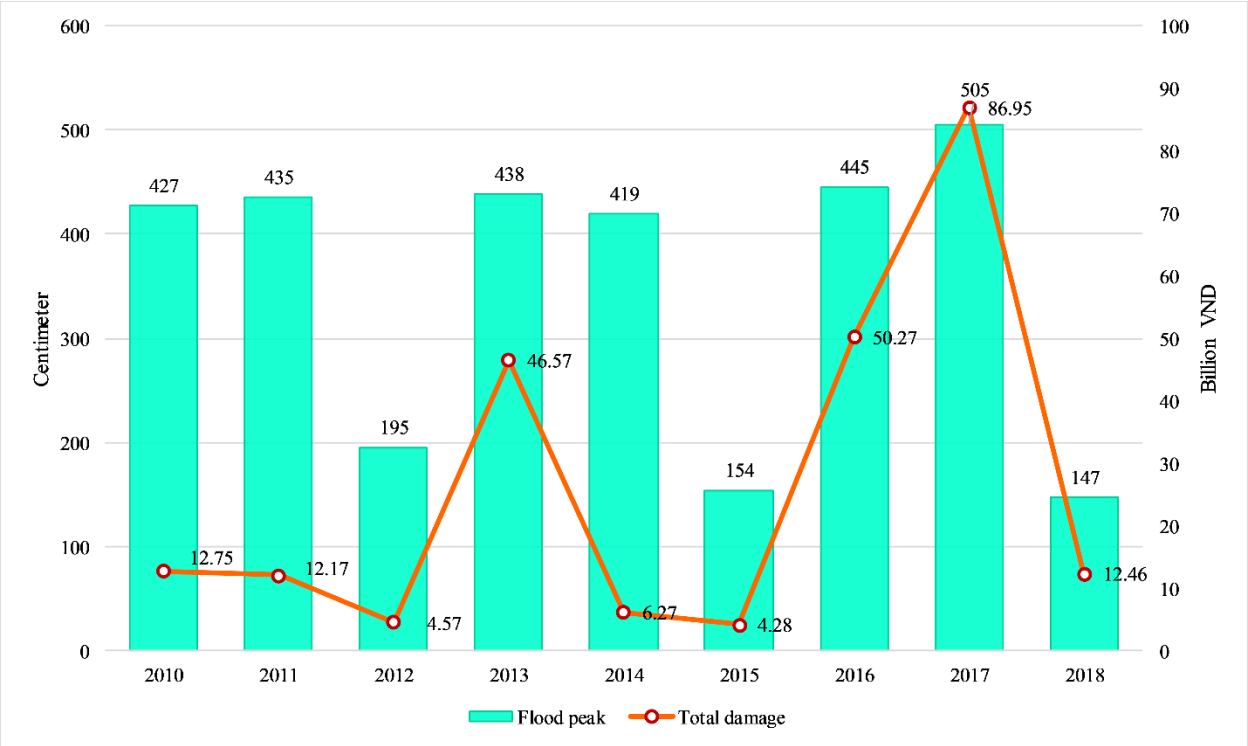
Figure 13: Map of study site

Source: Authors

Four villages, Mai Duong and Thu Le 3 (Quang Phuoc Commune); Phuoc Yen and La Van Ha (Quang Tho Commune) in Quang Dien district were selected for the survey. Quang

Dien is known as the most low-lying and flood-vulnerable districts in Thua Thien Hue Province, with nearly 86,000 inhabitants. Agriculture and aquaculture are the most dominant livelihoods in the locality, contributing to about 38.6% of the total production value. Low-lying terrain with dense river systems and concurrently adjacent to Tam Giang Lagoon creates a great advantage for the local economy, but also hides many potential hazards whenever flood comes.

Due to the simultaneous effects of intensive cold air, the circulation of severe storm No. 12 called Damrey and a huge amount of water discharged from hydroelectric dams, a widespread flood befell in Quang Dien rural district from 3 to 6 November 2017. As a result, the local inter-village and inter-commune roads were completely separated. Nearly 4,000 houses were submerged at least 0.5 meters deep. As reported by the district, nearly 400 hectares of paddy field, 260 hectares of vegetables, 400 tons of fish, 30,000 cattle and poultry, and many other infrastructures were damaged by this flood. The total tangible loss was estimated at approximately 90 billion VND, a huge burden for a quasi-agricultural district (Figure 14).

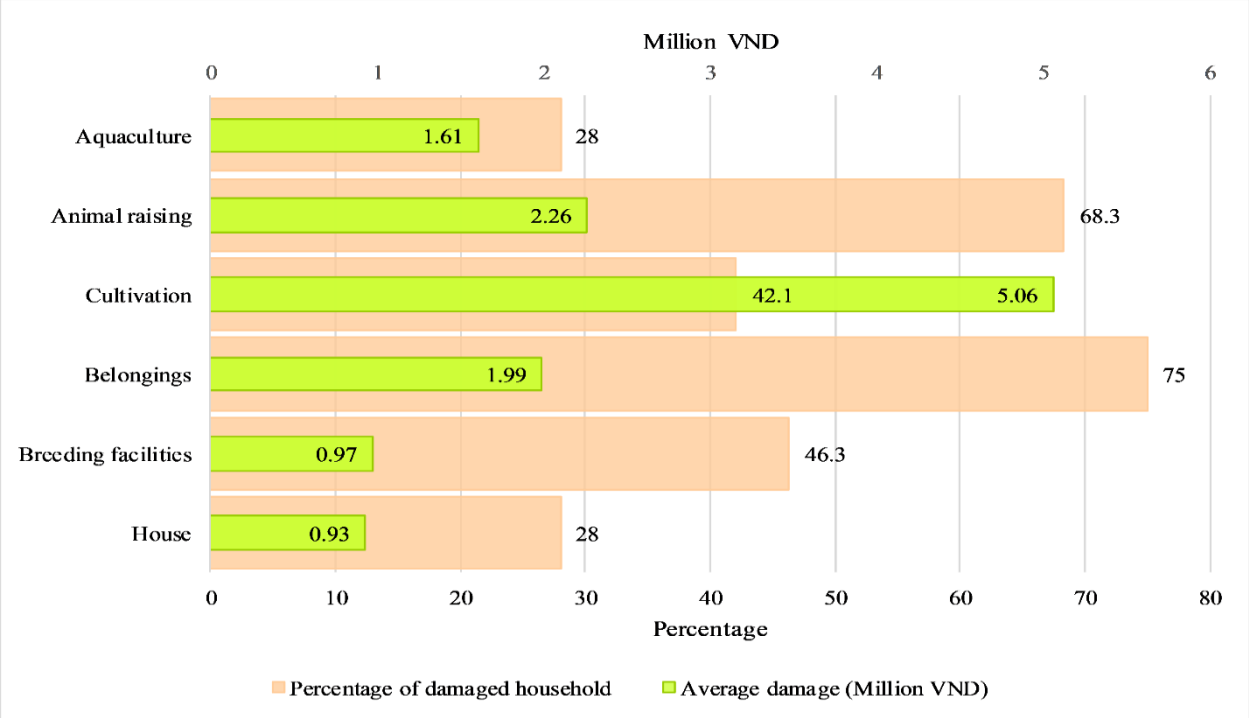


1 USD ≈ 23,184 VND

Figure 14: Tangible flood damage in Quang Dien district

Source: Quang Dien district People's Committee

Figure 15 shows the most common types of damage suffered by the interviewed households. Aside from the tangible aspect of damages, they were also converted into monetary terms based on the subjective estimation of interviewees. Basically, the extent of damage for each category was relatively similar among the surveyed villages. It is clear that in-house asset damage was the most common, as it was experienced by about three-quarters of interviewed households; animal husbandry activities followed with nearly 70%. On average, each household lost roughly 2 million VND in each of the above categories. Nearly half of the households (46.3%) also suffered in terms of breeding facilities. However, their damage was just under 1 million VND per household, as they were mostly made of low-priced materials. Damage to housing was low in both the household rate (28%) and damage value (0.93 million), as most villagers reinforced their houses relatively well before the flood. With regard to farming activities, although the damaged household rate was low (42.1%), the financial loss was the highest (5.06 million). The aquaculture loss was quite high (1.61 million) despite a low percentage of damaged households (28%). On average, each household lost about 13 million VND after the 2017 flood.



1 USD ≈ 23,184 VND

Figure 15: Household damage by the 2017 flood

Source: Household interviews, 2019

Quickly recovering after losing is a great challenge for both local authorities and villagers. Because local resources are limited, it is probable that villagers relied on others to rebuild their lives. This locality, therefore, was chosen to examine the recovery of villagers in connection with their social networks.

5.3.2. Methods

5.3.2.1. Data collection

Data collection was conducted in Quang Dien District from early September to late November 2019. The initial investigations using the in-depth interview method were carried out with key informants in Quang Dien District (Vice Head of Agriculture and Rural Development Department), Quang Phuoc, and Quang Tho communes (Vice-Chairman), and four suggested villages (village heads) to get an overview of the local socioeconomics, flood-related secondary data, as well as to search for appropriate study sites.

We applied Taro Yamane's formula to estimate the minimum sample size (Yamane 1967). The formula is given as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where: n is the sample size

N is the total number of affected households

e is the margin of error

As reported by village leaders, out of 1,862 households in four villages, about 1,187 households were affected by the 2017 flood at different levels (equivalent to 63.75%). By assigning the margin of error (e) at 10%, the minimum number of samples that need to be interviewed is 92. In other words, the number of interviewed households should be greater than 92 to ensure the representativeness of the sample. Therefore, the cross-sectional data of 164 households were collected by using the face-to-face interview method.

The number of interviewed households is relatively equally divided among the four villages. Since this study targets the post-flood recovery phase, only households who experienced damage in the 2017 flood were visited. To avoid bias or discrimination, these

households were randomly selected from the household list provided by the village leaders. Our target interviewers are household heads who are normally men, hold the highest decision-making power in the family, and understand clearly household recovery process. To facilitate the interviews, a semi-structured questionnaire was developed after a thorough process of document review combined with the consultation of specialists who are well-versed in both floods and villagers' lives. The questionnaire is a mixture of closed, semi-closed, and open questions. By following the questionnaire structure, the interviews usually began with questions related to household demographics, followed by their social networks with friends, neighbors, relatives, formal groups, and informal groups. The 2017 flood was then recalled to understand households' losses, time to full recovery, and contribution of social connections to their rehabilitation process.

Distinguishing these connections is one of the important points in the data collection process. In this study, we considered official community-based organizations (e.g., Farmers Union, Women's Union, Youth Union, Fishery Association, and Veterans' Association) as formal groups, which differ from informal ones (e.g., individual business group, ornamental plant group, ornamental bird group, mechanic group, bricklayer group, seafood trading group), both in terms of general goals and management mechanisms. Regarding the connection with neighbors and relatives, the counting of relatives was prioritized if there was any overlap in role between them. Meanwhile, links with other peers were comparable to those with friends.

In Table 7, the characteristics of the sample are briefly reported. Male household heads dominated the sample (81.71%). The majority of respondents were middle-aged (74.39%). Almost all respondents (53.66%) attended secondary school, and only 2.44% reached high school. More than two-thirds of the participants belonged to the middle-income class (71.34%), while 17.07% are defined as poor. The average number of laborers per household was 2.48. In which, about 45% of households had more than 2 laborers. Agriculture, aquaculture, and a combination of them were the main income source for 60%, 6,71%, and 18.29% of households, respectively. Semi-permanent houses were the most typical, accounting for nearly 70% of the total, and only 15.85% had been upgraded to permanent housing, while 14.63% remained temporary.

Table 7: Characteristics of the sample (n=164)

Characteristics		Frequency	Percentage
Gender	Male	134	81.71
	Female	30	18.29
Age	35–60	122	74.39
	> 60	42	25.61
Education level	Illiteracy	5	3.05
	Primary school	67	40.85
	Secondary school	88	53.66
	High school	4	2.44
Number of laborers	≤ 2	91	55.49
	> 2	73	44.51
Monthly income per capita	< 1.5 million VND	28	17.07
	1.5–4.5 million VND	117	71.34
	> 4.5 million VND	19	11.59
Main income source	Agriculture	98	59.76
	Aquaculture	11	6.71
	Agriculture and aquaculture	30	18.29
	Others	25	15.24
Household classification	Non-poor	136	82.93
	Poor	28	17.07
House type	Permanent	26	15.85
	Semi-permanent	114	69.52
	Temporary	24	14.63

1 USD ≈ 23,184 VND

Source: Household interviews, 2019

In Table 7, the characteristics of the sample are briefly reported. Male household heads dominated the sample (81.71%). The majority of respondents were middle-aged (74.39%). Almost all respondents (53.66%) attended secondary school, and only 2.44% reached high school. More than two-thirds of the participants belonged to the middle-income class (71.34%), while 17.07% are defined as poor. The average number of laborers per household was 2.48. In which, about 45% of households had more than 2 laborers. Agriculture, aquaculture, and a combination of them were the main income source for 60%, 6,71%, and 18.29% of households, respectively. Semi-permanent houses were the most typical, accounting for nearly 70% of the total, and only 15.85% had been upgraded to permanent housing, while 14.63% remained temporary.

5.3.2.2. Data analysis

This study applied both quantitative and qualitative approaches. Quantitative analysis was used to observe trends of association between variables, while the qualitative analysis was employed to explicate the implications.

In the first half, a multiple linear regression model (OLS) was executed to examine the influences of explanatory variables on the households' post-flood recovery speed. The outcome variable (recovery time) was defined as the time that households needed to re-establish at least 90% of their damages (housing, livelihoods), and reconnect with basic services they had before the flood.

The 90% rehabilitation threshold of housing and livelihoods was chosen based on the consultation of the village leaders, who are well-versed in both floods, associated damages, and villagers' recovery process. Accordingly, it is impossible to identify the absolute exact recovery time of households as it is a relative indicator. Hence, setting a recovery amplitude is proper to ease the data collection process. They also suggested that it would be appropriate to choose the 90% threshold as the function of housing and livelihoods is almost restored to the pre-flood condition. In terms of access to basic services, we only examined the ones related to electricity, clean water, schools, and healthcare. The questions used to obtain these data were: "How long did it take to restore housing and livelihoods to the pre-flood equivalent level?" and "How long did it take to get access to electricity, clean water, schools, and healthcare services?". It should also be noted that some livelihood activities, instead of being restored after the flood, were sometimes replaced by others. In these cases, the time required to search for or establish new equivalent livelihoods was recorded. Because the time to recover different types of damage is varied, we considered the longest time to restore all the above-mentioned damages and services as the full recovery time.

For explanatory variables, we focused on households' social networks, as they are an incarnation of social capital. Here, social networks include connections with friends, neighbors, relatives, formal groups, and informal groups. They were identified based on the number of trusted links households had for each type. In addition, variables related to total flood damage and household demographics were also included in the model (Table 8). From these variables, we expected to discover some statistically significant effects on households' recovery speed.

Likewise, we believed that recovery would be quicker for households with one of the following characteristics: male, younger and better-educated heads of household, more laborers, non-farm jobs, and higher income.

In the second half, quantitative comparative and qualitative analysis methods were utilized to examine how the roles of different social connections vary in recovery sub-phases. Bonding social connections were hypothesized to play a more important role in the early stage of recovery. The linking ones, meanwhile, were expected to contribute more significantly to households' long-term recovery.

Table 8: Descriptive statistics of the variables included in the model

Variable	Measurement	Min	Max	Mean	SD
Outcome variable					
Recovery time	Time to full recovery by month	0.5	8	3.12	1.46
Explanatory variables					
Gender	1 = Male, 0 = Female	0	1	0.82	0.39
Age	Age of household head	35	83	53.81	10.51
Education	Schooling year of the household head	0	12	5.82	2.52
Laborer	Numbers of laborers	0	5	2.48	1.00
Non-farm job	1 = Yes, 0 = No	0	1	0.52	0.50
Income	Monthly income per capita (million VND)	0.4	10	2.90	1.53
Damage	Total damage (million VND)	1	54.5	12.83	9.88
Friend	No. of links to trusted friend	0	10	3.78	1.87
Neighbor	No. of links to trusted neighbors	1	9	4.56	1.91
Relatives	No. of links to trusted relatives	2	13	5.71	2.10
Formal group	No. of formal groups with membership	0	5	2.53	1.12
Informal group	No. of informal groups with membership	0	5	1.52	1.20

1 USD ≈ 23,184 VND

Source: Household interviews, 2019

5.4. Results

In this section, the data obtained through household interviews are analyzed in the following order: determinants of the post-flood recovery speed; and the role of social connections in recovery sub-phases.

5.4.1. Post-flood recovery speed and determinant factors

The multiple linear regression model (OLS) was used to investigate the factors influencing households' post-flood recovery speed. Recovery speed is a continuous variable measured in units of months. Included in the model as predictors, there were eleven variables related to either household demographic characteristics, total flood damage, or social connections.

The results are briefly presented in Table 3. The data first confirm a high degree of correlation between the explanatory variables and the households' recovery speed. Overall, about 43.9% variation in the recovery time can be explained by the explanatory variables included in the model (R^2 = 0.439). Further, a statistically significant level at 1% of the F value (9.838) implies that the regression model predicts the dependent variable significantly. In other words, at least one regression coefficient in the model is non-zero. In addition, the multicollinearity related concern between the variables was released because all VIF coefficients (Variance Inflation Factors) are lower than 2 (Table 9).

In Table 9, factors accelerating households' post-flood recovery have been revealed. Contrary to our hypotheses, the connections between households' demographic characteristics and recovery time are non-significant. Accordingly, households' post-flood recovery time is not influenced by the gender and age of the household head ($p > 0.05$). These characteristics can be perceived as valuable inputs for the recovery process. This association direction is probably valid for middle-aged household heads, but may be irrational for the elderly, who probably rely on others to stabilize their lives. Similarly, we found no statistically significant relationship between household heads' education level and recovery speed ($p > 0.05$). For flood recovery, informal education or experience may play a more crucial role than formal education. It is also possible that the relatively low and coequal educational level of villagers is inadequate to convert into any significant advantages in the recovery phase.

Table 9: Results of linear regression on factors determining post-flood recovery time

Explanatory variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
Constant	4.992	0.738		6.763	0.000	3.533	6.450		
1. Gender	0.326	0.244	0.087	1.340	0.182	-0.155	0.808	0.885	1.131
2. Age	-0.002	0.010	-0.013	-0.192	0.848	-0.021	0.017	0.826	1.210
3. Education	-0.049	0.038	-0.084	-1.277	0.204	-0.124	0.027	0.854	1.171
4. Laborer	-0.112	0.113	-0.077	-0.984	0.326	-0.336	0.113	0.613	1.631
5. Non-farm job	-0.133	0.243	-0.046	-0.547	0.585	-0.613	0.347	0.532	1.880
6. Income	-0.135	0.073	-0.142	-1.858	0.065	-0.278	0.009	0.639	1.565
7. Damage	0.056**	0.011	0.382	5.121	0.000	0.035	0.078	0.669	1.494
8. Friend	-0.055	0.056	-0.071	-0.985	0.326	-0.166	0.056	0.716	1.396
9. Neighbor	-0.083	0.055	-0.109	-1.517	0.131	-0.192	0.025	0.717	1.395
10. Relatives	-0.120*	0.053	-0.173	-2.267	0.025	-0.225	-0.015	0.638	1.568
11. Formal group	0.027	0.090	0.021	0.295	0.769	-0.152	0.205	0.767	1.304
12. Informal group	-0.347**	0.095	-0.286	-3.657	0.000	-0.534	-0.159	0.609	1.643
Model summary									
R-squared					0.439				
Adjusted R-squared					0.394				
F value					9.838**				

**, ** Significant at 5% and 1%, respectively*

Source: Data calculated by authors

While other demographic variables negatively affect the recovery time of households (although statistically insignificant), the head's gender has a positive effect direction. This means that female-headed households, while hypothesized to recover more slowly, rehabilitated even somewhat quicker than male-headed households. This unexpected result caught our attention and encouraged us to dig deeper into this aspect. Therefore, a sub-analysis, as shown below, was performed to check the relationship between the gender variable and others (Table 10).

Table 10: Results of the t-test for the mean difference between the gender groups

Characteristic	Men	Women	t	df	Sig.		95% CI of the Difference	
	Mean (SD)	Mean (SD)					Lower	Upper
Laborers	2.60 (0.96)	1.93 (1.02)	3.39	162	0.001	**	0.277	1.050
Damage	13.41 (10.01)	10.21 (9.02)	1.61	162	0.109		-0.719	7.127
Friend	3.89 (1.91)	3.30 (1.60)	1.57	162	0.119		-0.153	1.329
Neighbor	4.60 (1.89)	4.40 (2.01)	0.51	162	0.611		-0.566	0.960
Relatives	5.66 (2.13)	5.90 (2.01)	-0.55	162	0.580		-1.076	0.604
Formal group	2.61 (1.05)	2.17 (1.34)	1.98	162	0.049	*	0.002	0.888
Informal group	1.56 (1.19)	1.37 (1.22)	0.79	162	0.428		-0.286	0.672

**, ** Significant at 5% and 1%, respectively*

Source: Data calculated by authors

Table 10 shows that there was no difference in the degree of damage, and social connections with friends, neighbors, relatives, and informal groups between the two gender groups ($p > 0.05$). In terms of the number of laborers and social connection to formal groups, women-headed households were even somewhat inferior to those headed by men ($p<0.05$). This result, on the one hand, may imply that women's capacity to cope with post-flood difficulties has been improved. On the other hand, it may indicate greater attention of local authorities and communities to vulnerable groups, including women, to help them overcome post-flood anxiety more effectively.

There is no doubt that financial capital is an indispensable resource for post-disaster rehabilitation, especially for those related to infrastructure and production activities. However, only weak linkages between households' financial-related characteristics and time for recovery was found. Although the number of laborers, job diversification, and income have certain positive influences on recovery time (B = -0.112, -0.133, -0.135, respectively), their associations are statistically insignificant ($p > 0.05$). Better-income

levels, an important ground for reconstruction, are often found in households with more laborers who are involved in non-farm jobs. The failure of households with these characteristics to shorten recovery time implies that there are certain barriers in translating these advantages into income in a short time period. Indeed, while agricultural production takes time to be harvested, the non-agricultural job market is less bustling after floods. A participant in Thu Le 3 village confided that "in addition to farming, I also work as a bricklayer. This work provides a stable income for my family, but only in the dry season (summer). As you know, nobody built a house right after the flood, so I did not have a job to improve the income." Therefore, it is impractical and unlikely that a person could make money from these opportunities in a short time period. This may be a possible reason why these advantages contribute little to households' recovery speed. Meanwhile, the failure of household income in hastening the recovery process may be the outcome of the correlation between income and investment. It is obvious that achieving a high level of income probably requires adequate investments from households. These investments, without severe floods, can yield large returns. Otherwise, households may suffer heavy losses, especially in the absence of adequate preventive measures. Therefore, the restoration can be extended. This assumption is bolstered because the recovery time was found to be negatively affected by the total damage. In this regard, more affected households tend to be delayed in recovery (B = 0.056; $p < 0.01$).

In contrast to demographic characteristics, some significant linkages were found while examining social connections. Households' recovery speed is first negatively influenced by relatives. Households who have more connections with relatives are likely to reconstruct more quickly (B = -0.120; $p < 0.05$). Living with relatives in the same or adjoining villages is quite common in Vietnamese rural society (Hirschman and Loi 1996). In the study site, this reality was also confirmed. For instance, an interviewee in La Van Ha village said that "My family has about thirteen trusted relatives living in this area. They live either in this village or in neighboring villages. We also regularly visit each other and share life difficulties." Achieving support is often easy and quick. As with the natural tightness among relatives, mutual help also emanates naturally. Additionally, since it is built on lineage ties, support from relatives is often greater physically and deeper mentally. These connections probably contribute to faster recovery of households. Connections with trusted friends and neighbors have no significant associations with households' recovery speed (B = -0.055; B = -0.083, respectively; $p > 0.05$). This reality may stem from the

relatively low income of the majority of the population. Households may also be less able to help each other since flood damage often occurs on a large scale and affects those in the same geographical circumstances. In this regard, a man living in Mai Duong village said, "Almost all the houses here were relatively equally flooded. So, damages were similar. Almost a month after the flood, I borrowed money from neighbors to repair the house and breeding facilities, but the amount was insufficient. Similar to me, they (neighbors and friends) also needed money to solve their difficulties after the flood." It is also likely that the primary aid from relatives subordinates other close relationships and makes them useful as reserves, which can be efficient if lineage ties fail.

Households' recovery time was shortened by informal groups ($B = -0.347$; $p < 0.01$) and was not affected by formal groups ($B = 0.027$; $p > 0.05$). Membership in an additional informal group shortens household recovery time by about 0.35 months. Members of voluntary formal groups normally includes almost all individuals with relevant characteristics, such as farmers, women, youth, and veterans. Due to their large scale, interactions between members of formal groups are usually superficial. This, combined with limited operational funding, makes these groups less helpful in supporting members. Meanwhile, informal groups are often built on the basis of identical traits (e.g., hobby or career), which help form empathy and cohesion among members. In addition, the smaller scale should also be seen as an advantage to promote stronger cohesion among members of informal groups. One of the typical examples of this is well presented in the statement of a man in La Van Ha village. He said, "Our team consists of about 12 ornamental flower growers living in this village. We interact with each other quite often. We usually support each other in terms of experience, flower care techniques, flower varieties, and capital goods as well." These are possible grounds for revealing why informal groups were more effective than formal ones in supporting their members.

5.4.2. Role of social connections in recovery sub-phases

To deeply examine how the role of different social connections vary over time, the post-flood recovery was divided into three sub-phases: immediately after the flood (within three days), the short-term recovery phase (within three months), and the long-term recovery phase (over three months). The first sub-phase was set within the first three days after the flood as it is viewed as the most arduous time for most households. Meanwhile, the transition point between the short-term phase and the long-term phase (three months) was determined through the mean (3.12 months) and median (2.65 months) of recovery

time. In the following figures, we examine the supported household percentage and corresponding supporters in different categories and at different sub-phases.

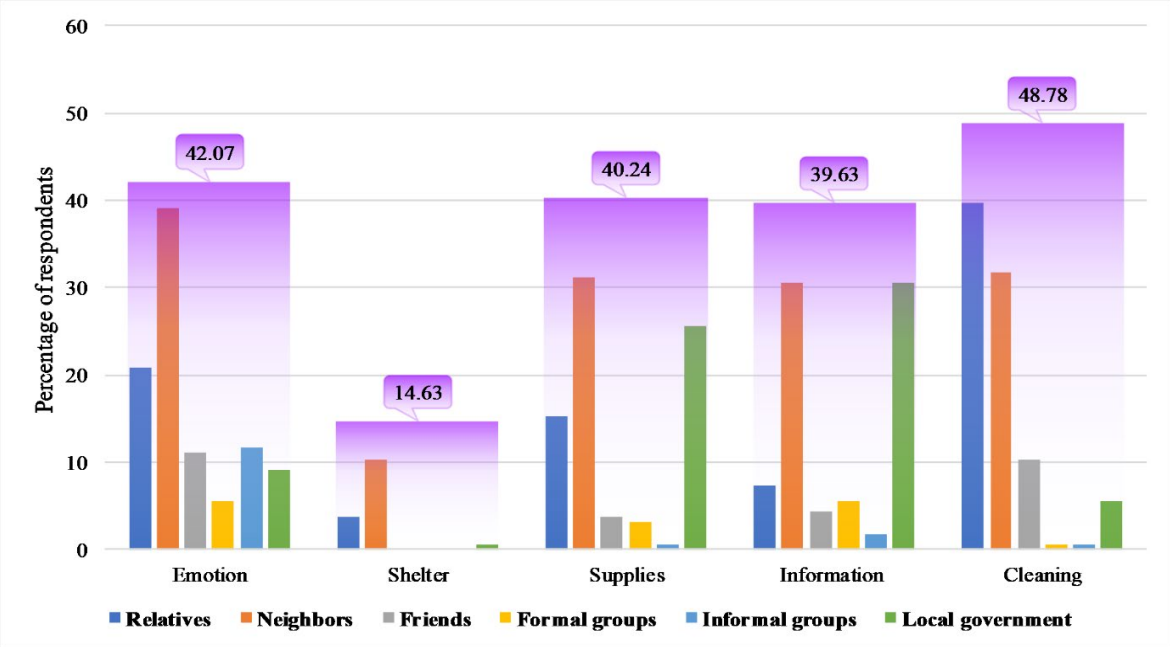


Figure 16: Social support immediately after flooding

Source: Household interviews, 2019

The rehabilitation process began shortly after the floodwater receded. Support related to emotions, shelter, supplies, information, and cleanup were the most common during the first days after the flood (Figure 16). Debris cleaning is the most popular help since it was received by nearly half of the respondents (48.78%), followed by emotions, supplies, and information (about 40%), and shelters (14.63%). The roles of relatives and neighbors were underscored in this stage; they provided the most support in almost all categories. Mental support, although non-financial, is extremely important, especially for those who experienced severe damage. Households reported that emotional support is indispensable for them to overcome flood-induced stress. Almost 40% of households received this type of support from neighbors, while over 20% were obtained from relatives. Similarly, 32% and 39% of households were supported by neighbors and relatives in cleaning up deposits and debris, respectively. For most households, cleaning mud deposits took place immediately after the floodwater had receded. This work is much easier with a water layer on the floor. This type of help is often directed towards solitary or labor-scarce households. In addition, providing temporary shelters was also mainly done by neighbors at about 10%. In contrast, the contribution of the local government in this emergency time

was only reflected through supports related to information and necessities. The authorities provided urgent necessities to 25% and information to 31% of households. Most of them are poverty-stricken or harshly damaged households. Supports from friends and formal groups were negligible during this period.

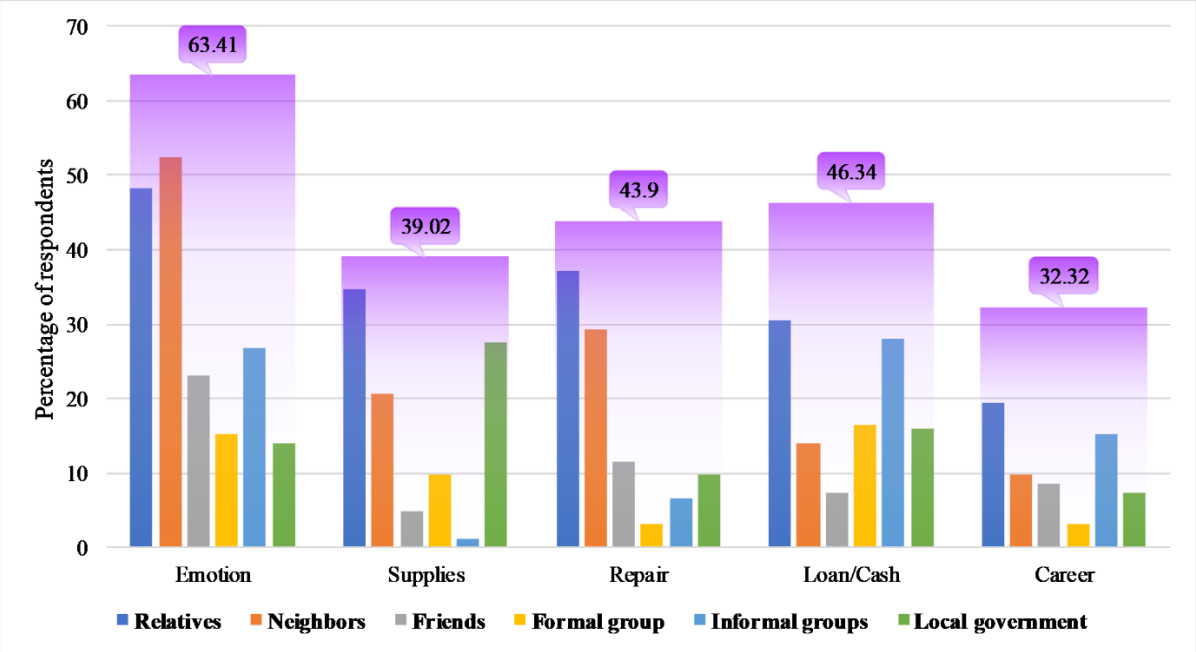


Figure 17: Social support in the short-term recovery phase

Source: Household interviews, 2019

In contrast to the early stage, the support efforts in the short-term recovery phase mainly concentrated on emotions (63.41%), supplies (39.02%), repair (43.90%), cash (46.34%), and career (32.32%). Relatives and neighbors still play a key role in this sub-phase. Notably, relatives gave most support in four out of five categories, including supplies (35%), repair (37%), cash (31%), and career (19%). Support from friends, formal groups, informal groups, and local government, though fairly modest in the early stage, also tended to increase during this period (especially for informal groups and local governments). For instance, informal groups provided cash to 28% and career support to15% of households. Meanwhile, approximately 27% and 15% of respondents received necessities and livelihood-related support from the local government. Similar to the first sub-phase, locals reported that the local government's support in this period was still limited in both the quantity and number of beneficiaries. Assistance from informal groups, by contrast, was both more in quantity and diverse in terms of beneficiaries. Friends and formal groups, though impressive in mental heartening, were underwhelming in providing

necessities, repairs, finance, and livelihoods. Only about 10% of interviewees obtained these kinds of assistance from friends and formal groups (Figure 17).

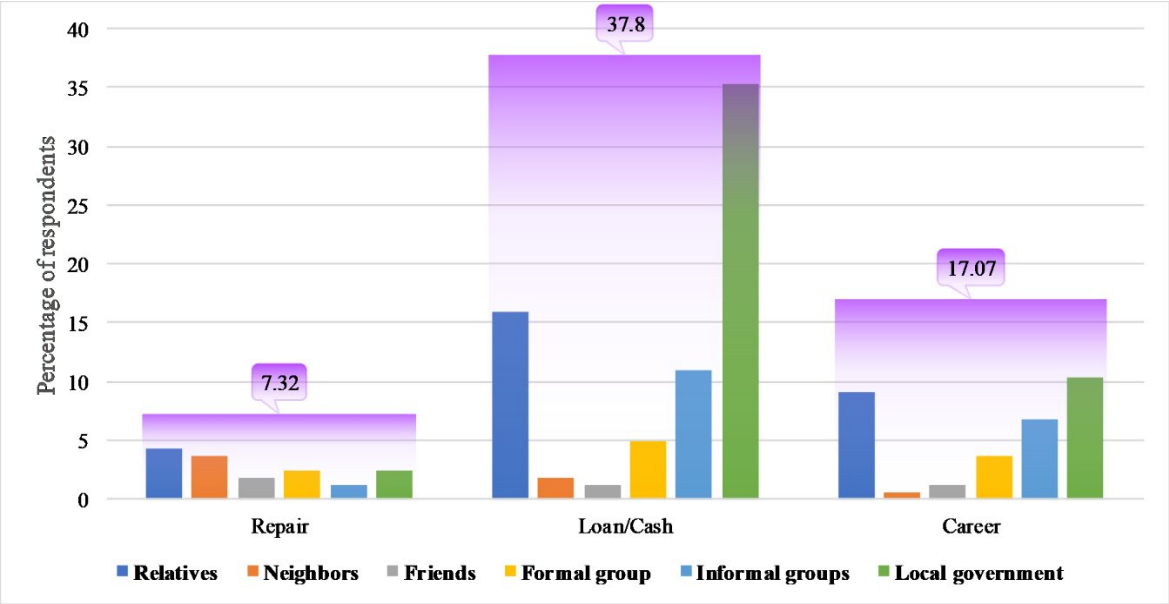


Figure 18: Social supports in the long-term recovery

Source: Household interviews, 2019

While support from neighbors, friends, and formal groups tends to gradually diminish, the long-term recovery sub-phase saw striking contributions of the local government. In this sub-phase, 7.32%, 17.07%, and 37.80% of interviewees benefited from support related to housing repair, livelihoods, and finance, respectively (Figure 18). The roles of relatives and local government, though relatively equivalent to other linkages in repairing housing, significantly surpassed in financial and livelihood categories. In particular, about 35% and 10% of households acquired financial and livelihood support from the local government, respectively. The allowance was mainly determined based on the extent of the damage. This is the local authorities' regular policy to share the losses with the villagers and facilitate their recovery process. This effort by the local governments was helpful, but it progressed slowly. So, it was less efficient in improving the recovery speed. This not only shows the limitations of local resources, but it also indicates difficulties in inventorying damages, as well as the cumbersome administrative procedures between authority levels.

5.5. Discussions

5.5.1. Demographic characteristics and post-flood recovery speed

Slow recovery is one of the causes of increased welfare expenditure. It also deepens economic losses and heightens emotional distress. Mobilizing all possible resources to recover from floods is one of the households' urgent priorities.

It is not surprising that the data recorded a negative effect of the damage level on recovery time. More severely damaged households tend to require more time for recovery. This result is consistent with those of Kurosaki et al. (2012), Bubeck and Thieken (2018), and Sadri et al. (2018), who found that the more physical items or economic value lost, the more delayed households recovery. However, this association contradicts the results of Platt (2018). Meanwhile, all relationships between households' demographic characteristics and post-flood recovery speed were statistically insignificant. Specifically, gender, age and educational qualifications of the head of household, number of laborers, engaging in non-farm jobs, and income level were futile in reflecting households' recovery time. In other words, rapid or slow recovery from floods is uninfluenced by household demographics. Our finding, while contrasts with those of Kurosaki et al. (2012), Francisco (2014), Himes-Cornell et al. (2018), and Sadri et al. (2018), corresponds well with the conclusion of Platt (2018). For instance, Sadri et al. (2018) found that large households can delay the recovery effort. Similarly, Francisco (2014) emphasized the role of income in shortening the property recovery process. The contrast in study area characteristics is probably the root of this difference. While our study focused on farming households in rural areas, Francisco (2014) analyzed the recovery of wage earners in Metro Manila, Philippines. Our results, meanwhile, intensify the outcomes of Platt (2018) that there appears to be very little relationship between the recovery time and exogenous factors, such as demographics and economics.

Since women are generally considered more vulnerable during recovery (Hamidazada et al. 2019), the similarity in recovery time between households headed by men and women pulled our attention (see Table 3).

This result, on the one hand, may imply that the coping capacity of women in post-flood recovery seems to be improved. This conjecture is bolstered since we found no significant difference in the damage extent ($p>0.05$), and social connections with friend, neighbor, relatives, and informal group ($p>0.05$) between two gender groups. In terms of number of laborers and social connection with formal groups, women-headed households are even somewhat inferior to those headed by men ($p<0.05$) (see Table 4). If this conjecture is accepted, it is most likely a positive effect emanated from flood resilience enhancing projects for vulnerable populations (including women), conducted recently in Thua Thien Hue Province (CSRD 2017). This finding is consistent with recent findings on women's role and capacity in post-disaster recovery. For instance, Clissold et al. (2020), through examining the recovery process after Cyclone Pam and severe drought followed in

Vanuatu, demonstrated critical roles of women as capital mobilizers, collectivizing and leading forces, innovators, and entrepreneurs. Kusumasari (2015), meanwhile, pointed out reasons why women have their capability to rebuild their life, even better after disasters. It suggested that social capital, economic development, information, and communication, as well as cultural-based competence, provided effective and sustainable assistance to crisis-affected women. This result, on the other hand, may imply greater attention of local authorities to vulnerable groups such as the poor, the lonely, and female-headed households in dealing with the aftermath of floods. As revealed by the Mai Duong's village head, insecure households in the village were often prioritized to distribute relief goods and support earlier and with a larger quantity. They also often received more support from the community than other households, he further explained.

Our results also suggest that different ages offer different advantages in recovery. Younger heads of household may have advantages in health and access to information but are often inferior in recovery experience and social connections; older people have an advantage in this regard. Similarly, informal education or experience are often more important than formal education in recovering from floods. In addition, the relatively low and coequal education level of household heads may also explain why educational qualifications are separated from the speed of recovery. The inefficacy of advantages in the number of laborers and non-farm jobs may be due to the scarcity of non-farm employment after floods and the time required for agricultural production. The inefficiency of the higher-income households in rehabilitation should be attributed to the causal relationship between investment level and extent of damage. This inference is verified because higher-income households tend to suffer more, and delayed recovery tends to accompany higher-damage households ($p < 0.05$).

5.5.2. Social connections and post-flood recovery speed

The data, contrary to the above results, demonstrate the more important role of social connections. In which, relatives and informal groups seem more helpful in hastening the households' recovery compared to friends, neighbors, and formal groups. The significant effect of relatives on recovery probably emanates from the tightness of the blood-based relationship. Almost all respondents stated that this biological link is the principal foundation driving the prompt, devotional, and considerable help from relatives. For some households, relatives were also viewed as a type of natural insurance, which never abandons them in difficult times. This notion that relatives usually pioneer in

supporting households to overcome the most difficult times supports the findings of Masud-All-Kamal and Hassan (2018), who conducted a case study in coastal Bangladesh. This result also resonates with the findings of Casagrande et al. (2015) that immediate family is viewed as a critical prop of rural residents living along the floodplain Mississippi River during both emergency and long-term restoration. Meanwhile, the positive influence of informal groups probably stems from their small scale, diverse membership, and grounds of formation. Members in informal groups, different from formal ones, are assembled with the purpose of satisfying personal and psychological needs. These characteristics can be regarded as advantages to build mutual sympathy and trust among members, which are essential to promote assistance. Supporting others to overcome difficulties, on the basis of the reciprocity theory, can be seen as a providence for uncertainties that may arise in the future as individuals tend to recompense those who helped them (direct reciprocity) (Trivers 1971). Also, since individuals tend to help those who help others (indirect reciprocity), assistance should be viewed as an investment in reputation to strengthen collaborations with others (Alexander 2017).

In addition, the significant effect of relatives and informal groups in the regression model may be partially due to their wider geospatial distribution, which can extend beyond the boundaries of flood-affected villages. This characteristic enables flood victims to access more abundant resources from relatives and informal groups in other areas less affected by floods. This result suggests that in addition to accepting relatives and informal groups as the usual "bonding type," they should also be viewed as the "bridging type." This is true for instances when they live outside the geographical perimeter of flood victims (neighboring villages, city centers, or other provinces, etc.). Our approach to the types of social connections is briefly described in Table 11. Formal groups may not have these traits, and this may explain why they were ineffective in supporting flood victims. The minor effect of neighbors on households' recovery speed is probably because of their relatively low income and flood-induced burdens. Reciprocal help between neighbors in post-floods, though common in rural society, is relatively modest in aid volume. This is because households living in the same terrain tend to suffer similarly. This result is in line with the findings of Islam and Walkerden (2014) in a case study in Bangladesh. After cyclones, households are often incapable of supporting neighbors due to the massive damage and losses they experience.

Table 11: Types of social connections

Social connections	Main type (within village)	Sub-type (outside village)
Friend	Bonding	Bridging
Neighbor	Bonding	No
Relatives	Bonding	Bridging
Formal group	Bridging	No
Informal group	Bonding	Bridging
Local government	Linking	No

Source: Field surveys and results, 2019

The ineffectiveness of friends and formal groups in speeding rehabilitation is corroborated; they were almost the least supportive in all recovery sub-phases. Meanwhile, the vital role of relatives is further proven; their assistance occupies a fairly high percentage throughout all the recovery phases. It is noteworthy that although neighbors' help was comparable to relatives in terms of proportion, it was statistically insignificant in accelerating recovery. This result likely stems from the low support volume and limited geographic diversity of neighbors compared to relatives. Despite this fact, neighbors' support was still highly valued by most villagers. As found by Masud-All-Kamal and Hassan (2018), this may be due to their crucial role in providing immediate and initial relief. It is also highly likely that the role of neighbors is more helpful in other aspects of the recovery process, such as securing survival or improving the mental health of flood victims. This may also be why informal groups, while not so impressive in support frequency, were statistically significant in speeding restoration. In addition, examining the contribution of social connections in different sub-phases also revealed reasons why local government's support is less effective. These include the inadequacy of urgent aid and the late arrival of immediate aid. This is probably due to limited local resources, delays in damage inventory, and cumbersome administrative procedures between levels of government. In fact, the aid, in many cases, just comes after households have accumulated sufficient resources for their recovery or after the recovery has been completed. This result mirrors the outcomes of a recent study by Masud-All-Kamal and Hassan (2018). Initial relief and rehabilitation work by the government and other external agencies, while should be provided immediately, normally takes a few days to arrive.

The segmentation of the recovery process is not only helpful in interpreting the regression model results, but it also indicates the variation in the role of connections in different sub-phases. The crucial role of relatives and neighbors was demonstrated. They provided the most support in almost all categories, even right after the flood and in the short-term phase. Support from friends, formal groups, informal groups, and local government, though sparse in the initial phase, intensified in the second phase, especially among informal groups and the local government. The long-term recovery phase, meanwhile, witnessed the prominence of the local government through support related to finance and livelihoods. By emphasizing the crucial role of neighbors and relatives immediately after the flood and in the short-term recovery, our findings reinforce the conclusions of some previous studies (Islam and Walkerden 2014; Kim et al. 2017; Chan et al. 2018). Islam and Walkerden (2014) indicated that affected families rely heavily upon their bonding links to overcome the immediate crisis. Following that period, they continue contributing to recovery by reducing food intake, helping with alternative income, and suggesting livelihood options. Likewise, Kim et al. (2017) found that tight-knit bonding social networks are essential for short-term recovery. Disaster victims rely on close community members, such as family, relatives, and neighbors. As they are available and useful immediately after the disaster, the importance of bonding social connections was also highlighted by Chan et al. (2018). This result, however, does not fully concur with the conclusions of Nguyen-Trung et al. (2020), who argue that bonding social capital (family ties, relatives, close friends) plays a crucial role throughout all the recovery phases.

Regarding other connections, our findings are somewhat different from those of other scholars. For instance, Marín et al. (2015) highlighted the importance of linking social capital in determining post-disaster trajectories, while Islam and Walkerden (2014) highly appreciated the contribution of community-based organizations in long-term recovery efforts. While our study indicates the prominence of the local government in the long-term sub-phase, Kim et al. (2017) stressed the role of bridging social connections as households increase their interactions with connections outside their community. With regard to local government contributions, our results resonate with the judgment of Thanvisitthpon (2017) that official flood-recovery financial aid was incommensurate with actual expenditures, leading to low satisfaction among the inhabitants. These limitations were also considered the reason why people in floodplain areas distrust the capacity of local governments to provide recovery resources and tend to invest more in personal

precautions as found by Nguyen et al. (2021). Due to limited resources, households, especially in developing countries, tend to be abandoned with their losses after natural hazards (Osberghaus 2015). Therefore, instead of relying on supports from local authorities, self-reliance and utilizing resources from social networks to reestablish should be considered a sustainable direction of flood-prone residents.

5.6. Conclusions

Despite the increasing unpredictability and drastic consequences of floods, the insight into how different resources contribute to the rehabilitation process of households is still limited. Realizing this paucity of knowledge, this study investigated the recovery speed of rural households in central Vietnam in relation to their demographic characteristics and social connections. This study also identified the role of these actors in different recovery sub-phases.

The results of the linear regression model first confirm a positive correlation between the degree of damage and recovery time. It also shows the ineffectiveness of socio-economic and demographic characteristics (e.g., age and educational qualifications of heads of household, number of laborers, engaging in non-farm jobs, and income level) on the recovery speed. In other words, the advantages related to these characteristics did not convert into advantages in recovery speed. By contrast, the model emphasizes the vital role of social connections in accelerating the rehabilitation process of households. As they contributed significantly to shortening the recovery, connections with relatives and informal groups appears to be more useful than the other linkages. While blood-based relations were crucial among relatives, small scale, diverse membership, and formation grounds of informal groups were believed to be helpful as well. In addition, the geospatial differences between social connection types, which allow flood victims to access more abundant resources outside the village, are also seen as potential causes for the considerable effect of relatives and informal groups on the post-flood recovery speed of households. However, since speed is only one aspect of the recovery process, the impact of contributions by friends, neighbors, formal groups, and local authorities remains valuable to other aspects of household recovery. In other words, the role of these connections can be manifested in other aspects of the recovery process, such as ensuring survival during urgent cases or relieving the victim's mental pain in the long run.

In addition, this study, through the subdivision of the recovery process, further exhibits the variation in the role of social connections over time. Our analysis accents the substantial role of relatives and neighbors in the urgent period after the flood and the short-term recovery sub-phase; they were the most supportive in almost all phases and categories. Although both parties were relatively equivalent in terms of the support rate, in comparison with relatives, neighbors' lesser contribution in the regression model was attributed to the limited amount of support they provided.

Based on their proximity, neighbors are believed to play a greater role in providing urgent assistance. Compared to the time immediately after the flood, results indicate a gradual increase in the role of friends, formal groups, informal groups, and local government in the short term; this is especially true for informal groups and the local government. Households' long-term recovery efforts relied on the leadership of local government in providing financial and livelihood support. This study also notes the limitation of the local government and community-based organizations to support affected communities, especially during the immediate crisis. In addition to the lack of financial-related resources in developing countries, slow administrative procedures were identified as a problem with government support.

These findings stress the vital role of social capital in speeding post-flood recovery and identify the dynamics of social connections in the recovery sub-phases, which should be integrated into post-flood rehabilitation policy.

CHAPTER 6: GENERAL DISCUSSIONS

6.1. Limitations of authorities in mitigating flood risks

Floods are one of the main natural disasters in Vietnam. Flood risk reduction is therefore one of the central tasks of the Vietnamese government. This has been demonstrated through legal framework that are rigorously developed regularly upgraded as well as an institutional framework requiring the involvement of many levels of government. This important goal has also been concretized through many specific measures such as the construction of major reservoirs and dams at the national level and other combinded structural and non-structural measures at the local levels. It can be said that the government's efforts have made certain contributions to flood risk reduction in Vietnam in recent years. However, besides achievements, the management mechanism and risk reduction practices in Vietnam still show certain limitations.

Our research results show that floods are becoming increasingly irregular, making anticipating them by conventional approaches ineffective. In addition to objective impacts from environmental and climate changes (Chau et al., 2014; Razafindrabe et al., 2012), this unsettling fact is also attributed to the popularization of massive hydropower dams and irrigation reservoirs in the province. In reality, the majority of people were skeptical and distrustful of the effectiveness of this kind of measure in preventing and mitigating flood risks. Reducing flood risk by relying on structural works such as major reservoirs and dams can be seen as an output of the government's top-down approach. Despite their significant contribution to reducing the flood frequency, public concern about their effectiveness, the fact of recent major flood events in recent years, and their associated damages are overwhelming evidence revealing the limitations of measures followed this top-down approach. Structural measures solely are insufficient to achieve effective risk reduction (Priest et al. 2011). This fact shows the need for a more integrated flood risk management system to replace the purely technical-oriented defense.

Additionally, our findings have also revealed the limitations of the authorities in both taking preventive measures before floods and supporting flood victims to reconstruct their life after being suffered. At local levels, a number of public measures have been taken to strengthen the residents' defense capability. However, except for early warning systems that are judged to be effective, other measures relating to food stockpiling, emergency shelter preparation, evacuation assistance, and resource distribution for post-flood

reconstruction were still not commensurate with most people's expectations. The lack of resources, which leads to disproportionate and unsynchronized investment in public preventive measures as usually seen in developing countries, is the primary cause making government efforts less effective. In addition, the government's delay in responding to emergencies such as supporting means and shelters for evacuation, providing essential supplies immediately after floods, and inadequacies related to distributing resources for post-flood reconstruction were also the major reasons explaining why households did not appreciate the government' interventions in this regard.

Reasons for these shortcomings may be manifold but likely include limitations related the institution for flood risk management in Vietnam. It is arguable that the flood risk management institution in Vietnam is basically designed on the base of the top-down approach following administrative decentralization, which emphasizes the role of relevant government agencies from central to local levels. This approach, on the positive side, creates consistency in management and ensures close multi-level and multi-agency collaborations, which is often required for effective disaster management (Derthick 2007; Waugh Jr and Streib 2006). However, this type of top-down approach has been shown to lead to unfair and unsustainable outcomes in disaster risk management such as delays, and unequal resource distribution (Bollin and Hidajat 2006). Many other studies also indicated that the top-down approach is ineffective in risk management because it does not meet the actual needs of vulnerable people, ignores the potential of local resources, and may even increase the vulnerability of communities (Staden et al. 2006). In addition, the lack of consultation with other key stakeholders such as NGOs, experts, sociologists, and local people can also influence decision-making regarding flood risk reduction. Affected communities themselves should be at the heart of decision-making when planning and implementing disaster risk reduction measures (My Thi et al. 2012). Indeed, effective decision-making requires a combination of updated scientific knowledge and a deep understanding of the local context (Luu et al. 2018).

In addition, the lack of effective solutions in Vietnam may be further hindered by other institutional-related factors, such as decentralization and empowerment of local governments. Decentralization is supposed to contribute to good disaster governance by enhancing local capacity and by bringing in local perspectives and knowledge through the participation of local actors. Decentralization is also believed to advance disaster management practices as disasters and disaster risks manifest themselves locally. Similarly,

the activities of local governments and non-governmental actors are believed to facilitate context-specific risk management solutions that are custom-tailored to the specific needs, wants, and capabilities of local communities (Garschagen 2016). However, the process of decentralizing and empowering local flood risk management in Vietnam is facing many challenges due to limited local capacity and resources as indicated by Garschagen (2016), Huynh and Stringer (2018), và Nguyen et al. (2021). Addressing these above issues is prerequisite for more effective and sustainable flood risk management in Vietnam.

The above discussion indicates that the current top-down approach of government still presents some limitations that need to be improved. Most of the measures and interventions implemented by the government have not been appreciated by floodplain residents. However, this does not imply that measures and interventions taken by authorities are entirely ineffective in reducing risks. These measures were still effective for certain groups in practice. For example, the improvement of the embankment directly reduced the risk of landslides during the flood season for households living along the riverbank. The initiative of local authorities to evacuate households living in places easily to be isolated by floodwater and lonely aged people to designated shelters contributed to reducing both human and property risks, and thus reduce the burden of authorities on emergency rescue. Emergency supports and credit-related intervention provided by the local authorities have contributed to reducing risks for vulnerable groups (poor, disabled, elderly, women-headed households) and severe damaged households after floods. It can be said that the measures taken by the authorities, although not really meeting demands of the entire floodplain population, have been effective in helping some social groups overcoming their limitations, and thereby further promote the bottom-up approach. Therefore, the mixture of both top-down and bottom-up approaches that enables the participation of all stakeholders should be seen as an ideal model for more effective and sustainable flood risk reduction.

6.2. Floodplain residents as a key actor in flood risk mitigation

6.2.1. Risk mitigation through the proactive preparedness

The increasingly irregular of floods is one of the inevitable consequences of global environment and climate changes. In Vietnam, this issue seems to be exacerbated due to the popularity of major hydropower dams and irrigation reservoirs under the government policy. While authorities' risk reduction measures and their support activities did not really satisfy and

touch the needs of most floodplain residents, the vulnerable population has gradually built their own strategies towards risk mitigation to minimize damage caused by floods.

Our analysis indicated that most households have significantly improved their precautionary measures both structurally and non-structurally after being suffered by major floods, such as the historic flood in 1999. The damage caused by floods, therefore, has noticeably diminished. It can be stated that household self-preparation, in the context of inadequate measures taken by the authorities, is the decisive factor in reducing flood risks. This confirms the central role of individual households in the bottom-up flood risk management strategy in developing countries.

However, this result does not mean that all floodplain residents have well improved prevention measures. Some social groups, despite long-term efforts, remained less than impressive in improving preventive measures in some respects. This output resulted from both internal (subjective) and external (objective) factors. Poverty is a dominant barrier since it is intricately linked to the improvement of all structural and non-structural measures. The poverty in the study sites was closely joined with labor shortages, high dependency ratio, living with disabilities, and precarious careers. This result reinforces the conclusion of Ahmad and Afzal (2020) who emphasized the crucial role of financial status in the implementation of risk reduction strategies. Fothergill and Peek (2004) and Skoufias et al. (2011) also insisted that the poor are the most vulnerable to disasters and usually suffer greater damage than the wealthy. Over reliance in external supports, besides implying strong cohesion within the community, was also considered as a psychological barrier that potentially leads to certain subjectivity. Our result concurs with the findings of Chen et al. (2019) and Grothmann and Reusswig (2006) that relying on external support leads households to underrate self-protective defense. Breaking down this psychological barrier is essential for people to be proactive in risk prevention, but this should be done by thoroughly considering its root causes by demographics and geographical characteristics such as between the poor and the non-poor, or between rural and suburban residents. For instance, external reliant thinking of suburban residents may be driven by specific functions in the area, while this of ones in rural areas may be affected by their more abundant social capital as discussed by Sørensen (2014). Besides, the contradictions of different policy initiatives in the surban, such as landscape rehabilitation, disaster prevention, and livelihood maintenance also negatively affected households' preventive measure implementation. Households' failure to improve structural measures, despite their

willingness and financial conditions, is a clear demonstration of the contradictions between development policies.

Through the above analyses, we also confirm the appropriateness of the Protection Motivation and Asset-Based approaches in examining the factors driving the improvement of protective measures of individual households, especially in the context of developing countries. Research on the implementation of protective measures, in addition to focusing on household assets, should also address factors such as risk perception, external reliant psychology, and other actual barriers such as housing location, and related regulations and policies.

6.2.2. Risk mitigation through social connections

The improvement of households' preventive measures has significantly contributed to reducing flood risks in general. However, flood damage still occurs in the research areas. This is because there is no way to completely neutralize the adverse effects of flooding. Households, after being damaged, often encounter many difficulties to rehabilitate with the few remaining resources. Self-recovery, in the face of limited resources, may prolong this process, and this is normally a premise of raising other socio-economic risks.

Our research results have shown that the recovery speed of households is relatively independent of demographic characteristics. Households' demographic features do not determine how quickly or slowly they recover. The data, in contrast, demonstrate the more important role of social connections. Relatives and informal groups seem more helpful in hastening the households' recovery compared to friends, neighbors, and formal groups. The tightness of the blood-based relationship, which usually drives the prompt, devotional, and considerable help was viewed as the advantage of relatives. This outcome supports the finding of Masud-All-Kamal and Hassan (2018), and Casagrande et al. (2015) that relatives is a critical prop of rural residents, and usually pioneer in supporting them to overcome the most difficult times. Meanwhile, the positive influence of informal groups probably attributes from their small scale, diverse membership, and grounds of formation as they are assembled with the purpose of satisfying personal and psychological needs, which are essential to building mutual sympathy and trust among members, and thereby to promote assistance. Besides, the positive effect of relatives and informal groups may be further due to their wider geospatial distribution, which enables flood victims to access more abundant resources from other areas less affected by floods. According to the reciprocity theory, supporting others overcoming difficulties can be seen as a providence

for future potential uncertainties as individuals tend to recompense those who helped them (direct reciprocity) (Trivers 1971). It should be also viewed as an investment in reputation to strengthen collaborations with others since individuals tend to help those who help others (indirect reciprocity) (Alexander 2017).

In contrast, the minor effect of neighbors on the recovery speed is probably because of their relatively low income and similar flood-induced burdens, which limit the aid volume. This result is in line with the findings of Islam and Walkerden (2014) in a case study in Bangladesh that households, after cyclones, are often incapable of supporting neighbors due to the massive damage and losses they experience. Despite this fact, neighbors' support was still highly valued by most villagers. The role of neighbors is likely more helpful in other aspects of the recovery process, such as securing survival or improving the mental health of flood victims. The result also emphasized the dominant role of local government, but only in the long-term recovery phase. This result resonates with the judgment of Thanvisitthpon (2017) that official flood-recovery financial aid was incommensurate with actual expenditures, leading to low satisfaction among the inhabitants. These limitations were also considered the reason why people in floodplain areas distrust the capacity of local governments to provide recovery resources and tend to invest more in personal precautions as found by Nguyen et al. (2021). Due to limited resources, households, especially in developing countries, tend to be abandoned with their losses after natural hazards (Osberghaus 2015). Therefore, instead of relying on supports from local authorities, self-reliance and utilizing resources from social networks to reestablish should be considered a sustainable direction of flood-prone residents.

Through the analysis, we also highlight the the importance of social assets in the Asset-Based Approach in accelerating farming households' rehabilitation. In comparison with other tangible assets, households' post-flood recovery process is more powerfully influenced by social connections. Social capitals, therefore, should be considered as a key factor in post-disaster recovery analyses, especially in the rural context of Vietnam.

In summary, most households in flood prone areas, despite some limitations, have shown an increasingly proactive in reducing flood risks. This is evidenced through their efforts to improve protective measures, and how they mobilize resources from social connections to facilitate post-flood rehabilitation. The effectiveness of these strategies in reducing risks was also proven in practice. This can also be seen as the way they respond to and compensate for the government's shortcomings in implementing the flood risk reduction strategy. This approach is theoretically and practically consistent with the concept of living with floods (LWF), which emphasizes the measures and initiatives of households to proactively adapt and cope with adverse conditions of floods. Most people have become familiar with flooding and are ready to deal with its adverse effects whenever the rainy season comes. The daily life activities and livelihoods of many households are also designed to be maintained as the normal condition if the floods are not too severe. Some households also see flooding as an opportunity to improve their income by providing temporary services (Figure 19, 20).

Figure 19: A woman is cooking dinner for her family in a flooded room

Source: vnexpress.net

Figure 20: Local people offering ferry services during floods

Source: vnexpress.net

In the context that measures taken by local authorities remain inadequate, the implementation and improvement of protective measures (both structural and non-structural) have gradually become one of the important long-term goals of vulnerable populations to protect their own lives and economic achievements from the pressure of nature. In addition, enhancing reconstruction efficiency through mobilizing resources from social connections has emphasized the importance of Community-Based Disaster Risk Management in developing countries, where public expenditure for this is usually inadequate. These findings are also a clear demonstration of the effectiveness of a bottom-up approach in Flood Risk Management, which does not seem to be well focused and implemented in Vietnam.

CHAPTER 7: CONCLUDING REMARKS

With the dramatic boost in frequency and damages in recent decades, floods are considered one of the most fearful natural hazards facing human society. As one of the most vulnerable countries to floods, flood risk reduction has become one of the top priorities of the Vietnamese government. Nevertheless, flood risk reduction remains a big challenge despite the unremitting efforts of the authorities at all levels. This fact implies the necessity of a more integrated flood risk management strategy by incorporating bottom-up approaches. The aim of this dissertation, therefore, was to provide a deeper insight into the potential effectiveness of bottom-up approaches in the practice of flood risk reduction in Vietnam. This aim was concretized through two case studies conducted in Thua Thien Hue Province, central Vietnam. One case investigated the long-term improvements to flood precautions taken by local actors, while another focused on the recovery of rural households in connection with their demographics and social connections.

The results first point out limitations in the government's risk reduction approach and the preventive measures implemented by local authorities. The government intervention through structural works has made flooding more irregular. Anticipating flooding by conventional approaches, therefore, has become ineffective. Floodplain residents tend to be skeptical of the results of this top-down approach in reducing risks and focused more on precautionaries. At the local level, the authorities have taken a number of measures to strengthen the defense capacity of households facilitate their rehabilitation process. These measures, however, were under-appreciated by most locals. The lack of resources, which leads to disproportionate and unsynchronized investment in public preventive measures, is the primary cause making government efforts less effective. The delay in responding to emergencies such as supporting evacuation, providing essential supplies immediately after floods, and inadequacies related to resource distribution for post-flood reconstruction were also the principal reasons making the government's efforts to be underestimated. The above limitations are believed to stem from the top-down flood risk management institution that follows the administrative decentralization applied by the government. Although not yet touching the needs of the majority of the population, the government's interventions have been effective in supporting some social groups to overcome their limitations. In this regard, the top-down approach has contributed to promoting the bottom-up approach.

To respond to the government's limitations, floodplain residents have developed their own strategies to minimize risks from flooding. This has been clearly demonstrated through the long-term efforts of households to improve protective measures and the ways they establish and mobilize resources from social connections to rehabilitate more effectively after floods.

Most households, nearly 20 years after the disastrous flood of 1999, improved considerably precausionaries both in structurally and non-structurally to actively deal with flood hazards. The reducing of flood damage is an undeniable proof of the effectiveness of these efforts. Through this finding, the central role of households in the bottom-up approach, especially in developing countries, is confirmed. Some social groups, nonetheless, seem to be lagging in this struggle against nature.

Poverty was a major bulwark constraining household improvement in both rural and suburban villages. Poverty eradication, hence, should be prioritized and integrated into flood risk management strategy. Hence, interventions for poverty eradication are a prerequisite to mitigating risks and should be integrated into flood risk management strategy as a foremost priority. The government's intervention should first focus on improving the poor's housing quality following the flood-resistant model. This can be done through the government's social housing construction programs, or through calling for contributions from individuals and businesses in the local. This process needs to be strictly monitored to ensure the housing quality, avoid loss of resources, and thereby build trust with the contributors. This can also be done through the preferential loan program aiming at upgrading housing and improving livelihoods for the poor. To avoid misuse of funds, these loans should be co-managed by local governments. Besides, stable livelihood support is also an important solution for the poor to be more proactive in improving protective measures in the long term.

Additionally, the external reliance was found as a psychological barrier negatively affecting the households' motivation. Breaking down this psychological barrier is required to enhance households' initiative, but this should be done by thoroughly considering this difference between rural and suburban areas. Propaganda can be effective in this case. Local authorities should propagate to enhance public awareness towards the importance of proactively taking protective measures in the context of increasing flood risks, and the potential dangers of over-reliance on external helps, especially in urgent cases.

Besides, the households living in the suburb riverine was further identified as vulnerable because of their inability to improve structural measures. This matter was primarily attributed to inadequacies in planning and implementing projects to preserve the old town landscape. This, on the one hand, indicates the additional complexity of coordinating projects in urban areas, while on the other, requires a smoother blend of development policies to limit adverse implications.

Regarding households' recovery efforts, our findings emphasize the more important role of social connections compared to other types of tangible assets. The crucial role of relatives and informal groups is revealed as they contributed significantly to shorten the recovery. While blood-based relations were crucial among relatives, small scale, diverse membership, and formation grounds of informal groups were believed to be helpful. In addition, the geospatial differences between social connection types, which allow flood victims to access more abundant resources outside the village, are also seen as potential causes for the considerable effect of relatives and informal groups on the post-flood recovery speed. However, the contribution of other connections is not therefore negated. Since speed is only one aspect of the recovery process, the contributions by friends, neighbors, formal groups, and local authorities can be manifested in other aspects of household recovery such as ensuring survival during urgent cases or relieving the victim's mental pain in the long run.

In addition, we, through the subdivision of the recovery process, further exhibit the variation in the role of social connections over time. The substantial role of relatives and neighbors in the urgent period after the flood and the short-term recovery sub-phase was accentuated as they were key providers in almost all phases and categories. Neighbors are believed to play a greater role in providing urgent assistance due to their proximity. Households' long-term recovery efforts relied on the leadership of the local government. This, however, also notes the limitation of the local government and community-based organizations in assisting affected communities, especially during the immediate crisis. Besides the lack of resources as normally found in developing countries, slow administrative procedures were further identified as a challenge that authorities need to improve.

Through revealing the importance of social connections in accelerating the households' post-flood recovery, this study calls for solutions to increase cohesion in the community. Creating more space for meetings and exchanges among individuals and households in the community should be focused by local authorities. In order to enhance the interaction, which is essential for

building mutual and trust relationships, this should be done through micro-level units or small groups such as villages, hamlets, residential clusters, occupational groups, or demographic-based groups, where the roles of members are better recognized. Besides, in order to maintain the enthusiastic and regular participation of households, activities should be diversified and associated with the spiritual life, customs and habits of the community, and livelihood development demand of households.

To sum up, this dissertation, through the two empirical case studies, in addition to highlighting the limitations of current top-down approaches by the government, demonstrated the key role of floodplain residents in the bottom-up approach of flood risk mitigation. Therefore, integrating this approach more extensively into the government's current strategy is crucial to be more effective in mitigating flood risks in the context of Vietnam.

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