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ARTICLE

Post-flood recovery in the central coastal plain of Vietnam: determinants and policy implications

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Abstract

This study focused on the timing aspects of post-flood recovery, which has not been adequately considered by previous scholars. Data for analysis were obtained from direct interviews with households in Quang Dien and Phong Dien coastal plain districts of Thua Thien Hue Province, Central Vietnam. Both quantitative and qualitative approaches were employed to gain insight into factors driving household rehabilitation. The findings accentuated improvements in women's post-flood resilience as a result of effective interventions from communities, authorities and NGOs. Diversifying livelihoods into the non-agricultural sector was also an important factor to shorten the rehabilitation processes. Additionally, the results emphasized the efficacy of social interactions, notably between relatives and informal groups, after floods. The potential negative consequences of reliance on government support in household rehabilitation efforts are also preliminarily discussed. We conclude by suggesting a number of policies and interventions related to poverty eradication, livelihood diversification, strengthening community cohesion, and breaking down the reliance psychology.

Keywords Floods · Flood recovery · Flood rehabilitation · Social connections · Central Vietnam

JEL Classification C52 · Q10 · R20 · R28

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1 Introduction

Humankind is facing the disturbing reality of global warming and climate change. In many parts of the world, this is manifesting in the increased volatility of extreme weather events. Over 475,000 people lost their lives during the last two decades (2000–2019), and 2.56 trillion US dollars in damage were incurred as a direct result of over 11,000 extreme weather events globally (Eckstein et al. 2021). This is also why, between 1980 and 2019, 180 million people find themselves in urgent situations every year (CRED 2020). Financially, natural catastrophe damage accounts for 0.29% of world GDP. Over 80% of which were caused by weather and climate-related calamities (Pielke 2019).

Flooding, among natural dangers, is one of the most devastating, resulting in fatalities and significant damage to personal property and public infrastructure. Major flood-related calamities have tripled in almost three decades since the 1980s (ADB 2013; Hoeppe 2016). On average, floods claim around 6000 lives and inflict 19 billion dollars in damage annually globally (CRED 2019). In the last two decades, floods have impacted an estimated 2 billion people globally (Ebi 2021). Asia appears to be the hardest region hit by natural disasters (ADRC 2016). In 2018, Asia incurred approximately 45% of catastrophe incidents, 80% of fatalities, and 76% of the impacted population. Flooding affected the greater part of the population (about 50%), followed by storms (about 28%) (CRED 2019). Hydrological-related disaster, hence, is probably one of the deadliest in Asia (Shaw 2006).

Located in Southeast Asia, Vietnam has been severely devastated by natural catastrophes in recent decades. In the report on Global Climate Risk Index 2021, Vietnam was accentuated as one of the twenty countries most affected by extreme climatic phenomena in the last twenty years (Eckstein et al. 2021). As the total national population share, Vietnam was ranked sixth with 45.8% of the population (equivalent to 45.5 million) at risk of severe flooding, according to the report on Poverty and Shared Prosperity 2020 (Rentschler and Salhab 2020). The high flood risk in Vietnam arises out of its tropical monsoon climate, a long coastline, dense river system, and dense population along rivers and coastal areas (Razafindrabe et al. 2012; Chau et al. 2014). Excessive human interventions, such as deforestation (McElwee 2004) or inconsequential land-use management (Chau et al. 2013), have further exacerbated the probability of these types of risks in Vietnam. According to the World Bank's estimates (2010), natural disasters damage Vietnam between 1% and 1.5% of its annual GDP.

Reducing flood damages, therefore, has become a central task of the Vietnamese government. However, despite the incessant efforts of both the authorities and floodplain residents, damages by floods still frequently occur on vast scales. It is evident that victims of natural hazards, after experiencing severe damages, usually encounter obstacles to rehabilitate due to mental distress and lacking resources (Opdyke et al. 2017; Chan et al. 2018). Recent studies highlighted that government resources for post-disaster reconstruction, especially in developing countries, are confined and, therefore, inefficacious in major floods (Aldrich et al.

2015; Chan et al. 2018; Nguyen et al. 2021). Most households tend to be forgotten after experiencing natural hazard-induced damages (Osberghaus 2015).

Moreover, the retard in relief operations leads the efforts of the government less worthwhile. As reported by Alam and Collins (2010), delivery of formal aid usually require nearly a week to access major-affected zones. In the context that formal support is still inadequate, households' recovery process is believed to be more reliant on informal assistance gained from their social networks (Hernández-Plaza et al. 2004; Sadri et al. 2018). Society seems to play more active and inclusive role than the authorities in supporting victims of natural hazards (Chan 2015). With regard to post-disaster recovery outcomes, most recent literature concentrated on physical robustness, emotional wellness, social welfare, and particularly the restoration procedure's satisfaction (Elgar et al. 2011; Dai et al. 2016; Maass et al. 2016; Bubeck and Thieken 2018). Households' post-flood restoration swiftness, though not less crucial, has inadequately been addressed. Why are some groups able to return to normalcy rapidly while others take longer? What factors influence their rate of recovery? Does social connection influence the recovery rapidity? Does psychological reliance on the government hinder the recovery process? Clarifying these issues is critical since delayed rehabilitation increase social burdens, deepen victims' emotional pain, and prolong their economic hardships. Additionally, failure to recover from floods will serve as a pretext for increasing other forms of risk, thus increasing the vulnerability of flood victims to future flood episodes.

By recognizing the meaning of quick recovery and knowledge gaps of prior literature, this study aims to examine post-flood recovery rapidity in connections with households' characteristics and resources, including demographics, social relationships, and reliant psychological reliance on the government. This objective was achieved through investigating farming households' efforts to restore from a severe flood befalling in 2017 in the central area of Vietnam. Through this study's results, we aim to deepen the understanding of factors accelerating post-flood recovery of farming households, which are fundamental to propose related policies and interventions.

Following the introduction, the remaining sections comprise the body of this paper: Sect. 2 explores published documents on factors touching the rehabilitation of households/communities following natural disasters. Section 3 provides key concepts and the theoretical framework. Section 4 shows an overview of the research area and our approaches. The key analysis is given in Sect. 5, followed by Sect. 6, presenting the conclusions and policy implications.

2 Literature review on factors associated with post-disaster recovery

Post-disaster recovery is an important topic pulling the attention of many economists and sociologists. Various variables were employed to examine the relationship with output aspects of households' rehabilitation process. In which, the most prominent are the ones reflecting household's demographics and their social capital. In this section, the main results from these studies will be systematically summarized.

2.1 Social–demographic characteristics and post-disaster recovery

The extent of damage is one of the most well-known aspects when contemplating a household's rehabilitation process. Most scholars found that households that suffered more harshly required longer terms to recover (Kurosaki et al. 2012; Bubeck and Thieken 2018; Sadri et al. 2018). The more physical possessions and economic value lost, the slower recovery of households. This trend, nonetheless, is contrary to the conclusion of Platt (2018) that the effect of damage level on households' recovery was insignificant.

As baseline factors, household demographic characteristics were also utilized by most researchers. Clissold et al. (2020) stressed the importance of women aftermath the rigorous storm and drought in the island nation of Vanuatu (belonging to the Melanesia archipelago) as trailblazers in innovation, fundraising, and enterprise establishment. Another study, meanwhile, stated the causes standing behind women's capacity to reconstruct, even better, after undergoing heavy damages. As a result of social interactions, effective policies supporting livelihood restoration, good communication, and culture-based capacity, crisis-stricken women have received adequate and sustained help (Kusumasari 2015).

Meanwhile, Himes-Cornell et al. (2018), Kurosaki et al. (2012), and Francisco (2014) stressed the crucial role of household income and other financial assets. For instance, households that initially had fewer assets and were hit by greater flood damage were difficult to restore. Similarly, Himes-Cornell et al. (2018), by employing the community capitals framework, indicated that communities with stronger financial capital tend to perform better immediately after a disaster, enabling longer-term processes of transformation or recovery. Francisco (2014), through a survey of 400 households in Marikina City in Metro Manila, Philippines, further highlighted the positive effects of credit access to households' post-flood rehabilitation. This study's results, however, underestimated the role of type of housing, education, and household size. This contrasts with the results found by Sadri et al. (2018) that big size family is an obstacle to the reconstruction efforts. Platt (2018), meanwhile, concluded that the association between recovery quickness and exogenous agents (sociologies and economics, for instance) appears to be weak.

2.2 Social connections and post-disaster recovery

As aforementioned, one of this study's focuses is the ″social connection.″ However, the term ″social capital″ is also included in this section due to its semantic closeness, as has commonly been discussed in previous articles.

Basically, social capital reflects the ability through which people can obtain necessary resources, particularly in troublesome circumstances. It develops as a result of social relationships, shared norms, and mutual trust (Coleman 1988; Krishna 2002) and has been shown to contribute significantly to post-disaster rehabilitation (Munasinghe 2007). Based on connections with different actors, social capital is commonly differentiated into three types: bonding, bridging, and linking

(Woolcock 2001). The term ″bonding″ is frequently used to reflect inward-looking or close relationships, such as family members, close friends, and neighbors (Woolcock and Sweetser 2002; Szreter and Woolcock 2004; Scott and Liew 2012). Bridging relationships, in contrast, are outward-looking, horizontal-direct relationships, and generally with similar entities. "Linking" implies vertical-direct relationships, particularly with individuals or organizations in the higher political, economic, or social hierarchy. 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). The social network is the incarnation of social capital, which is observed as an essential element providing common ground for empirical research (Bodin and Crona 2008). As Coleman (1988) accentuated social capital, unlike other forms of capital, is inherent in the structure of relationships between actors. Meanwhile, Krishna and Shrader (1999) noted that social links can be considered as a structural representation of social capital. As a key structural component, social networks offer objective signs of presence rather than nebulous concepts, such as beliefs and norms (White 2002).

Throughout the rehabilitation process, social capital regularly exhibits its importance at both village and family levels. For the village context, scholars prefer to clarify the way that collective resources are managed and handled, emphasizing the importance of shared confidence and civic solidarity in achieving communal goals (Aldrich 2012a; Joshi and Aoki 2014; Cagney et al. 2016; Kim et al. 2017). Meanwhile, research targeting families and individuals concentrated mostly on the process through which various forms of relationships translate to particularly dedicated aids (Islam and Walkerden 2014; Chan et al. 2018; Masud-All-Kamal and Hassan 2018; Hsueh 2019).

Joshi and Aoki (2014) revealed from research in India that the pre-disaster community's style and strong leadership of chiefs were critical to the rehabilitation campaign's effectiveness. Social capital, besides, was also emphasized as a decisive factor in the successful implementation of policies since it motivates individuals to employ public fundings effectively for reconstruction process. By reviewing the extant literature, Kim et al. (2017) underlined the significance of bridging links as a stimulus of collaborative creation for the long-run rehabilitation of communities. Through a study of preparation and restoration, Cagney et al. (2016) discovered individuals living in communities characterized by a greater level of social cohesiveness and social interaction were better in planning for and recovering from disasters. From various research on post-disaster in Japan, South India, and America, Aldrich (2012b) concluded that populations having powerful social interfaces faced better in the aftermath of calamities and thus resumed more quickly. The findings of Wei and Han (2018) indicated that rural households having more social capital recovered more easily from the 2008 earthquake in Wenchuan, China.

From a case study in Bangladesh's coastal zone after a tornado, Kamal and Hassan (2018) emphasized the critical role of social connections in serving victims' reconstruction. While disparaging the role of linking social capital (the government and NGOs), they accentuated the role of bonding relationships (relatives and neighbors) and bridging relationships (well-off neighbors or other villagers) as they significantly supported households from the crisis period

following the tragedy to the long-run rehabilitation. Through analyzing the context after a hurricane hit an island of Japan, Hsueh (2019) featured the value of bonding links as they provided essential servicing. Bridging connections, meanwhile, further empower victims' psychological aspect, particularly when bonding links fails functionally. In Southeast Asia, Nguyen-Trung et al. (2020), by investigating households' reconstruction under impacts of drought (a slow-onset disaster) in Southern Vietnam, emphasized the essential role of the bonding connection types in the whole reconstruction period. While the role of bridging ones was only helpful in the long run. Likewise, the vital need of linkages in the post-flood setting was highlighted in Malaysia's instance (Chan et al. 2018). Accordingly, social capital is believed to foster collaboration between disaster organizations, mobilize individuals to volunteer during disasters, increase household member bonds, and strengthen the resilience of communities. Also, this invisible resource increase self-assurance, enhance resilience, as well as accelerate post-flood rehabilitation.

Most remainder works, meanwhile, preferred to explore different outcomes of natural disasters and their determinants. Bubeck and Thieken (2018), by focusing on the mental health recovery of flood-affected inhabitants in Germany, found that socio-economic and emotional features were more crucial compared to the extent of damage and other characteristics of the flood (e.g., water depth). Sadri et al. (2018) indicated that recovery speed is viewed as an equally important aspect of post-flood recovery. The findings indicated that more damaged households required a longer time to recovery. Households holding more robust social connections rebuild more rapidly.

Besides positive outputs, some specialists discovered the adverse implications of this intangible capital. Elliott et al. (2010) explicated through an analysis of migration aftermath of Hurricane Katrina that social capital inequalities tend to rise in times of calamities resulting in the gradual fraying and weakening of less fortunate citizens' social safety-net. The inability to explore multinational connections in times of mass displacement was the major cause of these individuals' social capital gradually eroding. Stronger social cohesion sometimes becomes an obstacle to government policy, as Aldrich and Crook (2008) discovered that locations with stronger civic cohesion were authorized for fewer trailers following Hurricane Katrina. Apart from gathering civilians for public affairs, civilian groups provoked people to resist social disturbance and possible dangers from these trailers. By fostering strong devotion within groups, which is regarded as an essential factor in establishing ″sociological superglue,″ bonding social capital may also incite outsider animosity (Ritchie and Gill 2007). Through reviewing existing literature, we imply that an issue always has its downside, and social capital is no exception. This reality explains why robust intragroup attachment sometimes exacerbates tacit dangers within communities: increased injustice and unfairness (Aldrich and Crook 2008), high crime rate (Portes 1998), high suicide rate (Kushner and Sterk 2005), and greater stress (Weil et al. 2012), for instance.

3 Key concepts and theoretical framework

3.1 Key concepts

3.1.1 Flood risk, hazard, vulnerability

The concept of risk is a central issue for policymaking in areas as diverse as health, environment, technology, finance, and security (Johnson and Taversky 1984). The term risk is understood in different ways. While this diversity of interpretation may have no consequences, for scientific discussions, risks should be clearly and consistently defined. In the scientific field, risk is widely recognized as the consequence of the interaction between a hazard and the characteristics that make people and places vulnerable and exposed. Disasters are sometimes considered external shocks, but disaster risk results from the complex interaction between development processes that generate conditions of exposure, vulnerability, and hazard. Disaster risk is therefore considered as the combination of the severity and frequency of a hazard and their vulnerability to damage (Risk = Hazard * Vulnerability). Intensive risk is disaster risk associated with low-probability, high-impact events, whereas extensive risk is associated with high-probability, low-impact events (UNISDR 2004; UNDRR 2017; Dar and Alam 2020). The two essential elements in the formulation of risk can be briefly defined as follows:

"Hazard" is the probability of potentially damaging flood events at a specific location and is usually determined by a historical or user-defined scenario, probabilistic hazard assessment, or other methods. Potentially damaging means that there are elements exposed to hazards that could not necessarily be harmed. In other words, hazards are conditions that can cause fatalities, injuries to human beings, and damage to infrastructure, agriculture, the environment, and the economy. Hazards may be natural, anthropogenic or socio-natural in origin. Hazards can be minimized through a system of coping strategies. The term "vulnerability", meanwhile, accounts for the susceptibility to damage of assets exposed to forces generated by hazards. Damage by hazards depends on the vulnerability of exposed elements. The vulnerability itself is a complex term. Very often, we face various kinds of hazards and disasters. The term "vulnerability" refers to the inherent characteristics of these elements, which determine their potential to be harmed (Schanze 2006). Vulnerability describes the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process). It involves a combination of factors that determine the degree to which someone's life, livelihood, property, and other assets are put at risk by a discrete and identifiable event (or series or cascade of such events) in nature and society. The concept of vulnerability clearly involves varying magnitudes: some people experience higher levels than others. But this term is used to mean those who are more at risk. Therefore, when it comes to vulnerable people, it is certain that those at the 'worse' end of the spectrum are mentioned. Vulnerable groups are also those that also find it hardest to rebuild their livelihoods following disaster, and this in turn makes them more vulnerable to the effects of subsequent

hazard events (Scoones 1998; Wisner et al. 2003). Fragility and vulnerability functions estimate the damage ratio and consequential loss, respectively, and the social cost (e.g., number of injured, homeless, and killed) generated by a hazard, according to a specified exposure. Vulnerability is a combination of various factors, both human and physical. The main variables illustrating variations of the vulnerability include social class (e.g., wealth difference), gender, caste, occupation, ethnicity, disability, and immigration (legal or illegal), scope, and extent of social networks (Adger et al. 2004; Wisner et al. 2003).

The approach to flood risk is different across different fields of science. For instance, economic science's approach to flood risk mainly focuses on the vulnerability of assets at risk and the cost of protection. Meanwhile, social science often includes both direct and indirect impacts in tangible and intangible forms, such as the adverse impacts of floods on social structure, livelihood stability, and flood victims' physical and mental health. As a key element of risk, flood vulnerability, based on the principle of sustainability, can be classified into three main areas: social and cultural, economic, and ecological. Social and cultural vulnerability is loss of life, impact on health (injury), loss of vitality, stress, social impact, and loss of cultural heritage. Economic vulnerability refers to direct and indirect financial losses resulting from the failure of essential property, material and goods, and reduced productivity. Ecological vulnerability includes contamination of water, soil, and ecosystems with their biological populations (Messner and Meyer 2006).

Besides natural causes, anthropogenic activities have also exacerbated flood risk. For example, the increasing flood damage is often associated with deforestation in upstream areas and intensive land use in lowlands. Human encroachment on floodplains made urban communities more vulnerable to floods (Chang et al. 2009). Flood risk depends on having a source of flooding, such as a river, a route for the flood water to take (pathway), and something to be affected by it (receptor), such as houses, properties, and even humans. The risk is "high" if the possibility of a significant flood is high and could have a severe impact on the community. In contrast, the risk is low if the likelihood of a big flood is low, and its estimated effect is trivial. Of course, there is no risk if no people, properties, and other values could be affected by flooding. These cases are straightforward. However, considering risk is sometimes more complicated than that. For instance, a severe flood seldom occurs in certain areas but has grave consequences. As a convolution of flood hazard and flood vulnerability, flood risk is changeable because vulnerability and hazard are unstable. It changes over time. Therefore, it is necessary to consider these changes (current risk and future risk) when applying specific assessments and developing interventions (Birkmann et al. 2014).

3.1.2 Flood disaster and recovery

If a flood occurs and causes damage or adversely affects people's lives, livelihoods, and properties, it can be considered a disaster. Recovery after being affected is required. Disaster recovery, in general, is defined as the resetting of daily life patterns for households affected by disasters and potentially improving their resilience to disaster events in the future. However, our knowledge about household-level

rehabilitation decision-making and its impacts on disaster management is still limited (Chandrasekhar 2013). Flood/disaster recovery has three distinct but interrelated meanings. First, it aims to restore normal community operations that were crashed by the impact of the disaster as they were before the disaster struck. Second, it is a phase in the emergency management cycle that stabilizes disaster conditions (the last phase of the emergency response phase) and finishes when the community has reverted to its normal activities. Third, it is a process by which the target community returns to normal conditions. The recovery process includes planned activities before the disaster and those taken after the impact of the disaster (Lindell 2013).

3.2 Theoretical framework

Reviewing published documents was 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 (Aldrich 2012b; Casagrande et al. 2015; Masud-All-Kamal and Hassan 2018; Van Krieken and Pathirage 2019), post-disaster decision-making (Platt 2018), political capital (Himes-Cornell et al. 2018), and building capacity (Van Krieken and Pathirage 2019). We also identified a number of theories and frameworks suitable for analyzing households' recovery process, such as Sustainable Livelihood Framework, Social Capital Theory, Social Networking Theory, Social Support Theory, Theory of Reciprocity, Theory of Planned Behavior, and Emergency Management Theory. In this study, the Sustainable Livelihood Framework proposed by the Department for International Development (DFID 1999) that best suits our research in terms of generality, appropriateness, ease of application, and power of explanation were selected to create an academic context for the study and underpin the analytical process. It was adjusted to suit better the context of households' post-flood recovery. Our approach is briefly depicted in Fig. 1.

Figure 1 describes the influence and interactions between household assets (five types), policies and institutions (e.g., material, cash, medical, technical, and spiritual supports, preferential credit program), post-flood vulnerability context (e.g., housing and livelihood damages, environmental pollution, disease outbreak, price escalation, scarcity of off-farm jobs), and households' recovery outcomes (e.g., recovery rapidity, recovery quality). In this approach, we emphasize households' assets as a key factor for the recovery process in the context of post-flood vulnerability. Policy and institutions, although having specific effects on household assets and possibly influencing recovery outcomes, are beyond the scope of this study and therefore not analyzed.

The analysis based on household assets has commonly been discussed and applied in different research fields, such as resource management, community development, poverty, health, social risk, and natural disaster as well (Siegel and Alwang 1999; Curtis and Lefroy 2010; Harrison et al. 2019; Zhang et al. 2020). Most literature agreed that individuals, households, and communities control their lives (including post-flood challenges) by their own strengths, capabilities, and

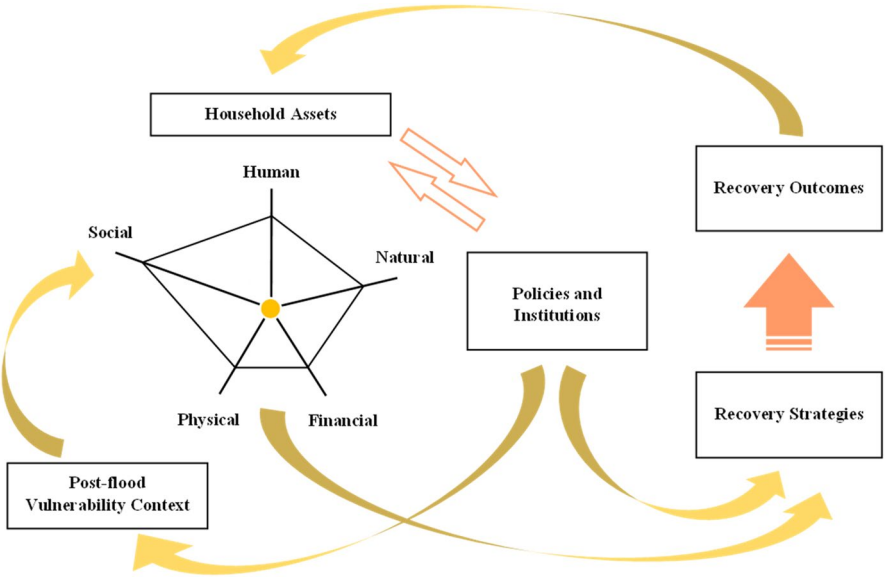

Fig. 1 Households' resources in the context of post-flood vulnerability. Source: Adapted from the Sustainable Livelihoods Framework (DFID 1999)

possessions. Households' assets were initially used 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 more significantly their assets are eroded, the greater their insecurity (Moser 1998). Focusing on households' assets has numerous benefits, including incorporating multiple aspects of the two concepts: assets and capitals. Modeling the effect of various capitals on household vulnerability helps policymakers target and guide a recovery effort more efficiently (Zhang et al. 2020).

An asset can be seen as a stock of human, natural, physical, financial, and social resources that can be acquired, developed, improved, and transferred across generations (DFID 1999; Grootaert and Bastelaer 2001; Moser 2006). It generates flows or consumption and additional stock (Ford Foundation 2004). Assets can be tangible (e.g., real estate, houses, cash, savings, jewelry) or intangible (e.g., social capital, proximity to markets, education, special skills). 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 essential in the context of risk management of vulnerable households (Siegel and Alwang 1999). Natural assets are the stock of natural resources, including geology, soils, air, water, and living organisms. Some natural capital assets provide people with free goods and services, often called ecosystem services. Physical assets are economic, commercial, or exchange value items that have a material existence, such as housing, land, machines, furniture, and jewelry. Financial assets are diverse, but more commonly,

cash, savings, loans and gifts, regular remittances or wages, and other financial instruments. Human assets measure an individual's skills, education, competencies, and attributes that affect productivity and earning potential. Social assets are a network of relationships between people living and working in a particular society, enabling society to function effectively. It involves the effective functioning of social groups through interpersonal relationships, a shared 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. In addition to diminishing households' environmental stress, natural assets 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 used in urgent cases such as re-establishing livelihoods repairing houses after 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 need. Depleting assets in a specific category may lead to a corresponding impact on the associated vulnerability (DFID 1999; McLeod 2001).

4 Study design

4.1 Study area

Located on a narrow strip of land on the North Central Coast of Vietnam, Thua Thien Hue (TTH) province was selected as this study's target area due to its vulnerability to flooding (Figs. 2, 4). With more than 100 km of coastline and a dense river system, the province has experienced many types of natural calamities, notably tropical storms and flooding (Vo et al. 2021). About 70% of the province's population is at risk of flooding during heavy rains (NCAP 2005). This is recognized as one of the most prone to natural disasters in Vietnam.

TTH province experienced many severe floods in 1953, 1975, 1983, 1989, 1999, 2017, and 2020. Many households have been caught in a vicious cycle of poverty due to flood damage. As the worst event of the century, the 1999 flood was deeply implanted in the mind of many people as a horrifying memory. The floodwaters rose approximately a meter every hour. The floodwater measured at Kim Long station on Huong River exceeded 5.81 m, equivalent to the height of a two-storey house. About 550 people were killed, dozens were missing, and 630,000 houses were damaged. The tangible damage was estimated at up to 4536 billion VND (VDMA 2019). The efforts of the government to construct massive structural dams (e.g., Ta Trach, Binh Dien, Huong Dien, A Luoi dams in THH Province), though contributing significantly to the reduction of flood frequency, sometimes failed to reduce flood intensity. The 2017 major flood can be taken as an example. This flood occurred following severe storm No. 12 named Damrey. With gusts reaching nearly 150 kph, this is one of the most powerful hurricanes striking Vietnam in the last two decades.

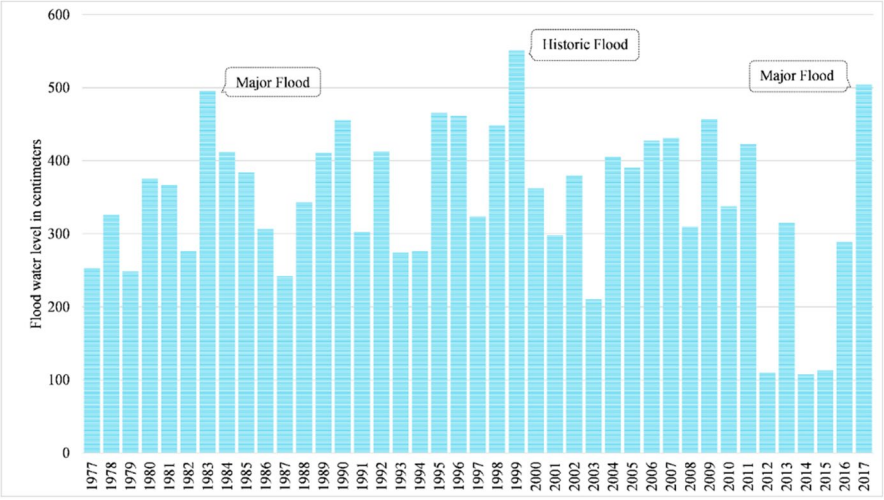

Fig. 2 Flood peak measured in Thua Thien Hue province in the period 1977–2017. Source: Thua Thien Hue Hydrometeorology and Forecasting Center

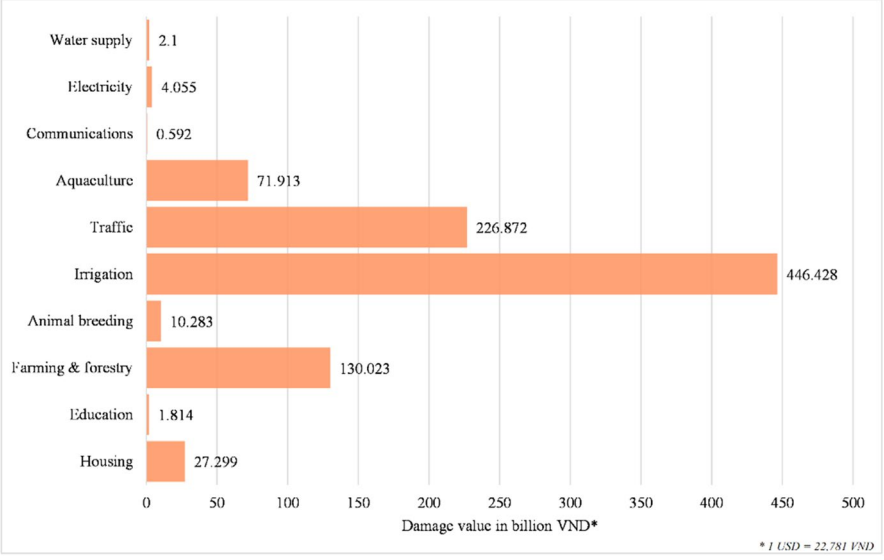

Fig. 3 Damage caused by the 2017 flood in Thua Thien Hue province. Source: Center for Natural Disaster Prevention and Control of Thua Thien Hue Province

Heavy rains induced by this storm's circulation combined with water discharge from hydropower and irrigation reservoirs resulted in flood depths comparable to the 1999 historic flood in some rural areas and thus caused heavy damage to the villagers (UNDP 2018). The damage caused by the 2017 flood is summarized in Fig. 3.

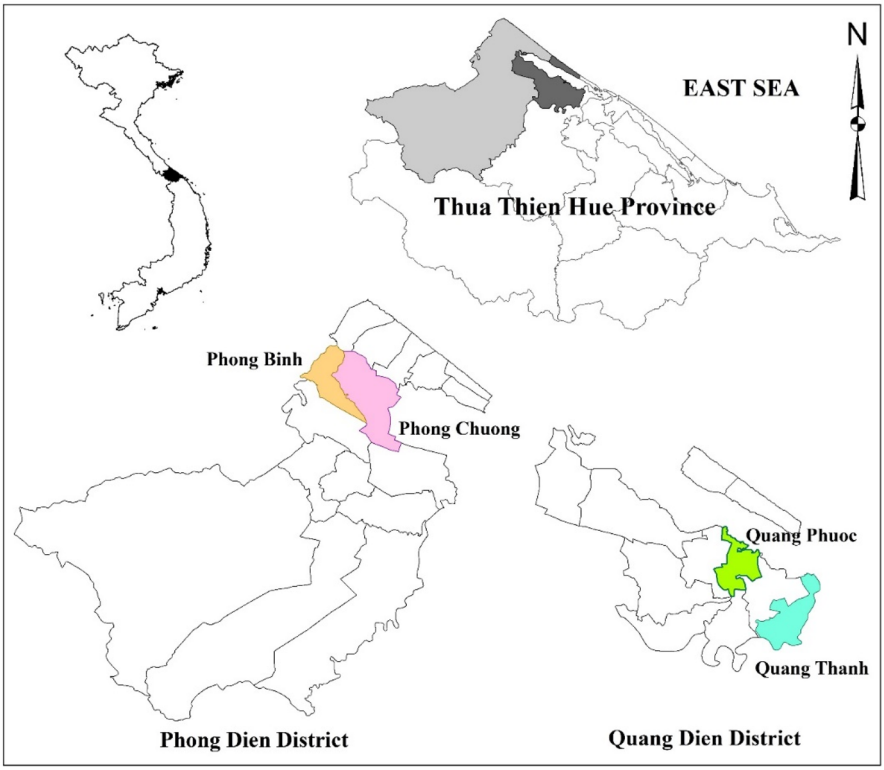

Fig. 4 Location of study sites. Source: Authors

The total damage amounted to 921.379 billion VND, the most considerable in the last decade.

The data analyzed in this study were collected from eight villages in four communes: Phong Binh and Phong Chuong (in Phong Dien district) and Quang Thanh and Quang Phuoc (in Quang Dien district) (Fig. 4). Quang Dien and Phong Dien are the two most floodable districts in TTH province. Nearly 90,000 people in Quang Dien district are usually at risk of flooding whenever the rainy season comes. As a rural district, agriculture and aquaculture are the primary income source for most households, contributing to approximately 40% of the total production value. While plentiful resources from the dense river system and Southeast Asia's most extensive lagoon system create great impetus for the local economy, they also pose many risks during the rainy season. In November 2017, flooding was triggered by heavy rainfall combined with water discharged from hydroelectric dams. In several rural regions, flood depths equivalent to the catastrophic 1999 flood were recorded (Nguyen et al. 2021). The local inter-village and inter-commune routes in Quang Dien were nearly wholly cut off. According to the district, around 4000 dwellings were inundated at least 0.5 m deep. Approximately 400 hectares of rice crops, 260 hectares of vegetable fields, 400 tons of fish, 30,000 head of cattle and poultry, and various other

infrastructures were damaged in this flood. The overall tangible damage was almost 100 billion VND, a considerable burden for a quasi-agricultural district. Similarly, six storms and tropical depressions swept Phong Dien district in 2017. Phong Dien district is located on a narrow strip of land and bounded by two large rivers, O Lau River in the North and Bo River in the South with various types of terrain, such as hills, plains, and coastal – lagoon. The 2017 flood caused heavy damage to people, public facilities, and private household properties. More than 112 houses were blown off the roofs, and 2956 houses were heavily flooded. Regarding agricultural production, more than 3298 hectares of winter-spring and summer-autumn rice were flooded; 256 ha of crops were infected (150 ha were eradicated); 26.7 ha of fruit trees fell; 920 ornamental flowerpots are wilted. About 160 cattle and 25,030 poultry were killed and washed away, and more than 1000 tons of fish drifted in the water. Floods destroyed several dikes for aquaculture and inland fields throughout the district, with more than 33.7 km. Total damage was estimated at up to 70 billion VND.

4.2 Methodology

4.2.1 Data collection

The data for analysis were collected in selected communes of TTH province from October to December 2019 and from March to April 2020. The initial investigations using the in-depth interview method were carried out with key informants at the district level (District People's Committee; Department of Agriculture and Rural Development) to get an overview of the local socio-economic, flood-related secondary data, as well as to identify appropriate study sites. This method was also used to interview the individuals responsible for flood control and prevention at the commune level (vice heads) and village level (village heads).

The study population was calculated using Taro Yamane's method (Yamane 1967), as shown below. Where n: Minimum study population; N: Number of affected households; and e: Error margin.

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

We relied on village heads' reports on the number of affected households to calculate the minimum sample size. Accordingly, about 1766 households out of 3365 in eight villages were suffered to varying degrees (account for 52.48%). With a margin of error of 5%, a minimum of 326 interviews was required to ensure the sample's representativeness. Face-to-face interviews were conducted with 347 households. However, only 331 questionnaires were completed and used in this study.

The number of interviewed households is relatively equally divided among the eight villages. To avoid bias or discrimination, we based on the list of affected households provided by the village leaders and applied the probability sampling method (systematic sampling) to select respondents. Our target interviewers were heads of farming households (no non-farmers were included), usually men, who

hold the highest decision-making power and understand family members' characteristics and recovery process. A semi-structured questionnaire was prepared to facilitate the interviews. It was developed through the literature review and consultation with experts who are well-versed in flooding and villagers' lives. The blend of closed, semi-closed and open questions was helpful for us to capture both quantitative and qualitative data. At first, households were asked to provide basic information on their demographics and views on resource mobilization for recovery. Then, we looked at important connections that households have established. Finally, we looked back on the 2017 flood to understand households' damages and recovery process. During the household survey, we sometimes incorporated the in-depth interview method to get insights into issues, such as the advantages and obstacles of post-flood recovery, the role of government and social connections, etc. Since household relationships are complex and overlapping, identifying them was one of the key challenges. Community-based organizations (e.g., Farmers Union, Women's Union, Youth Union, Fishery Association, and Veterans' Association) were considered formal groups, which differs from informal groups (e.g., individual business group, ornamental plant group, ornamental bird group, mechanic group, bricklayer group, seafood trading group) in terms of goals and membership recruitment mechanism. We noticed during the survey that there was sometimes overlap in role between neighbors and relatives. In these cases, the counting of relatives was prioritized. Meanwhile, links with other peers were comparable to those with friends.

We summarize the main characteristics of the study population in Table 1. Most respondents were male householders (81.3%) and middle-aged (55.9%). Their education level was relatively low. Most of them only attended secondary school, while only 5% claimed high school. On average, each household had 2.5 laborers, and only 43.8% had more than two laborers. By income level, most households (61.62%) were classified as middle class (1.5–4.5 million VND/month), while about 20% of households were categorized as poor. Agriculture, aquaculture, and fishing were villagers' primary livelihoods. Only a small part relied on other occupations (4.83%). Most households (nearly 65%) lived in semi-permanent houses, while about 15% were still attached to temporary dwellings.

4.2.2 Data analysis

This study was conducted by blending qualitative and quantitative methods. While the quantitative technique was applied to test the interactions between the output variable and predictors, the quantitative one was used to interpret meanings behind estimated numerical data.

The heart of this study was the use of the binary logistic regression model to investigate the factors promoting or hindering the households' post-flood recovery rapidity. The dependent variable was split into either ″quick recovery″ or ″delayed recovery,″ corresponding to the value one (1) and zero (0) in the regression model, respectively. Since the average recovery time of the whole sample was 3.12 months, households required less than this value were assigned a quick recovery (see Table 2). In this study, the recovery time was identified as the period required for households to restore almost all damages to housing and properties, livelihoods and

Table 1 Summary of the sample characteristics ($N = 331$)

Demographics	Frequency	Percentage
Householder's dender		
Male	269	81.3
Female	62	18.7
Householder's age		
< 45 years old	55	16.6
45–60 years old	185	55.9
> 60 years old	91	27.5
Householder's education level		
Elementary school	145	43.81
Secondary school	172	51.96
High school	14	4.23
Number of laborers		
≤ 2	186	56.19
> 2	145	43.81
Monthly per capita income		
< 1.5 million VND	69	20.85
1.5–4.5 million VND	204	61.63
> 4.5 million VND	58	17.52
Main Source of Income		
Agriculture	216	65.26
Aquaculture	43	12.99
Agriculture and aquaculture	56	16.92
Others	16	4.83
Household classification		
Poor	69	20.85
Non-poor	262	79.15
House type		
Permanent	72	21.75
Semi-permanent	213	64.35
Temporary	46	13.90

Source: Household survey

reconnect with basic services (e.g., clean water, electricity, education, and healthcare) as before the flood. As consulted by some village heads, who are knowledgeable about floods, damage, and villagers' recovery, applying "almost all" restoration amplitude is necessary because identifying recovery time precisely is impossible as it is a relative index. In our opinion, applying the degree to which the functions of objects are almost restored is acceptable in social research. The questions to collect 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 re-connect with electricity, clean water, schools, and healthcare services?". The time for developing new equivalent livelihoods was recorded for livelihood activities that did not restore after the

Table 2 Brief description of the key variables

Variable	Type	Explanation	Min	Max	Mean	SD
Dependent variable						
Recovery speed	Binary	1 = Quick recovery (< 3.12 months) 0 = Delayed recovery (≥ 3.12 months)	0	1	0.57	0.49
Explanatory variables						
Householder's gender	Binary	1 = Male 0 = Female	0	1	0.81	0.39
Householder's age	Nominal	1 = Under 45 years old 2 = 46–60 years old 3 = Over 60 years old	1	3	2.11	0.65
Householder's education level	Nominal	1 = Elementary school 2 = Secondary school 3 = High school	1	3	1.60	0.57
Number of laborers	Continuous	Number of laborers	0	5	2.49	1.01
Engagement in non-farm jobs	Binary	1 = Yes 0 = No	0	1	0.52	0.50
Monthly per capita income	Continuous	Income in million VND	0.4	10.2	2.89	1.51
Total damage by floods	Continuous	Damage in million VND	1	54.5	12.77	9.83
Connections to friends	Continuous	No. of trusted friends	0	10	3.76	1.86
Connection to neighbors	Continuous	No. of trusted neighbors	1	9	4.62	1.77
Connection to relatives	Continuous	No. of trusted relatives	2	13	5.65	2.04
Connection to formal groups	Continuous	No. of formal group with memberships	0	5	2.53	1.09
Connection to informal group	Continuous	No. of informal group with memberships	0	6	1.56	1.22
Reliance on government support	Binary	1 = Reliance 0 = Non-reliance	0	1	0.32	0.47

Source: Household survey

flood. We defined the recovery period as the time required to rebuild all the above damages.

This study considered thirteen variables related to household demographics, social networks, and reliance on government support as predictors. The way these variables are measured is briefly described in Table 2. We based on the respondents' subjective estimate of the damage value according to the categories shown in Fig. 4 to calculate the total damage. For social connections, they were identified based on the number of trusted links households had for each type (friends, neighbors, relatives, formal groups, and informal groups). Meanwhile, the government-reliant psychology of households was determined by taking into account their view towards the government's responsibility for flood recovery. Those who agreed that post-flood rehabilitation is primarily responsible by the government were viewed as the government-reliant group. Individuals with this view may wait for government help and thus may be less proactive in recovery. Meanwhile, those with the opposite view were classified as the non-reliant group.

Based on the literature review, we hypothesize that households with the following characteristics recover more quickly: male-headed, younger and better-educated householders, more laborers, engaging in non-farm jobs, higher income, less damage, more social connections, non-reliance on government support.

5 Results and discussion

5.1 Households' tangible damages

First, we examine the percentage of households suffering from the flood by most common categories and corresponding damage values in Fig. 5. It should be noted that the average damage was only calculated based on the number of households affected, not the total study sample.

In-house property, farming, and animal breeding categories were the most common damage categories with 77.34%, 55.29%, and 70.09% of households, respectively. The indoor property damage was the most common, but the extent of damage was only moderate (5.18 million VND). This was because that households actively moved most valuable assets to safe places or implemented adequate measures to protect them at home. About 30% of houses were damaged at different levels, such as roof blown off, partial collapse, and structural damage. On average, each household spent more than 5 million VND to repair their house. In terms of livelihoods, aquaculture suffered the most losses (16.93 million VND), despite the relatively low percentage of damaged households (36.86%). Aquaculture is an essential livelihood with high capital investment for many households in the study sites. Although villagers applied different measures to solidify or fix the fish cages before the flood, they were still washed away due to the strong flow. Besides, water pollution after floods also caused mass fish deaths. Similarly, farming activities also suffered heavy losses (9.67 million VND). Besides these damages, villagers also spent on medical examination and treatment, repairing animal breeding facilities, fishing, and aquaculture equipment, but these costs were relatively small (1.72–3.76 million VND).

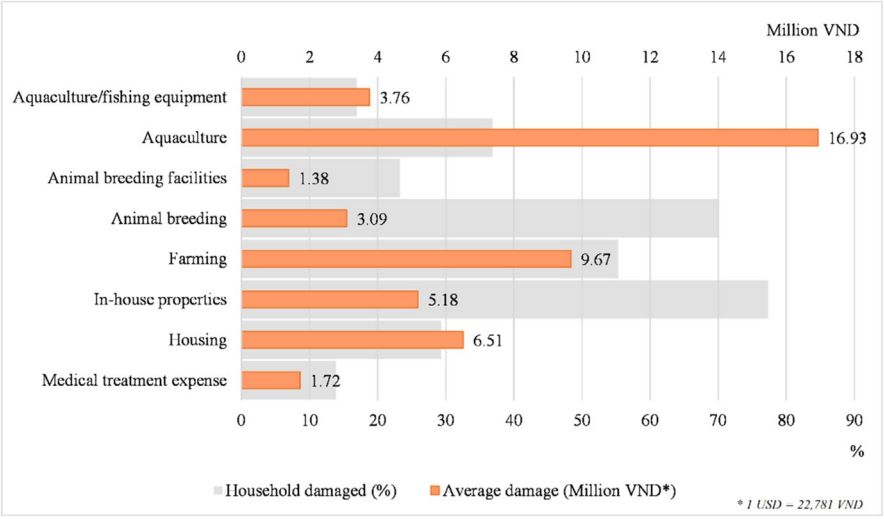

Fig. 5 Households' tangible damages by the 2017 flood. Source: Household survey

5.2 Factors influencing household recovery

Binary logistic regression was used to investigate the characteristics that influence how quickly households recover from floods. Accordingly, the recovery time is treated as a discrete variable that can only take values of zero or one. One (1) indicates households that recovered quickly after the flood, whereas zero (0) indicates those that took longer to reestablish normalcy. As predictors, the model comprised thirteen variables.

Table 3 summarizes the model's accuracy in making predictions. The model properly anticipated the delayed recovery of 109 out of 141 households (77.3%). Similarly, the model assessed just 34 instances inaccurately out of 190 quick-recovering households, equating to an accuracy rate of 82.1%. As a result, the model's average success rate reached 80.1%, indicating strong dependability.

Table 4 contains the calculated parameters for the binary logistic regression. The data reveal that the overall link between explanatory factors and households'

Table 3 Percentage accuracy in classification (PAC)

Observed	Predicted		
	Slow recovery	Quick recovery	Percentage correct
Slow recovery	109	32	77.3
Quick recovery	34	156	82.1
Overall percentage			80.1

Source: Household survey

Table 4 Results of binary logistic regression on factors influencing post-flood rehabilitation rapidity

Indicators	B	S.E	Wald	*df*	Sig	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Householder's gender**	−1.175	0.457	6.626	1	0.010	0.309	0.126	0.756
Householder's age			0.259	2	0.878			
Age (1)	0.049	0.444	0.012	1	0.912	1.050	0.440	2.506
Age (2)	0.212	0.495	0.183	1	0.668	1.236	0.468	3.265
Householder's education level			5.845	2	0.054			
Education level (1)	0.113	0.309	0.133	1	0.716	1.119	0.611	2.051
Education level (2)*	2.347	0.972	5.834	1	0.016	10.452	1.556	70.190
Number of laborers	0.022	0.157	0.020	1	0.888	1.022	0.751	1.391
Engagement in non-agricultural jobs*	0.753	0.332	5.148	1	0.023	2.123	1.108	4.070
Monthly per capita income**	0.448	0.136	10.862	1	0.001	1.565	1.199	2.042
Total damage by floods**	−0.067	0.018	14.345	1	0.000	0.935	0.903	0.968
Connections to friends	−0.100	0.087	1.309	1	0.253	0.905	0.762	1.074
Connections to neighbors	0.083	0.090	0.856	1	0.355	1.086	0.912	1.295
Connections to relatives **	0.377	0.083	20.811	1	0.000	1.458	1.240	1.715
Connections to formal groups	0.043	0.154	0.080	1	0.778	1.044	0.773	1.411
Connections to informal groups**	0.680	0.161	17.828	1	0.000	1.973	1.439	2.705
Reliance on government supports**	−1.053	0.321	10.790	1	0.001	0.349	0.186	0.654
Constant	−2.573	0.888	8.397	1	0.004	0.076		
Model summary	−2 Log likelihood	290.057						
	Cox & Snell R Square	0.386						
	Nagelkerke R Square	0.519						
	Chi-square	10.477						
	Sig.	0.233						

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

Source: Household survey

recovery probability is plausible ($\chi 2 = 10.477$; $p = 0.233 > 0.05$). The value of Nagelkerke R^2 (0.519) further indicates that the explanatory variables included in the model explained 51.9% of the probability of households' post-flood recovery rapidity.

The model results (Table 4) revealed characteristics and factors influencing households' post-flood recovery. As anticipated, the results show an adverse effect of damage extent on household recovery. Households with higher levels of damage tend to be slower to rebuild their lives (B = −0.067, $p = 0.000$). Households' quick recovery odds will be decreased by 6.5% if the damage level by floods increases by 1 million VND (OR = 0.935). This finding is in harmony with the results of Kurosaki et al. (2012), Bubeck and Thieken (2018), and Sadri et al. (2018) that the more physical goods or material possessions lost, the slower households recover. This result, however, disproves the finding of Platt (2018) that there was little connection between them.

Concerning demographic characteristics, the model indicates a statistically significant influence of 4 variables, including gender and education level of household head, engaging in non-agricultural works, and monthly per capita income.

Gender negatively affects households' recovery time at a 1% significance level (B = −1.175, $p = 0.01$, OR = 0.309). On the one hand, this finding may reflect that women's capacity to deal with flood-induced troubles has been somewhat improved. On the other hand, it may reveal the greater focus of local government, communities, and NGOs on vulnerable populations (e.g., the poor, the elderly, short of human resources households, women-headed families, etc.) to help them overcome post-flood hardships more effectively. The in-depth interviews with village leaders and local government staff indicate that vulnerable individuals were usually prioritized to dispense relief goods earlier and in larger quantities. In addition, they often received more help from neighbors than others. Regarding improving women's capacity, this could be a positive effect of recent projects to enhance flood resilience for vulnerable populations in TTH province. Our conjecture is consistent with current research on women's progress after natural disasters. By reviewing the recovery from the hurricane and subsequent harsh drought in Vanuatu (South Pacific Ocean nation), Clissold et al. (2020) highlighted the pivotal role of women as financial fundraisers, human resource mobilizers and leaders, innovators, and entrepreneurs. Similarly, Kusumasari (2015) explained why women are able to rebuild their lives, even somewhat better, after suffering heavy losses. The study found that social interaction, economic growth, good communication, and cultural ability contributed to women receiving practical and durable support following the crisis.

Our findings also suggest that education offers advantages in accelerating reconstruction. In this regard, although achieving level 2 of education (secondary school) makes no difference from level 1 (primary school) ($p = 0.716 > 0.05$), reaching level 3 (high school) offers a significant advantage in recovery (B = 2.347, $p = 0.016$, OR = 10.452). It is evident that informal training has a more substantial role in the restoration phase than formal schooling (Dinh et al. 2021). However, it should be acknowledged that formal education can also be helpful in some respects. For instance, more educated individuals tend to have more trusting relationships. Through these social connections, households can

quickly mobilize the resources needed for recovery. In addition, better-educated individuals may be able to exploit scientific and technical information and knowledge better to have more appropriate and effective livelihood restoration options.

The model also underlines the meaning of diversifying livelihoods into the non-agricultural sector. Households with non-farm jobs rebuild more quickly after floods. When controlling for other variables, farmers having off-farm jobs recovered 2.2 times faster than those engaged in agriculture alone (B = 0.753, $p = 0.023$, OR = 2.213). Income from off-farm work is progressively becoming an important part of rural households in Vietnam. Apart from agricultural production, many villagers engage in non-agricultural occupations, particularly during leisure time, to improve income and reduce dependence on traditional agricultural activities. If disregarding psychological effects, financial capacity is definitely the determining factor for the households' recovery speed. Since agricultural activities require a specific period to get results, purely agricultural producers frequently face financial challenges following severe damage caused by natural disasters. Meanwhile, farmers with extra off-farm jobs have more stable income sources because they can quickly enter the off-farm labor market after floods. Our additional analysis reveals that households engaged in non-agricultural activities tend to have higher per capita income than those engaged solely in agriculture ($p < 0.05$). This is why the household income contributes positively to post-flood recovery speed (B = 0.448, p = 0.001). Having off-farm jobs increases the probability of quick recovery of households by 56.5% (OR = 1.565).

Our data, meanwhile, suggest that neither the age of the household head nor the number of laborers has a significant influence on households' recovery time ($p = 0.878$, and $p = 0.888$, respectively). We believe that different ages provide different benefits and barriers to disaster recovery. Younger householders certainly have advantages in terms of physical health and market acumen. Although less favorable in these respects, older householders are often more experienced and knowledgeable about reconstruction and have more trusting relationships. In our judgment, the advantage-disadvantage antagonism by age may neutralize the effect of this variable on post-flood recovery. This finding concurs well with the output of Platt (2018) that the influence of exogenous factors, such as household attributes and financial resources, on rehabilitation speed was negligible. Also, more laborers do not shorten households' reconstruction time. This may stem from the fact that most households' labor was merely engaged in agriculture without participating in off-farm activities. Contrary to off-farm activities, agriculture requires more extended periods dictated by crops and livestock life cycles to get results. This could explain why the labor advantage is irrelevant to households' recovery efforts. While this result corresponds well with Francisco's (2014) conclusion that household size had no significant influence, it contradicts the findings of Sadri et al. (2018) that the larger families often hamper the reconstruction effort.

Our analysis also discovered some statistically significant connections while examining the influence of social relationships on households' recovery rapidity. Accordingly, links to relatives and informal groups influenced households' reconstruction rapidity.

The more relatives a household has, the faster they rebuild (B = 0.377, $p = 0.000$). Households' probability of rapid rehabilitation increases by 45.8% with each additional relatives (OR = 1.458). Relatives residing in the same or neighboring villages are relatively common in rural Vietnam (Hirschman and Loi 1996), as evidenced by the research locations. "My family has around seven trusted relatives living in this area. They are either residents of this village or nearby communities. We often meet to exchange and share life issues," an elderly resident in Quang Phuoc commune said. Stemming from the inherent closeness between relatives, mutual support occurs spontaneously. Geographical proximity further simplifies and expedites mutual help. Relatives' assistance, besides, is generally stronger physically and mentally as it is established based on bloodline ties. Almost all respondents agreed that this biological connection is the primary reason for relatives' immediate, devotional, and substantial assistance. Relatives, during the interviews, were sometimes mentioned as an invisible shield protecting them against life's difficulties. The result that relatives typically take the lead in assisting households during difficult times corroborates Masud-All-Kamal & Hassan's (2018) findings in Bangladesh. Our study also reverberates the conclusions of Casagrande et al. (2015). Accordingly, the direct family was regarded as a vital supporter of communities residing alongside the Mississippi River during the period of crisis and long-term recovery.

Similarly, households involved more in informal groups tend to recover more rapidly (B = 0.680, $p = 0.000$, OR = 1.973). When all other variables stay constant, participation in an informal group increases households' probability of rapid recovery by 97.3%. Informal groups are usually formed based on shared characteristics and interests, such as hobbies or occupations, which effectively foster relationships and adhesion among the participants. Additionally, fewer participants in informal groups can be viewed as an essential trait to encourage ties among members. This reality was demonstrated through the story of a man in Quang Dien: "Our group consists of 12 ornamental flower growers in the district. We communicate with one another regularly. We complement one another in terms of experience, flower care practices, flower types, and financial resources." This result is consistent with the reciprocity theory suggested by Trivers (1971) that assisting others in overcoming obstacles can be viewed as a providence for uncertainties that may occur in the future since people tend to reimburse those who helped them (direct reciprocity). Help is also considered an expense to gain fame and prestige, which is often helpful in networking. According to Alexander (2017), people are often impressed and help those who saved others in times of trouble (indirect reciprocity).

Apart from the above explanations, the more significant influence of relatives and informal groups may also derive from their broader geography, which often extends beyond the flood-stricken communities. This feature allows villagers to get more supplies from relatives and informal group members in areas less affected by floods. This finding implies that, in addition to recognizing relatives and informal groups as the traditional "bonding type," they should also be considered the "bridging type." Our suggestion seems reasonable if they reside out of victims' homeland boundaries (e.g., adjacent villages, urban areas, different provinces, etc.). These attributes are not characterized by formal groups, which explains why they could not assist their members (B = 0.043, $p = 0.778 > 0.05$). Additionally, formal groups typically

comprise almost all persons who share standard characteristics. Because the scale of formal organizations is often large, interactions between members are often shallow. This, along with insufficient resources, makes these organizations less effective in supporting members. Similarly, we found that neighbors had little influence on household recovery time (B = 0.083, $p = 0.355 > 0.05$). Neighbors have a negligible impact, most likely due to their low income and flood-induced burdens. Mutual assistance among neighbors is relatively small in terms of aid volume but is widespread in rural areas. This is because households in the same situation usually face similar hardships. A man in Phong Chuong commune stated, "Almost all houses here were relatively equally flooded." As a result, our damage level is also quite similar. I borrowed money from neighbors over a month after the disaster to rebuild the shelter and purchase fishing gear, but the amount borrowed was much less than what I expected. Like me, they also need to restore the flood damage quickly". Additionally, it is likely that immediate assistance from relatives diminishes the role of other connections and makes them reserves, which can be effective if relatives cannot provide support. This result is consistent with Islam and Walkerden's (2014) findings in a case study in Bangladesh. Following cyclones, households frequently cannot assist neighbors due to the tremendous damage and losses sustained.

This study also examined the link between psychological factors and households' post-flood reconstruction. The results demonstrate that reliance on government support reduces the initiative and effort of households and thus slows down their recovery (B = – 1.053, $p = 0.001$). This should be considered an invisible barrier to household post-flood recovery. The quick recovery probability will be lowered by 65.1% if households are psychologically reliant on government support (OR = 0.349). The recovery process was initiated by most households immediately after the floodwaters had receded. Households often mobilize all available resources to accelerate recovery, as they recognize that a prolonged recovery may expose them to other risks. Meanwhile, some households were passive in the recovery, which is reflected in the mentality of looking forward to government support. It can be said that assisting natural disaster victims is a great policy and effort of government at all levels, especially in the context of limited financial resources. However, the lack of finance is one of the reasons why most flood-prone villagers have not appreciated this policy. Through a study in Central Vietnam, Nguyen et al. (2021) revealed that flood-prone households were dissatisfied with the government's support both before, during, and after the flood due to the delay and shortage of aid goods. This implies that households are still central to flood recovery. Waiting for government assistance may limit households' initiative and efforts toward recovery. Their recovery thus could be stagnated. We believed that this reliant psychology is likely associated with women, the poor, less educated, lacking laborers, or older individuals. However, our additional analysis denies these hypotheses. There is no difference in the psychological reliance between gender, age, education, income, and laborer groups ($p = 0.796$, $p = 0.179$, $p = 0.673$, $p = 0.581$, $p = 0.900$, respectively). To encourage villagers to be more proactive in the recovery process, this psychological barrier needs to be broken down. Thus, further research on this topic is required to deeper understand the underlying causes of this kind of mentality.

6 Conclusion and policy implications

Flooding is still one of the most fearful natural threats facing human society despite humankind's everlasting efforts. Nonetheless, our knowledge of how various resources contribute to households' reconstruction remains inadequate. This study, therefore, examined the recovery rapidity of rural households in coastal plain districts of TTH province, Central Vietnam.

The results first show a negative association between the extent of damage and the probability of a quick recovery. In terms of demographics, the findings indicate that the education level of household heads, engagement in non-agricultural jobs, and per capita monthly income all positively influence the likelihood of rapid recovery. Advantages acquired from these characteristics are useful for households' reconstruction. The household head's gender, meanwhile, has a negative effect. While often assumed to restore more slowly, female-headed households recover even more quickly than those headed by men. Our finding implies an increase in women's ability to deal with post-flood difficulties through, for instance, projects targeting vulnerable populations recently conducted in TTH province. It may also reflect greater attention to vulnerable groups by local government, communities, and non-governmental organizations (NGOs) to help them deal more effectively with flood-induced obstacles. Meanwhile, the effect of household heads' age and the number of laborers on household recovery time was negligible. The age-induced advantage–disadvantage opposition may, in our judgment, neutralize the effect of this variable on the reconstruction process. While the over-reliance of households on agriculture, which often requires certain periods to achieve results, is regarded as the cause that makes the advantage of the number of laborers meaningless.

Additionally, this study underscores the crucial part of social interaction in facilitating household recovery. In terms of recovery rapidity, relatives and informal groups appear to be more valuable than friends, neighbors, and formal groups, since they considerably contributed to the households' rehabilitation process. The adhesion of the lineage links, which usually drives the prompt, holy, and considerable help, was viewed as the advantage of relatives.

The positive influence of informal groups is reasonably attributed to their establishment target, more modest size, and diverse membership. They are assembled to satisfy personal and psychological needs, which are essential to building shared harmony and faith within the group, and thus promoting assistance. Besides, the positive effect of relatives and informal groups may further stem from their broader geography, which allows villagers to obtain more plentiful supplies from those in less flood-prone places. We, however, do not negate other linkages' roles. Because rapidity is just one component of the reconstruction phase, the efforts of other links should be seen in different facets, such as guaranteeing survival in emergencies or soothing the victim's emotional distress over time. Our study also discusses the potential negative consequences of relying on government assistance on households' rehabilitation attempts. Reliance on the government is an occult impediment to households' recovery following floods.

The above findings have revealed aspects that policymakers might concentrate their efforts to design policies and interventions that increase the post-food efficiency and speed. As researchers, we suggest some specific solutions as follows:

Since the low-income group tends to face many difficulties aftermath of floods, poverty eradication should be prioritized and integrated into flood risk management strategy. This solution aims to eliminate flood risk at its source. This can be accomplished through the government's social housing development initiatives or by soliciting contributions from local residents or businessmen. This process needs to be strictly monitored to ensure housing quality, minimize resource loss, and thereby foster donors' trust. This may also be accomplished through the preferential loan program, enabling the underprivileged to modify their houses and better their livelihoods. To prevent funding misuse, these loans should be co-managed by local governments.

Besides, supporting the poor to diversify livelihoods into non-farm jobs may also be an important solution to reduce farmers' dependence on agriculture so that they become more active in recovery in case of damage. Besides the poor, middle-income households should also be encouraged to apply this measure. Local authorities should develop policies related to supporting skills training and off-farm work, especially for low-income households. However, the balance between agricultural and non-agricultural livelihoods should be ensured to maintain the sustainability of rural society as higher incomes from off-farm activities may cause farmers to neglect traditional agricultural production.

By emphasizing the critical role of social ties in accelerating households' rehabilitation, this study advocates solutions for community cohesion. Local authorities should provide more space and chances for meetings and exchanges among individuals and households within communities. Cohesion and mutual support within communities are crucial for members to overcome the difficult times right after floods. To foster interaction, which is essential to building mutual trust, this should be accomplished through micro-level units or small groups, such as villages, hamlets, residential clusters, occupational groups, or demographic-based groups, where members' roles are better recognized. Additionally, activities should be diverse and linked to spiritual life, community norms and habits, and households' livelihood development demands to maintain households' enthusiasm. Since relatives were a critical factor throughout the recovery of households, clans' activities that are gradually vanishing in modern society should also be preserved and promoted to tighten the blood kinship further. In addition, farmers themselves should actively expand and diversify trusted social connections by actively participating in informal groups (e.g., related to hobbies or occupations) to be able to mobilize more resources outside the community when falling into difficult circumstances.

Since reliance on government support was identified as a negative factor, this reliant psychology needs to be broken down to increase households' proactive towards recovery. But this should be done by thoroughly considering different causes between the poor and non-poor social groups. Propaganda may be effective in this case. Local authorities need to propagate so that villagers understand the meaning of

quick recovery as well as the accompanying consequences that they may face in case of delayed recovery. Households' key role and the government's supporting responsibility, in this regard, should also be emphasized during this process.

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Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical standards All procedures performed in participatory human studies were obtained with the informed consent of the participants and were in accordance with research ethical standards. This article does not contain any studies involving animals performed by any authors.

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