DOCTORAL DISSERTATION

博 士 論 文

STUDY ON MECHANISM OF BUILDING RESILIENCE TO FLOODS IN URBAN LOW-INCOME COMMUNITIES IN THAILAND

タイの都市貧困コミュニテイにおける洪水に対する レジリエンスの形成に関する研究

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ABSTRACT

This study identifies community resilience indicators and, based on empirical evidence, shows the complex relationship between them. The study involved field surveys, face-to-face questionnaires, in-depth interviews and telephone interviews. The data were analysed using a Pearson correlation coefficient calculator, the Mann-Whitney U-test and structure equation modeling on an SPSS AMOS 20.0.0. To identify the underlying indicators, the areas studied comprise the urban low-income communities that had suffered from the 2011 mega floods in Thailand. The main findings of this research can be summarized as follows:

First, field survey results indicate that flood-affected people need to engage in a number of common activities in the immediate aftermath of a flood. Therefore, the time taken for people to return to their community and begin to engage in these common activities was considered. The underlying indicators that identify the status of flooded people as having returned to normal are linked with the "time spent in house repair," "time spent cleaning the house," "time spent buying furniture," "time until income had been recovered," "time spent in waste management" and "time before local businesses reopen." Prior to the survey, only some of these indicators had been expected, such as the time spent repairing and cleaning a house, and the time before recovering personal income, because these are well known as built environment and socioeconomic factors by virtue of supporting both the household and community aspects of recovery. However, the unexpected indicators identified in discussions with residents included the period until waste management activities began and the period until local businesses reopened. The indicator period for reopening a local business is specified in a community case study of a lower-to-middle income community.

Second, the most vulnerable group are poor communities in more flood-prone areas, which have uncertain levels of "social capital." Originally, they become vulnerable because they cannot gain access to supported programs that enhance their adaptation to risk. In this study, the adaptation to risk is identified by improved housing conditions such as the use of strong construction material and building houses with a higher story and a raised floor. The results confirm that these housing characteristics are essential for mitigating residential flood damage and reducing recovery time.

Third, in the aftermath of floods, with respect to the physical aspect, improvements in housing characteristics is also required to reduce the frequency and magnitude of flooding. The

Baan Mankong program (BM) is a government program for low-income people in the study areas. The main objective of this program is the development of sustainability at the community level. However, to qualify, the community must demonstrate an active collective program among community members, such as joining saving groups promoted by Thailand's Community Organizations Development Institute (CODI). In fact, the savings group is a tool CODI uses to drive "social capital" at the community level. When a community achieves a target in a particular program such as a saving group, then CODI will initiate the upgrading of homes and infrastructures in their community. This means that building "social capital" is a community requirement to obtain access to the program as well as a way to improve the housing characteristics in low-income communities. The study found that communities with a BM program experienced shorter times to clean a flooded house than those without a BM program. Therefore the physical upgrading of houses and the provision of public infrastructures were considered in this study. Economically speaking, lower income groups with only informal recovery arrangements take longer to recover their income. These results reveal that lower income people who fall into the informal group are most vulnerable in the aftermath of a flood catastrophe.

Finally, "social capital" is an unavoidable and relevant factor in building resilience against floods at the community level in Thailand. A mechanism for promoting "social capital" is required. Based on the results of a previous study, bonding, bridging, and linking activities are the main underlying components for building "social capital." To address this topic, a case study was conducted in an area that had suffered serious flooding. In addition, a case study was made with respect to progressive activities. The Nakhon Sawan City Municipality was chosen, in particular, for its community networks located in flood-prone areas. The results show that the basic social capital characteristics for building adaptive capacity is bonding and linking social capital. For instance, community networks with social capital links with CODI result in communities having the ability to build bridging social capital with other communities, and this bridging social capital was essential for building resilience against floods at the community level.

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CHAPTER 1. INTRODUCTION

1.1. Background

In recent years, the number of natural disasters has dramatically increased, resulting in damage to both life and property. The impacts are both tangible and intangible. Intangible impacts include psychological loss and long-term business impacts that are difficult to quantify. In the aftermath of a catastrophe, affected systems that are not prepared in terms of risk reduction are also not able to immediately resume their normal activities. Despite the fact that the onset of disasters such as earthquakes cannot be forecasted and thus lack the time for making short-term preparations, disaster preparedness must be initiated in existing systems. If systems are always in a state of preparedness for catastrophes, the impacts would then be more controllable, and their consequences may not necessarily be scaled up to that of a disaster. Of course, suffering no effects from disasters would be the first and finest outcome desired but this seems to be an idealistic and unrealistic goal.

With respect to disaster management, mitigation efforts have been recommended for implementation in the early stages, as this is when impacts from disasters can be better controlled. Additionally, during a disaster, a system should be in place with its own resources and related organizations for immediate response. Also, humanitarian aid and emergency responses should be initiated for victims as quickly as possible. Ultimately, any relief activity can reduce the damage caused to victims. In the aftermath of disasters, recovery is essential. Physically, the repair of the built environment and public infrastructure is necessary. However, affected people are a priority for attention as some may have lost family members who had been both an asset as well as income providers. Relief agencies have made efforts to minister especially to those who have experienced disaster and sustained heavy losses. However, in cases where the system itself was devastated, recovery is made more difficult. Therefore, systems must be resilient.

The Intergovernmental Panel on Climate Change (IPCC) reports that climate-related hazards affect poor people’s lives both directly and indirectly. In a recent report (IPCC, 2014), the IPCC identified the negative effects on the poor as including reductions in crop yields and destruction of homes, but also points out a number of indirect positive effects such as the diversification of social networks and agricultural practices, although these effects are limited. The study of Mileti and Gallus (2005) reports that the poor may also suffer greater risk from disastrous events worldwide mainly because they live in lower quality housing that is more likely to be damaged and is often located closer to technologically hazardous sites. In both developing societies and in wealthy industrialized nations, poor families around the world suffer

the greatest losses and have access to the fewest public and private recovery assets. As such, this study confirms the limited accessibility to resources of low-income people.

Resilience to natural disaster has been reported to reduce the impact of disasters. At the 2005 international conference in Hyogo, Japan, there was agreement by governments, international agencies, disaster experts, and many others to work to reduce risks by building community resilience. It is widely accepted that promoting resilience is in the public interest. Resilience is not a new concept, and many past studies have addressed it. For example, Tubin (1999) used three resilience models to investigate ways to strengthen resilience. First, the mitigation model links practical system programs, such as constructing an embankment to protect against floods, and other proposals for a mitigation program. Second, the recovery model relates to the adaptation of a policy or program in the system. Third, the structure cognitive program shows the power of a society that has adequate budgetary resources to deal with disasters that have occurred. Carpenter et al. (2001) also suggested that systematic guidelines enhance resilience by the following three measures: (a) the amount of change the system can undergo (and implicitly, the amount of extrinsic force the system can sustain) and remain within the same domain of attraction (that is, retain the same controls on structure and function); (b) the degree to which the system is capable of self-organization (versus lack of organization, or an organization forced by external factors); and (c) the degree to which the system can build in the capacity to learn and adapt.

Previous research has pointed out that resilience has several levels, from the national to the community and the individual level (Chang and Shinozuka, 2004; Miman and Short, 2008; Schelfaut et al., 2011). Local communities and individual decision-making pathways are embedded within nested hierarchies of scale. At these levels, there is an indirect expression of resilience which informs and influences resilience actions taken by individuals and households Of these levels of resilience, community resilience is important because the community is very close to people's daily life and it is subject to the social, economic, and environmental aspects of a natural disaster (Wilson, 2012). Indicators of resilience and vulnerability and appropriate data sets must be identified and developed as crucial elements of resilience to improve our understanding and management of disaster preparation and response (Buckle et al., 2001). In previous studies of Cutter et al. (2008), resilience indicators were classified as the generic capacity of a community's social, economic and institutional components. Therefore, it is essential that resilience indicators be examined, as well as the factors that strengthen resilience at the community level.

The number of natural disasters has dramatically increased in recent years and the consequence of this increase is found throughout developing countries. For instance, Indonesia and the Philippines were hardest hit by recent natural disasters, which killed more than 350,000

people in more than 500 incidents. Floods and storms were most frequent in these regions, accounting for 64 per cent of the total number of such events reported between 1970 and 2014. These data are taken from a 2015 publication by the UN Economic and Social Commission for Asia and the Pacific (UNESCAP). This annual report also showed that disaster fatalities in the Asia-Pacific region rose more than three-fold over the past decade, largely due to a handful of extreme disasters. In addition, disasters in 2011 caused massive flooding and the consequences seriously affected all of Thailand. The World Bank reported that the 2011 floods affected more than 65 of 77 provinces and were also declared disaster areas.

For this study, a field survey was conducted and a case study undertaken in urban low-income communities in Thailand that had suffered from floods.

1.2. Problem statement

Recently, the concept of disaster resilience at the community level has appeared in hazard literature. Even without a precise definition, resilience is widely accepted, and the aspects of resilience most widely adopted are preparedness, adaptation and responsiveness toward disasters. However, few papers have comprehensively addressed disaster reduction from the pre- to post-period based on the concept of resilience. Furthermore, there have been frequent calls in the literature for approaches for building resilience at the community level, and few answers provided beyond rough outlines.

Very few studies have focused on building community resilience towards disaster at the community level in Southeast Asia, and while there is one particular region dramatically threatened by disasters, and especially floods, there has been little research suggesting how communities might assess their resilience against disasters, or how to determine the factors associated with moving in the direction of becoming more resilient. Methods are needed for determining a community's capacity to cope with disasters, especially floods, and the relevant processes necessary to improve that capacity.

The objective of this research is to address the gaps in our understanding of how to build resilience when a community has been repeatedly inundated. As a case study, flood-affected communities in Thailand are used to determine the most relevant disaster resilience factors, based on field experience investigations.

The study addresses building resilience from mitigating vulnerability to the recovery period, covering all stages of risk reduction. Moreover, it identifies the complex relationship between the factors and implementation processes in building resilience at the community level.

The study results provided here are attempts to make operational the concept of disaster

resilience. The findings can also be used as a beginning step in supporting communities to make a plan for mitigating their vulnerability and facilitating recovery. Based on this preliminary study, other organizations such as local administration offices, community development offices and others should take steps to formulate plans, strategies, and policies to formally anticipate and deal with floods.

1.3. Research Objective

In this study, the main research question is ‘What are the factors that can build resilience against floods in urban low-income communities in Thailand?’

Subsequent to this main question, further questions were considered:

- What are the relationships between the relevant factors?
- How can affected communities build resilience against floods?

To answer the above questions, following objectives were established to conduct the research.

- Identify factors related to floods and clarify the complex relationship between them.
- Explore the relevant processes that build resilience at the community level.
- Provide useful recommendations to support both communities themselves and related organizations to formulate a plan, strategy, and policies to decisively deal with flooding.

1.4. Organization of the study

The thesis is divided into seven chapters according to the thematic approach:

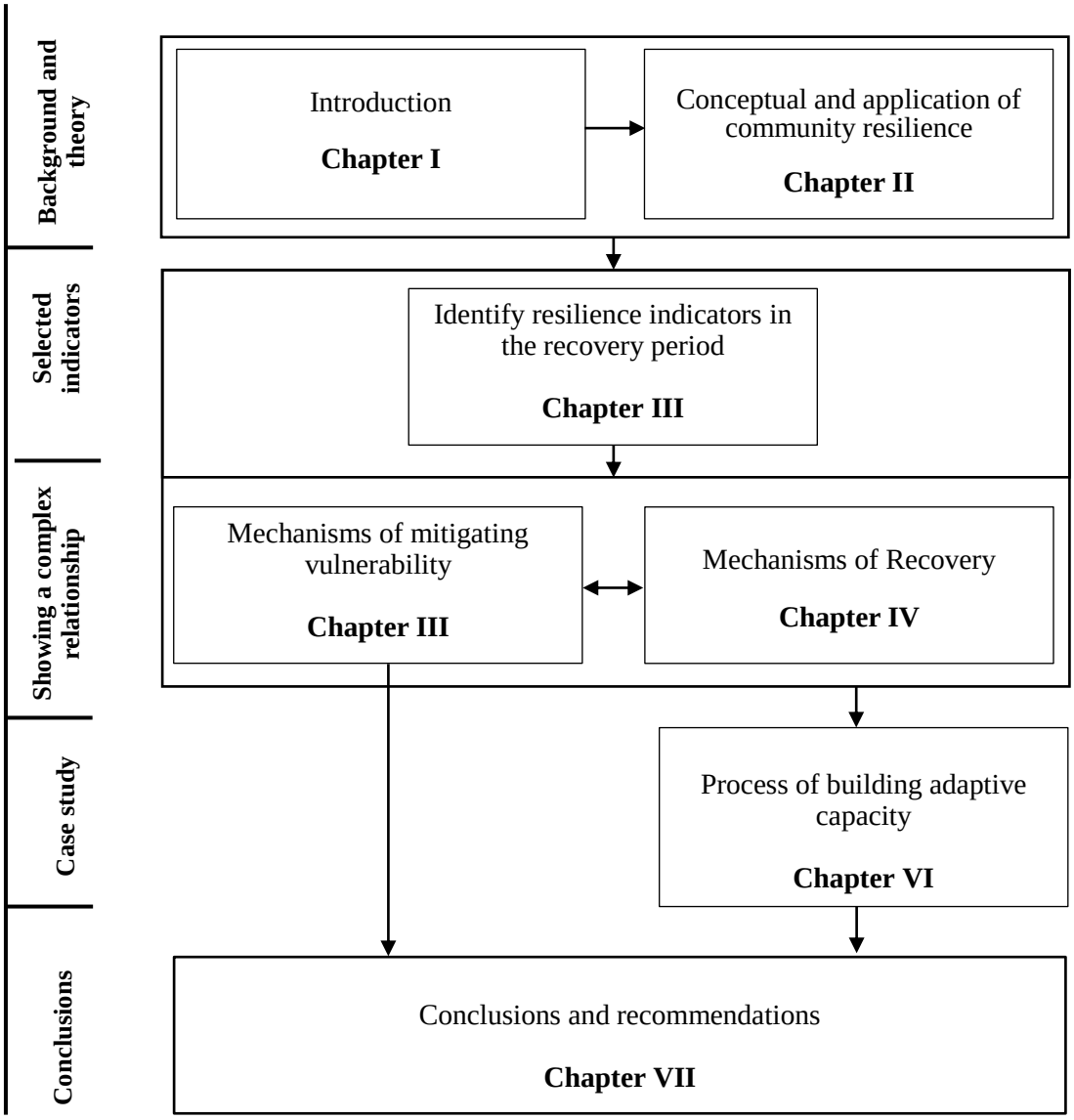


Figure 1-1 Logical flow of dissertation chapters

1.5. Research methodology

The study aims to identify indicators and its factors and shows the complex relationship between them based on the empirical evidences. Therefore main approaching are filed survey, observation, face to face questionnaire survey, interviews as well as a case study.

Table 1-1 Summary of research methodology

Chapter	Research methodology	Objective
Chapter III	**Field survey** with community leaders / committees and staffs of related organizations **Analytical tool** • Explanatory analysis	**To identify factors**
Chapter IV and Chapter V	**In-depth interviews** with community leaders and 2-3 community members: **Questionnaire survey**: Head of family or his/ her spouse, 20% of total household **Analytical tool** • Pearson Correlation Coefficient Calculator • Mann-Whitney's U test • Structure equation modeling analysis on SPSS AMOS 20.0.0 • Explanatory analysis	**To show the complex relationship between factors**
Chapter VI	**Observation** **In-depth interview** : community leaders/ committees mayor of city municipality, staff of related organization **Focus group**: community member **Telephone i0nterview:** committees leaders/ committees, staff of related organization **Analytical tool** • Explanatory analysis	**To explore the process that builds resilience at the community level**

1.6. Definition of terms

a. Resilience

Tierney (2003) defined resilience as a property of physical and social systems that enables them to reduce the probability of disaster-induced loss of functionality, to respond appropriately when damage and disruption occur, and to recover in a timely manner. More generally, resilience can be understood as the ability of one or more systems (e.g., physical, economic, or community systems) to: (1) reduce the probability of a major disaster-induced shock through effective mitigation measures; (2) cope with a disaster when it occurs by launching an effective response; and (3) recover quickly from the impact following a disaster.

Following the above definition of resilience, which covers the strategy of disaster management, this study adopts this definition to define ‘resilience’ as a property of a community to mitigate its vulnerability and recover quickly in the aftermath of disaster.

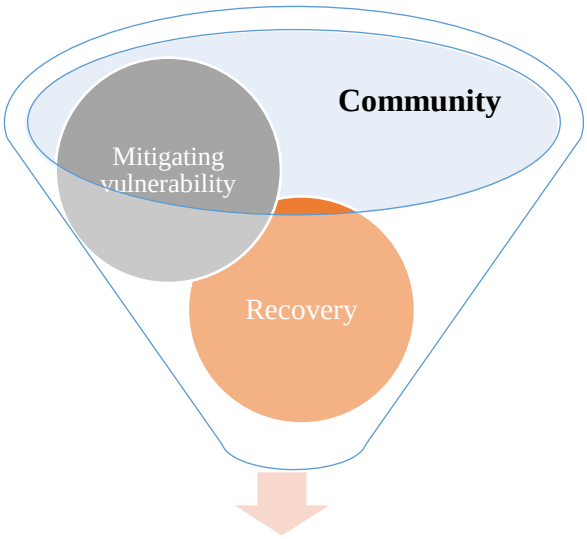


Figure 1-2 Definition of "resilience" used in this study

b. Mitigation

Hazard mitigation is the action taken to reduce or eliminate long-term risk to people and property from hazards and their effects (Godschalk, 2003). In this research, mitigation is defined as the actions taken to reduce or eliminate the long-term risk of people in a community.

c. Vulnerability

Brouwer et al. (2007) explicitly distinguished between the individual (household) and the collective (community) and established an association between risk exposure and poverty as the main component of vulnerability. In this study, vulnerability is defined as exposure to risk and the sensitivity to risk that is linked with the socioeconomic aspects of flood victims.

d. Recovery

Tobin and Montz (1994) provided a conceptual idea of recovery that entails not only simple clean-up and restoration operations to get a community back on its feet, but also require long-term rehabilitation processes that are affected by prevailing socio-economic conditions and structural constraints. Additionally, an empirical study of Finch et al. (2010) examined how pre-existing social vulnerabilities within New Orleans were related to the level of flood exposure and produced inequities in the socio-spatial patterns of recovery, based on the measure of time to recovery. Their results show that less flooded and less vulnerable areas are recovering faster than tracts that are home to more vulnerable populations and higher levels of flooding.

This study proposes that recovery is related to issues that explicitly relate to the direction of affected people returning to a normal state in their communities, in particular, recovery after a flood catastrophe that empirically addresses both rehabilitation and socio-economic factors.

e. Adaptive capacity

Smith and Wandle (2006) developed a model showing the nest hierarchy of vulnerability and adaptive capacity. In their study, they describe adaptive capacity as being context-specific and varying from country to country, from community to community, and among social groups and individuals over time. It varies not only in terms of its value but also its nature. The scales of adaptive capacity are not independent or separate. The capacity of a household to cope with climate risks depends to some degree on the enabling environment of the community, and the adaptive capacity of the community reflects the resources and processes of the region. For example, the presence of a strong kinship network may increase adaptive capacity by allowing greater access to economic resources, increasing managerial ability, supplying supplementary labour and buffering psychological stress. This study adheres to the existing concept, thus adaptive capacity is defined as the process of activities taken by a community to mitigate vulnerability and carry out an on-going progressive program towards future disaster.

f. Hazard

In 1997, the U.S. Federal Emergency Management Agency (FEMA) defined hazards as events or physical conditions that have the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business or other types of harm or loss. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity, frequency and probability (JICA , 2013). This study deals with natural hazard and defines the floods as hazards that frequently occur in Thailand.

g. Community

Communities are composed of built, natural, social and economic environments that influence one another in complex ways (Norris, 2008). In this study, the meaning of community emphasises its physical aspects, comprising the area where people live. It combines clear boundaries and linkages, including the sharing of public infrastructures such as roads, rivers, canals, temples, schools and health centres.

CHAPTER 2. LITERATURE REVIEW

2.1. Why is resilience important with respect to hazards?

Resilience is an important goal for two reasons. First, the vulnerability of technological, natural and social systems cannot be predicted completely and resilience is the ability to accommodate change flexibly and without catastrophic failure. Resilience is critical in times of disaster (Foster, 1997). Second, people and property fare better in resilient cities struck by disasters, than in less flexible and adaptive places faced with uncommon levels of stress. In resilient cities fewer buildings collapse, fewer power outages occur, fewer households and business are put at risk, fewer deaths and injuries occur, and fewer communications and coordination breakdowns take place (Godschalk, 2003).

2.2. From theories to practice in building resilience to hazards

2.2.1 Definition of resilience

Resilience is becoming an increasingly popular concept in research and for application of the principles behind effective hazard planning and prevention (Tubin, 1999; Kampfer 1999). Resilience was introduced to the literature more than four decades ago by the theoretical ecologist C.S. Holling (1973). Initially, the ecological regime described resilience in two ways. First, stability was the persistence of a system near or close to an equilibrium state. Second, resilience was introduced to indicate the behaviour of dynamic systems far from equilibrium, and was defined as the amount of disturbance that a system can absorb without changing its state (Gunderson, 2000). The definitions of resilience used in previous studies are summarized in Table 2-1.

The resilience literature has adopted different approaches and been addressed by several disciplines. For example, societal resilience, as defined by Dover and Handmer (1992), offers a typology of resilience including three types as follows:

Resilience Type 1: resistance and maintenance

This type is characterized by resistance to change. A management system of this type will do its utmost to avoid change and uncertainty, and enormous resources will be expended to maintain the status quo. Threats will be identified and anticipatory mechanisms put in place. Where an appropriate reaction would threaten the status quo, appeals to ignorance are common, often expressed in calls for more information and an insistence upon inaction due to uncertainty. A society totally reliant on Type 1 responses will likely be poorly equipped to deal with

unexpected shocks or thresholds of change.

Table 2-1 Definitions of resilience

Author	Definition
Mileti, 1999	Resiliency to disasters means that a locale can withstand an extreme natural event with a tolerable level of losses. It takes mitigation actions that are consistent with achieving that level of protection.
Tobin, 1999	Resilient communities are defined as societies that are structurally organized to minimize the effects of disasters and at the same time have the ability to recover quickly by restoring the socio-economic vitality of the community.
Walker et al., 2002	Resilience is the potential of a system to remain in a particular configuration and to maintain its feedbacks and functions, and involves the ability of the system to reorganize following disturbance-driven change. In an operational sense, resilience must be considered in a specific context.
Bruneau, et al., 2003	Community seismic resilience is defined as the ability of social units (e.g., organizations, communities) to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize social disruption and mitigate the effects of future earthquakes.
Tierney, 2003	Resilience is a property of physical and social systems that enables them to reduce the probability of disaster-induced loss of functionality, to respond appropriately when damage and disruption occur, and to recover in a timely manner.

Resilience Type 2: change at the margins

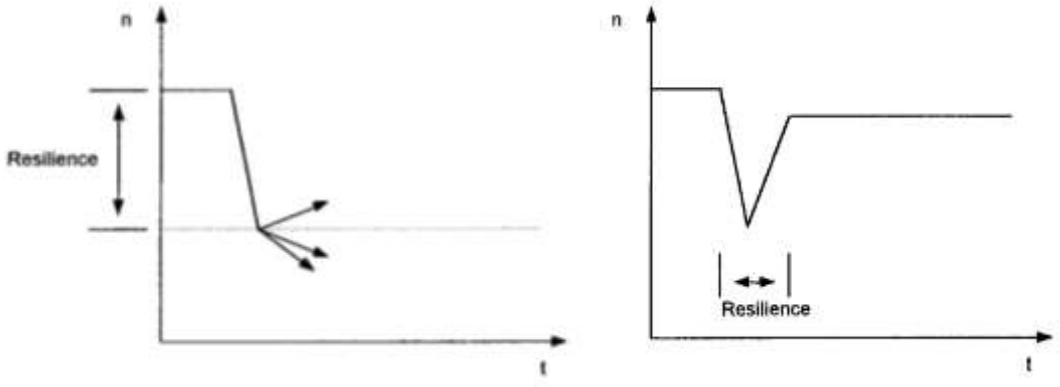
This type is characterized by incremental change—change that does not challenge the basis of society, but which may lead to changes in emphasis at the margins. Where substantial change occurs, it usually serves the interests of the powerful elite, not necessarily those of the general population or the immediate environment, and rarely of the biosphere.

Resilience Type 3: openness and adaptability

This approach reduces vulnerability through a high degree of flexibility. Its key characteristic is the ability to change basic operating assumptions, and thus its institutional structures, and adopt new ones. Of course, throughout history this has happened, but usually only in slow and painful ways. An adaptable society would be open to the possibility of moving in a new direction quickly and relatively painlessly.

In one particular area of ecology, resilience is an emergent property of ecosystems and is related to the self-organizing behaviour of those ecosystems over time, by which a system can absorb trauma without changing its stability domains (Gunderson, 2000). Ecological resilience, as presented by Adger (2000), is certainly related to stability, but it is not clear whether this

characteristic is always desirable, such as in evolutionary terms. In this study, two sorts of graphs can be used to explain the definition of resilience, which was originally developed by Holling C.S. (1973). Specifically, resilience is the buffer capacity or the ability of a system to absorb perturbations, or is the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behaviour (see Figure 1 (a)). By contrast, other definitions of resilience emphasize the speed of recovery from a disturbance, highlighting the difference between resilience and resistance, which is the extent to which disturbance is actually translated into impact (see Figure 2-1 (b)). It is important to note that these definitions, shown for a population in the graphical representations in Figure 2-1, are mostly relevant at the ecosystem scale.



(a) Resilience = Disturbance which can be absorbed before state change

(b) Resilience = rate of recovery from perturbation
(Resilience + resistance = stability)

Figure 2-1 Ecological resilience. There being no precise definition of resilience, two alternatives appear to be (a) disturbance which can be absorbed before the dynamic equilibrium is changed completely (Holling C.S. (1973)) and (b) the rate of recovery from a disturbance (Adger, 2000).

Furthermore, Adger (2000) stated that resilience in both its social and ecological manifestations is an important aspect of the sustainability of development and resource utilization. Each of these social and ecological aspects has several empirical indicators, but no single indicator captures the totality of resilience.

Resilience can be enhanced by communities, municipalities and agencies and may occur at different scales and levels of resolution. Community is defined here as any group of people living in a defined area or any group of people with shared interests (such as occupation or gender) or sharing a common characteristic (such as age or gender) (Buckle et al, 2001).

2.3. Characteristics of resilience towards hazards

Disaster resilience requires combinations of apparent opposites: redundancy and efficiency, diversity and interdependence, strength and flexibility, autonomy and collaboration, planning and adaptability (Godschalk, 2002). Bruneau et al. (2003) specifically describe a resilient system as a regime that has the following components:

- Reduced failure probabilities
- Reduced consequences from failures, in terms of lives lost, damage and negative economic and social consequences
- Reduced time to recovery (restoration of a specific system or set of systems to their ‘‘normal’’ level of performance)

Moreover, resilience in both physical and social systems can be further defined as consisting of the following properties:

- Robustness: the strength, or ability, of elements, systems and other units of analysis to withstand a given level of stress or demand without suffering degradation or loss of function
- Redundancy: the extent to which elements, systems or other units of analysis exist that are substitutable, i.e., capable of satisfying functional requirements in the event of disruption, degradation or loss of functionality
- Resourcefulness: the capacity to identify problems, establish priorities, and mobilize resources when conditions exist that threaten to disrupt some element, system or other unit of analysis; and further, the ability to apply material (i.e., monetary, physical, technological and informational) and human resources to meet established priorities and achieve goals
- Rapidity: the capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruption.

The term resilience is often used in combination with the adaptive capacity to learn and to have the flexibility to experiment and adopt novel solutions, and the development of generalized responses to broad classes of challenges (Carpenter et al., 2001; Walker, et al., 2002).

Following the definitions and characteristics that were developed in past studies, resilience and its characteristics have risen to become a strategy for the disaster management scholar. In particular, it is used with respect to mitigating the consequences of hazards and simultaneously for the recovery process of a system.

2.4. Scenario of disaster resilience in response to hazards

Response to environmental change is captured by the concepts of mitigation and adaptation (Nelson et. al, 2007).

2.4.1 Mitigation strategy

Hazard mitigation is action taken to reduce or eliminate long-term risk to people and property from hazards and their effects (Godschalk, 2003). Mileti et al. (2005) reported the effects of unexpected events, which are the predictable result of interaction among three major systems: the physical environment (the events themselves); the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges and other components of the built environment. The mitigation tools used to address losses from hazards and disaster were also addressed, including land use planning, warning systems, engineering and building codes, insurance, new technology and emergency preparedness and recovery. When used, these tools can help to save lives and prevent injuries, limit property damage, minimize disruption and enable communities to recover more quickly.

Uitto and Shaw (2006) proposed risk as a function of the exposure to hazard and the degree to which society has engaged in disaster mitigation activity. Their study expressed the general formulation of risk as follows:

$$R= ((H \times V)-M) /C,$$

where R = risk, H = hazard (an extreme event or process), V = vulnerability, M = mitigation and C = capacity.

Regarding the equation above, vulnerability is an underlying variable. Throughout the literature, vulnerability is the reflection of (or function of) the exposure and sensitivity of the system to hazardous conditions and the ability or capacity or resilience of the system to cope, adapt or recover from the effects of those conditions (Smith and Wandel, 2006). Adger (2006) stated that vulnerability is most often conceptualized as being constituted by components that include exposure sensitivity and the capacity to adapt to perturbation or external stress.

2.4.2 Adaptation strategy

Adaptation is the action of responding to the experienced or expected impacts of changing climatic conditions to reduce impacts or to take advantage of new circumstances. Adaptation is not about returning to some prior state, since all social and natural systems evolve, and in some senses co-evolve with each other over time (Tompkins and Adger, 2003).

Adaptability (or adaptive capacity) was originally defined in biology to mean an ability to become adapted. It involves the process of learning, which is a way that resilience can also be developed (Gallopin, 2006; Fatti and Patel, 2013). In the field of climate change, adaptive capacity is defined as ‘‘the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences’’ and adaptation is defined as an ‘‘adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates, harms, or exploits beneficial opportunities,’’ including anticipatory and reactive, autonomous or spontaneous and planned, and public and private (IPCC, 2001). Additionally, it refers to the actions that people take in response to, or in anticipation of, projected or actual changes in climate, to reduce adverse impacts or take advantage of the opportunities posed by climate change (Tompkins and Adger, 2003). The study of Gunderson (2000) provided more details regarding anticipation. There are at least two components contributing to the ability of human communities to anticipate natural disasters. One is the predictive capacity of knowing when and where a disaster might occur, and the second is anticipating the impact of those disasters on communities. Both of these components generally rely on past experience or a history of natural disasters.

2.5. Scenario of disaster resilience in recovery from hazards

Following the definitions of resilience presented in the previous section, i.e., resilience to disaster, recovery phases are also presented due to their influences on the mitigation of any consequences of future disasters and perturbations.

McCreight (2010) presented the recovery phase as the short-term period directly after a disaster, which could last from several months to several years depending on the magnitude of the disaster. Recovery essentially restores the basic functions of society in the best possible way under the circumstances, such that those who have left the disaster area may then return to live in the area again. One of the important indicators of recovery is population growth. Population recovery is an essential part of disaster recovery. Plyer et al. (2010), focusing on the aftermath of a catastrophic U.S. disaster, summarized the measurement of a population by collecting on-going basic data such as utility accounts, United States Postal Service (USPS) counts of residences actively receiving mail, USPS national changes of address, drivers licenses and registered passenger cars, traffic volume, voter registration data and school enrolments.

2.6. Community resilience to natural hazards

The term community is notoriously hard to define, but we mean any group of people living in a defined area or any group of people with shared interests or sharing a common

characteristic. Communities also consist of shared and common activities such as festivals and sporting events, as well as shared personal and information exchange networks. All of these aspects can be damaged by disasters; either physically damaged in the case of buildings and other physical infrastructure or functionally damaged in the case of networks, systems and processes in terms of their efficiency in mediating news, information and social bonding. (Bunkle et al., 2001).

2.7. Concepts of community resilience with respect to disasters

Regarding a unified definition of resilience, the enormous number of conceptual frameworks and components to build resilience was developed based on the unique purposes of researchers.

For instance, Tobin (1999) suggested that the relationship between community resilience and hazards are complex and involve many social, economic, political and physical factors. He also developed a conceptual framework for analysing resilience that combined three theoretical models: a mitigation model, recovery model and a structural–cognitive model. The consequences of these models generated a boundary of sustainability and resilience communities that consisted of seven characteristics, including low risk, low vulnerability, having an initiative plan, a high level of aid organizations, being in partnership with governmental and/or private sectors, strengthened networks as well as planning at the appropriate scale.

Mayunga (2007) developed a conceptual and methodological framework for the analysis, measurement and mapping of community disaster resilience based on the measurement of five capital resources. First, social capital can be measured through activities such as involvement in public affairs, public meetings, informal sociability and trust. Second, economic capital can be measured through household income, property value, employment, and investments. Third, physical capital can be measured by the number, quality and location of housing units, businesses/industry, shelters, lifelines and critical infrastructures. Fourth, human capital can be measured through education attainment (e.g., years of schooling), health, population density, population growth, demographic characteristics (e.g., racial and ethnicity), access to transportation services, household characteristics, housing quality and dependence ratios. Lastly, natural capital can be measured through water quality, air quality, soil quality, areas of wetland and forests and national and local parks.

Cutter et al. (2008) provided yet another framework—the disaster resilience of place (DROP) model—designed to improve comparative assessments of disaster resilience at the local or community level. A candidate set of variables for implementing the model were also presented as a first step towards its implementation (see Figure 2-2). The DROP model is a simplification of reality, with several implicit assumptions in its conceptualization. First, the model was created specifically to address natural hazards, but could be adapted to other rapid-onset events such as terrorism or technological hazards, or slow -onset natural hazards like drought. Second, the DROP model focuses on resilience at the community level, thus distinguishing it from models created to assess resilience at the meso- or macro scale level or models based on sectors. Third, the main focus of this model is on the social resilience of places. The Cutter et al. study also listed variables indicating measures of community resilience based on dimensions of ecological, social, economic, institutional, infrastructural and community competence.

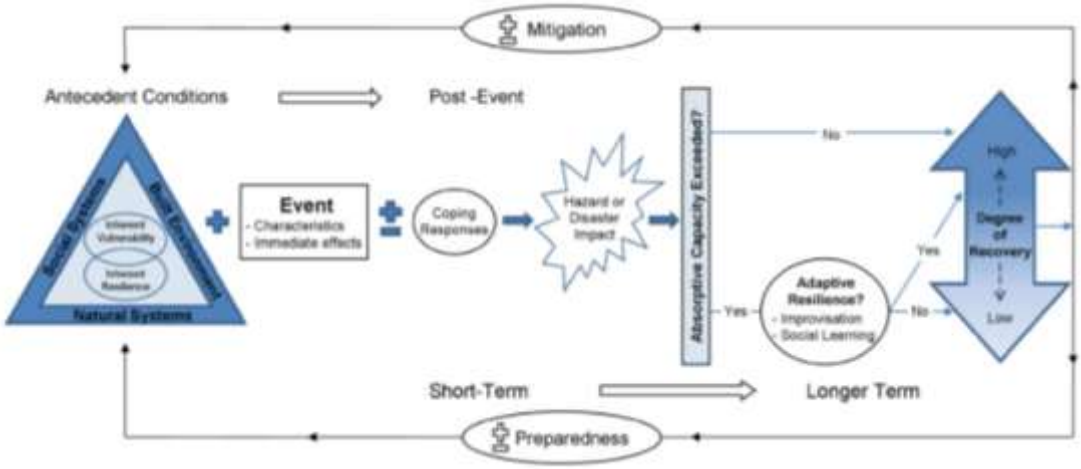


Figure 2-2 Schematic representation of the disaster resilience of place (DROP) model (Cutter et al., 2008)

An enormous number of conceptual frameworks of community resilience to disaster have been initiated, including their purposed indicators and factors. Only a few studies have been empirically implemented, and there have been no studies of the magnitude of interaction between variables.

2.8. Application of empirical idea of community resilience to disasters

A few case studies have measured community resilience and the relationship between factors. For instance, Brouwer et al. (2007) conducted a case study in Bangladesh and investigated the relationship between relevant community components against climate change and flooding. Their study focused on the household and community levels, and the analytical model of socioeconomic vulnerability to flood risk exposure used in their case study is shown in Figure 2-3. The measurements of their study were reviewed and compared with those from past

studies in terms of socioeconomic vulnerability. For example, the probability of risk exposure was determined with respect to the distance (in kilometres) people live from the river at the community level (the closer to the river, the higher the probability of flooding). The authors also determined the risk exposure based on inundation depth (in feet) at the individual household level, and then the consequence of risk exposure by analysing economic damage cost (local currency converted to US$) when the flooding occurs at the individual household level. Using Gini coefficients, this Brouwer et al. study also included poverty as the predominant component (see Figure 2-3).

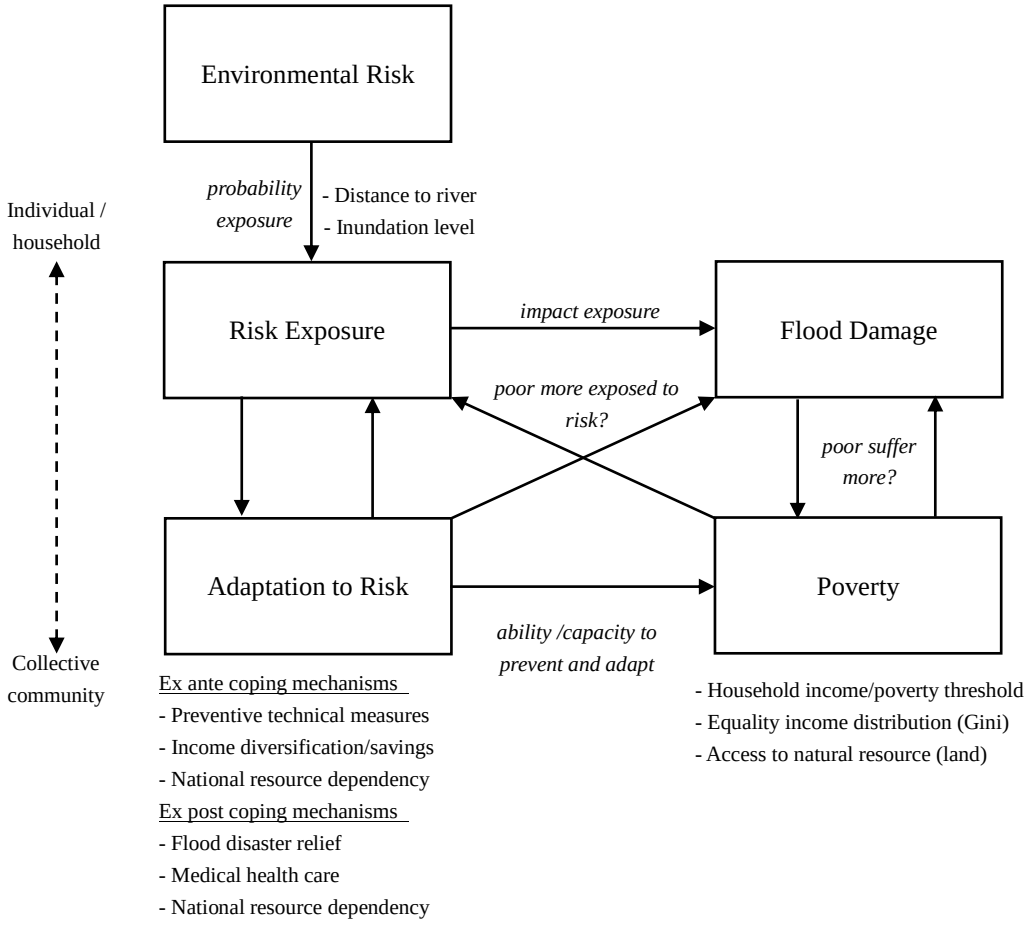


Figure 2-3 Analytical framework of the case study (Brouwer et al., 2007)

Harte et al. (2009) proposed that residents living in or just above the poverty level are potentially vulnerable to a range of environmental hazards. The authors conducted a case study of a major fire in Cape Town, Africa. Most buildings were characterised as being low-quality housing and infrastructure, and the area was identified as a lower income community. Despite the fact that fire events happened ten times within nearly three years, the community has continually rebuilt and remains viable, thus displaying a high degree of adaptive capacity. The

aim of the present paper is to identify and examine the factors underpinning such resilience, notably during hazard response and recovery. A qualitative study is used to identify the influencing factors of community resilience to disaster. The results reveal that livelihood security, social networks, formal community networks as well as personal resourcefulness enhance community resilience. In sum, socioeconomic and demographic disadvantages, community politics and resource allocation and alcohol abuse are factors that threaten to erode resilience in a community.

2.9. Conceptual ideal for developing the mitigating vulnerability model

This study defines "mitigating vulnerability" as part of the process of developing resilience. The mitigation of vulnerability can be defined as reducing or eliminating long-term risk to people in a community, especially with respect to their socioeconomic networks.

In this regard, Brouwer et al. (2007) developed an analytical framework to show the relationship between the salient factors of a flood at the household and community levels (see Figure 2-3). Their study on adaptive capacity highlights several interrelated mechanisms, including the social, economic, technological, institutional, and cultural mechanisms. In particular, Brouwer et al. defined the social mechanism as the social networks of relatives and neighbours, and which relies on the "social capital" concept. From this viewpoint, "social capital" is a key factor in fostering coping strategies at various phases of the hazard cycle. Moreover, it is applicable for analysing the roles of the social network, civil society, trust, social norms and participation (Pelling, 1998; Cannon, 2000; Sanderson, 2000; Wong and Zhao, 2001; Nakagawa and Shaw (2004); Pertzold and Ratter (2015). The empirical study of Nakagawa and Shaw (2004) also found the social capital of a community to be the most dynamic element in the period following the Kobe Earthquake.

Following the above, we approach social participation as the core element in building social capital in a community. The study of Jones and Moore (2012) found that individuals who did not participate in any associations were more likely to be physically inactive than those with high levels of participation. Further, the authors found that social participation seemingly supports the mitigation of vulnerability to catastrophe. Based on these findings, in this study we adopted the analytical model of Brouwer et al. with respect to the adaptation to risk through social participation at the community level (see Figure 2-4).

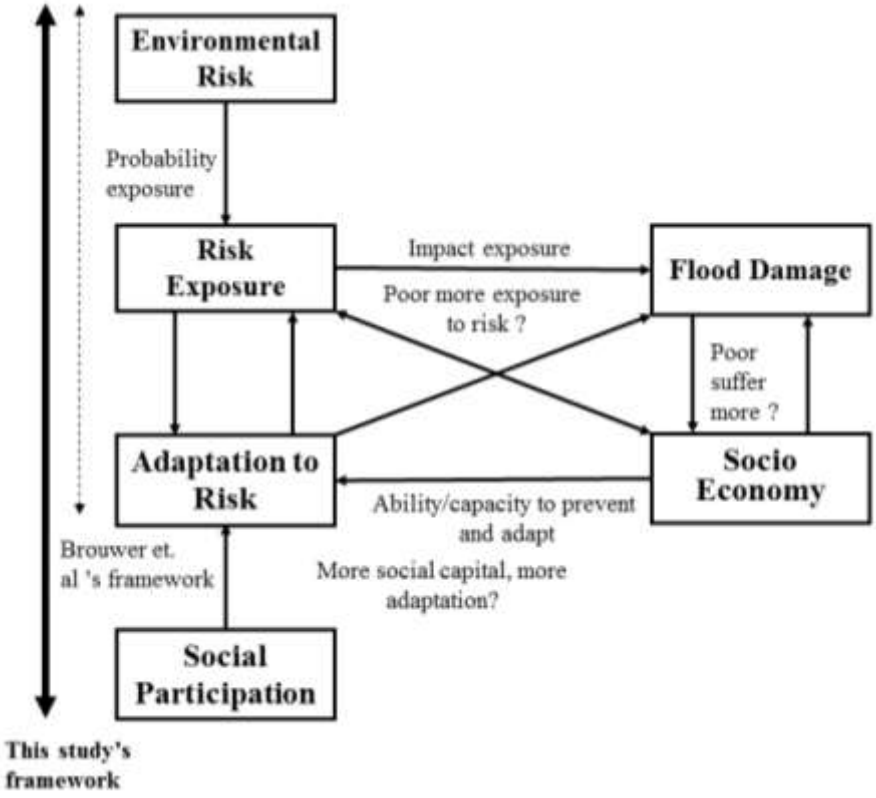


Figure 2-4 Analytical framework of the study

2.10. Conceptual ideal for developing the recovery model

Resilience can be understood as the ability of a system to reduce its likelihood of shock, to absorb a shock if it occurs, and to recover quickly after a shock (Bruneau et al., 2003). Most specifically, recovery is addressed because it focuses on responsiveness to future disasters. The study of Finch et al. (2010) presented recovery from a disaster as a function of the magnitude of a disaster's impact on place, pre-existing vulnerability, and the coping capacity of an affected population, as well as access to and the availability of recovery assistance.

First, pre-existing vulnerability means the degree to which a specific area is hazard prone, which influences the level of damage incurred. Finch et al. (2010) also found that less flooded and less vulnerable areas recovered faster than those with more vulnerable populations and higher flood levels. Moreover, vulnerability is related to resource distribution. Disasters do not impact all social groups to the same degree. Marginalized sub cultures and the poor are more severely impacted and are less likely to recover than wealthier segments of society (Tubin (1999); Chang and Shinozuka (2004); Gasper et al. (2011)). Interestingly, Finch et al. (2010) found that the slowest rates of recovery were in middle income groups due to resource distribution factors. Relief charities have prioritized vulnerable groups such as the poor and the

richer families have the capacity to recover themselves. Therefore, there was a gap in the recovery period regarding the support given to those in the middle income range.

Second, the coping capacity or adaptability of an affected community is linked to its restoration activities, including not only the cleaning process but also considerations regarding the policies and programs of related organizations. Previous hazard experience also enhances adaptability in improving vulnerable conditions, and thus the affected community's responsiveness to future disaster. As a consequence, the time of recovery is also reduced (Tubin (1999); Finch et al. (2010)). Furthermore, Agder (2003) pointed out the importance of social capital framing for both public and private resource management institutions, which builds resilience in the face of the risks of climate change. The collective actions that specifically relate to social capital, and which are based on trust, reputation and reciprocity, are the factors that contribute to adaptive capacity. In turn, this capacity is related to the performance of institutions that must cope with the risks of climate change.

On the basis of the above studies, this study establishes an original recovery mechanism model, which is based on the particular findings generated from the studied locations (see Figure 2-5)

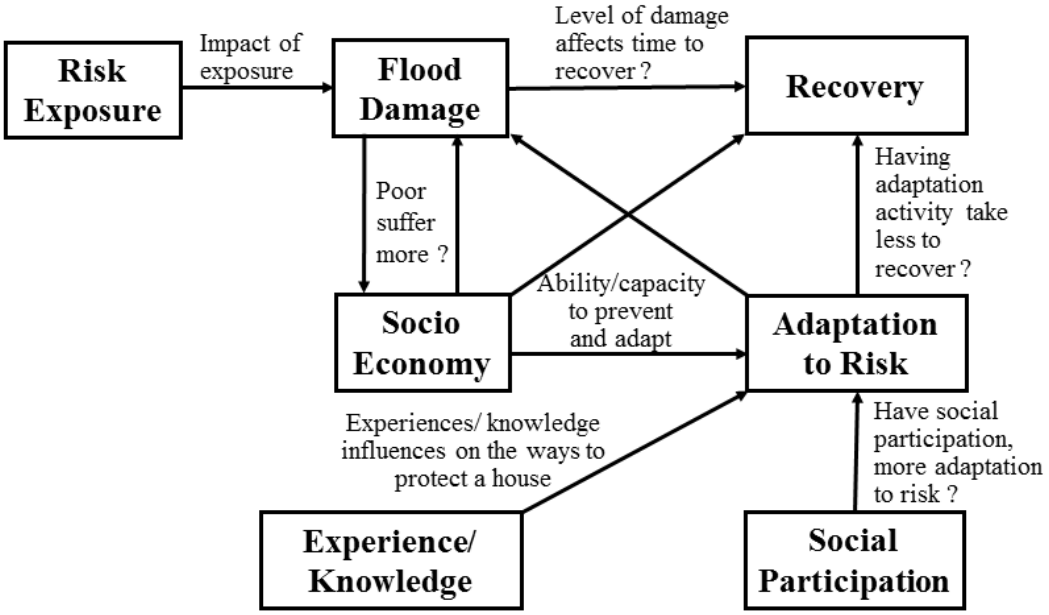


Figure 2-5 The analytical model of recovery model

2.11. Process of building adaptive capacity though social capital

With reference to the content in sections 2.4 to 2.9, it is possible for communities affected by catastrophes to determine how best to mitigate damage and quickly recover in the aftermath

by considering salient factors such as existing community resources, necessary capital, and the support response from related community authorities and disaster reduction management disciplines.

Adger (2003) stated that particular public-good aspects of social capital are pertinent elements in adaptive capacity, particularly with respect to the cooperative efforts of both private and public resource management institutions. Moreover, Adger's study results showed that new institutions, as outcomes of social capital, can provide social resilience in the face of climatic risks. Carter et al. (2015) also developed a framework for urban climate change vulnerability, risk assessment and adaptive capacity as a dependent function of climate hazards, vulnerability of different systems and receptors to hazards. Carter et al. characterised information and resources, stakeholders, institutions and government as attributes of adaptive capacity. Further, the authors stated that these components are related to the ability to reduce the vulnerability of a system and are reliant on its infrastructures, communities and buildings. Moreover, many scholars have identified access to resources as the most important determinant of adaptive capacity (Smith and Pilifosova 2001; Adger 2003; Phillips 2003; Patt and Gwata 2002). Social capital is predominant aspect of these studies with respect to building adaptive capacity and their functions are an excellent issue on which relevant scholars and institutions can focus to improve their abilities to support essential resources and reduce system vulnerability. However, few scholars have addressed the efficacy of the concept of social capital in disaster management resilience (Aldrich and Meyer 2014).

In recent years, social capital has had various typologies. For example, Putnam (1993) defined social capital as norms, trust and social networks. Szreter and Woolcock (2004) also separated social capital into three main types: "bonding," "bridging" and "linking." First, "bonding social capital" refers to the trusting, cooperative relationships between members of a network who see themselves as being similar and sharing a social identity. "Bridging social capital," by contrast, comprises relationships of respect and mutuality between people who know that they are not alike in some sociodemographic or social identity sense (differing by age, ethnic group, class, and so forth). Third is "linking social capital," which is defined as norms of respect and networks of trusting relationships between people who are interacting across explicit, formal or institutionalized power or authority gradients in society. The definition of social capital used herein follows that of Szreter and Woolcock (2004).

The roles of each social capital type are addressed in previous studies. For instance, 'bonding social capital" is the first and most common form of social network available to disaster-affected individuals. In particular, family ties are often the first provider of assistance (Garrison and Sasser, 2009; Haines et al., 1996; Hurlbert et al., 2000). Ties among people in the community also display higher levels of bonding social capital. For example, Wollebaek and

Selle (2003) tested and confirmed that participation in associations related to social capital and having multiple affiliations has an active accumulation effect on building social capital. The study also highlighted that the most effective form of participation with respect to the formation of social capital seem to be not only participation in several associations, but multiple affiliations in association with different purposes. However, the process of building casual relationships among associations was also considered.

Szreter and Woolcock (2004) state that social networks are a "wire" through which information and resources travel, and further, that the network relationship is social capital's core component. On the other hand, scholars such as Lin (2008) see social capital as the "electricity" running through those wires, or in other words, as the information and resources that are exchanged. Following Szreter and Woolcock's definition of social capital, here, we identify as the key steps in building adaptive capacity the types of "wires" that can build adaptive capacity in poor communities and how these wires can be developed.

This section addresses the following two questions:

- What types of social networks or capital can promote adaptive capacity to prevent flooding damage in low-income communities?

- What processes and conditions of poor urban communities help to form social capital that leads to building adaptive capacity?

CHAPTER 3. IDENTIFICATION OF COMMUNITY RESILIENCE INDICATORS THROUGH RECOVERY ACTIVITIES AFTER FLOODS

3.1 Introduction

In recent years, there have been enormous losses caused by hydro-meteorological disasters all over the world. The impact of the devastating flooding of Hurricane Katrina in United States, for example, is estimated to have caused $40–50 billion in losses, along with widespread fatalities of residents and damage to public facilities. The reconstruction of the physical infrastructure of New Orleans was estimated to likely take 8–10 years in the aftermath of Hurricane Katarina (Kates, et al., 2006). Mega hydro-meteorological disasters have recently occurred in several Asian countries as well, such as the mega flooding in Thailand in 2011 and in Jakarta, Indonesia in 2012, which brought enormous damage and chaos to these two countries.

"Vulnerability" is one of the main concepts that may be examined to determine how to minimize damage to society that is caused by natural disaster. The concept of "resilience" has received much recent attention following the experience of several severe natural disasters around the world, such as the Great East Japan Earthquake in 2011.

Though a number of studies have examined the concept of "resilience," as yet there is no common definition in use. Bruneau et al. (2003) defined resilience as "the ability of a social unit to mitigate hazard, minimize the effects of disaster when they occur, carry out recovery activities in that disrupted society and mitigate the effects of future disaster." In this study, resilience is defined as "the ability to quickly return to normal functioning," and here we focus on the recovery period following a disaster.

As mentioned above in Chapter 2, previous research has stated that resilience has several levels, from national to community to the individual (Chang and Shinozuka, 2004; Miman and Short, 2008; Schelfaut et al., 2011). Among these levels of resilience, community resilience is particularly important because the community is very close to people's daily life and natural disasters affect communities socially, economically and environmentally. It is essential that the factors that enhance resilience at the community level be carefully examined.

In previous studies, there has been a considerable amount of interest devoted to the meaning and measurement of resilience. For example, Cutter et al. (2008) developed the DROP model, as described in Chapter 2, which was designed to improve comparative assessments of disaster resilience at the local or community level. However, there are only a few studies that

have empirically examined the factors associated with community resilience.

Given this background, this study focuses on community resilience with respect to the mega flooding in Thailand in 2011. The study objective is to identify the main indicators of community resilience and the factors affecting them.

The methodology used in this study is to review past studies and associated secondary data, interview community leaders and residents, conduct focus group discussions among community members and carry out field observations. The field surveys were conducted twice in 2013, from 4 March to 20 March and from 18 August to 4 September.

3.2 Case study

Two areas were selected for case study—the city of Rangsit in the Thayaburi district, Pathumthani province and the Bang Phlat district in Bangkok (see Figure 3-1). The selection criteria for the target areas involved two critical issues.

First, it was important to know the perceptions of flooded people after a flood catastrophe and to distinguish the case study areas with respect to the magnitudes of the floods, i.e., the level of water and period of inundation. Second, the results of interviews with Community Organisations and Development Institute (CODI) staff members revealed that after the floods, communities with an active Baan Mankong Collective Program (BM program) had returned to a normal state a relatively quickly. Therefore, the first field survey was conducted in the areas mentioned above, and their overall details are presented as follows:

a. Thayaburi district , Rangsit city municipality, Pathumthani Province

Of all its urban areas, the Thayaburi district is home to the largest population of people in the city of Rangsit and the Rangsit Canal (Klong Rangsit). Five communities were selected for this case study, which are located nearby the Klong Rangsit (see Figure 3-2).

Based on the field survey, we found that the selected communities had suffered from mega floods from the end of September until December, for approximately two months, at an average flood depth of 100−150 cm. Most residents had evacuated to the relief centre nearby until the inundation receded.

b. Bang Phlat District, Bangkok

The Bang Phlat District is located in the inner city of the Bangkok metropolis and is close to the Chaopraya River (see Figure 3-3). Seven communities were selected as case study areas.

The entire Bang Phlat district was declared to be a flood disaster zone. Based on the field surveys, we discovered that the selected communities were fully submerged from the end of October until November, at a water level of approximately 100–120 cm. While the local temple, Wat Ruak, was repurposed as a relief center, most residents had evacuated to other places, such as relatives' homes, and some had moved to live nearer to their workplaces.

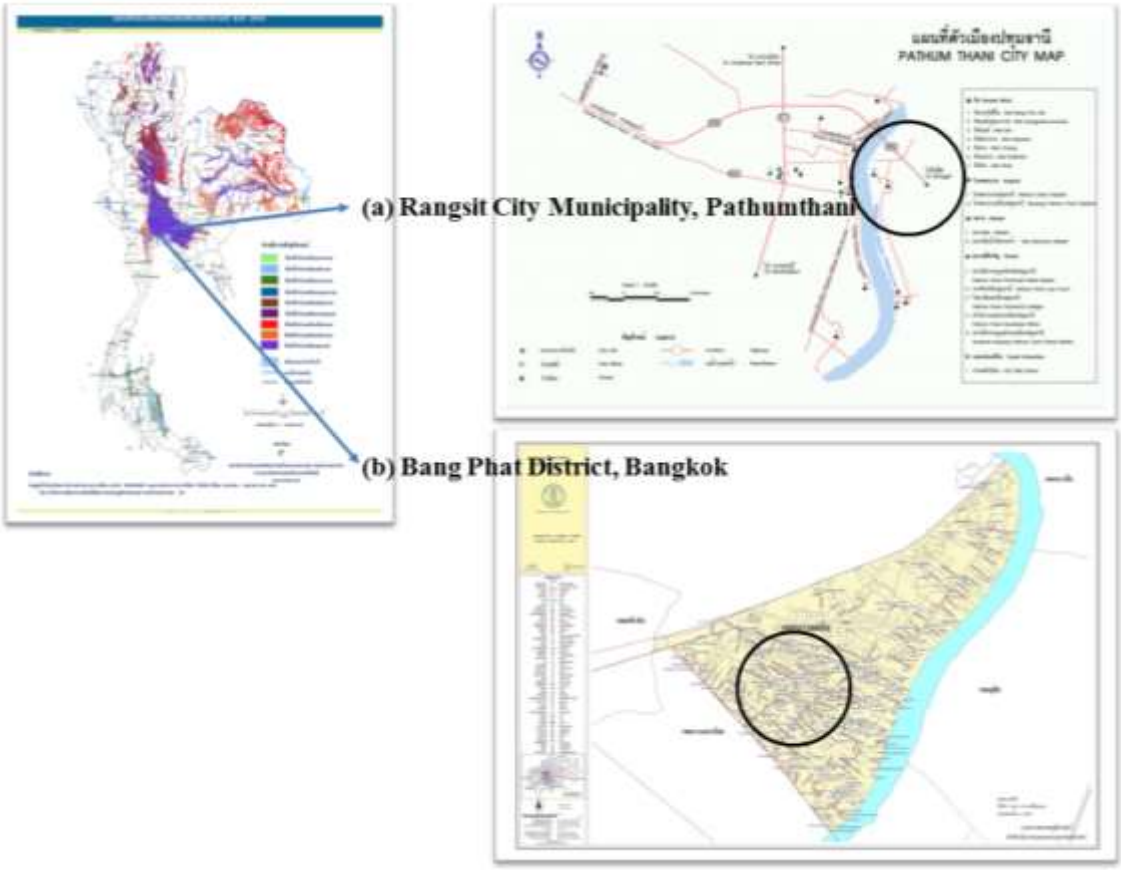


Figure 3-1 Locations of selected areas (a) Rangsit City Municipality, Pathumthani province and (b) Bang Phlat District, Bangkok

Figure 3-2 Locations of selected communities, Rangsit City Municipality in the Thayaburi District in Patumthani province

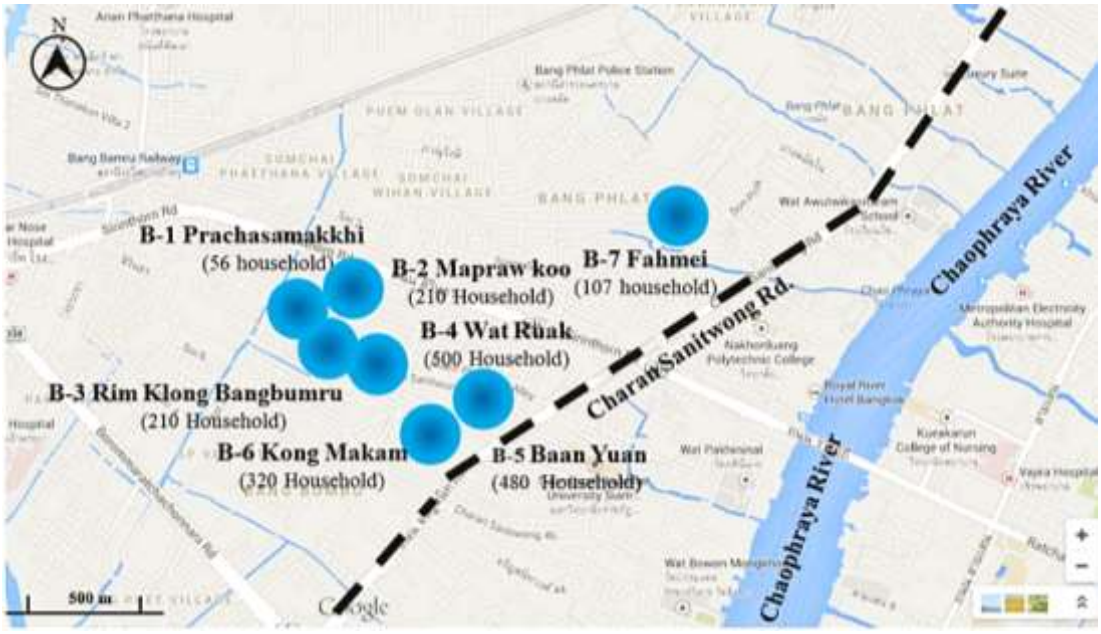


Figure 3-3 Locations of the selected communities in the Bang Phlat District in Bangkok

(a)

(b)

Figure 3-4 Water trail in the study area (a) Rangsit, Pathumthani province and (b) Bang Phat District, Bangkok (photos were taken in September 2013)

Figure 3-5 Data collection (photos were taken in September 2013)

3.3 Resilience indicators

In order to empirically examine resilience indicators and their factors, in this chapter we establish a hypothesis regarding the practical actions of flooded people after a flood catastrophe.

3.3.1 How to identify resilience indicators

In interviews with community leaders and residents and focus group discussion, the first topic addressed was ‘what is a normal situation?’. Then, the discussion focused on the process of recovery to return to normal and the essential elements of and obstacles to the recovery methods used to reach a state of normalcy.

3.3.2 Indicators

From the interviews and focus group discussions, the perspectives of most residents about normal situation can be described as ‘to stay at home in the same environment, with the same level of income and have the same social gatherings with neighbours as before the floods.’

To return a house to its same environment as before flooding, to repair the damage to the house, to clean the house and to buy new furniture are reported to be essential steps to recovery. Therefore, the following three indicators were proposed: 1) the period taken to repair a house, 2) the period taken to clean the house and 3) the period taken to buy new furniture.

Additionally, one obstacle to note is the presence of waste in the community. After flooding, mountains of waste were generated in each community, consisting of solid and daily waste. This huge volume of waste became a significant community problem. Residents living near the mountains of waste stated that their lives did not return to normal until after the waste had been removed from the community. As such, a fourth indicator of community resilience was added: 4) the period taken for community waste management to be initiated.

From the discussions, those interviewed also considered social networks, such as gatherings with neighbours, to be a very important part of their normal lives. Such gatherings are usually held at local places of business, such as hair salons and fresh food and grocery stores. These local businesses are the mainstays of Thai communities. Hence, reopening local businesses is essential for residents to resume their normal lives. Thus, another indicator was added: 5) the period taken to reopen local businesses. The last crucial indicator is an economic one: 6) the period taken to recover financial income.

3.4 Factors Affecting Community Resilience

3.4.1 Identifying resilience factors

After identifying the above six indicators of community resilience, the factors affecting these indicators were discussed in the interviews and focus group discussions. For example, regarding indicator (1), we asked about the factors affecting the period taken for a house to be repaired. A number of the factors were identified for each of the six indicators. The causal chain for each indicator is described in Figures 3-6 to 3-11. Tables 3-1 to 3-6 explain how each factor affects each indicator. The numbers in Tables 3.1 to 3.6, such as 1.1, correspond to the same numbers shown in Figures 3-6 to 3-11, respectively.

3.4.2 Period taken to repair a house

Based on our field surveys, the results show that almost all houses were submerged by the floods in each community. From the discussion, six main factors affecting this indicator were identified, including: 1) housing tenure, 2) the number of household members physically able to work, 3) the extent of damage to the house, 4) external aid, 5) internal aid and 6) available finances (see Table 3-1, Figure 3-6).

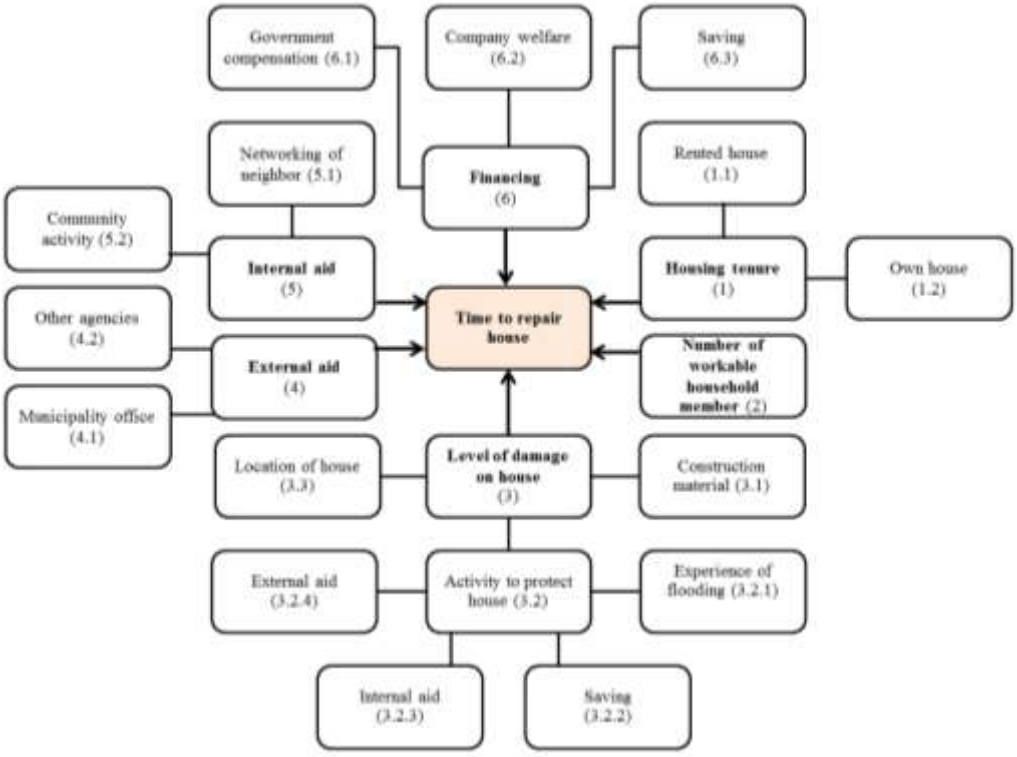


Figure 3-6 Causal chain of period taken to repair house

Table 3-1 Factors that influence the period taken to repair a house

Resilience factors of repairing house	
1. Housing tenure	Residents started cleaning and repairing their house immediately aftermath of flooding. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7) On the other hand, Tenants took a responsibility only their private property. Residents should wait owner to repair their houses. (B-3)
2. Number of workable household members	Basically, people repaired their house by themselves and number of workable household member effect on period of repair house. Household without workable member, that was aged household. This group should call construction company to repair their house and it takes longer time. (B-3, B-4)
3. Level of damage on house	Level of damage of house affected on period to repair house. The less damage‘s house had taken the shorter period to repair the house. The levels of damage of houses

Resilience factors of repairing house	
	were affected by construction materials of house. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
3.1 Construction material	Damage level of houses differed by construction materials of houses, such as wood frame or brick house. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
3.2 Activity to protect house	Some residents prepared and used the appropriated items such as water pumping, board and sand bags, etc. to protect their houses. (B-1, B-2, B-5)
3.2.1 Experience of flooding	Some people who had experience of flooding, they prepared appropriated items to protect their houses. (A-4, B-1, B-2)
3.2.2 Saving	People spent their saving to buy the items. ((A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
3.2.3 Internal aid	Some communities had community working group to act and to prevent water from entering through community. (A-4, B-1, B-5)
3.2.4 External aid	In some communities, they had an originally networking with external organization and some items such as sand bags were provided by them. (A-4, B-1, B-3)
3.3 Location of house	Houses were located next to the canal; housing was suffered more seriously. (A-3)
4. External Aid	
4.1 Municipality office	Giving information of compensation for the affected residents of flooding from government. (A-1, A-2, A-3, A-4, A-5, B-1, B-2, B-3, B-4, B-5, B-6, B-7).
4.2 Other agencies	Repairing house program for elderly people's house by the military office. (B-3)
5. Internal aid	
5.1. Networking of neighbor.	Some residents helped their neighbor for repairing house because they work in the construction sector and have techniques. (A-4)
5.2 Community activity	Setting a team that had construction skills to help the other residents. (A-4, B-1)
6. Financing	
6.1 Government compensation	Residents lived in the natural disaster zone, they usually got 5,000 baht. However, residents who got damage on their houses got an additional compensation maximum 20,000 baht. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
6.2 Company welfare	Residents worked in the formal sector, they got the company welfare. (B-6)
6.3 Saving	To repair houses, residents spent their saving and government's compensation. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

3.4.3 Period taken to clean a house

Cleaning the flood-damaged house was the first activity that had be carried out in the aftermath of flooding. Actually, people started cleaning their houses when the water level dramatically decreased. The cleaning process can be separated into two stages; cleaning the house interior and furniture and then removing the waste to the community garbage site. From the discussion, three main factors affecting this indicator were identified: 1) the number of household members physically able to work, 2) the amount of household savings available to purchase needed assistance, and 3) the degree of damage to the house interior and furniture (see Figure 3-7, Table 3-2).

Table 3-2 Factors that influence the period taken to clean a house

Resilience factors of cleaning house	
1. Number of workable household member	Basically, people clean house and move out waste from their house to dumping site in community by themselves and number of workable household member effect on its period. Household without workable member, that is aged household and single family, should hire and call private company to move waste from their house and it takes longer time. (B-2, B-3, B-4)
2. Saving	The average cost for hiring a private company is approximately1, 000 baht per trip and some household without workable member spent their saving on it. (B-4)
3. Level of defilement of house interior	
3.1 Construction material	Damage level of house interior, such as wall and floor differed by construction materials of houses, such as wood frame or brick house. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
3.2 Activity to protect house	Some residents prepared and used the appropriated items such as water pumping, board and sand bags, etc. to protect their houses. (B-1, B-2, B-5)
3.2.1 Experience of flooding	Some people had experience of flooding; they prepared appropriated items to protect their houses. (A-4, B-1, B-2)
3.2.2 Saving	People spent their saving to buy the items.(A-2,B-3,B-4,B-5,B-6)
3.2.3 Internal aid	Some community had community working group to act and to prevent water from entering to community. (A-4, B-1, B-5)
3.2.4 External aid	In some communities, they had originally networking with external organization and some items such as sand bags were provided by them. (A-4, B-1, B-3)
3.3 Location of house	Houses closed to the canal, it suffered more seriously. (A-3)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

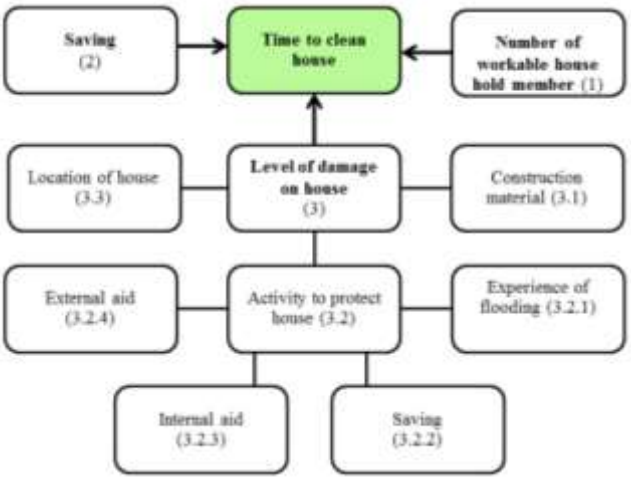


Figure 3-7 Causal chain of period taken to clean a house

3.4.4 Period taken to manage wastes

Regarding waste management, this term means cleaning up the community and the removal of the mountains of waste accumulated to each community's dumping site. Two main factors were found to affect this indicator: 1) internal aid and 2) external aid (see Figure 3-8, Table 3-3).

Table 3-3 Factors that influence the period taken to manage waste

Resilience factors of waste management	
1. Internal aid	
1.1. Community activity	Big cleaning day in which local residents had joined to dredge the water drainage system. (A-1, B-2, B-5)
2. External Aid	
2.1 Municipality office	Providing garbage trucks and staffs to collect flood wastes. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
2.2 Other agencies	Some relief agencies and the other municipality offices had worked in the affected area. For example, local administrative office of south eastern region came to pick up waste to dispose in the dumpling site. (A-1, A-2, A-3,A-4, A-5,B-2)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

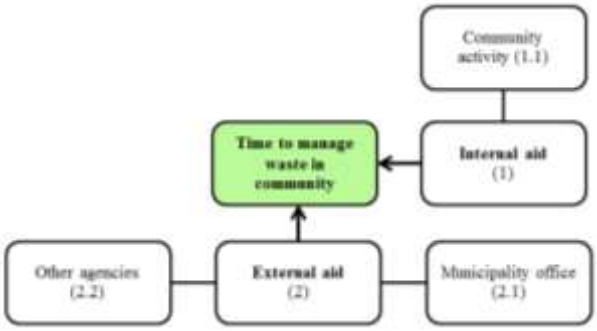


Figure 3-8 Causal chain of period taken to initiate waste management

3.4.5 Period taken to buy new furniture

The household furniture as well as the houses themselves were damaged by the inundation of floods. Two main factors affecting this indicator were identified: 1) available finances and 2) degree of damage to the household furniture. For example, the degree of damage of the furniture can be linked to the construction materials, as brick houses better prevent water from immediately flowing into houses than do wood frame houses. As such, residents of brick houses had more time to move their belongings upstairs. At the same time, some residents had implemented strong protection activities, such as piling up sandbags and pumping out water, so they also had more time to move their belongings (see Figure 3-9, Table 3-4).

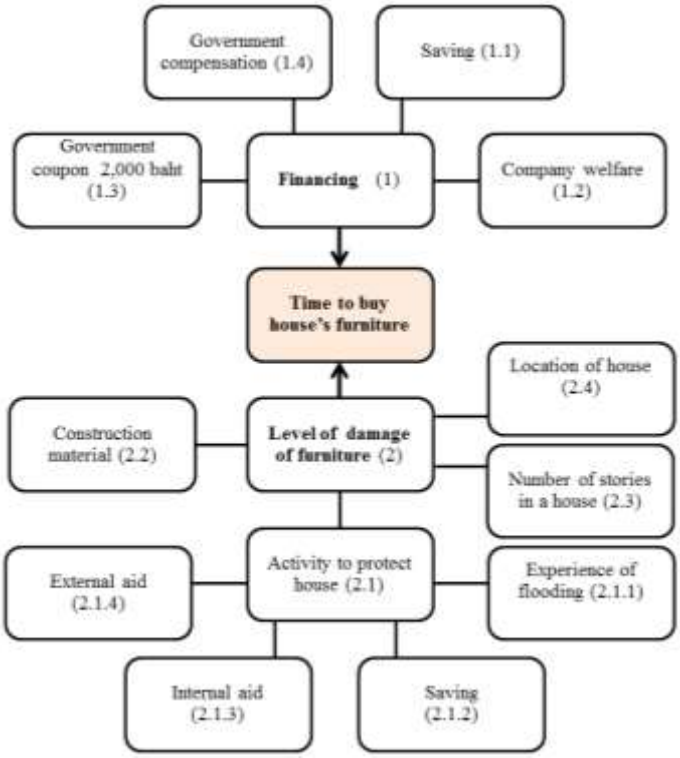


Figure 3-9 Causal chain of period taken to buy new furniture

Table 3-4 Factors that influence period taken to buy new furniture

Resilience factors of buying house's furniture	
1. Financing	
1.1 Saving	Using saving money for buying funiture because the additional compensation were limited. (A-2, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
1.2 Company welfare	Residents worked in the informal sector; they did not get the company welfare. (B-6)
1.3 Government counpon 2,000 baht	Residents used counpon for discount when they bought domestic appliances. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
1.4 Government compensation	People lived in the natural disaster zone, they usually got 5,000 baht. However, residents got the impacts of housing; they got an additional compensation maximum 20,000 baht. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
2. Level of damage of furniture	
2.1 Activity to protect house	Some residents prepared and used the appropriated items such as water pumping, board and sand bags, etc. (B-1, B-2, B-5)
2.1.1 Experience of flooding	Some people had experience of flooding; they prepared appropriated items to protect their houses. (A-4, B-1, B-2)
2.1.2 Saving	People spent their saving to buy the items. (A-2,B-3,B-4,B-5,B-6)
2.1.3 Internal aid	Some community had community working group to act and to prevent water from entering to community. (A-4, B-1, B-5)
2.1.4 External aid	In some communities, they had originally network with external organization and sometimes such as sand bags were provided by them. (A-4, B-1, B-3)
2.2 Construction material	Damage level of house interior, such as wall and floor differed by construction materials of houses, such as wood frame or brick house. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
2.3 Number of Stories in a house	In case of one story house, people could not move their furniture to upstairs. (A-1, A-3, B-2)
2.4 Location of a house	Houses closed to the canal, it suffered more seriously. (A-3)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

3.4.6 Period to financial recovery

From the interviews, the financial indicator is dependent on income; most affected people mentioned the income they normally earn and then lost due to the floods. Not only evacuated residents were affected in this respect. The incomes of almost all residents were impacted, since they could not work properly during the flood period. Thus, the factors affecting household income include: 1) level of damage to the workplace, 2) the existence of a business competitor outside of the flooded area, 3) type of occupation held in formal and informal sectors and 4) employment status. Type of occupation is a significant factor affecting the revenue of residents. Residents employed in pubic organizations or by substantial private companies earned their income as usual, from the time leading up to and after the flooding. In contrast, those employed in the informal sector, such as food street vendors and those working at home, lost the jobs and income from the initial stages of the floods until the time of recovery (see Figure 3-10, Table 3-5).

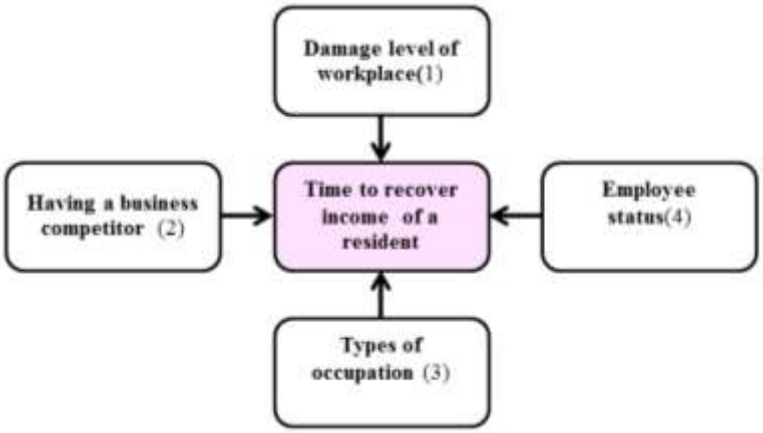


Figure 3-10 Causal chain of period taken to recover income

Table 3-5 Factors that influence period taken to recover income

Resilience factors of time to recover income	
1. Damage level of workplace	People lived in the national disaster zone, they usually got 5,000 baht. However, residents got the impacts of housing; they got an additional compensation maximum 20,000 baht. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
2. Having a business competitor outside of flooded area	During flooding, business owners could not work properly and business owners who have competitor outside flooded area seriously (B-7)
3.Types of Occupation(Formal and informal sector)	People working in the pubic organization or big private company earned their income normally from pre to post of flooding. On the other hand, the informal sector such as food street vendors and those who work at home lost their job opportunity during flooding. (A-5)
4. Employee status	People who worked as daily factory worker, they lost their job opportunity and income. (A-1, A-4)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

3.4.7 Period taken to reopen local businesses

Typically, local shop owners run their small businesses from their own houses. When the floods approached the communities, all local businesses were disrupted. Three factors affecting the local businesses indicator were identified from the discussions, as follows: 1) available finances, 2) degree of damage to the shop's equipment and 3) degree of damage to the store (see Figure 3-11, Table 3-6).

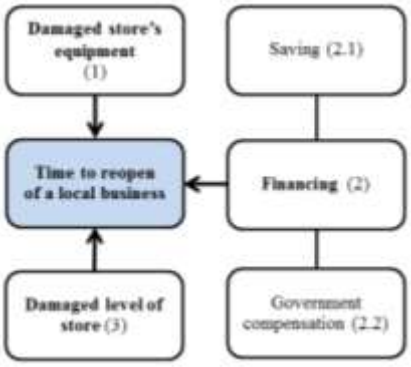


Figure 3-11 Causal chain of period to taken to reopen local businesses

Table 3-6 Factors that influence the period taken to reopen local businesses

Resilience factor of local business recovery	
1. Damaged store's equipment	Refrigerators and some machinery were submerged. Shop owners had to spend time and money to repair their machineries. (B-3 ,B-4)
2. Financing	
2.1 Saving	Shop's owner had used saving in the initial stage of recovery time. (A-1, A-2, A-3, A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7).
2.2 Government compensation	Additionally, people lived in the natural disaster zone, they usually got 5,000 baht. However, residents got the impacts of housing; they got an additional compensation maximum 20,000 baht. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)
3. Damaged of building	Most of local shops were located in the community so the stores were totally approached by flooding. (A-1, A-2, A-3,A-4, A-5, B-1, B-2, B-3,B-4, B-5,B-6,B-7)

Note: A: Name of community in Pathumthani province (A-1: Klong 1 Pattana, A-2: Soi 40, A-3: Klong Sawan, A-4: Sangsan Nakon Rangsit, A-5: Klong 2 Samakkhi) **B: Name of community in Bangkok** (B-1: Prachasamakkhi, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

3.5 Discussion and Conclusions

In the case study of two areas in central Thailand, the main indicators of a community's resilience to flooding were identified and the factors affecting these indicators were examined. Based on the results, six indicators are proposed as well as a number of factors that affect the individual indicators.

Prior to the survey, some indicators were expected, such as the periods taken to repair a house and to clean it and the period taken to recover household income. However, some unexpected indicators were identified from the discussions with residents, such as the periods taken to initiate community waste management and to reopen local businesses. The indicators for 'the period taken to reopen local businesses' is likely to be specific primarily to the specific community studied—a lower-to-middle income community in which there are strong relationships between neighbours. All other indicators are expected to be applicable to other communities as well.

Regarding the factors affecting these indicators, some have been pointed out in previous conceptual studies, such as the financial status of residents, i.e., their available savings, as well as internal and external aid. On the other hand, some new items such as housing tenure and types of occupation were identified. These indicators are expected to be applicable to other communities in Thailand. In future studies, in order plan effectively to build community resilience against floods in Thailand, quantitative research, such as questionnaire surveys, will

be necessary to identify with some certainty those factors that have the greatest impact on community resilience.

CHAPTER 4. MECHANISMS OF MITIGATING VULNERABILITY

4.1 Introduction

IPCC reports that those climate-related hazards affect poor people's lives directly and indirectly. IPCC (2014) points out negative effects on the poor, such as reductions in crop yields and destruction of homes, and on the other hand, it also points out positive indirect effects such as diversification of social networks and agricultural practices, though it is limited (IPCC, 2014). Thus a relationship between poverty and natural hazards is bilateral character and complex. The relationship is expected to differ from countries to countries and places to places. Since 1990s, a variety of studies has focused on how socio economic is affected by and responds to floods in flood-prone developing countries. Several papers state relationship between socio poverty and geography of exposure, simply the poor tend to occupy the more flood-prone environment (Davis and Hall, 1999; Cairness and Ouano, 1990; Chan and Parker, 1996). The relationship between poverty and suffering from natural hazards, which is damage, is argued by some authors (Chan and Parker, 1996; Blaikie et al., 1994).

Additionally, coping capacity, which is an adaptation to risk, and poverty are argued by some researchers (Few, 2003). Thus there are a range of papers which argue the relationship between "poverty" and "risk exposure," "damage" and "adaptation". However, papers that investigate complex relationship between poverty and "risk exposure," "damage" and "adaptation" in a lump, which is the mechanism of vulnerability, are limited. However, Brouwer et al. (2007) develop "analytical model" which shows relationship between them based on past theoretical and empirical studies, and then tries to verify the model in case study of flood-prone rural area in Bangladesh. Their results also supported the above studies about the poor. In terms of the poor is inaccessibility to resources and live in the risk area. Furthermore they take less to protect themselves from the impacts of a flood that is consequences from limited resources and networks. However, the results have not shown the direction of a relationship between underlying variable.

In this paper, we modify this Brower et al.'s "analytical model" and try to verify the modified analytical model in a case study of nine urban communities which affected by the 2011 mega flood in Thailand. In households survey carried out in 2014 in Bangkok and its suburbs in Thailand, we asked almost 230 residents who were affected seriously by the mega flood in 2011 about their flood risk exposure, flood damage on houses and adapting activities. Additionally, we carry out almost 60 semi- structured interviews with key informants at community level. Cutter (1996) points out that vulnerability to environmental hazards can be analyzed at different scales, from the personal to the societal level. This study focuses on the

local scale, on households and communities. The main objective of this study is to investigate and provide further empirical evidence of the complex relationship between socio economic and social and economic vulnerability in a case study of urban Thailand. To verify the "analytical model," Brouwer et al. (2007) use linear correlations and nonparametric test. One question on these methods is described in the last part of the paper, "how much the observed relationship tell us about underlying causal relationship and in which direction of these causal relationship acts?" This study follows Brouwer et al.'s methodology, to adapt linear correlations and nonparametric test to verify the "analytical model". Additionally, Structure Equation Modeling (SEM) is adopted to show the relationship of indicators more clearly.

4.2 Analytical method

Recently some researchers' scope of vulnerability does not include only risk and risk exposure but also coping and adaptation mechanism (Pelling, 1999). Adaptive capacity is treated as a key component of the concept of vulnerability, in addition to risk exposure (Adger, 2000; IPCC, 2001). Few (2003) provides overview and discussion of recent theoretical and applied research on vulnerability and adaptive capacity. He points out empirical studies that focus more and more on variations in both exposures to natural hazards and people's capacity to cope with these hazards.

Based on these relevant discussion and empirical research, Brouwer et al. (2007) developed the "analytical model" of socio economic vulnerability to flood risk exposure shown in Figure 3-1. In Brower et al.'s model, a social network of relatives and neighbors is considered as one of the components of "social mechanism". "Social mechanism" is one component of "adaptive capacity", which is expressed "adaptation to risk" in Figure 3-1. The social network of relatives and neighbors is one component of "social capital", which is defined 'connections among individuals—social networks and the norms of reciprocity and trustworthiness that arise from them' by Putnam (2000). Moreover, a number of relevant studies say that social capital is a key in fostering coping strategies at various phases of hazard cycle (Pelling, 1998; Cannon; 2000; Sanderson, 2000; Wong and Zhao, 2001).

Coping strategy is one of adaptive activities. This study abstracts "social participation" from "adaptation to risk" and modifies the "analytical model" that shown in Figure 3-1. In this study, six components of the model, such as "environmental risk," "risk exposure," "flood damage," "adaptation to risk," "socio economic" and "social participation" are measured by indicators which are defined based on situations in the case study. "Risk exposure" is simply measured by the state or condition of risk exposure through maximum flood level outside a house (cm) and inundation level (cm) and period of inundation (days) inside a house (household level). "Flood damage" is measured by the situation of damage on a house and furniture through

government's compensation (household level). After the mega floods, Thai government offered compensation to each affected household, and the amount of compensation is decided by damage on a house and furniture, which is inspected by inspectors. "Adaptation to risk" needs to be divided into "before" and "during" the flood. "Adaptation to risk" before the flood is preparation. There are mainly two dimensions of preparation in this case study; one is housing and another is the preparation of equipment such as sandbags and water pump to prevent water inundation. In the case study area, houses are constructed of brick or wood or a combination of brick and wood. Most of the houses are one-story houses or two-story houses. Moreover, some houses are raised flooring typed house, which is a traditional type of house near rivers and canals in Thailand. "Adaptation to risk" during the flood is activities to prevent water inundation. Some households had an activity to prevent water inundation, and some households received assistance from inside or/and outside of the community. Therefore, "Adaptation to risk" during flooding is measured by whether they have assistance or not (household level) and whether they have an activity to prevent inundation (household level). "Socio economic" is measured by conventional income, monthly household income (Baht). Three indicators are used to measure "social participation," that are "frequency of attending community meeting", "frequency of attending community activity", "frequency of attending volunteer work in a community". The study of Jones and Moores (2012) found that individual who did not participate in any associations, the groups were more likely inactive activities compared to those with high levels of participation. It mentioned that social participation seemingly support the mitigating vulnerability to catastrophes. Moreover, these indicators are a representative of voluntary associations that are often ascribed a fundamental role and been recognized as a type of behavior/ structure in the formation of social capital (Wollebek and Selle, 2003).

4.3 Outline of survey

4.3.1 The Case Study Area

The case study is carried out in two urban areas that consider the criteria in terms of number of household and nearby community (see Table 3.1, Figure 3-2). The total numbers of household of the case studied communities are around 810 in Bangkok and 530 in Pathumthani province, respectively. One area is five adjacent communities in Bangphlat district in Bangkok, a capital city of Thailand. Another area is four adjacent communities in Rangsit city municipality in Pathumthani province, which adjoins the southern part of Bangkok. Both of the areas were severely devastated by the mega flooding in 2011. Large-scale floods have threatened the central region of Thailand, where Bangkok and Pathumthani province located, and almost every ten years. Both of the two case study areas were suffered by the large-scales floods in 1998 and 2005 before 2011 mega flood. These two areas are identified as the urban flood-prone area.

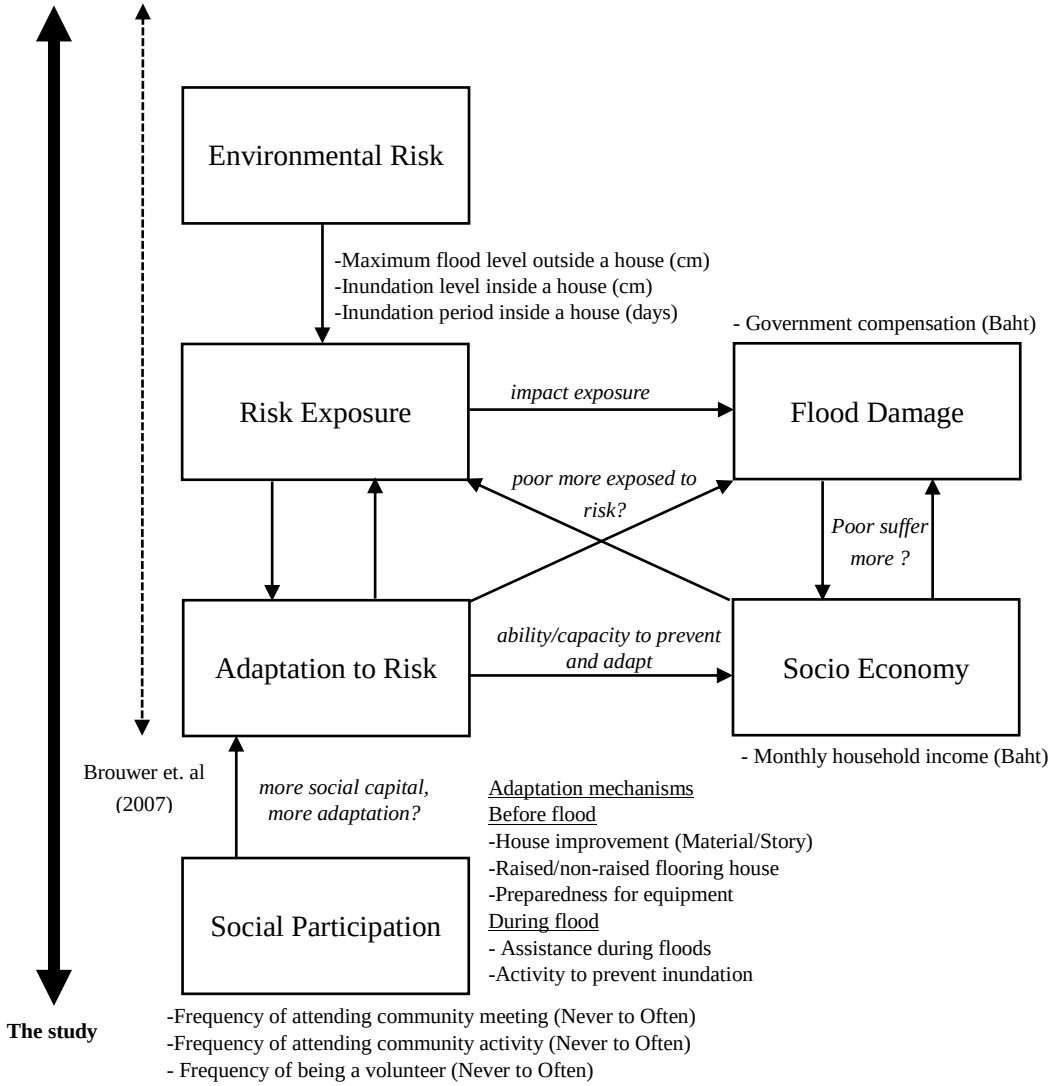


Figure 4-1 Analytical framework underlying the case study

In our "analytical model," characteristics of the house, such as housing construction material, the number of the story are one of the components of "adaptive capacity." From our pre-survey, these house characteristics are expected to affect to flood damage decisively, so we need to select case study areas that have the variety of house characteristics including the social networks of a community. In both case study areas, there are some communities joining "Baan Mankong Collective Housing Program (BM Program)" and others are not joining it. The study Boonyabancha (2005) presented that BM program is a government program and is organized by Community Organizations and Development Institute (CODI), Ministry of Social Development and Human Security. BM program was set up for the poor to improve their housing, living, and tenure security. This program has started to build the horizontal relationship between members by establishing a saving group in a target community. Also, these communities have worked with local governments, professionals, universities, and NGOs in the city Therefore, community

members of BM program have supposed to connect both internal and external relationship. Moreover, during interviews survey, a staff of CODI mentioned that the community with BM program returns to a normal state shortly.

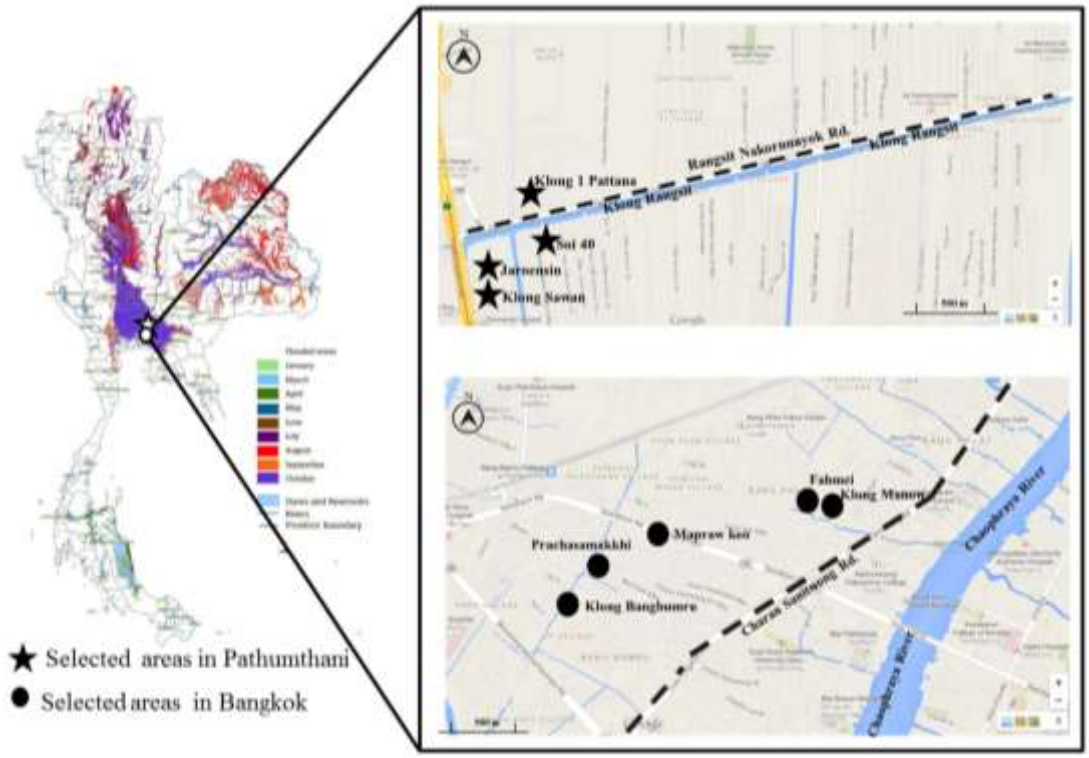


Figure 4-2 Location of case study areas in Thailand (Left: Base Map: Floods situation, 2011 by Hydro and Agro Informatics Institute)

4.3.2 Survey and sampling procedure

This study is based on two field surveys. In the first field survey in August 2013, in-depth interview with community leaders and residents, 64 people in total, were conducted to grasp situation of communities during and after the mega flooding in 2011 and case study communities were selected based on this survey. The second field survey was conducted in March 2014, in which face-to-face questionnaire survey at household level was conducted in the nine communities in two provinces. The interview was targeted to head of the household or his/her spouse. In each community, around 20% of residents responded the survey and the total number of respondents are 230 people (see Figure 4-3).

The questionnaire sheet of this interview consisted of seven parts. Among them, first three parts consisted of the household level activities to the response of the house through antecedent mechanism towards the floods. Furthermore, a part linked to the compensation that the affected

people received after estimating the damage level by the government. Then, to conduct the explicit detail of inundated situations, the interview focused particularly in time, maximum water level inside a house and the community area.

Figure 4-3 Data collection

After that, next part contained the social capital that is supposed to be an impressive strategy for reducing the vulnerability of the affected people. Finally, the last part combined with two pillars that were the socioeconomic and house character of the respondent. The lists of questions were prominently indicated the statement of the main objectives of this study.

Table 4-1 Number of household in each community

Name of community	Number of household
Bangkok	
1. Prachsamakkhi	56
2. Mapraw koo	200
3. Klong Bangbumru	238
4. Fahmei	107
5. Klong Manow	214
Pathumthani province	
6. Klong 1 Pattana	254
7. Soi 40	178
8. Klong sawan	55
9. Jaroensin	47
Total	**1,349**

4.3.3 General characters of respondents

Table 4-2 summarizes the general demographic, socioeconomic and housing characteristics of the 230 respondents. The range of respondents' age was from 23 to 79 years old, and the average age was 52 years old. Female and male respondents were 134 people (58 %) and 96 people (42%), respectively. The number of household members is approximately

4.6 people per household. This number is higher than 3.2 people, the average in Bangkok and vicinity. 68% of respondents' main occupation is in the informal sector, such as day labor, street vendor and motorcycle taxi driver. The average monthly household income is around 20,000 Baht and monthly household income per household member is around 4,347 Baht. By comparing this household income per household member with average in Bangkok and vicinity in 2011, 11,924 Baht (The Official Report of the National Statistic of Thailand, 2011), we can say that the case study communities are poor communities in Bangkok and vicinity. CODI has several criteria to select communities that join the BM Program, and one of the criteria is average household income. Communities whose average household income is less than 15,000 baht, the community can join the BM program because it is a program for the poor community, subsided by the government. In this study, this 15,000 Baht is used as threshold value that divides poor and not-poor households. In the case study areas, 36% of households' income is less than 15,000 Baht. As shown in Table 4-1, there are five communities in the case study area in Bangkok, and there are four communities in the case study area in Pathumthani province. Table 4-3 shows economic characteristics in each community. It shows that there is economic some disparity between communities in each case study area.

Table 4-2 Respondent characters

Respondent household characters	Value		
	Bangkok	**Pathumthani**	**Total**
Number of respondents	140	90	230
Socio economic characteristics			
Gender	Male:58 Female: 82	Male : 38 Female: 52	Male : 96 Female: 134
Average age (years old)	52.0 (SD;13)	52.7 (SD;11)	52.3 (SD;13)
Occupation (%)	Day time labour (18.6) Office worker(14.3) Street vendor (10.7) Retirement (10.7) Housewife (8.6) Business owner (7.9) Civil servant (6.4) Motorcycle taxi driver (5.0) Waste collector (4.3) Needle work (4.3) Others (9.3)	Housewife (20.0) Day time labour (15.6) Street vendor (15.6) Office worker (8.9) Factory worker (8.9) Business owner (7.8) Motorcycle taxi driver (6.7) Civil servant (4.4) Taxi driver (2.2) House keeper (2.2) Others (7.8)	Day time worker (17.4) Housewife (13.0) Street vendor (12.6) Office worker (12.2) Business owner (7.8) Retirement (6.5) Civil servant (5.7) Motorcycle taxi driver (5.7) Factory worker (3.9) Waste collector (3.0) Others (12.2)
Number of household member (pp)	4.5 (SD;2.4)	4.7 (SD;2.7)	4.6 (SD;2.5)
Monthly household income (baht)	21,000 (SD; 10,900)	17,500 (SD;13,000)	20,000 (SD;11,850)
Number of income earner (pp)	2.3 (SD; 1.2)	2.0(SD; 1.2)	2.2 (SD; 1.2)
Monthly household income per person (baht)	4,666	3,723	4,347
Households whose income < 15,000 baht (%)	28.6	47.8	36.1
Situation of the mega flood in 2011			
Maximum water depth outside a house (cm)	119.1 (SD; 33)	150.0 (SD; 34)	131.2 (SD; 36)
Inundation period inside a house (days)	30.4 (SD; 3.6)	66.7 (SD; 12.5)	44.6 (SD; 19.6)
Inundation level in a house (cm)	105.4 (SD; 48)	134.1(SD; 47)	116.6 (SD; 49)
Government's compensation (baht)	11,742.1 (SD;7535)	20,372.2 (SD;6735)	15,119.1 (SD; 8361)
Households prepared equipment to prevent inundation (%)	Yes (7.9) No (92.1)	Yes (10.0) No (90.0)	Yes (8.7) No (91.3)
Households having activity to prevent inundation (%)	Yes (38.6) No (61.4)	Yes (30.0) No (70.0)	Yes (35.2) No (64.8)
Characteristics of house			
Housing construction material (%)	Wood(26.4) Wood and brick(25.7) Brick(47.9)	Wood (51.1) Wood and brick (23.3) Brick (25.6)	Wood (36.1) Wood and brick (24.8) Brick (39.1)
Number of storey	1 storey (12.1) 2 storeys (86.4) Others (1.4)	1 storey (56.7) 2 storeys (42.2) Others (1.1)	1 storey (29.6) 2 storeys (69.1) Others (1.1)
Type of house (%)	Raised floor (22.9) Non-raised floor (77.1)	Raised floor (45.6) Non-raised floor (54.4)	Raised floor (31.7) Non-raised floor (68.3)

(a) Wood frame house

(b) Wood and brick house

(c) Brick house

Figure 4-4 Material of Houses

Table 4-3 Economic characteristics in each case studied community

Name of community	Average monthly household income (baht)	Average monthly household income per person (baht)	Households whose income < 15,000 baht (%)
Bangkok			
Prachsamakkhi	14,500	4,394	4.8
Mapraw koo	24,000	4,800	9.6
Klong Bangbumru	23,000	4,792	10.8
Fahmei	16,000	4,103	12.0
Klong Manow	21,500	4,674	10.8
Pathumthani province			
Klong 1 Pattana	17,000	3,723	27.7
Soi 40	20,500	3,469	10.8
Klong sawan	14,500	5,395	6.0
Jaroensin	16,000	3,636	7.2

4.3.4 Risk exposure and damage

In the questionnaire survey, respondents reported the situation of their community and their houses during the mega floods in 2011. Average of maximum water level outside of a house is 119 cm in Bangkok and 150 cm in Pathumthani province, respectively. Floods magnitude in Pathumthani province was found more than in Bangkok. From the in-depth interview survey, the same tendency is found in the past large-scale floods in 1998 and 2005.

Case study communities in Pathumthani province located in the more floods-prone area than in Bangkok. The maximum inundation depth and period inside a house in 2011 mega floods is 105 cm and 30 days in Bangkok and 135 cm and 67 days in Pathumthani province. These numbers tell us the fierceness of the 2011 mega floods. In this study, compensation from the government to each affected household is used as an indicator of damage to a house and furniture. Respondents in Bangkok received 11,742 Baht in average and 20,372 Baht in Pathumthani province; that is to say that damage to a house in Pathumthani province is more severe than in Bangkok.

4.4 Results of correlation analysis and nonparametric test

In this chapter, we examine relationship between the five components shown in the analytical model in Figure 4-1, “Risk exposure”, “Flood damage,” “Socio-economic,” “Adaptation to risk,” and “Social participation.” There are six components in the Figure 4-1 and relationship between “Environmental risk” and other components is not examined. It is because “Environmental risk” in terms of floods, can be measured by the quantity and speed of water flow in the overflowed river/canal but in the case studied areas, water came from not only one canal but also plural canals/ rivers during the floods, so measurement of “Environmental risk” in the case study areas is difficult. Furthermore, flood damage to the houses is measured according to government compensation. After the mega floods, the Thai government offered compensation

to each affected household, and the amount of compensation was decided according to the amount of damage to the house and furniture, which was assessed by inspectors. Houses in Pathumthani province communities were damaged more seriously than those in Bangkok.

The relationship is examined through correlation analysis and nonparametric test. In this study, "statistically significant" means that statistically significant at 10% level.

a. Risk exposure and socio economic

This section reveals the relationship between risk exposure and poverty, whether the poor tend to occupy more flood-prone environment or not. In general, a scope of residential choice for poor people is smaller because they have the limited affordability of transportation cost and most of their job is in the informal sector, and they live nearby their workplace. Therefore, we analyze data in Bangkok and Pathumthani province separately. The analysis is conducted at two levels, household level, and community level. Household-level analysis verifies whether the poor household occupies more flood-prone environment or not. Community-level analysis verifies whether poor community occupies more flood-prone environment or not. The community-level analysis is conducted because there is some economic disparity between cases studied communities in the same province, shown in Table 4-4.

First, through correlation analysis at the household level (see Table 4-5), we found an opposite result of correlation analysis between maximum floods level outside a house and monthly household income in Bangkok and Pathumthani province. In Bangkok, there is the positive relationship between them (r =0.70). However, in Pathumthani, their relationship is negative (r = -0.73) though both of them and the results are not statistically significant There is not a significant correlation between flood situation inside a house and monthly household income. Second, through correlation analysis at community level (Table 4-5), we found similar relationship. Though the number of data, that is number of community, is very small and some result is not statistically significant, in Bangkok, Flood problems and flood damage there shows an existing positive relationship between them but in Pathumthani their relationship is negative. In terms of inundation inside a house, high correlation coefficient (r = -0.735) is found between inundation level and household income in Pathumthani province, though it is not statistically significant.

As the expectation, the flooded people who had lost of income, they might suffer the situations inside a house both period and level of inundation. The study found that the relationship between income stability and situation of a period and the inundated level inside a house is not significantly.

The analysis at both household and community level in Bangkok shows a positive

relationship between ‘maximum flood level outside a house’ and ‘household monthly income’, though it is not statistically significant. It means that the poor tend to occupy the less flood-prone environment. On the other hand, in Pathumthani province, the analysis at both household and community level shows the negative relationship between the two values. It means that less income household faced higher water level during the flood, namely the poor tend to occupy more flood-prone environment.

In the case study area in Bangkok, other factors are expected to affect people’s residential preference more than flood risk. On the other hand, case study area in Pathumthani province, where is more flood-prone area, flood risks affect people’s residential preference, then the poor live in more flood-prone area.

Table 4-4 Correlation coefficient for floods situation and household income (household level)

Floods situation	Household monthly income	
	Bangkok (n=140)	Pathumthani (n=90)
Maximum flood level outside a house (cm)	0.700 (P = 0.411)	-0.730 (P = 0.492)
Maximum inundation level inside a house (cm)	0.117 (P =0.170)	0.109 (P = 0.306)
Inundation period inside a house (days)	-0.068 (P =0.422)	-0.068 (P = 0.525)

Table 4-5 Correlation coefficient for floods situation and household income (community level)

Floods situation	Household monthly income	
	Bangkok (n=5)	Pathumthani (n=4)
Maximum flood level outside a house (cm)	0.771(P = 0.127)	-0.903 (P = 0.097)*
Maximum inundation level inside a house (cm)	0.208 (P = 0.738)	-0.735 (P = 0.265)
Inundation period inside a house (days)	0.642(P = 0.243)	-0.527 (P = 0.473)

Table 4-6 Correlation coefficient for floods situation and income stability

Floods situation	Income stability (Total loss income from pre to post of flooding; baht)	
	Bangkok	Pathumthani
Maximum level of inundation inside a house (cm)	-0.065 (P = 0.444)	0.016 (P = 0.883)
Inundation period inside a house (days)	-0.38 (P = 0.658)	0.018 (P = 0.864)

b. Risk exposure and damage

As expected, the consequences of risk exposure, measured through floods inundation level, period inside a house and flood water depth outside a house, are positively correlated with damage level on a house, measured by government’s compensation (Table 4-7). It shows that risk exposure is strongly correlated with damage level on a house.

Table 4-7 Correlation coefficient for floods situation and damage level (government's compensation) (household level)

Floods situation	Compensation (Baht) =Damage on a house
Maximum flood level outside a house (cm)	0.278 (P = 0.000)*
Maximum inundation level inside a house (cm)	0.134 (P = 0.042)*
Inundation period inside a house (days)	0.479 (P = 0.000)*

c. Damage and socio economic

As shown in Table 4-8, positive but statistically not significant correlation between household income and damage level on a house is found (r= 0.017, P= 0.794). Correlation analysis by province shows same tendency. In Pathumthani province, the poor occupy more flood-prone area but damage on their house is less damage than others. Additionally, Table 4-9 shows the differences between household living under and above the socio economic threshold value in this study, 15,000 Baht, in terms of damage level on a house. We find that higher income family (> 15, 000 Baht) received more compensation both in Bangkok and Pathumthani province, though the result is not statistically significant. In Pathumthani province, the poor occupy more flood-prone area but they received less compensation. It supposed that higher income family's house is bigger, and their furniture has a higher value.

Table 4-10 shows the income stability found negative relationship with damage level but it was slightly significantly different in Pathumthani province (r = -0.193). It might say that the higher income who lost slightly their money. The impacts level is more significant.

Table 4-8 Correlation coefficient for household income and damage level (=government's compensation) (household level)

Household income (Baht)	Compensation (Baht) =Damage on a house		
	Bangkok	**Pathumthani**	**Total**
	0.112 (P = 0.188)	0.103 (P = 0.334)	0.017 (P = 0.794)

Table 4-9 Differences between poor household and not-poor household in terms of damage level

Monthly Household Income	< 15,000 Baht	> 15,000 Baht	Mann Whitney U test
Bangkok			
Government compensation (Baht) =Damage on a house	64.84	72.77	-1.074 (P = 0.283)
Pathumthani			
Government compensation (Baht) =Damage on a house	40.93	49.68	-1.930 (P = 0.110)

Table 4-10 Correlation coefficient for damage level and income stability

Damage level	Income stability (Total loss income from pre to post of flooding; baht)	
	Bangkok	**Pathumthani**
	-0.025 (P = 0.768)	-0.193 (P = 0.068)*

d. Risk exposure and adaptation to risk

First, the relationship between risk exposure and adaptation to risk before the mega flooding, which is the improvement of the house, raised floor typed house and preparation of equipment is examined. Table 4-11 shows the negative correlation between inundation level and period and house material and number of the story. It says that the houses with more rigid material and second floor have less inundation level and period. Improvement house is effective in the prevention of flood inundation.

Table 4-11 Correlation coefficient for risk exposure (inundation inside a house) and house construction material and no. of story (household level)

Situation of floods	House material (1:wood 2:wood&brick 3:Brick)	Number of story
Maximum inundation level inside a house (cm)	-0.348 (P = 0.000)*	- 0.128 (P = 0.053)*
Inundation period inside a house (days)	- 0.335 (P = 0.000)*	-0.463 (P = 0.000)*

Table 4-12 shows the result of the nonparametric test (Mann-Whitney U test). Raised floor typed house has significantly higher flood level outside a house. It says people build raised floor typed house in a more flood-prone area for preparation. On the other hand, inundation level in raised floor typed house is significantly less than non-raised floor typed house (see Table 4-12). It means raised floor typed house prevented inundation of water inside a house. There is almost no difference in terms of floods level outside of a house between households that prepare equipment such as sandbags and water pumps, and households that did not prepare. It says that flood risk does not effect on preparation. Next, a relationship between risk exposure and adaptation to risk during the mega flooding, which are "have assistance to prevent inundation/not" and "have activities to prevent inundation/not," is examined. Table 4-12 shows households that received assistance to prevent inundation have higher water level outside a house though it is not statistically significant. A household that had activities to prevent inundation, such as piling sandbag around a house and draw water through the water pump have higher water level outside a house, as well. It means if flood situation around a house is serious, the household tends to receive assistance and has activity by themselves to prevent inundation.

Table 4-12 Differences between two groups about house improvements (construction material, type of house), preparedness, assistant to protect a house and activity to protect a house in terms of situation of flood

Before			
Floods situation	**Raised floor house**	**Non-raised floor house**	**Mann Whitney U test**
Maximum flood level outside a house (cm)	146.27	101.19	-4.819 (P = 0.000)*
Inundation level inside a house (cm)	109.41	129.36	-2.041 (P = 0.041)*
Inundation period inside a house (days)	105.87	136.21	-3.701 (P = 0.000)*
Floods situation	**Prepare equipment**	**Not prepare**	**Mann Whitney U test**
Maximum flood level outside a house (cm)	116.98	115.36	-0.105 (P = 0.917)
During			
Floods situation	**Receive assistant to protect a house**	**No assistant to protect a house**	**Mann Whitney U test**
Maximum flood level outside a house (cm)	123.45	112.70	-1.070 (P = 0.285)
Floods situation	**Have activity to protect a house**	**No activity to protect a house**	**Mann Whitney U test**
Maximum flood level outside a house (cm)	121.65	104.19	-1.915 (P = 0.055)*

e. Socio economic and adaptation to risk

It is natural to expect richer households have more rigid construction materials and two-stories house, but correlation coefficient between household income and house construction material and number of a story is very small (see Table 4-13). The reason is expected that in the BM program, households improve their houses; it means that they construct their houses with rigid materials and two-story houses with the support of CODI and government's subsidy. An only poor community whose average monthly household income is less than 15,000 Baht can join the program. Households in the poor community have more chance and support to improve their house.

A Man-Whitney test indicates that the income stability was greater for no- preparedness toward the floods (Mdn= 117.62) than for preparedness to the floods (Mdn= 93.20), U= -1.613, P =.107). However, the result showed non-significant between them. It might say that the financial support is the relevant issue for their basic needs. In consequent, the flooded people victims, especially low income did not pay attention in terms of the level of preparedness, such as piling of sand bags or cardboard against the floods (see Table 4-14).

Table 4-13 Correlation coefficient for household income and house construction material and no. of story (household level)

Household income (Baht)	**House material (1:wood 2:wood&brick 3:Brick)**	**Number of story**
	0.028 (P = 0.671)	0.041 (P = 0.541)

Table 4-14 Difference between preparedness and non-preparedness again the flood in terms of income stability

Income stability	**Preparedness activity against the flood (Yes/ No)**		
	Prepare	**No- Prepare**	**Mann Whitney U test**
	93.20	117.62	-1.613 (P = 0.107)

f. Adaptation to risk and social participation

In this section, the relationship between adaptation of risk through house construction material and number of stories and social participation through a frequency of attending community meetings, activity and volunteer is examined. As mentioned above, households in communities joining the BM program have more chance to improve their house. Differences between communities joining the BM program and communities not joining it in terms of participation are shown in Table 4-15. There are significant differences in terms of social participation between communities joining the BM program and communities not joining it.

In Figure 4-1, a direction of the arrow between “Social participation” and “Adaptation to risk” means that social participation enhances activity/capacity to adapt risk. Social participation is a tool to gather a people to share faith and makes a lesson learnt together. It points out that people has a gathering activity, they also build social capital in the community. In the BM program, micro-credit saving groups are established within the community. Microcredit saving group is considered as one of mean to build social capital by many scholars (Feigenberg et al., 2010). This establishment of saving group might build social capital. On the other hand, to apply the BM program, community committee needs to make consensus to join the program among the community and make survey about issues in community. Making consensus and conducting survey requires good network within the community. It means communities which apply BM program; the community has social capital before joining the BM program. In sum, social capital and adaptive capacity/activity may be interaction each other during their development. Additional research which shows how communities have enhanced their adaptive capacity and social capital and how they have been interacted each other during their development is necessary to identify the direction of arrows between “Social participation” and “Adaptation to risk” in Figure 4-1.

Table 4-16 shows differences between groups of adaptation to risk (Receive assistance/No assistance) in terms of social participation. Though the result of indicators of

another social capital is not statistically significant, we find same tendency. Therefore, it could be said that the more social capital, the more chance to receive assistance.

Table 4-15 Differences between community with and without Bann Mankong program in terms of social capital

Social participation (Never, Rarely, Sometimes, Often)	Communities joining Baan Mankong	Communities not joining Baan Mankong	Mann Whitney U test
Frequency of attending community meeting	167.30	99.99	-6.804 (P =0.000)*
Frequency of attending community activity	145.21	106.60	-4.011(P =0.000)*
Frequency of being a volunteer	164.20	100.92	-6.426 (P =0.000)*

Table 4-16 Differences between groups of adaptation to risk (Receive assistance/No assistance) in terms of social capital

Social participation (Never, Rarely, Sometimes, Often)	Receive assistance to protect a house	No assistance to protect a house	Mann Whitney U test
Frequency of attending community meeting	128.28	110.89	-1.843 (P= 0.065)*
Frequency of attending community activity	125.09	112.05	-1.422 (P = 0.155)
Frequency of being a volunteer	120.36	113.75	-0.704 (P = 0.481)

g. Adaptation to risk and damage

In this section, the relationship between house characters, which is housing construction material and number of the story, and damage level on a house, which is government compensation, is examined (see Table 4-17). There exists a significant negative correlation between damage level and housing indicators. The result presented the strong construction material precisely endured the damage level, in particular. Moreover, two-stories houses and furniture inside were less damaged.

Table 4-17 Correlation coefficient for damage level and house construction material and no. of story (household level)

	House material (1:wood 2:wood&brick 3:Brick)	Number of stories
Government compensation (Baht)	-0.121 (P = 0.067)	-0.214 (P = 0.001)*

h. Social participation and socio economic

The analysis shows the negative relationship between social participation and household income. It is slightly a negatively e significant in terms of participation of both community meeting (r=-117) and activity (r=-0.124).

This study classifies the difference between household living under and above the socio

economic of household income value based on 15,000 baht. A Man Whitney test indicates that social participation as following participated community issues (attending the activity, joining the meeting and being a volunteer) are not significantly greater for the group of lower household income than the higher income group.

The findings reveal the community ‘s meeting might be a way for addressing the problems of the community , so the lower income group uses this avenue to raise the challenges that were released by making a consensus of the community meeting. Moreover, the lower income group likely involve in the informal section so the working times are flexible. Therefore this group had more opportunity to attend the community meeting, activity as well as being the volunteer. Consequently, lower income group might be grater social participation than the higher income group.

Table 4-18 Correlation coefficient for social participation and household income

Social participation (Never, Rarely, Sometimes, Often)	**Monthly household income (Baht)**
Frequency of attending community meetings	-0.117 (P = 0.075)*
Frequency of attending community activities	-0.124 (P = 0.059)*
Frequency of being a volunteer	0-.022 (P = 0.739)

Table 4-19 Difference between poor and not poor household in terms of household income

Social participation (Never, Rarely, Sometimes, Often)	**Household income (Baht)**		
	<15,000	**>15,000**	**Mann Whitney U test**
Frequency of attending community meetings	123.89	110.77	-1.555 (P = 0.120)
Frequency of attending community activities	124.38	110.49	-1.602 (P = 0.109)
Frequency of being a volunteer	117.01	114.65	-0.273 (P = 0.785)

g. Summary of the analysis

Table 4-20 summarizes pair of variables that was shown statistically significant correlations or significant differences between groups by MW test.

Table 4-20 Pair of variables which have significant correlation

Section Table Analysis	Component Variable	Component Variables
(a) Table 4.6 Correlation	**Socio economic** Household monthly income	**Risk Exposure** ・Maximum flood level outside a house (community level, only Pathumthani)
(b) Table 4.7 Correlation	**Damage** Damage level on a house	**Risk Exposure** ・Maximum flood level outside a house ・Maximum inundation level inside a house ・Inundation period inside a house
(d) Table 4.12 Correlation	**Adaptation to risk** House material	**Risk Exposure** ・Maximum inundation level inside a house ・Inundation period inside a house
	Adaptation to risk Number of story	**Risk Exposure** ・Maximum inundation level inside a house ・Inundation period inside a house
(d) Table 4.10 MW test	**Adaptation to risk** Raised floor/Non-raised floor house	**Risk Exposure** ・Maximum flood level outside a house ・Maximum inundation level inside a house ・Inundation period inside a house
	Adaptation to risk Have/No activity to protect a house	**Risk Exposure** ・Maximum flood level outside a house
(f) Table 4.15 MW test	**Adaptation to risk** Communities joining/not joining BM program (improvement of house)	**Social participation** ・Frequency of attending community meeting ・Frequency of attending community activity ・Frequency of being a volunteer
(f) Table 4.16 MW test	**Adaptation to risk** Receive assistance/ no receive assistance to protect a house	**Social participation** ・Frequency of attending community meeting
(g) Table 4.17 Correlation	**Damage** Damage level on a house	**Adaptation to risk** ・House Material ・Number of story
(h) Table 4.18 Correlation	**Social participation** ・Frequency of attending community meeting ・Frequency of attending community activity	**Socio economic** Monthly household income

4.5 Causal relationship between indicators by using Structure Equation Modeling (SEM)

Next, to show an underlying causal relationship between indicators and directions in which the causal relationship act, structure equation modeling (SEM) is implemented. Indicators that are used in the “analytical model,” are used as observed variables. SEM analysis was manipulated on SPSS AMOS 20.0.0. The variables used to develop the models are listed in Table 4-21.

Table 4-21 Lists of factors relating to recovery period activities

No	Code	Definition
1	Experience	Respondent had previous experience of mega flood or not. (D)
2	Prepare_HH	Respondent had prepared for flooding or not. (D)
3	Knowledge	Before the flooding in 2011, respondent had knowledge about protecting a house or not. (D)
4	Protect_Assist	Received external assistance or not. (D)
5	Protect_HHmember	Total number of household members that worked to protect a house. (people×day)
6	Protect_Numberexternal	Total amount of labour from external assistance worked to protect a house. (people×day)
7	Protect_Supplymaterial	Receive external assistance; supplied some materials to protect a house or not. (D)
8	Protect_Info	Received external assistance; provided information to protect a house or not. (D)
9	Evacuate_HH	Household member participated in evacuation activity or not.(D)
10	Shift_Furniture	Household shifted furniture/electronic devices to avoid flooding or not. (D)
11	Clean_HHmember	Total number of household members required to clean a house. (people×day)
12	Clean_Hirepeople	Total number of people hired to clean a house. (people×day)
13	Clean_Assist	Received external support in cleaning a house or not (D)
14	Clean_Assistmaterial	Received external material support to clean a house or not (D)
15	Clean_Assistlabour	Total number external assistants for cleaning a house (people×day)
16	Money_Repairhouse	Total cost for repairing a house (Baht)
17	Repair_HHmember	Total number of household members who repaired a house (people×day)
18	Repair_Hirepp	Total number of people hired for repairing a house (people×day)
19	Repair_Assist	Received external support to repair a house or not (D)
20	Repair_Assistmat	Received external support (materials) to repair a house or not (D)
21	Repair_Assistlabour	Total number of external assistants for repairing a house (people×day)
22	Repair_Techadvices	External support (technical advice) for repairing a house (D)
23	Income_decrease	Decrease of income during until after the flooding (D)
24	Loss_Income	Total amount of decreased income during and after the flooding (Baht)
25	Newlivelihood	Had other income sources during/after the flooding or not (D)
26	Newlivelihood_Baht	Total amount of money from other income sources (Baht)
27	Damage_Level	Amount of government compensation (Baht)
28	Money_Companycompen baht	Amount of workplace compensation (Baht)
29	Social_Knowneigh	Number of household neighbours that respondent knows in this community (Family) (1: < 10, 2: 11–20, 3: 21–30, 3: 31–40 and 4: > 41)
30	Social_Meeting	Frequency of attendance at public meetings on a community issue (1: never, 2: rarely, 3: sometimes, and 4: often)
31	Social_Participation	Frequency of participation in local activities or events (e.g., children's day, religious activities) (1: never, 2: rarely, 3: sometimes and 4: often)
32	Social_Volunteer	Frequency of participation in local activities or events (e.g., children's day, religious activities) (1: never, 2: rarely, 3: sometimes and 4: often)
33	Social_Savingroup	Member of a saving group or not (D)
34	Time_Comflood	Period of flooding in a community (day)
35	Time_Houseflood	Period of flooding inside a house (day)
36	Waterdepth_Outside	The maximum depth of water outside the house (centimeters)
37	Waterdepth_Inside	Maximum depth of water inside the house.(centimeter)
38	Occupation	Occupation. (D, 1: formal sector and 0: informal sector)
39	Household_Numbermember	Number of household members. (people)
40	HHmember_Children	Number of children in the household. (people)
41	HHmember_Aged	Number of aged people in the household (people)
43	HHmember_Income	Number of income earners (people)
44	Money_HHincome	Average monthly household income. (Baht) (1: <10,000, 2: 10,000-15,000, 3:15,001- 20,000, 4: 20,001- 25,000, 5:25,001- 30,000, 6: 30,001- 35,000, 7: 35,001- 40,000, and 8: > 40,001)
45	Cons_Material	Construction materials of the house. (1: wood, 2: wood and brick and 3:brick)
46	Number_Story	Number of stories.
47	Type_House	Type of house (D, 1: raised and 0: non- raised floor).
48	Time_Clean	Period taken to clean the house (days)
49	Time_Repair	Period taken to repair the house (days)
50	Time_income	Period taken to recover income (days)

Note: D: Dummy variable

The established path analysis model is shown in Figure 3-5. GFI (goodness of fit index in which 0.90 indicates a perfect fit) is 0.968, and AGFI (goodness of fit index in which 0.90 indicates a perfect fit) is 0.905. RMSEA (root mean square error of approximation in which values less than 0.1 indicates the model good fit) is 0.098. Consequently, the model is proved the good integral fit of the model.

According to the obtained standardized path coefficient, latent variable "Risk exposure," which is composed of inundation period and level inside a house is a dominant variable affecting "flood damage." The standard path coefficient shows a positive significance at 0.52. Also, latent variables, 'adaptation to risk, which is composed of the three housing indicators, has the strong significant influence on "risk exposure." The standard path coefficient shows a negative significance at -0.54.

Furthermore, the significant negative relationship was found between inundation period inside a house and type of house (raised/non-raised floor) in which the standard pathway illustrated at -0.47.

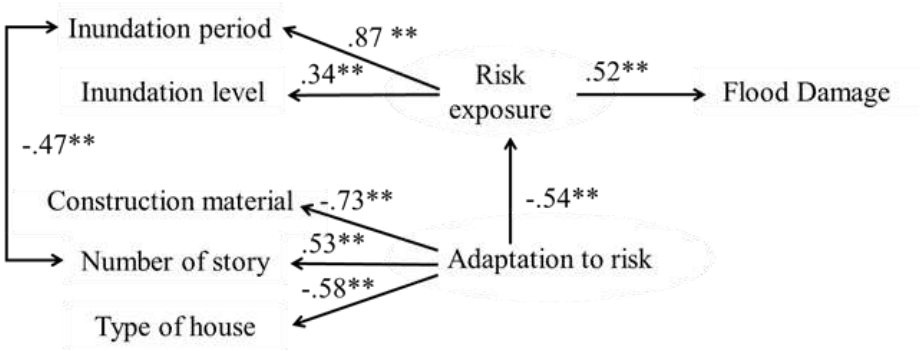


Figure 4-5 Path analysis model (**p<0.05); GFI: 0.968, AGFI: 0.905., RMSEA : 0.098

4.6 Discussion and Conclusion

This study tries to verify the analytical model that was initially developed by Brouwer et al (2007) and is modified by authors through correlation analysis, nonparametric test and Structural Equation Modeling. The result is summarized in Figure 4-6.

In Figure 4-6, statistically significant relationship between two components which is verified by both correlation analysis/MW test and SEM, is illustrated by a bold arrow. A statistically significant relationship that is shown only by correlation analysis or MW test is illustrated in a narrow arrow. In case of that, the analysis is conducted by province, and the statistically significant relationship is shown in only one province by correlation analysis or MW test, a dotted arrow illustrates it.

As same as expected, risk exposure has the positive correlation with flood damage. When floods level outside of a house and inundation level and period inside a house are higher and

longer, a house and furniture receive higher damage.

There are several indicators in “adaptation to risk” and especially house construction material and number of the story have the significant correlation with risk exposure and flood damage. In case of extra large-scale flood like the mega floods in 2011, improvement of house decrease damage directly and indirectly. For poor people, improvement of a house is the most effective way to mitigate their vulnerability to flood.

Additionally, in the more flood-prone area, the more people build traditional raised floor typed house to prepare for flood. And if the magnitude of flood is higher, residents tend to have more assistance. By these preparation and assistance, a person in more flood-prone area tries to mitigate flood damage.

The above relationships consist of the “analytical model.” The relationships between socio economic and other components are more complex than expected. Only in Pathumthani province, where is more flood-prone, the poor tends to occupy more flood-prone environment. There is no significant relationship between socio economic and adaptation to risk. In turn if poor communities have social participation that is a way to form social capital, they can join the BM program and receive support to improve their house. The combination of social capital and socio economic enable communities to receive support to improve their houses, which enhance adaptation to risk. Moreover, social participation has positive impact on receiving assistance. Therefore, broken arrow and line are illustrated between social participation, socio economic and adaptation to risk in Figure 4-6.

From this study, it is revealed that the most vulnerable group is a poor community in a more flood-prone area that have weaker social participation/ social capital. Originally they are vulnerable, and they cannot join the program that supports to enhance their adaptation to risk. To mitigate poor people’s vulnerability to flood, enhancing their social participation/ social capital is indirect but essential way.

Vulnerability to a natural disaster is place specific because social, natural as well as built environment is different. The relationship between the six components in our model will differ from place to place. Additionally, the relationship might differ by the magnitude of a disaster. Further studies indifference place and difference level of a flood are necessary to investigate the complex relationship between components of vulnerability.

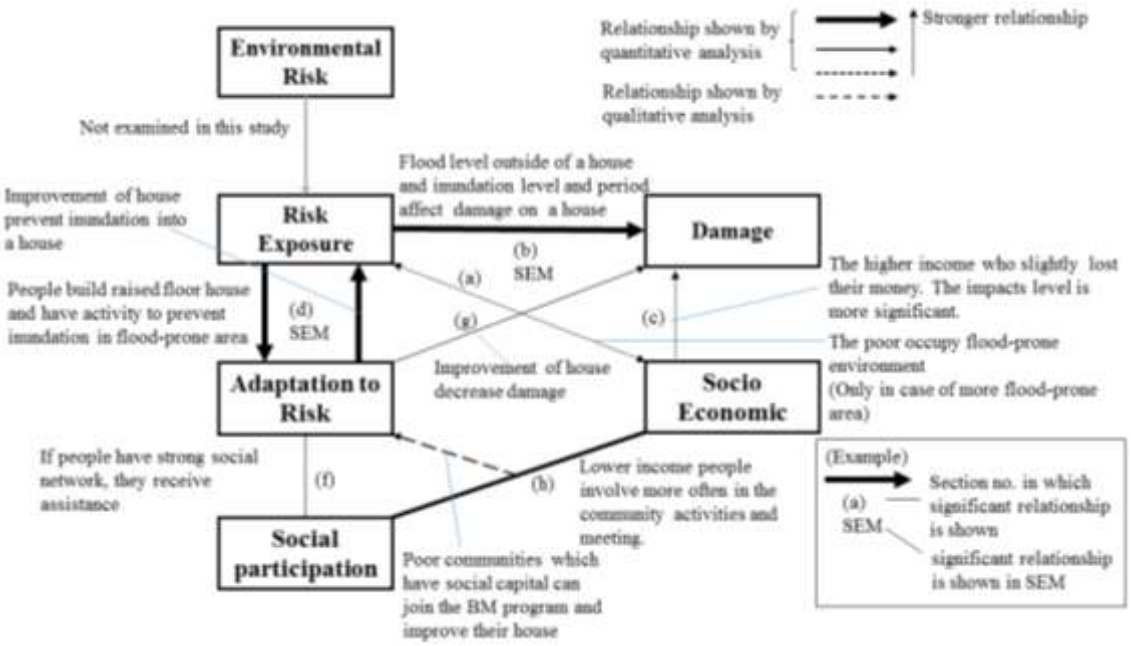


Figure 4-6 Vertical model in the case

CHAPTER 5. MECHANISMS OF RECOVERY AFTERMATH OF FLOODS

5.1 Introduction

This chapter places emphasize on "recovery period in the aftermath of a flood". The main objective of this research is to identify factors affecting community resilience and to show the complex relationship between resilience indicators and their factors in the recovery period. The methodologies of this chapter are relies on Chapter 4. This research started establishing the analytical model of recovery based on the findings of past studies. Then the dominant factors to build resilience are summarized and presented as the practical implementation in Chapter 7.

5.2 Analytical Model of Recovery

Following the previous studies (see section 2-10), the study developed the analytical model to show relationship between factors that related the recovery period. The indicators in each factor are generated from the actual operating of the affected community toward floods (see Figure 5-1 and Figure 5-2).

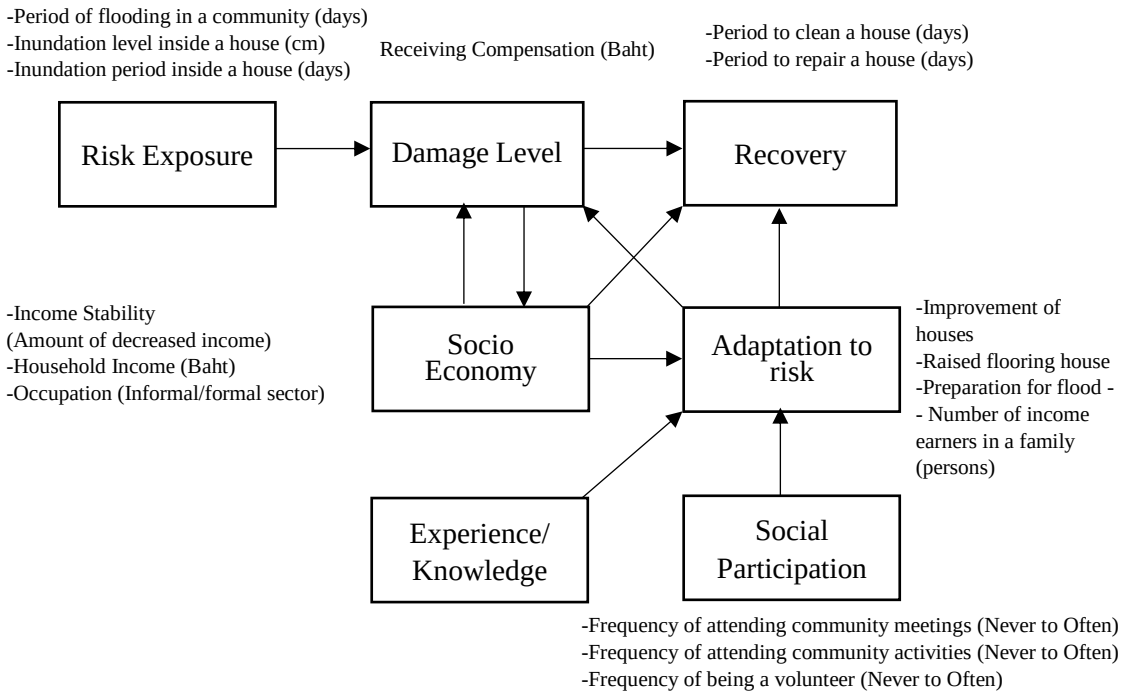


Figure 5-1 The analytical model of physical aspect

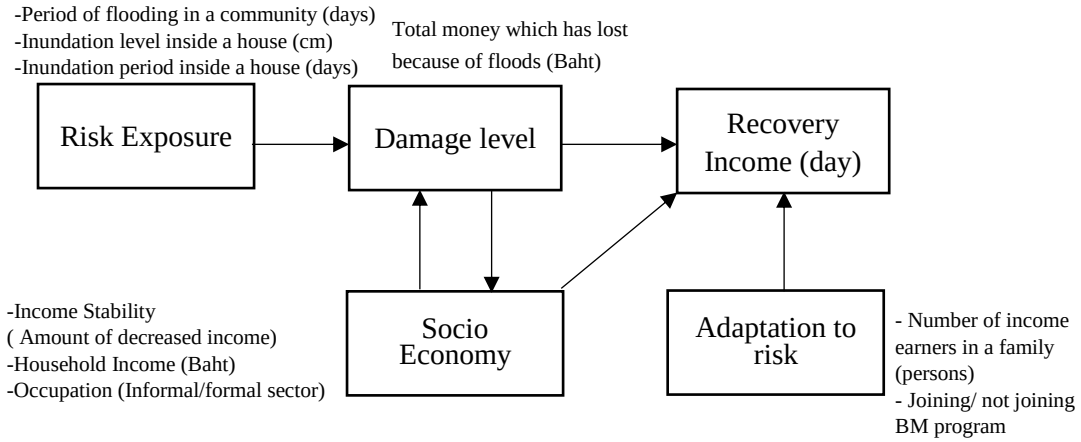


Figure 5-2 The analytical model of financial aspect

5.3 Analysis of the relationship between "recovery" and other components model by using linear correlation and non-parametric test

5.3.1 Period of recovery

Table 5-1 shows the period of recovery using three dimensions: period to clean the house, to repair the house and to recover income. Communities in Pathumthani province, which had suffered more severe damage from flooding, took longer to recover in all three dimensions. However, the result was slightly different between two provinces. Incidentally, the amount of damage was previously compared by the three indicators of recovery: "period to clean a house," "period to repair a house" and "period to recover income."

Table 5-1 Period of Recovery

Period to clean a house	
Bangkok = 10.2 days	Pathumthani = 12.1 days
Period to repair a house	
Bangkok = 11.7 days	Pathumthani = 12.7 days
Period to recover income	
Bangkok = 15.8 days	Pathumthani = 22.0 days

5.3.2 Relationship of underlying factors and physical recovery aspects (periods to clean and repair a house)

a. Risk exposure and damage

This section addresses the relationship between risk exposure and level of damage. On one hand, risk exposure is measured by the ease with which floods affect communities and individual households as follows: the inundation time of floods in a community and its households and the magnitude of inundation in a house. On the other hand, we assessed damage level by applying the government compensation plan in which the cost of repair to the interior

and exterior of a house is estimated, such as broken furniture, damaged electrical appliances and so on.

Table 5-2 shows the relationship between risk exposure and damage level and its statistical significance. Since the results in Table 4-2 showed the average time and inundation level and distinguished between Pathumthani Province and Bangkok, these areas are addressed separately.

The correlation analysis results show that the relationship between risk exposure and damage level was not statistically significant (see Tables 5-2 and 5-3). First, there is no statistically significant relationship in either Pathumthani Province or Bangkok between the period of flood in a community area and the damage level. Second, in Pathumthani Province, the inundation level inside a house was negatively related to the damage level, but not significantly so. Lastly, the inundation period inside a house was mentioned only occasionally by respondents along with the period of water remaining in the community. Consequently, this value was not statistically significant in explaining the relationship between the time of inundation inside a house and the damage level.

Table 5-2 Correlation coefficient for risk exposure and damage

Floods situation	Receiving compensation (damage level)
Maximum flood level outside a house (cm)	0.479 (P = 0.000) *
Maximum inundation level inside a house (cm)	0.479 (P = 0.000) *
Inundation period inside a house (days)	0.278 (P = 0.000) *

Table 5-3 Correlation coefficient for risk exposure and damage

Floods situation	Receiving compensation (damage level)	
	Pathumthani	Bangkok
Maximum flood level outside a house (cm)	0.076 (P = 0.476)	0.068 (P = 0.423)
Maximum inundation level inside a house (cm)	-0.095 (P = 0.374)	0.035 (P = 0.678)
Inundation period inside a house (days)	0.076 (P = 0.476)	0.068 (P = 0.423)

b. Damage and recovery

In general, in a community devastated by a disaster, the time taken for recovery might be slow because of the unexpected nature of flooding as well as inadequate resources, wider impacts and so forth. Thus, in the study, the relationship between damage level and recovery time is highlighted.

Measuring physical recovery involves two indicators: “period to clean house” and “period to repair a house.” For compensation, affected people initially received immediate emergency relief funding of approximately 5,000 baht to mostly pay for cleaning the house. Then, after the catastrophe, the flood victims were eligible to receive more compensation after an evaluation was made. The evaluation report lists broken items, which must be approved by a community

leader or authority. The second compensation amount could be spent for both repairing the house and supporting individual livelihoods.

As shown in Table 4-2, the average compensation in Pathumthani Province was approximately twice that of Bangkok, indicating that Pathumthani Province had suffered greater damage than Bangkok. As such, an analysis was carried out for the household level in each location. The results show that the period to clean a house was not significantly related to the compensation received. A statistically insignificant value was also found for the repair period, but the relationship is negative (see Table 5-4).

The study results yield a different perspective from the typical statements of previous findings. For instance, systems that had suffered greatly returned to normalcy more slowly. Eventually, the time for recovery might not be highlighted as much as the damage level. As such, these underlying factors must be evaluated with respect to the affected communities.

Table 5-4 Correlation coefficient for receiving income and recovery indicators

Recovery indicators	Receiving compensation (baht)	
	Pathumthani	Bangkok
Period to clean a house (days)	0.092 (P = 0.386)	0.024 (P = 0.778)
Period to repair a house (days)	-0.051 (P = 0.635)	0.129 (P = 0.129)

c. Experience/knowledge and adaptation to risk

Past studies have mentioned the need for communities to build and increase their resistance capacity to disasters, with the influencing factors involving personal experience and knowledge. Therefore, an analysis of a household' personal knowledge and experience and its adaptation to risk was essential. Adaptation to risk in this study primarily focused on the improvement of housing quality, construction materials and increasing numbers of the stories in buildings.

As the results in Table 5-5 show, in Pathumthani Province, there was a negatively significant relationship between the mentioned factors and both construction materials and number of stories. Also in the same province, the affected people had previous knowledge and experience, yet they had chosen to rebuild their houses using non-rigid materials such as wood frames or a combination of wood and brick materials rather than the rigid materials like brick. As the field survey revealed, the studied communities had not been approached by the house improvement program regarding reconstruction. The housing characteristics of the original building were simply restored. Also, most people were categorized as lower income workers who were employed as labourers. Unavoidably, the total income of this group was spent more in supporting their livelihoods than on anything else. Therefore, these people may have decided to

live in houses constructed of non-rigid materials since it was easier to build their house with them at lower construction cost.

Furthermore, the relationship between knowledge and the number of stories was positive and significant in Bangkok. In particular areas, some communities were involved in the BM program that was simultaneously targeting the enhancement of the physical condition of a house and upgrading the house type, while also considering its functionality with respect to the low income family living there. Despite the fact that the respondents may not consider enhancing the capacity of their houses to resist floods, it seemed beneficial to construct a house that had more than one story. As the interviews show, the second floor of a house was used as a temporary shelter for household members, as well as a dry area for safekeeping valuable furniture.

Table 5-5 Correlation coefficient for adaptation to risk (construction materials, number of stories) and personal experience and knowledge

Adaptation to risk	**Pathumthani**	**Bangkok**
	Respondent had previous experience of floods (Dummy)	
Construction materials (wood, wood and brick, brick)	-0.235(P = 0.026)*	-0.160 (P = 0.059)*
Number of stories	0.089 (P = 0.406)	-0.003 (P = 0.975)
Adaptation to risk	**Respondent had knowledge to prevent a house (Dummy)**	
Construction materials (wood, wood and brick, brick)	-0.217 (P = 0.040)*	0.050 (P = 0.556)
Number of stories	-0.099 (P = 0.351)	0.172 (P = 0.042)*

d. Adaptation to risk and damage

This section presents the relationship between adaptation to risk and damage level. Typically, people enhance their capacity to adapt and cope with risks to minimise the extent of damage and thereby reduce stress. To clearly determine this factor, this study analysed the relationship between adaptation to risk and damage level. Adaptations to risk at the household level consist of making preparations against flooding, upgrading a house and the number of income earners. The latter is a preventative factor that counts the people in the family who are able to work. It is assumed that a family with more members who are able to work have the capacity to recover more efficiently. In most typical urban low-income communities in Thailand, the family members are working people. As the living costs in the city are rather high, a couple must both work. Furthermore, because of the gender equality in social earning power, their incomes would be similar. However, the field survey results indicate that vulnerable families consist of aging people who are alone in the community. With respect to the impacts of a flood, this group had more serious exposure and also took a longer time to recover.

As shown in Table 5-6, the relationship between adaptation to risk and damage level was negative but non-significant in Pathumthani Province. In Bangkok, the relationship was positive but was also not statistically significant. This suggests that affected people in Pathumthani

Province's communities were sensitive to floods because of their vulnerable location and household characteristic.

In addition to the type of house, a raised floor affected the damage caused by floods, and perhaps indicates that households located along the river or in flood-prone areas were mostly built with raised floors. As such, the damage level of these houses was higher, although the relationship was not statistically significant (see Table 5-8).

Table 5-6 Correlation coefficient for adaptation to risk and damage level

Adaptation to risk	Pathumthani	Bangkok
	Receiving the compensation (Baht)	
Improvement of houses (Number of story)	-0.137(P = 0.197)	0.121(P = 0.153)
Number of income earners in a family (Persons)	-0.207(P = 0.050)*	-0.068 (P = 0.426)

Table 5-7 Difference between preparedness against the floods and damage level

Preparedness against the flood (Dummy)	Prepare	No- Prepare	Mann Whitney U test
	130.23	114.10	1.094 (P = 0.296)

Table 5-8 Difference between adaptation to risk (type of house) and damage level

Receiving compensation (Baht)	Raised -floor	Non- raised floor	Mann Whitney U test
	124.45	111.34	1.974 (P = 0.160)

Table 5-9 Difference between adaptation to risk (construction material) and damage level

Receiving compensation (Baht)	Wood	Wood and brick	Brick	Mann Whitney U test
	124.45	111.34	106.39	4.148 (P = 0.124)

e. Socioeconomic factors and recovery time

Tables 5-10 to 5-12 show the differences between socioeconomic and recovery indicators in the studied areas. The results indicate that higher income people more spent time cleaning and repairing their houses.

Table 5-10 Correlation coefficient for socio-economic and recovery

Recovery indicator	Income Stability(Amount of decreased income)	
	Pathumthani	Bangkok
Period to clean a house (days)	0.135(P = 0.205)	-0.118 (P = 0.165)
Period to repair a house (days)	-0.347(P = 0.001)*	0.151 (P = 0.076)*

Table 5-11 Difference between socio economic (Monthly household income) and recovery indicators

Recovery indicator	Household Income, <15,000 baht,	Household Income, > 15,000 baht)	Mann Whitney U test
Period to clean a house (days)	109.87	118.68	.963 (P = 0.326)
Period to repair a house (days)	107.14	120.22	2.088 (P = 0.149)

Table 5-12 Difference between socioeconomic (type of job) and recovery indicators

Recovery indicator	Occupation; informal sector	Occupation; formal sector	Mann Whitney U test
Period to clean a house (days)	112.04	122.94	1.387 (P = 0.239)
Period to repair a house (days)	111.84	123.37	1.525 (P = 0.217)

f. Damage and socioeconomic indicators

Table 5-13 shows the differences between damage level and socio-economic indicators. The latter were measured by household income below and above a certain amount (15,000 baht) and the type of job held.

First, the table shows that those with a higher household income suffered more serious damage than those with lower incomes, although the findings were not statistically significant. This may simply indicate that the house of a higher income family might have been bigger and/or had a higher property value. Second, with respect to formal employment, this group sustained a higher impact than the informal group. Again, this finding might indicate that the financial status of the formal group was better than the informal. As such, this group had the capacity to buy more valuable items and consequently sustained more serious damage.

Table 5-13 Difference between damage level and socioeconomic factors (household income and type of occupation)

Damage level	Household Income, <15,000 baht,	Household Income, > 15,000 baht)	Mann Whitney U test
Two Provinces			
Receiving compensation (baht)	115.16	115.69	0.003 (P = 0.953)
Pathumthani			
Receiving compensation (baht)	40.93	49.68	-1.930 (P = 0.110)
Bangkok			
Receiving compensation (baht)	64.84	72.77	-1.074 (P = 0.283)
Damage level	**Occupation; Informal**	**Occupation; Informal**	**Mann Whitney U test**
Two Provinces			
Receiving compensation (baht)	116.05	114.32	0.034 (P = 0.853)
Pathumthani			
Receiving compensation (baht)	45.75	44.84	0.022 (P = 0.881)
Bangkok			
Receiving compensation (baht)	68.36	74.60	0.790 (P = 0.374)

g. Adaptation to risk and recovery time

This section analyses the relationship between adaptation to risk and recovery indicators. Adaptation to risk in this study comprises improvement of a house and preparedness against floods, such as moving belongings to higher areas, preparing sandbags and the number of income earners. In this study, the number of income earners indicates the people in a household

who are able to work.

As the results show, the relationship between adaptation to risk and the period taken to clean a house was mostly statistically insignificant and negative. However, those living in a non-raised floor house and who had no preparedness against floods seem to take more time to clean their house. Also, the relationship between adaptation to risk and the period to repair a house was not significant in either location. Those living in houses with a raised floor suffered greatly from the impacts of flood, and thus the time required to repair the house is longer. Again, this finding might be related to the fact that houses with raised floors are typically built along a canal or in flood-prone areas. Therefore, they experienced more serious damage in the flood aftermath and consequently took longer to repair their houses. Moreover, preparedness against floods influenced the time taken to repair a house, which might also be linked to the house location, as mentioned above.

Furthermore, the BM program has a community development program to enhance community capacity, particularity in low-income communities. This program addresses the physical components of housing and community infrastructure, as well as the development of social capital in particular communities. Tables 5-14 to 5-18 show the relationship between having membership in the BM program and recovery indicators. Communities without membership in the BM program seem to take longer times to clean and repair their houses. However, the results were not statistically significant.

Table 5-14 Correlation coefficient for adaptation to risk and period to clean a house

Adaptation to risk	**Period to clean a house (day)**	
	Pathumthani	**Bangkok**
Improvement of houses (Construction material)	-0.079 (P = 0.461)	-0.154 (P = 0.069)*
Improvement of houses (Number of stories)	-0.021 (P = 0.841)	-0.090 (P = 0.291)
No. of income earners in family (persons)	-0.154 (P = 0.146)	0.093 (P = 0.276)

Table 5-15 Difference between adaptation to risk and period to clean a house

	Raised flooring house	**Non Raised flooring house**	**Mann Whitney U test**
Period to clean a house	115.42	115.54	0.000 (P = 0.990)
	Prepare	**Not prepare**	**Mann Whitney U test**
	96.30	117.33	1.892 (P = 0.169)

Table 5-16 Correlation coefficient for adaptation to risk and period to repair a house

Adaptation to risk	**Period to repair a house (day)**	
	Pathumthani	**Bangkok**
Improvement of houses (Construction material)	0.178 (P = 0.093)	0.012 (P = 0.892)
Improvement of houses (Number of stories)	-0.134 (P = 0.208)	-0.116 (P = 0.173)
No. of income earners in family (persons)	-0.062 (P = 0.563)	0.050 (P = 0.557)

Table 5-17 Difference between adaptation to risk and period to repair a house

Period to repair a house	**Raised flooring house**	**Non Raised flooring house**	**Mann Whitney U test**
	121.77	112.59	0.967 (P = 0.325)
	Prepare	**Not prepare**	**Mann Whitney U test**
	130.60	114.06	1.150 (P = 0.284)

Table 5-18 Difference between adaptation to risk in terms of joining or not joining BM program and recovery indicators

Recovery indicator	Not Joining BM program	Joining BM program	Mann Whitney U test
Period to clean a house (days)	118.38	105.90	1.489 (P = 0.222)
Period to repair a house (days)	117.54	108.68	0.738 (P = 0 .390)

h. Social participation and adaptation to risk

Tables 5-19 to Table 5-23 show the relationship between social capital and adaptation to risk. The results reveal a slightly negative significant relationship between attending community activities and adaptation to risk.

Table 5-19 Correlation coefficient for social participation and adaptation of risk (construction material)

Social participation (Never, Rarely, Sometimes, Often)	Construction material (wood, wood and brick, brick)
Frequency of attending community meetings	-0.020 (P = 0.769)
Frequency of attending community activities	-0.080 (P = 0.226)
Frequency of being a volunteer	0.044 (P = 0.510)

Table 5-20 Correlation coefficient for social participation and adaptation of risk (number of stories)

Social participation (Never, Rarely, Sometimes, Often)	Number of story
Frequency of attending community meetings	-0.097 (P = 0.141)
Frequency of attending community activities	-0.138 (P = 0.037)*
Frequency of being a volunteer	0.015(P = 0.816)

Table 5-21 Correlation coefficient for social participation and adaptation of risk (type of house; raised floor/ non-raised floor house)

Social participation (Never, Rarely, Sometimes, Often)	Type of house (raised floor/ non raised floor house)
Frequency of attending community meetings	-0.065 (P = 0.329)
Frequency of attending community activities	-0.046(P = 0.488)
Frequency of being a volunteer	-0.145(P = 0.028)*

Table 5-22 Correlation coefficient for social participation and adaptation of risk (Preparation to a flood)

Social participation (Never, Rarely, Sometimes, Often)	Preparation to a flood (dummy)
Frequency of attending community meetings	0.099 (P = 0.135)
Frequency of attending community activities	0.022(P = 0.745)
Frequency of being a volunteer	-0.017(P = 0.830)

Table 5-23 Correlation coefficient for social participation and adaptation of risk (number of income earners; people able to work)

Social participation (Never, Rarely, Sometimes, Often)	Number of income earner (people)
Frequency of attending community meetings	-0.058 (P = 0.383)
Frequency of attending community activities	-0.126 (P = 0.056)*
Frequency of being a volunteer	-0.008 (P = 0.902)

i. Summary of analyses

Table 5-24 summarised the pair of analysis that shows the statistically significant of correlation and between the groups by MW test.

Table 5-24 Statistically significant correlations between component physical variables

Section/ Table/ Analysis	Component Variable	Component Variable
(a) Table 5-2/Correlation	**Risk exposure** • Period of flooding in a community (days) • Inundation level inside a house (cm) • Inundation period inside a house (days)	**Damage level** • Receive compensation (baht)
(c) Table 5-5/ Correlation	**Adaptation to risk** • Construction material	**Experience and Knowledge** • Having an experience with a flood (community level)
	• Construction material	• Having knowledge of a flood (community level: Pathumthani)
	• Number of stories	• Having knowledge of a flood (community level: Bangkok)
(d) Table 5-6 /Correlation	**Adaptation to risk** • Number of income earners (people able to work)	**Damage level** • Receive compensation (community level: Pathumthani)
(e) Table 5-10 /Correlation	**Socio economic** • Income stability (amount of decreased income)	**Recovery time** • Period to repair a house
(h) Table 5-20, Table 5-21, Table 5-23 /Correlation	**Social participation** • Frequency of attending community activities	**Adaptation to risk** • Number of stories
	• Frequency of being a volunteer	• Type of house
	• Frequency of attending community activities	• Number of income earners (people able to work)

5.3.3 Causal relationship between influencing factors on physical recovery activities using structural equation modeling (SEM)

A structural equation modeling (SEM) analysis, using SPSS AMOS 20.0.0 software, was carried out to examine and weigh the factors influencing these two indicators of recovery: “period to clean a house” and “period to repair a house.” The variables used to develop the models are listed in Table 4-21.

j. Period to clean a house

Fig. 5-3 illustrates “the period of cleaning” model. The GFI (goodness of fit index in which 0.90 or greater indicates a perfect fit) is 0.94, and the AGFI (goodness of fit index in which 0.90 or greater indicates a perfect fit) is 0.90. The RMSEA (root mean square error of approximation in which values less than 0.1 indicates the model is a good fit) is 0.06. These

outputs prove the good integral fit of the model.

According to the obtained standardized path coefficient, the period of flooding inside a house decreased income during and after the flood and the household's preparation for flooding was a significant factor in the period taken to clean a house. The period of flooding inside a house has the highest correlation (standard path coefficient = 0.17). Decreased income during and after the flood is second in value (standard path coefficient = 0.14). Third is the household's preparation for flooding, whose standard path coefficient is 0.13.

However, the loss of income factor, during and after flooding, is negatively related to the period taken to clean a house. Therefore, the period of flooding inside a house has the greatest impact on the time taken in cleaning, followed by decreased income during and after the flood and the inundation period inside a house.

Additionally, the latent variables in the adaptation to risk in terms of housing characteristics consists of three variables—construction material, number of stories and type of house (non-raised/raised house)—revealing that the ruggedness of a house affects the "period of flooding inside a house.

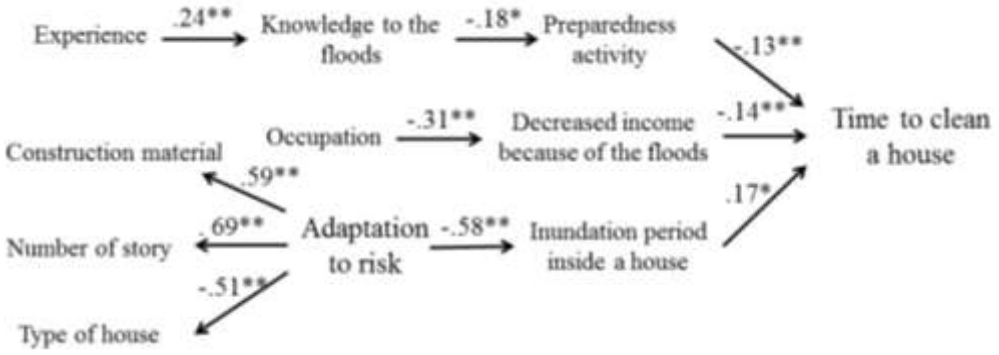


Figure 5-3 Model of Period for Cleaning a House (**P < 0.05, *P < 0.01) GFI: 0.94, AGFI: 0.90, RMSEA: 0.06

k. Period to repair a house

Fig. 5-4 shows "the period of repairing a house" model. The GFI is 0.97, the AGFI is 0.93 and the RMSEA is 0.07. The outputs thus prove the good integral fit of the model.

These results illustrate that the amount of decreased income during and after a flood and the maximum depth of water inside a house most affected the period taken to repair a house. Of these, the amount of decreased income during and after the flood (standard path coefficient = 0.22) has the greatest impact, which mitigates the "time taken in repairing a house." The second strongest factor is the maximum depth of water inside a house (standard path coefficient = 0.16).

Additionally, the latent variable adaptive capacity, with respect to the housing characteristics that indicate the ruggedness of a house, affects the maximum depth of water inside the house.

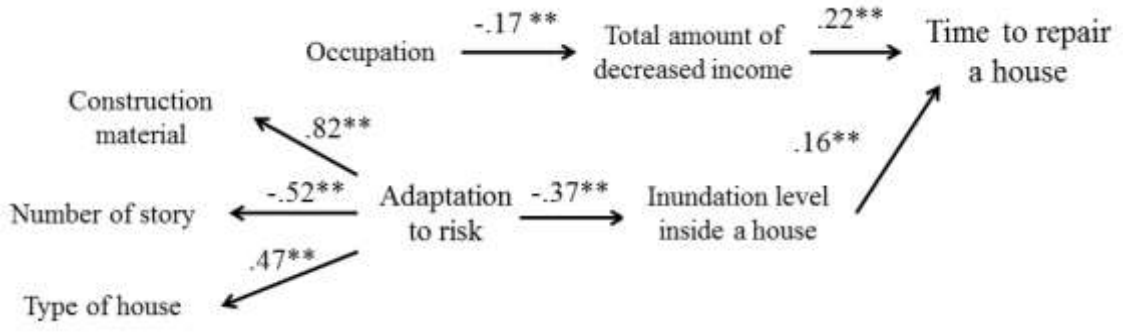


Figure 5-4 Model of Period for Repairing a House (**P < 0.05, *P < 0.01) GFI: 0.9, AGFI: 0.93, RMSEA: 0.07

5.3.4 Discussion and conclusions regarding physical aspects of recovery time

This study verifies that the existing model accurately depicts the relationship between the physical aspects of recovery and other components. The results, generated using correlation analysis and a non-parametric test, are summarized in Figure 4-5.

Figure 5-5 shows the significant relationship between the two components analysed by the correlation/Mann Whitney test (MW test) and SEM, as illustrated by the bolded arrows. Statistically significant relationships shown only by correlation analysis or the MW test are indicated by the narrow arrows. In the analysis by the province and of the statistical significance of the province, the results were either correlative or non- parametric, as illustrated by the dotted arrow.

Based on these results, the relationship between indicators shows slight statistical significance. First, the inundation time and level of the water inside a house and the period during which water was present in the community are the underlying factors influencing the damage level of a house. Second, with respect to the relationship between experience/knowledge and adaptation to risk, the results in Pathumthani province show negative significance between previous flood experience and the improvement of a house in terms of construction materials, as well as with respect to knowledge of how to protect a house by improving its materials. In essence, this means that the people in flood-prone areas who have experienced and gained knowledge about floods have chosen non-rigid materials to build their houses. Third, the damage level of a house is less when the household has more members who are able to work. This finding might relate to the preparedness activities carried out by

physically able people, such as lifting household furniture into high areas, building obstacles to flood water to protect against inundation and so forth. Fourth, the relationship between the socioeconomic level and recovery components are particularly significant; people who lost a significant amount of income took longer to repair their houses.

These analytical results reveal several significant relationships between the component variables. For instance, there is a strongly significant relationship between risk exposure and the damage level in each location. This means that the length of the inundation times and their levels affect the damage level of a household. Additionally, the recovery period of a household comprises the times taken to clean and repair the house, which are not direct impacts from the physical damage of a flood. As such, they are more useful to consider here in terms of socioeconomic components.

However, these results were generated only from the study areas, which were hit by the 2011 mega flood. The options for adaption to risk might be limited and remain focused on immediate physical issues. Therefore, further research should be conducted in frequently flooded areas to address adaptation to risk.

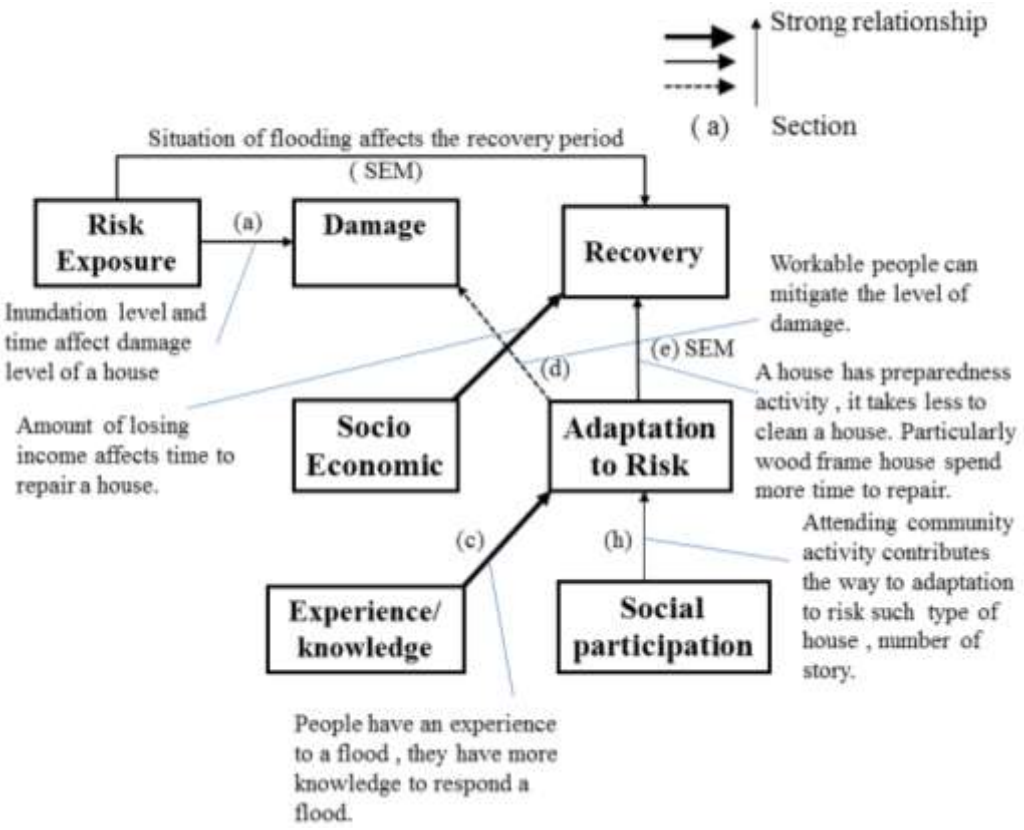


Figure 5-5 Vertical model of the physical aspects of flood analysis

5.3.5 Relationship of underlying factors and income recovery

l. Risk exposure and damage

In this section, we address the relationship between risk exposure and damage level. On one hand, risk exposure was measured by the ease of which floods affect communities and individual households, as follows: the inundation time of floods in the community and household and the extent of inundation in houses. On the other hand, to assess the damage level, we considered the total amount of money lost, from the pre- to the post-flood periods. On the questionnaire, this money was calculated as lost income, expenditures for defence against flooding, cleaning and repairing a house and so forth. The findings show that the relationship between the inundation level inside a house and damage level was statistically significant. However, the length of time of inundation in a house was not significantly different than the damage level.

Table 5-25 Correlation between risk exposure and damage level

Floods situation	Total money lost (damage level)
Maximum flood level outside a house (cm)	0.117 (P = 0.075)*
Maximum inundation level inside a house (cm)	0.143 (P = 0.031) *
Inundation period outside a house (days)	-0.050 (P = 0.447)

Table 5-26 Correlation between risk exposure and damage level at the community level

Floods situation	Total money lost (damage level)	
	Pathumthani	Bangkok
Maximum flood level outside a house (cm)	-0.018 (P = 0.867)	0.257 (P = 0.002)*
Maximum inundation level inside a house (cm)	-0.094 (P = 0.378)	0.321 (P = 0.000)*
Inundation period outside a house (days)	-0.040 (P = 0.708.)	-0.017 (P = 0.839)

m. Damage and recovery income

Tables 5-27 and 5-28 show the relationship between total money lost and income recovery. The results are not statistically significant. This means that although a household had lost money due to loss of income and the expenses incurred in mitigating the impact and responding to the flood, this doesn't affect the time taken to recover income.

Table 5-27 Correlation between damage level and income recovery

Total money lost (damage level)	Income recovery (days)
	0.074 (P = 0.265)

Table 5-28 Correlation between damage level and period to recover income

Total money lost (damage level)	Income recovery (days)	
	Pathumthani	**Bangkok**
	0.039 (P = .714)	0.110 (P = 0.194)

n. Damage and socioeconomic level

Tables 5-29 to 5-33 present the relationship between damage level and socio economic aspects.

First, Tables 5-29 to 5-30 show the difference between damage level and socioeconomic level in terms of occupation. The results were not statistically significantly but the formal occupation sector had lost income.

Second, the relationship between household income and total money lost is statistically significant, particularly in Pathumthani province with respect to positive income (See Table 5-31). The difference between damage level and socioeconomic level in lower/higher income groups is not statistically significant but the higher income families sustained more damage, despite the findings not being statistically significant.

Third, the relationship between damage level and income stability is statistically significant. This means that people were able to spend their income primarily on activities related to mitigation and response to flooding (see Table 5-33).

Table 5-29 Correlation between damage level and occupation

Occupation	**Total money lost (damage level)**
	0.008 (P = 0.903)

Table 5-30 Difference between socioeconomic aspects in terms of occupation type and damage level

Total money lost (damage level)	**Occupation, informal sector**	**Occupation, formal sector**	**Mann Whitney U test**
	113.78	119.20	-0.576 (P= 0.564)

Table 5-31 Correlation between household income and damage level

Household income (Baht)	**Total money lost (damage level)**		
	Bangkok	**Pathumthani**	**Total**
	0.119 (P = 0.161)	0.203(P = 0.055)*	0.159 (P = 0.016)*

Table 5-32 Difference between socioeconomic level in terms of type of household income and damage level

Monthly Household / Damage level	< 15,000 Baht	> 15,000 Baht	Mann Whitney U test
Bangkok			
Total money lost (damage level)	62.56	73.68	-1.468 (P = 0.142)
Pathumthani			
Total money lost (damage level)	42.21	48.51	-1.147 (P = 0.251)

Table 5-33 Correlation between income stability and damage level

Total money lost (damage level)	Income stability (Total income lost from pre- to post-flooding; baht)		
	Bangkok	Pathumthani	Total
	0.260 (P = 0.002)*	0.652 (P = 0.000)*	0.415 (P = 0.000)*

o. Socioeconomic level and income during recovery period

Tables 5-34 to 5-38 present the relationship between socioeconomic level and income during the recovery period. The results show that occupation, household income and income stability almost affect the time taken to recover income.

First, on the topic of occupation, people involved in the informal employment sector differed significantly from those in the formal sector (see Table 5-34, Table 5-35). Second, the relationship of household income with recovery income is statistically and negatively significant. The difference between recovery time and socioeconomic level in terms of household income is statistically significant in Pathumtani province. Also, this reveals that the lower income group had a longer time to income recovery (see Table 5-36, Table 5-37). Third, the relationship of income stability with the period of income recovery is strongly significant in both targeted areas.

Table 5-34 Correlation between occupation and period of income recovery

Occupation	Income recovery (days)		
	Bangkok	Pathumthani	Total
	-0.332 (P = 0.000)*	-0.249 (P = 0.018)*	-0.310 (P = 0.000)*

Table 5-35 Difference between socio economic in terms of type of occupation and time to recover income

Income recovery (days)	Occupation, informal sector	Occupation, formal sector	Mann Whitney U test
	157.13	90.48	-4.504(P = 0 .000)*

Table 5-36 Correlation between household income and period of recovery income

Household income (Baht)	Recovery income (day)		
	Bangkok	**Pathumthani**	**Total**
	-0.203 (P = 0.16)*	-0.269 (P = 0.010)*	-.250 (P = 0.000)*

Table 5-37 Difference between socioeconomic levels in terms of type of household income and time to recover income

Monthly Household / **Period of income recovery**	**< 15,000 Baht**	**> 15,000 Baht**	**Mann Whitney U test**
Bangkok			
Income recovery (days)	76.56	68.08	-1.267 (P = 0.205)
Pathumthani			
Income recovery (days)	49.64	41.71	-1.843 (P = 0.065)*

Table 5-38 Correlation between income stability and period of income recovery

Period to recover income (day)	Income stability (Total income loss from pre- to post-flooding; baht)		
	Bangkok	**Pathumthani**	**Total**
	0.522 (P = 0.000)*	0.386 (P = 0.000)*	0.471 (P = 0.000)*

p. Adaptive capacity and income recovery

As mentioned earlier, the number of income earners represents the number of household members able to work. This assumes that the total household income might be higher than the income of the head of the household. As such, the active response of all family members can contribute to the expenses of mitigation and recovery after a flood. The results show that the relationship between the income earner and period taken to recover income is not statistically negatively significant (see Table 5-39).

Table 5-40 shows the difference between joining/not joining a BM program and income recovery, and the results are not significantly different. Moreover, those in the ‘joining BM program’ group took a longer time to recover their income. This might be related to the fact that most BM members were defined as lower income earners and had been involved in the informal occupation sector. Therefore, the ‘joining BM program’ group received slightly more income than the ‘not joining BM program’ group.

Table 5-39 Correlation between number of income earners and period of income recovery

Period taken to recover income (days)	Number of income earners (people)		
	Bangkok	**Pathumthani**	**Total**
	0.106 (P = 0.212)	-0.175 (P = 0.100)	-0.027(P = 0.684)

Table 5-40 Difference between joining/not joining BM program and income recovery

	Not Joining BM program	Joining BM program	Mann Whitney U test
Income recovery (days)	112.71	124.83	1.816 (P = 0.178)

q. Summary of analysis

Table 5-41 summarises the pair of analyses showing the statistical significance of the correlation and that between the groups by the MW test.

Table 5-41 Statistical significance between component variables of financial aspect

Section/ Table/ Analysis	Component Variable	Component Variable
(l) Table 5-25/Correlation	**Risk exposure** • Maximum flood level outside a house • Maximum inundation level inside a house • Inundation period inside a house	**Damage level** • Total money lost (Baht)
(n) Table 5-31, Table 5-33 Correlation	**Damage level** • Total losing money (Baht)	**Socioeconomic** • Household income • Income stability
(o) Table 5-34/Correlation, Table 5-35/ MW test	**Socio economic** • Occupation	**Period to recover income** • Time taken to recover income (days)
(o) Table 5-36/ Correlation, Table 5-37/ MW test, Table 5-38/ Correlation,	**Socio economic** • Household income • Income stability	**Period to recover income** • Time taken to recover income (days)

5.3.6 Causal relationship between influencing factors in income recovery using Structural Equation Modeling (SEM)

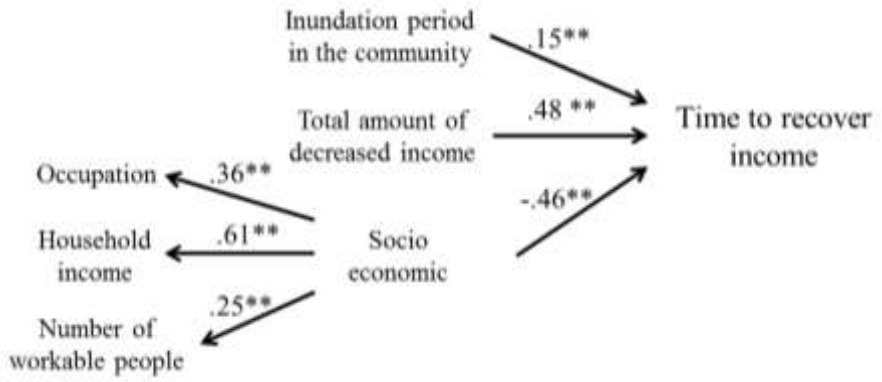


Figure 5-6 Model of period for income recovery (***P < 0.001, **P < 0.05, *P < 0.01) GFI: 0.96, AGFI: 0.91 RMSEA: 0.097

Fig. 5-6 shows the "period to recover income" model. The GFI is 0.96, AGFI is 0.91 and RMSEA is 0.097. These outputs prove the good integral fit of the model.

The recovery model illustrates a latent variable—the socioeconomic level—which itself consists of three variables: informality/formality of occupation, household income and number of income earners in a household. Additionally, a household's economic characteristics—amount of decreased income during and after the flood—and the period of flooding in the community affect the period taken to recover income. Amount of decreased income during and after the flood (standard path coefficient = 0.48) shows the highest correlation with "period to recover income." The second most important factor is the household economic characteristics, for which the standard path coefficient is -0.46. Time of flooding in a community is the third most significant influential factor in the period taken to recover income.

5.3.7 Discussion and conclusions of recovery time with respect to financial aspects

This study verifies the model depicting the relationship between recovery indicators and other components. The results, generated through correlation analysis and a non-parametric test, are summarized in Figure 5-7.

Figure 5-7 illustrates the significant relationship between the two components analysed by the correlation/MW test and SEM, which is illustrated by the bold arrow. A statistically significant relationship shown only by correlation analysis or the MW test is illustrated by the narrow arrow. For the analyses conducted by the province and regarding the statistical significance of a province, correlation or non-parametric results are illustrated by a dotted arrow.

Based on the results, the relationship between indicators shows a slight statistical significance. In particular, statistical significance is shown in two parts. First, there is a relationship between socioeconomic level and the recovery component, particularly in the lower income group members who do informal sector work. It takes more time for these people to recover their income. Second, there is a strong relationship between risk exposure and damage level. This reveals that the people with lower income lost their income due to their level of flood exposure. Therefore, it is necessary to reduce both the time and level of inundation in the affected areas in order to reduce the expenses incurred by flooded people. Third, the higher income group spent a lot of money to mitigate and respond to the flood. This might be related to the value of the damaged items that required the use of skilled tradesmen for recovery. Fourth, the inundation level of a community affects the time taken for its people to recover their income, and might particularly affect lower income people who run their own businesses in flooded community areas. Also, day labourers in various areas might not take the same approach to their workplace activities.

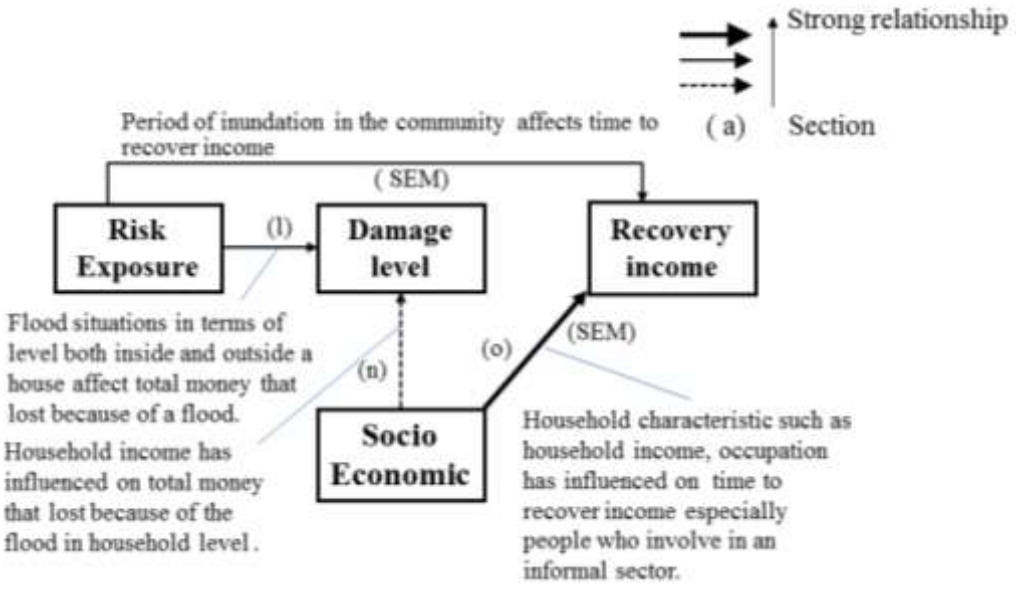


Figure 5-7 Vertical model of the analysis

Furthermore, in the aftermath of the flooding period, related organizations such as charity bodies, local offices and so on offer support by providing financial assistance to meet the requirements of flooded people. This compensation begins as soon as the physical debris is cleared. The study results show that monetary flow is essential to the affected areas, and that income is also a key concern. The results indicate that by joining a BM program a community influences the time taken to recover income. The results also reveal that lower income people who work in the informal sector, they are the most vulnerable group after a flood catastrophe, based on the time required to recover their income. One solution might be to promote the BM program to lower income groups.

These results were generated from and are specific only to the study areas that were hit by the 2011 mega flood. As such, the ways the affected people adapted to risk might be limited to their focus on income recovery issues. Further research will be necessary in frequently flooded areas to better address adaptation to risk.

CHAPTER 6. PROCESS OF BUILDING ADAPTIVE CAPACITY TO CLIMATE CHANGE THROUGH SOCIAL CAPITAL IN LOW-INCOME COMMUNITIES: A CASE STUDY OF NAKHON SAWAN MUNICIPALITY IN THAILAND

6.1. Introduction

In recent decades, we have faced many natural disasters that are said to be caused by global climate change, such as flooding, storm surges, droughts, and heat waves. These natural disasters have caused great damage on people physically, socially, and economically. Currently, decreasing vulnerability to climate change is a big challenge. Adaptive capacity, exposure, and sensitivity are considered three determinants of vulnerability (Polsky et al. 2007). The World Bank points out that exposure to risk by the urban poor is exacerbated by where they live within cities and their limited access to basic infrastructure and services. It also states that land tenure, employment, financial security, and availability of social networks affect the sensitivity and adaptive capacity of the urban poor to climate change and disaster risk. That is, the urban poor are particularly vulnerable to climate change and natural hazards (Baker 2012). This study especially focuses on adaptive capacity and activity, and examines how the urban poor can build their adaptive capacity to climate change, especially flooding. In this study, adaptive capacity is defined as "The ability of a human or natural system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences," following IPCC's definition (IPCC 2001).

In poor communities in developing countries, physical as well as knowledge and information resources, which can be obtained within the community, are limited. Therefore, accessing resources outside of the community is necessary. How can these communities access outside resources? Many scholars identify that people are enabled to access outside resources through social networks. In sum, the poor community can build their adaptive capacity and access to resources by developing social capital and networks with other groups or organizations.

This paper takes up a case study of the "Nakhon Sawan Community Development Organisation" (NSCDO) in Thailand, a community network composed of 21 poor communities as of 2015 in Nakhon Sawan Municipality, Nakhon Sawan Province. The Nan River and Ping River, both of which flow from the northern part of Thailand, run together into Chaopraya River in Nakhon Swan Province (see Figure 6.1). Therefore, this area is one of the most flood-prone areas in Thailand. In the case of the mega flood in 2011, the river dike in the city was broken,

and the built-up area of the city was inundated by one to two meters. In some communities, the water remained stagnant for three to five months without retreating. The NSCDO's activities during and after the mega flood in 2011 received great attention (The Community Organizations Development Institute, 2011, The Asian Coalition for Housing Rights, 2012) and were studied as low-income communities that have high adaptive capacities and conduct good adaptive activities in Thailand. This local-level community network is under the community network of Nakhon Sawan Province. In Thailand, there are hierarchically organized community networks, from the national level to the neighborhood level, and this layered community network system is organized by the Community Organizations Development Institute (CODI).

Figure 6-1 Location of Nakhon Sawan City Municipality

CODI is a public organization under the Ministry of Social Development and Human Security in Thailand, and its objective is to address the housing problems of the country's poorest urban and rural citizens. Networking between low-income communities is CODI's method to empower such communities. Today, low-income community networks are recognized as a strong tool to empower poor communities in Thailand as well as in other countries. The Asian Coalition for Community Action (ACCA) program seeks to address poor communities' housing problems by utilizing city-wide community networks, and is conducted in many

developing Asian countries by the Asian Coalition for Housing Rights (ACHR), a coalition of Asian professionals and NGOs. There are several papers about the effectiveness of community networks to empower low-income communities (Leonhardt, 2015; Bhatkal and Lucci, 2015).

However, there are very few researches that deal with the effectiveness of community networks on building adaptive capacities toward disaster.

6.2. Social Capital and Disaster

So far, a large number of articles have been devoted to the study of how social capital effects on disaster management, such as providing access to various resources in a disaster situation and post-disaster (Elliot al, 2010; Hurlbert et al. 2000). Though the scholars have shown evidence of efficacy of social capital to disaster management, resilience research has not yet embraced social capital as a critical component (Aldrich and Meyer 2014). Szreter and Woolcock (2004) separate social capital into three main types: bonding, bridging, and linking. Some scholars adopt this three typology to analyze the role of social capital to disaster management (Aldrich, 2012a; Kawachi, Kim, Coutts, and Subramanian, 2004; Szreter and Woolcock, 2004). Bonding social capital refers to trusting, co-operative relationships between members of a network who see themselves as being similar, regarding their shared social identity. An example of bonding social capital includes relationships between friends or family.

Bridging social capital, by contrast, comprises relationships of respect and mutuality between people who know that they are not alike in some socio-demographic or social identity sense (differing by age, ethnic group, class, and so forth). Another type of social capital is linking social capital, which is defined as norms of respect and networks of trusting relationships between people who are interacting across explicit, formal, or institutionalized power or authority gradients in society (Szreter and Woolcock 2004). The difference between bonding social capital and bridging social capital is that the former is characterized by homogeneous in demographic characteristics, and the latter has demographic diversity. The difference between bridging social capital and linking social capital is that the former is a horizontal metaphor, while the latter is a vertical one.

Disaster scholars have used social capital to understand the trajectory of individuals and communities. Social networks provide financial and non-financial resources (Aldrich and Meyer 2014), and many scholars have used the three typologies of social capital and show the roles of each type. *Bonding social capital*, the first and most common form of social network available to disaster-affected individuals (Norris et al. 2002) provides a number of types of resources, such as warning, disaster preparation, shelter, supplies, and immediate aid and initial recovery assistance during and after catastrophes (Hawkins and Maurer 2010; Heller et al., 2005). In

particular, family ties can be a first provider of assistance (Garrison & Sasser 2009, Haines et al., 1996; Hurlbert et al., 2000). Ties among the community display higher levels of bonding social capital. Nakagawa and Shaw reveal that communities with higher social capital and community leadership showed higher satisfaction with community rebuilding, and also showed the quickest recovery in the case of the Gujarat and Kobe earthquake (Nakagawa and Shaw, 2004).

Bridging social capital has been shown to provide opportunities and information to access novel resources that assist in long-term recovery (Hawkins and Maurer 2010). Ties to social organizations provide connections to an organization that can provide support through institutional channels and potential informational ties to individuals (Aldrich and Meyer 2015). After Hurricane Andrew, members of social groups received more support (Haines et al., 1996).

Many scholars point out that *linking social capital* also provide resources that assist in long-term recovery. Bonding social capital allows underdeveloped regions and low socio-economic individuals to "get by" during and just after catastrophe but without linking connections to an extra local organization, they have difficulty in long-term recovery (Woolcock et al., 2000; Dahal et al., 2008; Elliott et al., 2010). Thus, there are some researches on the role of three types of social capital during and after a disaster. However, there are very few researches that examine the role of social capital from pre-disaster to post-disaster continuously, especially including preparedness for disaster in a normal period. Therefore, this study attempts to examine the role of the three types of social capital from the normal period to that which follows a catastrophe. In addition, there are several levels of each of the three types of social capital, such as local, regional, national, and international levels. Each different level is expected to have a different role, but there is no research that classifies the three social capitals horizontally. Therefore, this research classifies the three social capital types by level and seeks to identify their role.

6.3. The NSCDO as a Case Study

6.3.1 Methodology of this Research

As previously mentioned, the NSCDO is observed in this study, and is composed of 21 poor communities in Nakhon Sawan Municipality as of 2015. In this study, a field survey was conducted from March 4th to 29th in 2015, and interview surveys were administered to a leader of the NSCDO, community leaders and committee members in the network, and villagers in the communities, as well as to CODI staffs and Nakhon Sawan Municipality office staffs. After the field survey, telephone interviews were also conducted 15 times. From the interview surveys and analysis of related documents, the processes of organizing the network and building adaptive capacity were clarified. Further, during the process of organization and building capacity, the types of social capitals and resources obtained were clarified.

6.3.2 Urbanization and Increase of Flood Damage in the Nakhon Sawan Municipality

The Nakhon Sawan Municipality is an area that is highly prone to flooding, experiencing small- to large-scale floods almost every year. Before around 1995, seasonal floods seemed to be rather beneficial to the villagers since most of them worked in agriculture or at freshwater fisheries, the main sources of household income in that area. First, regarding agriculture, humus was carried into the affected areas after flooding inundation as it enriched the soil. Consequently, a yard would generate the best-quality crops, such as sweet waxy com, and high profit would result. Second, flood causes diversification of the aquatic ecological system, and a huge number of the freshwater animals had generated a high income for fishermen.

In this age, most of the houses in this area are traditional raised-floor, wood-frame houses. This kind of house provides space on the first floor. Functionally, space is useful for the house in the tropical zone as it enables the free flow of air during times of high temperature. Furthermore, space is required to store job equipment such as boats, fertilizers, fishing nets, and so on. Simultaneously, the traditional raised-floor house has the function of acting as a sort of floodway during rainy season. When a flood occurs, people move their valuable items and functional furniture up to the second floor. Thus, this raised floor house matches people's lifestyle, and when flooding occurs, people do not suffer so greatly. However, some households did not have houses with raised floors, leaving them unable to respond to flooding disasters and to suffer greatly from the outcome. These individuals evacuated to relief centers that were established and supported by the local and national government. Still, people's life matched the local climate, including seasonal floods.

Since around 1995, immigrants to Nakhon Sawan Municipality from the rural areas had increased, the overall population also increased, and the previous circumstance had been changed. Most of the immigrants' occupations were not in the agricultural sector but mainly in the service jobs mainly in informal sector. Additionally, the main job type of residents who were born and raised in Nakhon Sawan Municipality changed from the agricultural sector to the service sector. Most of the houses for immigrants are houses with non-raised floors because raised-floor houses are not comfortable for the extended family member. Moreover, as their livelihood has changed such as from the agricultural to the service sector, the space of the first floor is no longer necessary. In addition, most of the newly developed houses for non-immigrants are also houses with non-raised floors. Therefore, residents' lives have come to be impacted by flooding now more than ever before.

6.4. The Nakhon Sawan Community Development Organisation

6.4.1 Formation of the NSCDO and its Suspension

a. Development of Women Group

Some communities in Nakhon Sawan Municipality have the problem of land tenure because they were squatters and thus feared eviction. Initially, residents worked together to tackle this problem in each community. This is the first case of social capital, and specifically is bonding social capital. The communities came to know that neighboring communities have the same problem, and finally they united to address the problem. This social tie among neighborhood communities is another example of bonding social capital as they demonstrated together to appeal their problem. By working collectively, they could appeal the problem more drastically, and the city municipality office finally became aware of the problem and began to support the communities. In addition, linking social ties appear here. In 1993, a joint group of women were organized by those communities with the support of the city municipality office, and became known as the "Women's Group." For the most part, women of the communities joined this group because housewives had more time for such an activity than did their husbands. They discussed their common problems, which involved not only land tenure but also debt, environmental management, and community welfare, and worked together to solve these issues. By developing a network in this community, the local groups could receive support to formalize their networks according to the municipality office.

b. Development of the NSCDO

Eventually, one of the staffs of the municipality office connected the Women's Group to the Urban Community Development Office (UCDO). The UCDO is a former organization of CODI and aims to support low-income urban communities with funds from the government. The UCDO began to support the Women's Group because the UCDO supports low-income communities to secure land tenure. This network between the Women's Group and the UCDO is an example of linking social capital.

In 1995, the group was reformed to be named the "Nakhon Sawan Community Development Organisation" with the support of the UCDO and the municipality office. The UCDO had a program to develop networks within neighborhood communities, and the city municipality office continued to support the NSCDO by, for example, providing facilities such as office space, stationary, and so forth. In addition, the UCDO provided the organization with some helpful resources, such as instructing upon management and public hearing techniques. In 2000, the UCDO merged with the Rural Development Fund to create CODI, a public organization under the Ministry of Social Development and Human Security in Thailand. Its main objective is to address the housing problems of the country's poorest urban and rural

citizens. Eventually, however, member communities of the community network disagreed with one another on some particular issues, and also faced disagreements with the city municipality office. Finally, the community network ceased its operation from 1999 to 2005.

6.4.2 Reorganizing the Nakhon Sawan Community Development Organisation

a. Reorganizing the NSCDO

In early 2005, CODI proposed to re-establish the community network. First, savings groups were established in eight communities in 2005. These savings groups are illustrative of bonding social capital. In the same year, the "Nakhon Sawan Development Network" was re-established as well.

b. Joining the National Union of Low Income Community Organisations

After re-organizing the network, the NSCDO jointed the low-income community network of Nakhon Sawan, which consists of the provincial level of the layer of hierarchical community networks mentioned in the first chapter. This means that the NSCDO joined the hierarchical community network. The national-level community network is called "The National Union of Low Income Community Organisations" (NULICO). At the national level, NULICO is organized by committees that are composed of representatives of each region and team. There are four teams: 1) The land security team, 2) The community welfare fund team, 3) The law and regulation team, and 4) The internal development of the community networks team. NULICO committees mainly support the coordination of community organizations and local authorities to solve problems that occur in member communities. NULICO is an extremely powerful platform for community development–a platform that involves a synergy of learning, the sharing of experiences, the boosting of morale, and inspiration. Community networking has become the main community-led development mechanism of CODI. By joining this hierarchical community network, the NSCDO developed bridging social capital with community networks at the national, regional, provincial, and city levels. Further, although the community network has a hierarchical structure, the relationship between the NSCDO and each level of the community network is horizontal. Each community network and its member communities have broad demographic diversities beyond simply sharing the commonality of "low-income." Therefore, social ties between the NSCDO and each community network can be recognized as bridging social capital.

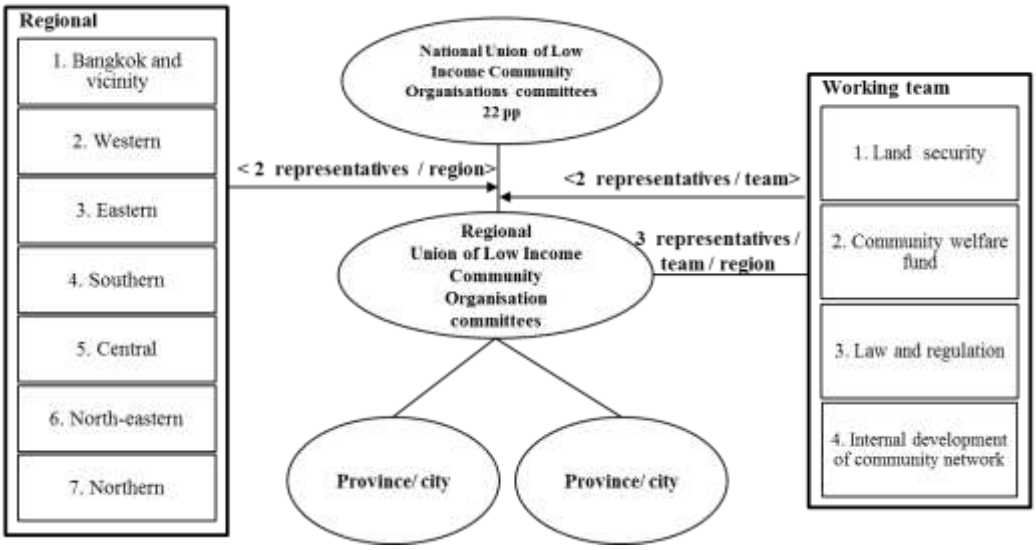


Figure 6-2 National Union of Low Income Community Organizations

Source: Translated from National Union of Low Income Community Organizations (2010)

c. Housing Improvements by the Baan Mankong Collective Program

Furthermore, in 2006, two communities of the NSCDO met the requirements and joined the Baan Mankong Collective Program (BM program), which is organized by CODI. The program channels government funds, in the form of infrastructure subsidies and soft housing and land loans, directly to poor communities, which plan and carry out improvements to their housing, environment, basic services, and tenure security, and also manage the budget themselves. Through this program, a large number of poor communities all over Thailand have succeeded to improve their houses and environment since 2003. First, the micro-credit savings groups were organized in communities, and through these groups the communities acquire financial support and loans to secure land tenure or ownership groups. The cornerstone of the program is the principle of community-based financial mobilization enabled by savings groups. To obtain BM loans, communities develop housing in a collective way, and must save 10% of the amount they borrow in a community savings account for the community cooperative to qualify for a loan. CODI provides housing loans to community cooperatives at a 4% annual interest, and allocates a grant to each community of 20,000 baht ($570) per family. Cooperatives then on-lend to members, usually adding a margin on the interest rate to create a fund to cover cases of unsteady loan repayments and to fund other community activities, expenses, and some welfare programs (Bhatkal and Lucci 2015). In 2015, 19 communities in the NSCDO joined the BM program.

d. Community Construction Team "Chang Chumchon"

Community networks in many cities have started to make a list consisting of local masons, carpenters, plumbers, electricians, and skilled construction workers who live in these communities. These individuals are called upon whenever there are any building or construction needs. CODI has managed to enable the state to provide over 68,000 baht/ unit subsidies directly to the people. The total budget is $46 million covering 1,010 communities nationwide. The people can decide for themselves who to hire and work with.

The self-build network is a technical support mechanism, but it is also a kind of job creation scheme and a collective business. Much of this expertise is being channeled into community construction groups, who are taking on jobs with other communities, as well as small contracting jobs on the outside. These teams are now called "Chang Chumchon" ("Guilds of the Commune"). Occasionally, communities hire Chang Chumchon like a contractor to build everything, and sometimes they merely help out with the heavy work of laying foundations in communities that want to do most of the work themselves. At times, they provide the labor force, and at other times they are asked to provide specific technical expertise to work out problems of drainage, structural engineering, or house design. Not all BM housing projects were built by Chang Chumchon because houses and apartment buildings over two stories high typically required more specialized work (CODI webpage, "The Guilds: a Self-Build Community Network"). Still, communities that are joining the BM program in the NSCDO establish this Chang Chumchon in their communities. Wages to members of the construction team are set at 300 baht per day, which is the average wage without consideration of skill level. Therefore, theirs is somewhat voluntary activity.

6.4.3 Adaptive Capacity and Activities in the 2011 Mega Flood

Next, we try to identify the adaptive activities observed in the 2011 mega floods in the NSCDO. Each adaptive activity, as well as their resources and social network through which access to resources was enabled, are summarized in Table 6-1. Additionally, each adaptive activity is divided into the categories of "get by" and "long-term disaster management."

In 2011, Nakhon Sawan Municipality was seriously hit by a mega flood. However, houses that had been renovated or constructed with concrete materials mainly through the BM program were less affected. Therefore, renovation/construction of houses with concrete materials can be recognized as an effective adaptive activity and is a long-term adaptation of disaster. To renovate/construct houses in the BM program, various resources are required, such as funds, construction skills, and money-saving systems. The fund is not only saved money in a savings group, but also a loan from the program. Further, construction teams support the

renovation or construction of some houses, and they are subsidiaries of CODI, as previously mentioned. Construction team members obtained their skills from on-the-job training. Therefore, funds, human resources for construction, construction skills, and the BM program's system itself are resources for the renovation/construction of houses with concrete materials. Funds and the BM program are obtained through CODI. Human resources and skills are obtained through the community and neighborhood communities ((1) in Table 6-1).

The improvement of community infrastructure such as paving roads is also an adaptive activity, and most of these are realized by the BM program. In addition, such an adaptive activity is a long-term adaptation to disaster as well. Therefore, resources and social networks through which resources are obtained are the same as those noted as required for housing renovations ((2) in Table 6-1). In addition, when the flood was approaching, information teams of the community network *updated flooding information daily* by cooperating with the neighborhood community networks and local authorities. This is short-term adaptation to "get by." Resources to these adaptive activities are information of floods and human resources to collect and distribute the information ((3) in Table 6-1).

From before the flood and during the recovery stage, communities conducted *collective activity for preparation, protecting against the flood, evacuating, and recovery of affected houses and infrastructure* by cooperating with the municipality office. These are also short-term adaptive activities. Human resources as well as some funds and supplies came through the NSCDO and the municipality office. During and after the mega flood, the NSCDO received donations and relief supplies such as food, drinking water, and boats from NULICO and CODI. Members of NULICO who were not affected by the flood have agreed to contribute 30 baht (approximately $1) each to help those who were affected. These and other funds that have been raised will be managed by the community network in order to aid flood relief activities. These donations and supplies were utilized for evacuating and protecting communities at relief centers and for recovery. These funds and supplies came through NULICO and other hierarchical networks as well as CODI ((4) in Table 6-1).

During and after the mega flood, *two relief centers* were launched and operated by some communities in the NSCDO, two of 13 relief centers in the city municipality. In total, 1,839 households received benefits from these relief centers. During the mega floods, the tasks of the two relief centers did not only provide supplies, kitchens, and sleeping spaces, but also provided skill improvement programs. This is the unique feature of these two relief centers, which provide job opportunities and training courses so that the affected people are capable of earning income during and after flooding catastrophes. Funds and relief supplies are donated from NULICO and CODI. Such activities, including launching and managing relief centers and offering job training, are also short-term, adaptive capacities to "get by" ((5) in Table 6-1).

After the mega floods in 2011, the NSCDO played a key role in supporting the affected communities. First, the network launched a campaign to clean and to recover the greenery areas of the communities. Second, it made *a survey to check the level of damage*, and they found that two houses were totally destroyed. Thus, the network made a consensus among members and consequently two houses were re-built by the construction team of the network. Third, the flood devastated many essential items in the agricultural sector, such as seeds, working tools, and equipment. In this case, the community network p*rovided seeds for farmers*. These activities are both short-term and long-term adaptive activities. Funds for these activities came from the "disaster fund," which was established with contributions from savings groups, NULICO, and a seed fund from the ACHR. This social network with the ACHR is an example of linking social capital at the international level. Human resources and the skill of the construction team are the key resources of these activities ((6) in Table 6- 1).

During and after the catastrophe, the NSCDO *gathered data and information* about the flood severity and its damages to plan future disaster responses and to respond to the current disaster. This is reflective of long-term adaptation, and human resources are necessary to collect data and information ((7) in Table 6- 1).

After the flooding disasters in 2011, a rehabilitation program, supported by the World Bank and implemented by CODI (both of which display linking social capital), provides financial support for small infrastructure projects and housing repairs for flood victims still struggling to recover. This program also provides income support for community members to carry out needed construction work themselves (The World Bank website, Thailand's Flood Victims on Track to Recovery and Resilience). Six target communities were selected from the community network with a recommendation by CODI, and held a public hearing to decide on what projects to take up in their communities. Most of the communities decided to develop infrastructures such as road pavement, water drainages, and so on. Water pumping was decided as necessary to construct within the affected communities: some communities shared the budget to construct the center of water pumping that covered the affected areas. A total budget of approximately 1.2 million baht was allocated to the communities, but this was not enough for the required project. Then, the city municipality subsidized part of the budget ((8) in Table 6-1).

Table 6-1 Adaptive capacity/Activity and its resource and social capital thorough which NSCD network obtained them

No.	Timing	Adaptive capacity/activity	Resources	Social Capital
(1)	Before	Renovation/construction of houses with concrete materials (Long term)	-Fund -Human resources -Skills of construction -BM program system	NSCDO (Bonding SC at local level) communities (Bonding SC at local level) Saving groups (Bonding SC at local level) CODI (Linking SC at national level)
(2)	Before	Improvement of community infrastructure (Long term)	-Fund -Human resources -Skills of construction -BM program system	NSCDO (Bonding SC at local level) communities (Bonding SC at local level) Saving groups (Bonding SC at local level) CODI (Linking SC at national level)
(3)	Before -During	Update flood information (Get by)	-Human resources -Flood information	NSCDO (Bonding SC at local level) Neighborhood community network (Bonding SC at local level) Municipality office (Linking SC at local level)
(4)	Before -After	Collective activity to prepare, protect, evacuate and recovery (Get by)	-Fund -Human resources -Relief supplies (Food, Boat and Sand Bag etc.,)	NSCDO (Bonding SC at local level) NULICO and other community networks (Bridging SC at national level) Municipality Office (Linking SC at local level) CODI (Linking SC at national level)
(5)	During	Establish and manage two relief center by communities and give vocational training (Get by)	-Fund -Human Resource -Relief Supplies (Food and equipment etc.,)	NSCDO (Bonding SC at local level) NULICO (Bridging SC at national level) CODI (Linking SC at national level)
(6)	During -After	Rebuild affected houses, improve community environment and provide seeds to farmers with disaster fund (Long term)	-Fund -Human resource -Construction skills	NSCDO (Bonding SC at local level) NULICO (Bridging SC at national level) CODI (Linking SC at national level) AHCR (Linking SC at international level)
(7)	During -After	Collect information and data of the flood for future planning (Long term)	-Human resources	NSCDO (Bonding SC at local level)
(8)	After	Development of small infrastructure (Community-based Livelihood Support for the Urban Poor Program) (Long term)	- Fund -Human resources	NSCDO (Bonding social capital at local level) City Municipality (Linking SC at local level) CODI (Linking SC at national level) World Bank (Linking SC at international level)

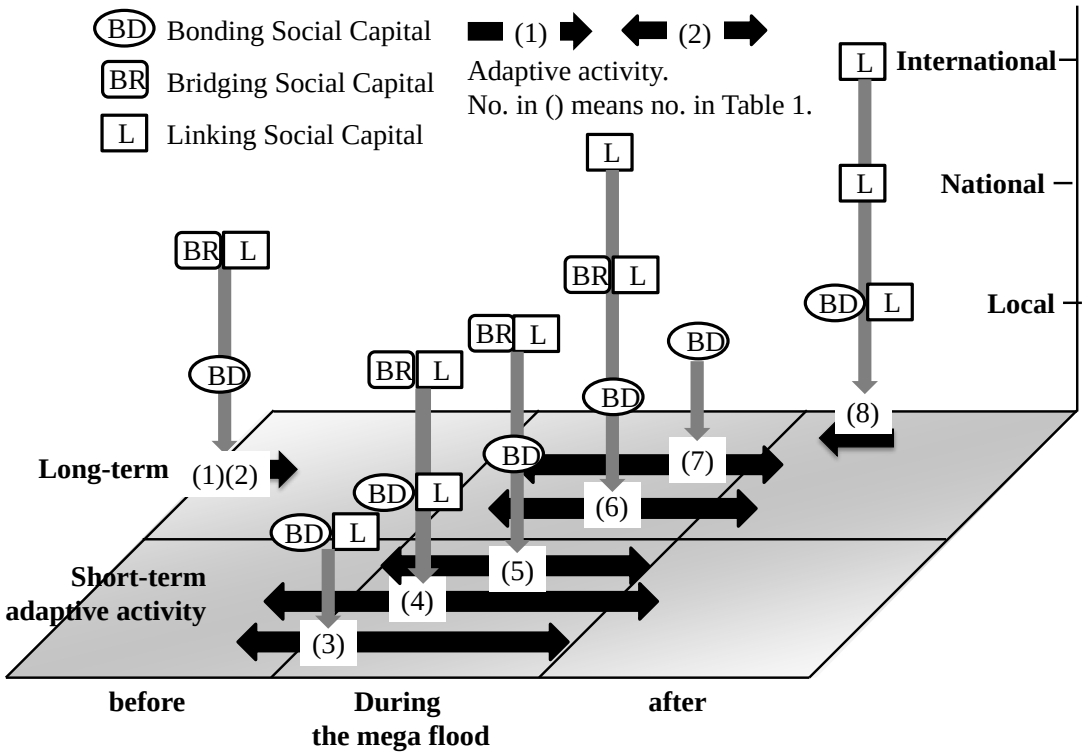


Figure 6-3 Timing and term of adaptive activities and type and level of social capital

Figure 6-3 summarizes the timing (before/during/after the mega flood) and term (short-/long-term) of the adaptive activities, as well as the type (bonding/bridging/linking) and level (local/national/international) of social capital through which resources of adaptive activities are obtained. Many scholars point out that bonding social capital allows low-income communities to "get by" during and just after catastrophes, but without linking social networks to the extra-local organisation, they face difficulty in long-term recovery (Woolcock et al., 2000; Dahal et al., 2008; Elliott et al., 2010). In this case study, a small-scale adaptive activity for the long term was conducted exclusively by the NSCDO ((7) in Table 6-1), while middle- and large-scale adaptive activities for both the short term and the long term are carried out by a combination with the NSCDO and bridging and linking social capital at various levels. This case study has the same result as previous researches. However, it can be said that bonding social capital is the basis of all adaptive activities for both the long term and short term.

Most of the activities are conducted by a combination of bonding social capital at the local level and bridging social capital at the national level, and/or linking social capital at national and international levels. Especially, bridging social capital and linking social capital at the national level, namely CODI and NULICO, play an important role at all times. Paradoxically, as adaptive activities that can be conducted by local-level social capitals are very

small, communities that do not have a social network with bridging and linking social capital can perform the limited adaptive activity in the face of disaster.

A characteristic of this case study is that there is bridging social capital at the national level, which is NULICO. NULICO played a very important role for both "get by" and long-term adaptive activities. This is because communities in regions that are not affected by flooding can support communities in affected areas. The main objectives of this multi-layered community network are to secure land tenure and improve the houses and living environment, but this system is effective for disaster management as well.

So far, there are limited numbers of researches that deal with adaptive activities from a normal period to during and after a disaster. In a normal period, some communities renovate or build their houses with concrete materials and improve community infrastructure through the BM program. Thus, bonding social capital and national-level bridging and linking social capital play significant roles for this long-term adaptive activity.

6.5. The Process of Developing Social Capital

The first social capital is bonding social capital among communities to tackle with the land tenure problem. The demonstration for land tenure was conducted by several communities in 1993, and it was the first opportunity in which the communities worked collectively. They now build bonding social capital between communities ((1) in Figure 6-4).

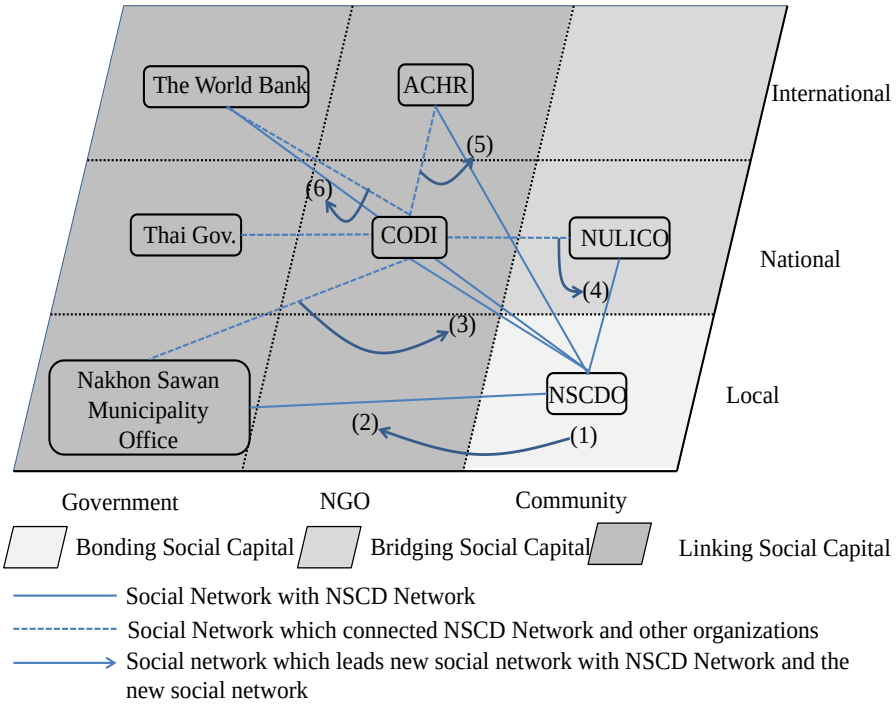


Figure 6-4 Social network between NSCD network and other institutions

As the communities worked collectively against land tenure problems, they increased their presence and became familiar with some staffs in the Nakhon Sawan Municipality office. Finally, the municipality office started to support them and helped to organize the Women's Group. In this way, the communities developed linking the social capital with the municipality office and through the social capital ((2) in Figure 6-3).

This linking social capital gave the Women's Group a chance to develop linking social capital with UCDO, a national-level organization and former organization of CODI. By networking with UCDO, the Women's Group was reformed to the NSCDO ((3) in Figure 6-3). Further, this linking social capital with CODI led to develop bridging social capital with multiple levels of community networks, including NULICO. This social networking with community networks is considered as bridging social capital ((4) in Figure 6-3).

By joining these community networks and the BM program by CODI, the NSCDO can receive Thai government subsidies through CODI and NULICO. CODI also connected the NSCDO with the international NGO, ACHR, and could thus receive some part of disaster funds. This relationship with ACHD is a display of linking social capital ((5) in Figure 6-3).

After the mega flood in 2011, some communities in the NSCDO were selected to join the World Bank's program, and they improved infrastructure in their community with financial support from the World Bank. This linking social capital with the World Bank was led by CODI. CODI recommended these communities for the program ((6) in Figure 6-3).

6.6. Discussion and Conclusion

This research reveals that bonding social capital is the basis of all adaptive activities for all periods. However, this type of social capital must link with other organizations at the local, national, and international levels. As it is essential to link connections with other organizations, especially national-level organizations, we can say that low-income communities that do not have such connections are extremely vulnerable to natural disasters. To connect with national-level organizations, uniting within a community is the first step, followed by the next step of collaborating with the neighbourhood community. Then, networks should connect with the local organization in order to establish connections with national-level organizations, which in turn leads to connections with other national level and international-level organizations. Therefore, a connection at the local level is the essential step to establish "wires" with other organizations and to create social capital. Paradoxically, low-income communities that do not unite or have a good connection with neighbourhood communities are vulnerable to natural disasters, and thus must be looked after.

This case study of the NSCDO illustrated how to connect with multi-layered, low-income

community networks. This developing community network in Thailand does not aim for disaster management. However, as a result, this network system was effective for disaster management because, in the case of disaster, communities in regions that were unaffected by a disaster could offer support to communities in affected regions. Therefore, this system has the possibility to function well in other countries. However, it is also important to note that we must always be aware of low-income communities outside of the network.

CHAPTER 7. CONCLUSIONS AND RECOMMENDATIONS

This dissertation identifies indicators of community resilience, factors influencing these indicators and the relationship between them. This chapter summarizes the main findings and implications for building resilience and for understanding community resilience to floods in general.

7.1 Summary of findings

The overall goal of this dissertation was to identify the underlying factors that mitigate the vulnerability of communities to flood, and to determine how communities can recover quickly following a flood. Conclusions regarding the main findings of this research are summarized as follows:

7.1.1 Complex relationship between factors in building resilience at the community level

The research objective was to identify both the factors associated with resilience and the complex relationships between them. In this study, resilience was defined as "the property of a community that mitigates vulnerability and facilitates quick recovery in the aftermath of disasters." Due to field realities, different actions were associated with different periods of time, so the findings were divided between two analytical models.

A model for mitigating vulnerability was first developed by Brouwer et al. (2007) and showed the relationship between components relevant to climate change and flooding. This study adopted this model and added to it a social participation component. The results indicated that specific flood situations definitely affect the damage level of houses. For the purposes of government compensation, damage level has typically been evaluated by estimating the value of damaged items inside a house. Higher-income households were given more severe impact ratings due to the higher value of the damaged items they owned. In communities in Bangkok and Pathumthani Province, residents were distinguished by a particular willingness to live in flood-prone areas. Lower income communities in Bangkok had made a conscious decision to live in flood-prone areas. This characteristic was not linked to a particular income level but might have other associations. For lower income communities in Pathumtani Province located in flood-prone areas, the inundation level outside the house was a relevant factor for them. Also, lower income households had faced higher inundation levels during a flood, which means that the poor were living in more flood-prone areas. However, the study results show that the poor were also involved in the community activities, such as community meetings and volunteer efforts. This group was given the opportunity to receive more assistance to protect their houses.

Taking action to protect one's house is an aspect of adaptation to risk. In addition, adaptation to risk with respect to improving housing characteristics also served to mitigate the level of inundation inside a house. Another way the poor community can improve their housing characteristics is to join the Baan Mankong Collective (BM) program. An interactive relationship was found between social participation and connection with the BM program. As a result, communities participating with the BM program demonstrated strong positive social participation. This finding might indicate that poor populations with high levels of social participation can be considered to have a form of social capital in that they can join the BM program and improve their houses.

Second, the recovery model results show that, in addition to revenue, access to formal employment influences economic and physical recovery.

The physical aspects of adaption to risk with respect to housing characteristics was not a relevant factor in the reduction of recovery time, especially with respect to cleaning a house. Adaptation to risk before a flood occurs does play a key role, especially when flooded people had knowledge about and were prepared to cope with floods, such as skills in piling sand bags or pumping water. Such activities reduced the time required to clean a house. Lower income households had experience with floods and intentionally preferred using non-rigid material in their house construction. Because poor people had long occupied flood prone areas, they seemingly faced more frequent and higher flood impacts. Since non-rigid construction materials were less costly and saved time in repair, poor people used these materials to build their houses. However, improving housing characteristics is also required to reduce the recovery time and the magnitude of the impact of a flood. As mentioned above, the BM program is a government program for low-income people that are aimed at enhancing adaption to risk in terms of housing upgrades, and to develop sustainability at the community level. The study results revealed that communities participating in the BM program needed shorter time periods to clean their houses than those without a BM program. Therefore, the physical upgrading of houses and the provision of public infrastructure are considered to be important factors. However, the community must demonstrate a collective effort between its members, such as joining savings groups promoted by CODI. In fact, the savings group is a CODI tool for driving "social capital" at the community level. When a community achieves the target of a particular program such as a savings group, then CODI will initiate upgrades to houses and the public infrastructure in the community. This means that building "social capital" is a necessity for a community to access this program as well as serving as a way to improve housing characteristics for low-income communities.

The economic aspects of community resilience were considered next, as income is a dominant issue following a flood catastrophe. Obviously, income stability affects the period in

which there is a return to regular income, especially for poor people with uncertain employment and who have suffered seriously from the impacts of a flood. However, taking temporary jobs, such as boat driver or garbage collector, can contribute to household income during the flood recovery period.

7.1.2 Process of building adaptive capacity to a flood through social capital

It is clear that "social capital" is a relevant factor in building resilience against floods at the community level in Thailand. A mechanism for promoting "social capital" is therefore required. In a previous study, "bonding," "bridging" and "linking" were identified as underlying components for building "social capital." To continue to develop this framework, in this study, a case study area was identified that had suffered seriously from the 2011 mega floods in Thailand and had showed progressive activities. The Nakhon Sawan Community Development Organisation (NSCDO) was chosen and field surveys were then conducted.

The study results show that social capital with respect to building adaptive capacity can be understood as a bonding social capital component between neighbours. For instance, a women's group was established in order to connect neighbouring communities sharing a similar purpose to work and solve challenges together. Meanwhile, the linking social capital component played a key role in pooling resources, specifically linking the community with related organisations at the local and national levels. At the local level, for example, after the communities worked collectively on a land tenure problem, they had become familiar with the Nakhon Sawan Municipality Office. The resulting social capital this afforded widened their connections, a linking social capital, with the Community Organizations Development Institute (CODI), which supports development programs for low-income communities by allocating disaster funds to repair damaged houses and public infrastructure. Moreover, this network can build a bridging social capital component with neighbouring communities by using the CODI network of associations, such as the National Union of Low Income Community Organisations (NULICO). In particular, most communities under NSCDO were faced with difficult conditions resulting from floods, and NULICO representatives had flown to the affected areas to offer human resources, funds and skilled construction teams. Based on interviews with key stakeholders, the results explicitly show that NSCDO was extended as a bridge to neighbouring community networks, that this is an effective ways to pool and gain access to resources by sharing flood data and flood protection equipment, and that doing so served to develop strong relationships prior to and after a flood. With a linking social capital component with CODI, communities were able to build bridging social capital with other community networks, which is essential for building resilience against flood at the community level.

7.2 Research contribution and practical implementation

This research makes a contribution to the research regarding building resilience in urban, low-income communities in Thailand. Communities can adopt mitigating strategies and also provide systematic assistance with respect to given community needs. Furthermore, a clear strategy was outlined and should be distributed to related organisations, such as municipality offices, the Community Development Organization Institute (CODI), the Department of Disaster Prevention and Mitigation and so on, in order to develop suitable strategies, policies, plans and projects at the community level. The study contributions are described in the following:

First, not all of the low-income communities are less resilient to natural disaster. The results show that poor communities are located in more vulnerable flood-prone areas in Pathumthani Province, but in Bangkok poor communities are not always located in vulnerable flood-prone areas. This means that residential location choices involve not only vulnerability conditions but other factors as well.

Second, regarding physical aspects (housing characteristics), low-income communities can mitigate their vulnerability and reduce their recovery time from a natural disaster. That is, a community can enhance its resilience by certain adaptive activities. Improving houses is one useful adaptive activity. To enhance the adaptive capacity of a community, an underlying factor is the bonding social capital within a community and between neighbouring communities. Moreover, communities must have linking social capital at the national level to access outside resources in order to be able to carry out adaptive activities. Specifically, linking social capital at the local level is essential for linking low-income communities with national-level linking social capital.

Third, regarding the financial aspect, economic recovery is slower for those who work in the informal sector and whose salary is unstable. In other words, low-income communities have less financial resilience.

Fourth, experience and knowledge are also salient factors that support communities to carry out adaptive activities. Regular training would make low-income communities more resilient.

Fifth, paradoxically, low-income communities that are located in flood-prone areas do not typically unite or have real connections with neighbouring communities. These communities are particularly vulnerable to natural disasters, and thus, must be given attention.

Sixth, in the aftermath of the 2011 megaflood, the Thai government issued compensation

based on the estimated damage sustained to a house, but compensation according to the salary damage incurred should be considered as well. Also, job training for new jobs, such as in waste management, is necessary during and immediately after a disaster to mitigate the financial damage to informal-sector workers. This job skills improvement initiative should be considered as a priority in affected communities.

Seventh, the results of this study show the processes and relationships involved in building adaptive capacity through social capital as well as the salient resources that support communities at different levels of organization from ordinary life conditions to the aftermath of catastrophe. These results can support key stakeholders in communities as well as administrative offices to develop future plans and strategies with respect to areas that are vulnerable to floods.

Eighth, the study results show that improving houses—the main activity of the Baan Mankong program—is an effective adaptive activity. The BM program is based on the networks of poor communities. Additionally, NULICO plays a critical role in supporting affected communities during a flood. In Thailand, this national low-income community network and mutual aid system is essential for the disaster management of low-income communities and has the potential to function similarly well in other developing countries.

In summary, the informative findings of this study offer potential options for building resilience particularly at the community level. In addition, the empirical results will be valuable to relevant organisations responsible for community schemes and disaster reduction management, and should be incorporated into future plans and strategies. Further studies should be carried out in different locations and for different catastrophes.

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3. SAIYOT S. and MATSUYUKI M. (2015) *A Quantitative Analysis of Community Resilience towards Flooding in Thailand.* Journal of Sustainable Urbanization and Regeneration Selected Paper from International Alliance for Sustainable Urbanization and Regeneration, 145-153 pp.
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APPENDIX 1

LIST OF FIGURES

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APPENDIX 2

1. Questionnaire Survey (English version)

Interview's name _____Date _____/ March / 2014_____

No. of house _____Name of community_____

When did you start living in this community? ……

What is your position in this community?

□Community leader □ Community committee

□Local business owner □ Community resident

This is a survey about your situation during the great flood in 2011. It will take you about 10-15 minutes to complete. The answers that you will give will be treated as confidential. Thank you very much for your cooperation.

Conducted by Yokohama National University, Japan
International Urban & Community Planning Laboratory
Graduate school of Institution of Urban Innovation
79-5 Tokiwadai Hodogaya,
Yokohama 240-8501, JAPAN

Doctor Student, Sayamon Saiyot
Associated professor, Mihoko Matsuyuki

Target person

■Head of a household

■Those who lived in this community during the great flooding in 2011

Answering method of this questionnaire

This questionnaire has two answering methods, "checking off a box" and "writing the answer on the ruled line". Please fill out as shown in the following example.

<Example of how to answer>

1. Gender ☑Male □Female
2. Age 53 years old

⋮

4. Number of people who live together including you

5 Persons

If you live with someone, choose the relation of all members with you.

☑Your Spouse ☑Your child(ren) (2 persons)

☐Parent(s)/Parent(s)-in-law (___persons)

☐Grandparent(s)/Grandparent(s)-in-law (___persons)

☐Grandchild(ren) (___persons) ☑Relative(s) (1 persons)

☐Others(___persons)

PART 1 Before the flood

1.1 **Do you have experience of flood such as in 1995 and/ or 2006?**

□Yes □No

1.2 **Before the flood in 2011, do you usually prepare for flooding, such as buying sand bags**?

□Yes □No

1.3 **Before the flooding in 2011, did you have knowledge about how to protect your house such as moving essential items up, piling sand bag?**

□Yes □No

PART 2 During the Flood

2.1 **Did you/your household members have some activities to protect your house while water was approaching, such as piling sand bags around your house and draw water by water pump. If yes, how many persons worked for how many days?**

□Yes -> _____ people _____ days

□No

2.2 **You have some assistance about protecting your house from community organization/neighbors/outside organization? If yes, what kinds of assistance and from whom did you receive?**

□ No (move to 2.3) □Yes

-> □***laborer*** _____ ***people*** _____ ***days***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

□***Receive items such as sand bags/water pump***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

□***Receive information about flooding/protection of house***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

□Other items (please specify_____)

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

2.3 **Did you and your family evacuate? If yes, when did you evacuate and come back? Where did you evacuate? When you evacuated, how deep was water level inside your house? You think that did you evacuate smoothly?**

□No (move to 2.4) □Yes

-> from_____/_____/_____to_____/_____/_____

In □Formal evacuation center

□Relative's/friend's house

□Others (Please specify_____)

->Water depth in house _____cm

-> We evacuated

□very smoothly □ smoothly □ moderate

□not smoothly □not smoothly at all

2.4 **Did you shift your furniture/electronic devices to avoid flooding? If yes, where did you shift them to? You think that did you shift them smoothly?**

□No (move to 2.5) □Yes

->□Second floor of your house

□Friend's/relatives house

□Others (Please identify_____)

->We shifted them

□very smoothly □smoothly □moderate

□not smoothly □not smoothly at all

2.5 **Did you have some assistance about evacuation from community organization/neighbors/outside organization? If yes, what kind of assistance and from whom did you receive?**

□No (move to 3.1) □Yes

->□***Receiving information about evacuation center***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

->□***Laborer*** _____people _____days

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □***Receiving food/commodity in the evacuation center***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □***Others items*** (Please specify_____)

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

PART 3 After the flood

Damage on your house

3.1 **How much money did you pay for repairing or replacing all broken item of your house for example door, window frame interior floor, etc.?**

_____Baht

3.2 **How much total money did you pay for broken furniture and electric device such as television, refrigerator, table, sofa, cabinet and so forth?** _____Baht

Cleaning Your House

3.3 **How many days did you take to clean the house?**

_____Days

3.4 **How many family members worked on cleaning your house?**

_____Person(s)

3.5 **Did you hire people to help cleaning house? If yes, for how many days and how many people did you hire and how much did you pay?**

□No (move to 3.6)

□Yes ->_____person(s) _____days _____Baht

3.6 **Did you have any assistant to clean your house from community organization or outside organization or neighbors? If yes, what assistance did you have and from whom?**

□No (move to 3.7) □Yes

->□***Receiving items for cleaning***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □***Laborer*** _____people _____days

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

□***Other items*** (Please specify_____)

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

Repairing your house

3.7. **How many days did you take to repair your house?**

_____Days

3.8 **How many of you/your household member worked on repairing your house and how many days?**

_____Person(s) _____days

3.9 **Did you hire people to repair your house? If yes, for how many days and how many people did you hire and how much you paid?**

□Yes _____Person(s) _____days _____Baht

□No

3.10. **Totally how much did you pay for repairing your house?**

_____Baht

3.11 **Did you have any assistance from community organization/neighbors/outside organization for repairing your house? If yes, what assistance did you receive from whom?**

□Yes □No (move to 4.1)

->□***Receiving materials/tools***

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □***Laborers*** _____people _____days

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □**Technical advice**

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

-> □***Other items*** (Please specify_____)

From □Community organization □neighbors

□Municipality office □CODI

□Department of disaster prevention and mitigation

□Military □Politician

□Others (Please specify_____)

PART 4 Compensation, your job and income during and after the flooding

4.1 **During and after the flooding, did your income decreased? If Yes, how much and how long did it decrease?**

□No (move to 4.2)

□Yes -> decreased monthly_____Baht for_____days/month(s)

4.2 **During or after the flooding, did you have new mean of livelihood, such as working as scavenger instead of motor cycle driver? If yes, what was the new mean of livelihood and how much you earned per week?**

□No (move to 4.3)

□Yes -> _____ _____Baht/week

4.3 **Totally how much money did you household lose for the flooding, such as loss of income, fee for evacuation, repairing house and furniture and buying new furniture?**

_____Baht

4.4 **Did you borrow money to pay for the flooding? What was the source of money? If yes, how long did you take to pay back? If no, how long it takes to recover your savings to as much as before the flooding?**

□Yes Source of money_____ days/months/years, not yet

□No _____ days/months/years, not yet

4.5 Did you get government compensation? If yes, **how much compensation did your household receive from government?**

□Yes -> _____ Baht

□No

4.6 **Did you or your family member receive compensation from your workplace? If yes, how much did you receive?**

□Yes -> _____ Baht

□No

PART 5 Relationship with neighbors

5.1 How many household neighbor have you known in this community?

☐ < 10 Families ☐ 11- 20 Families ☐ 21-30 Families

☐ 31-40 Families ☐ > 40 Families

5.2 In regard to participating in life in this community, please describe how often you undertake each of the following

	Often	Sometimes	Rarely	Never
a) participate in local activities or events (e.g., children's day, religious activities)	**4**	**3**	**2**	**1**
b) I have attended a public meeting on a community issue	**4**	**3**	**2**	**1**
c) I have been involved in volunteers activities intended to benefit my community (e.g. Big Cleaning Day	**4**	**3**	**2**	**1**

5.3 Are you a member of saving group

□Yes

□No

PART 6: Flooding Situation in 2011

6.1 **In the great flood in 2011, how long was your community flooded?**

From _____/_____/_____ until _____/_____/_____

6.2 **In the great flood in 2011, how long was your house flooded?**

From _____/_____/_____ until _____/_____/_____

6.3 **When your house was flooded, how much was the maximum depth of water outside of your house?**

_____Meter(s)

6.4 **When your house was flooded, how much was the maximum depth of water inside your house?**

_____Meter(s)

6.5 **How many days did it take for you to feel your life come back to normal situation since the water drew from your community?**

_____days

PART 7: Data of respondent and his/her household and his/her house

7.1 **Gender** □Male □Female

7.2 **Age** _____years old

7.3 **Occupation**

□Office worker □civil servant □Government cooperation employee

□Factory worker □Day time worker in factory

□Taxi Driver □Motorcycle taxi □Tuk Tuk Driver

□Street vendor □Scavenger □Construction worker

□Security guard □House's keeper □Local Business owner

□Others (Please identify ……) □Unemployed

Number of people who live together including you

_____Person

⇒If you live with someone, choose the relation of all members with you. (multiple answers)

□Your Spouse □Your child(ren) (persons)

□Parent(s)/Parent(s)-in-law (persons)

□Grandparent(s)/Grandparent(s)-in-law (persons)

□Grandchild (ren) (persons) □Relative(s) (persons)

□Others(persons)

7.4 How many people in your family do they have income?

_____People

7.5 **Average monthly household income (the total of the income of your family who lives together)**

☐ 10,000-15,000Baht ☐ 15,001- 20,000 Baht☐ 20,001- 25,000 Baht

☐ 25,001- 30,000 Baht ☐ 30,001- 35,000 Baht ☐ 35,001- 40,000Baht ☐ > 40,000Baht

7.7 **Length of living in this community**

_____Years

7.8**Construction Material of Your House**

□Wood frame □Wood and Brick Frame □Brick House

□Concrete □Others (Please identify_____)

7.9**Number of stories (Observation)**

□1 story □2story □3story

7.10 **Type of House (Observation)**

□raised flooring type of house □non-raised flooring type of house

2. Questionnaire Survey (Thai version)

ชื่อผู้สัมภาษณ์_____**วัน/เดือน/ปี** ____ / มีนาคม / 2557

บ้านเลขที่_____
ชื่อชุมชน_____

คุณเริ่มเข้ามาอยู่ที่ชุมชนนี้ตั้งแต่ปีไหน_____

ตำแหน่งหรือบทบาทของคุณในชุมชน

□ประธานชุมชน □คณะกรรมการชุมชน □ผู้ประกอบการร้านค้าชุมชน

□สมาชิกที่อาศัยในชุมชน

แบบสอบถามฉบับนี้เป็นวิทยานิพนท์ระดับปริญญาเอกของนางสาว ศยามล สายยศ มหาวิทยาลัย โยโกฮาม่า ประเทศญี่ปุ่น เรื่อง สถานการณ์น้ำท่วมในปี 2554
ข้อมูลที่ได้จากแบบสอบถามฉบับนี้ใช้เพื่อการศึกษาเท่านั้น ไม่มีส่วนเกี่ยวข้องกับหน่วยงานใดๆ ทั้งสิ้น
ทั้งนี้แบบสอบถามจะใช้เวลาทั้งสิ้นประมาณ 10-15 นาทีและทุกคำตอบจะเป็นความลับ
ขอบพระคุณอย่างยิ่งสำหรับความร่วมมือในการทำแบบสอบถาม

ภายใต้การดำเนินงานวิจัยของมหาวิทยาลัย โยโกฮาม่า
ประเทศญี่ปุ่น
International Urban & Community Planning Laboratory
Graduate school of Institution of Urban Innovation
79-5 Tokiwadai Hodogaya,
Yokohama 240-8501, JAPAN
นักศึกษาระดับบัณฑิตวิทยาลัย นางสาวศยามล สายยศ
รองศาสตราจารย์ มัตซูยูกิ มิโฮโกะ

กลุ่มเป้าหมาย

■หัวหน้าครอบครัว ■เป็นผู้ที่อาศัยอยู่ในชุมชนช่วงน้ำท่วมปี 2554

วิธีการใช้แบบสอบถาม

แบบสอบถามนี้มี 2 วิธี คือ “กาเครื่องหมายในช่องว่าง” และ “เขียนข้อความในเส้นที่กำหนด”
กรุณาใส่ข้อมูลตามตัวอย่างดังนี้

<ตัวอย่างการตอบแบบสอบถาม>

3. เพศ ☑ชาย ☐หญิง

4. อายุ 53 ปี

3. จำนวนสมาชิกที่อยู่ในครอบครัวร่วมทั้งตัวท่าน

5 คน

ถ้าคุณพักอยู่กับผู้อื่น กรุณาเลือกความสัมพันธ์ของคุณกับสมาชิกในครอบครัวเหล่านั้น

☑คู่สมรส ☑บุตร (2 คน) ☐พ่อ/แม่ หรือ พ่อ/แม่ของคู่สมรส (___คน)

☐ตา/ยาย หรือตา/ยายของคู่สมรส (___คน) ☐หลาน (__คน)

☑ญาติ (1 คน)

ส่วนที่ 1: ก่อนน้ำท่วม

1.1 คุณเคยมีประสบการณ์น้ำท่วมเช่น ปี 2538 หรือ/ และ 2549 หรือไม่

☐มี ☐ไม่มี

1.2 ก่อนน้ำท่วมปี 2554 โดยปกติแล้วคุณเคยจัดเตรียมสิ่งต่างๆ กรณีน้ำท่วมหรือไม่ ยกตัวอย่างเช่น การซื้อถุงทราย เป็นต้น

☐มี ☐ไม่มี

1.3 ก่อนน้ำท่วมปี 2554 คุณเคยมีความรู้เรื่องการป้องกันบ้านจากน้ำท่วมมาก่อนหรือไม่ ยกตัวอย่างเช่น การยกของขึ้นที่สูง การกั้นน้ำด้วยกระสอบทราย

☐มี ☐ไม่มี

ส่วนที่ 2: ระหว่างน้ำท่วม

2.1คุณหรือสมาชิกในครอบครัวมีกิจกรรมป้องกันบ้านจากน้ำท่วมขณะที่น้ำมาบ้างหรือไม่ ยกตัวอย่างเช่น ตั้งกระสอบทรายรอบบ้าน และใช้ปั๊มน้ำดูดน้ำออก เป็นต้น หากมีกิจกรรมดังกล่าว สมาชิกในบ้านจำนวนกี่คน และใช้เวลากี่วันที่ช่วยกันทำกิจกรรมนี้

☐มี -> จำนวน_____คน ใช้เวลา_____วัน ☐ไม่มี

2.2 คุณได้รับความช่วยเหลือในการป้องกันบ้านจากน้ำท่วม จากองค์กรของชุมชนคุณ หรือเพื่อนบ้าน หรือ หน่วยงานภายนอกบ้างหรือไม่ ถ้ามี

คุณได้รับความช่วยเหลือในเรื่องอะไรและจากใคร (ตอบได้มากกว่า 1 ข้อ)

□ไม่มี (ข้ามไปข้อ 2.3) □มี

->□***แรงงานคน***_____คน_____วัน

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

->ได้รับสิ่งของ ยกตัวอย่างเช่น ถุงทรายและปั๊มน้ำ

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □***ได้รับข้อมูลข่าวสารเกี่ยวกับน้ำท่วมและการป้องกันบ้านจากน้ำท่วม***

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

2.3 **คุณและ/ หรือสมาชิกในครอบครัวได้อพยพหรือไม่ ถ้าใช่ เมื่อไรที่คุณอพยพและกลับมาสถานที่อพยพไปช่วงน้ำท่วม อพยพไปเมื่อวันที่วันที่เท่าไร น้ำที่เข้ามาในบ้านระดับเท่าไร และคุณคิดว่าระหว่างอพยพนั้นราบรื่นไหม**

□ไม่ได้อพยพ (ข้ามไปข้อ 2.4) □อพยพ

-> จาก_____/_____/_____ถึง_____/_____/_____

พักที่ □ศูนย์อพยพ □บ้านญาติ หรือ บ้านเพื่อน

□อื่นๆ (ระบุ_____)

->ระดับน้ำในบ้าน_____เซนติเมตร

->การอพยพ

□ราบรื่นมาก □ค่อนข้างราบรื่น □ปกติ □ไม่ราบรื่น □ ไม่ราบรื่นมากๆ

2.4. **คุณยกเฟอร์นิเจอร์และ/หรือ เครื่องใช้ไฟฟ้า เพื่อเลี่ยงการถูกน้ำท่วมหรือไม่ ถ้าใช่ คุณยกสิ่งของพวกนั้นไว้ที่ไหน และคุณคิดว่าคุณยกของเหล่านั้นราบรื่นดีหรือไม่**

□ไม่ (ข้ามไปข้อ 2.5) □ใช่

->□ยกไว้ที่ชั้น 2 ของบ้าน □บ้านญาติหรือบ้านเพื่อน □อื่นๆ (ระบุ_____)

-> การยกของเฟอนิเจอร์และ/หรือเครื่องใช้ไฟฟ้า

□ราบรื่นมาก □ค่อนข้างราบรื่น □ปกติ □ไม่ราบรื่น □ ไม่ราบรื่นมากๆ

2.5. **คุณได้รับความช่วยเหลือในการอพยพจากองค์กรของชุมชนคุณ หรือเพื่อนบ้าน หรือหน่วนงานภายนอกบ้างหรือไม่ ถ้ามีคุณได้รับความช่วยเหลือในเรื่องอะไรและจากใคร (ตอบได้มากกว่า 1 ข้อ)**

□ไม่ (ข้ามไปข้อ 3.1) □มี

->□***ข้อมูลข่าวสารเกี่ยวกับศูนย์อพยพ***

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____

-> □***แรงงานคน***_____คน_____วัน

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง □อื่นๆ (ระบุ_____)

-> □***ได้รับอาหาร และ/หรือ เครื่องใช้ใน ศูนย์อพยพ***

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □สิ่งของ*อื่นๆ* (ระบุ_____)

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □
สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

ส่วนที่ 3: หลังน้ำท่วม

ข้อมูลความเสียหายของบ้าน

3.1. **คุณเสียค่าใช้จ่ายทั้งหมดเท่าไรสำหรับการซ่อมแซมหรือเปลี่ยนใหม่สิ่งที่เสียหายของตัวบ้าน เช่น ประตูบ้าน หน้าต่าง ผนัง และพื้น เป็นต้น** _____บาท

3.2. **คุณเสียค่าเสียหายทั้งสิ้นเท่าไร**
สำหรับเฟอร์นิเจอร์และเครื่องใช้ที่เสียหายมากจนคุณต้องซ่อมหรือเปลี่ยนใหม่ เช่น โทรทัศน์ ตู้เย็น โต๊ะ โซฟา ตู้ เป็นต้น _____ บาท

การทำความสะอาดบ้าน

3.3. **คุณใช้เวลาในการทำความสะอาดบ้านกี่วัน** _____ วัน

3.4 **สมาชิกในครอบครัวคุณกี่คนที่ช่วยทำความสะอาดบ้าน** _____ คน

3.5 **คุณจ้างคนเพื่อช่วยในการทำความสะอาดบ้านใช่ไหม ถ้าใช่,**
คุณใช้เวลากี่วันและจ้างคนกี่คนในการทำความสะอาด และใช้เงินไปทั้งสิ้นเท่าไร

□ไม่ใช่ (ข้ามไปข้อ 3.6) □ใช่->จำนวน_____คน_____วัน_ใช้เงินไปทั้งสิ้น_____ บาท

3.6 **คุณได้รับความช่วยเหลือในการทำความสะอาดบ้านจากองค์กรของชุมชนคุณ หรือเพื่อนบ้าน หรือหน่วนงานภายนอกบ้างหรือไม่ ถ้ามีคุณได้รับความช่วยเหลือในเรื่องอะไรและจากใคร**
(ตอบได้มากกว่า 1 ข้อ)

□ไม่มี (ข้ามไปข้อ 3.7) □มี

->**□อุปกรณ์ทำความสะอาด**

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □

สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □**แรงงานคน** _____คน_____วัน

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □
สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □**สิ่งของอื่นๆ** (ระบุ_____)

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □
สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

<u>การซ่อมแซมบ้าน</u>

3.7 **คุณใช้เวลาเท่าไรในการซ่อมแซมบ้าน** _____ วัน

3.8 **สมาชิกในครอบครัวคุณกี่คนที่ช่วยซ้อมบ้านและใช้เวลากี่วัน** _____ คน _____ วัน

3.9 **คุณจ้างคนเพื่อช่วยในการซ่อมบ้านใช่ไหม ถ้าใช่,**
คุณใช้เวลากี่วันและจ้างคนกี่คนในการซ่อมบ้าน และใช้เงินในการจ้างไปทั้งสิ้นเท่าไร

□ไม่ใช่ □ใช่ ->จำนวน_____คน_____วัน ใช้เงินไปทั้งสิ้น_____
บาท

3. 10 **คุณใช้เงินไปทั้งสิ้นเท่าไรในการซ่อมแซมบ้าน** _____บาท

3.11 **คุณได้รับความช่วยเหลือในการซ่อมแซมบ้านจากองค์กรของชุมชนคุณ หรือเพื่อนบ้าน หรือหน่วนงานภายนอกบ้างหรือไม่ ถ้ามีคุณได้รับความช่วยเหลือในเรื่องอะไรและจากใคร (ตอบได้มากกว่า 1 ข้อ)**

□มี □ไม่มี (ข้ามไปข้อ 4.1)

->□ได้รับวัสดุและ/หรือ เครื่องมือ

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □ **แรงงานคน**_____คน_____วัน

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

-> □ **คำแนะนำด้านเทคนิคในการซ่อมแซมบ้าน**

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง □อื่นๆ (ระบุ_____)

-> □**สิ่งของอื่นๆ** (ระบุ_____)

จาก □คณะกรรมการชุมชน □ เพื่อนบ้าน □สำนักงานเขต □ สถาบันพัฒนาองค์กรชุมชน (CODI)

□กรมป้องกันและบรรเทาสาธารณภัย □หน่วยงานของทหาร □นักการเมือง

□อื่นๆ (ระบุ_____)

<u>ส่วนที่ 4: ค่าชดเชย งาน และรายได้ ระหว่างและหลังจากน้ำท่วม</u>

4.1. **ระหว่างและหลังน้ำท่วม รายได้ของคุณลดลงหรือไม่ ถ้าใช่ รายได้เท่าไรและนานเท่าไรที่รายได้ลดลง**

□ ไม่ (ข้ามไปข้อ 4.2) □ ใช่ -> รายได้ต่อเดือนลดลง ประมาณ _____ บาท สำหรับ _____ วันต่อเดือน

4.2 **ระหว่างและหลังจากน้ำท่วม คุณมีความเป็นอยู่แบบใหม่ๆ หรือไม่ ยกตัวอย่างเช่น**

ทำงานเป็นคนเก็บของเก่าแทนการเป็นคนขับรถมอเตอร์ไซด์รับจ้าง ถ้าใช่ คุณได้ทำอะไร และมีรายได้ประมาณเท่าไรต่อสัปดาห์

□ไม่ใช่ (ข้ามไปข้อ 4.3) □ใช่ ระบุสิ่งที่ทำ _____-> รายได้ _____ บาท ต่อสัปดาห์

4.3 **ครอบครัวคุณสูญเสียรายได้ทั้งหมดเท่าไรเมื่อเกิดเหตุการณ์น้ำท่วมที่ผ่านมา ยกตัวอย่างเช่น จากการสูญเสียรายได้ ค่าใช้จ่ายในการอพยพ ค่าใช่จ่ายในการซ่อมแซมบ้าน และเฟอร์นิเจอร์ รวมถึงการซื้อเฟอร์นิเจอร์ใหม่ๆ ด้วย**_____ บาท

4.4 **คุณได้ยืมเงินเพื่อใช้จ่ายเมื่อเกิดน้ำท่วมหรือไม่ และคุณยืมเงินจากที่ใด ถ้าใช่ คุณใช้เวลาเท่าไรในการจ่ายเงินคืน ถ้าไม่ได้ยืมเงิน**
คุณใช้เวลาเท่าไรในการได้เงินส่วนตัวหรือเงินเก็บที่ใช้จ่ายไปกลับมาคืนก่อนน้ำท่วม

□ใช่ ระบุแหล่งเงิน _____ วัน/เดือน/ปี, _____
ยังไม่ได้จ่ายคืน

□ไม่ใช่ _____ วัน/เดือน/ปี ยังไม่ได้จ่ายคืน

4.5 **คุณได้รับเงินชดเชยจากรัฐบาลหรือไม่**

□ได้ ระบุจำนวนเงินที่ได้รับ _____ บาท □ ไม่ได้

4.6 **สมาชิกในครอบครัวของคุณได้รับค่าชดเชยจากที่ทำงานหรือไม่ ถ้าใช่ คุณได้รับเท่าไร**

□ ได้ -> _____ บาท □ ไม่ได้

ส่วนที่ 5 ความสัมพันธ์กับเพื่อนบ้าน

5.1 **คุณรู้จักเพื่อนบ้านในชุมชนประมาณกี่ครัวเรือน**

☐ < 10 ครัวเรือน ☐ 11- 20 ครัวเรือน ☐ 21-30 ครัวเรือน
☐ 31-40 ครัวเรือน ☐ > 40 ครัวเรือน

5.2 **ในเรื่องของการใช้ชีวิตในชุมชน กรุณาอธิบายความถี่ในกิจกรรมต่างๆ ดังนี้**

	บ่อย	**บางครั้ง**	**น้อยมาก**	**ไม่เคย**
ก) ฉันเข้าร่วมกิจกรรมหรือเหตุการณ์ต่างๆ ของชุมชน เช่นวันเด็ก วันสำคัญทางศาสนา	4	3	2	1
ข) ฉันเข้าร่วมประชุมรวมของชุมชน	4	3	2	1
ค) ฉันเข้าร่วมที่เป็นอาสาสมัครเพื่อทำประโยชน์ให้กับชุมชนเช่น กิจกรรม Big Cleaning Day	4	3	2	1

5.3 **คุณเป็นสมาชิกออมทรัพย์ใช่หรือไม่**

□ใช่ □ไม่ใช่

<u>ส่วนที่ 6 : ข้อมูลสถานการณ์น้ำท่วมปี 2554</u>

6.1 **ช่วงน้ำท่วมปี 2554 ระยะเวลานานแค่ไหนที่ชุมชนของคุณได้รับผลกระทบจากน้ำท่วม**

จาก____/___/____ถึง____/____/____

6.2 **ช่วงน้ำท่วมปี 2554 ระยะเวลานานแค่ไหนที่บ้านของคุณได้รับผลกระทบจากน้ำท่วม**

จาก ___/___/____ถึง____/____/____

6.3 **เมื่อตอนที่บ้านโดนน้ำท่วมระดับน้ำสูงสุดภายนอกบ้านคือเท่าไร**____เมตร

6.4 **เมื่อตอนที่บ้านโดนน้ำท่วมระดับน้ำสูงสุดภายในบ้านคือเท่าไร**____ เมตร

6.5 **คุณใช้เวลาทั้งหมดที่วัน ที่ทำให้คุณรู้สึกว่า**
ชีวิตความเป็นอยู่ในชุมชนของคุณกลับมาเหมือนเดิมเมื่อน้ำลด_____ วัน

<u>ส่วนที่ 7 : ข้อมูลของผู้ตอบแบบสอบถาม และข้อมูลที่เกี่ยวกับบ้านและสมาชิกครอบครัว</u>

7.1 **เพศ** □ชาย □หญิง

7.2 **อายุ**_____ ปี

7.3 **อาชีพ**

□พนักงานบริษัท □ข้าราชการ □พนักงานรัฐวิสาหกิจ
□พนักงานโรงงาน □พนักงานรายวันในโรงงานอุตสาหรรม
□คนขับรถแท็กซี่ □คนขับรถมอเตอร์ไซด์รับจ้าง □คนขับรถตุ๊กตุ๊ก
□ขายของแผงลอย □คนเก็บของเก่า
□คนงานก่อสร้าง
□พนักงานรักษาความปลอดภัย □พนักงานทำความสะอาด
□เจ้าของร้านในชุมชน
□อื่นๆ (ระบุ.....) □ ว่างงาน

จำนวนสมาชิกที่อยู่ในครอบครัวร่วมทั้งตัวท่าน _____ คน

⇒**ถ้าคุณพักอยู่กับผู้อื่น กรุณาเลือกความสัมพันธ์ของคุณกับสมาชิกในครอบครัวเหล่านั้น**
(ตอบได้มากกว่า 1 ข้อ)

□คู่สมรส □บุตร (_____ คน) □พ่อ/แม่ คู่สมรส (_____ คน)

□ตา/ยาย หรือ ตา/ยายของคู่สมรส (_____ คน) □หลาน (_____ คน)

□ญาติ (_____ คน) □อื่นๆ (_____ คน)

7.4 .**ในครอบครัวคุณมีคนที่ทำงานและมีรายได้กี่คน** _____คน

7.5 **รายได้เฉลี่ยรายเดือน (คิดจากรายได้รวมทั้งหมดของสมาชิกในครอบครัวที่อาศัยอยู่รวมกัน**

☐ 10,000-15,000 บาท ☐ 15,001- 20,000 บาท ☐ 20,001- 25,000 Baht

☐ 25,001- 30,000 Baht ☐ 30,001- 35,0000 Baht ☐ 35,001- 40,000Baht

☐ > 40,000Baht

7.6. **ระยะเวลาที่อาศัยอยู่ในชุมชน** _____ ปี

7.7 **วัสดุที่ใช้สร้างบ้าน**

□บ้านไม้ □บ้านครึ่งตึกครึ่งไม้ □บ้านปูน □ บ้านคอนกรีต

□อื่นๆ (ระบุ_____.)

7.8 **จำนวนชั้นของบ้าน (ใช้การสังเกต)**

□บ้าน1 ชั้น □ บ้าน 2 ชั้น □ บ้าน 3 ชั้น □อื่นๆ (ระบุ_____.)

7.9 **ลักษณะบ้าน (ใช้การสังเกต)**

□บ้านยกพื้นสูง □บ้านไม่ยกพื้นสูง