

ASSESSMENT RESILIENCE CHARACTERS TO ENHANCE COMMUNITY RESILIENCE TO FLOODING IN THAILAND

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ABSTRACT: This study focuses on community resilience in the mega flooding in Thailand in 2011. The objectives of this study are to identify main indicators of community resilience and its effect factors of them. Two areas are selected for case study. From interview survey with community leaders and residents and focus group discussion, six indicators are proposed; 1) Period to repair a house, 2) Period to clean a house, 3) Period to buy new furniture, 4) Period of waste management, 5) Period to reopen local business and 6) Period to recover income. Then effect factors on each indicator are examined. For example, six main effect factors can be pointed out to the indicator ‘period to repair a house’, That is; 1) housing tenure, 2) number of workable household members, 3) level of damage on house, 4) external Aid, 5) internal Aid and 6) financing.

KEYWORDS: indicator and effect factor of community resilience, flooding, Thailand

1. Introduction

Recently, mega losses by hydrometeorological disaster can be observed all over the worlds. For example, the impact of devastating flash flood of Hurricane Katrina in United States is estimated to \$40- 50 billion in monetary losses. Moreover, a number of residents were passed away and numbers of public facilities were damaged. For instance, the effort of reconstruction the physical infrastructure is likely to take 8- 10 years in the aftermath of Hurricane Katarina (Kates et al., 2006). Mega hydrometeorological disaster occurred in several Asian countries as well, such as mega flooding in Thailand in 2011 and in Jakarta, Indonesia in 2012 and they introduced enormous damage and confusion to the two countries.

‘Vulnerability’ is one of the main concepts to examine how to reduce damage on society by

natural disaster. Recently, the concept ‘resilience’ has win attention from experience of several severe natural disasters in the world, such as the Great East Japan earthquake in 2011.

Though there have been a number of researches examining concept of ‘resilience’, there is no common definition of resilience. For example, Bruneau (2003) uses ‘resilience’ as ‘the ability of social unit to mitigate hazard, minimize the effects of disaster when they occur, and 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 return a normal functioning briefly’, that is to focus on the recovery period in the aftermath of disaster.’

In previous research, it is pointed out that resilience has several levels, from national to community and individual level (Chang and

Shinozuka., 2004; Miman and Short, 2008; Schelfaut et al.,2011). Among the several level of resilience, community resilience is important because community is very close to people's daily life and it is subject to natural disaster socially, economically and environmentally. Therefore, it is essential to examine factors which enhance resilience at community level.

In the previous studies, there is considerable research interest on the meaning and measurement of resilience. For example, Cutter et. al. provides a new framework, the disaster resilience of place (DROP) model, designed to improve comparative assessments of disaster resilience at the local or community level (Cutter et al., 2008). However, there are only few studies which examine factors of community resilience empirically.

From these backgrounds, this study focuses on community resilience in the mega flooding in Thailand in 2011. The objectives of this study are to identify main indicators of community resilience and its effect factors of them.

Methodology of the study is literature review, interview community leaders and residents, focus group discussion among community members and field observation. The field survey was conducted twice, from 4 March to 20 March and from 18 August to 4 September in 2013.

2. Case Study Areas

In this study, two areas were selected for case study. One is Thayaburi district in Rangsit city municipality in Pathumthani province and another one is Bang Phat district in Bangkok (see Figure 1).

The selected are located in the central part of Thailand that was estimated to the maximum losses during mega flooding in 2011

2.1 Thayaburi district , Rangsit city municipality, Bangkok

Thayaburi district is the largest population place in Rangsit city and the Rangsit canal (Klong Rangsit) crosses in the area. Five communities are selected for case study and they are closed to the Klong Rangsit (see Figure 2).

Based on the field survey, it was found that the selected communities were totally approached by flooding from the end of September until December, approximately for 2 months and the average flood depth was 100-150 centimetres. Most residents evacuated to the relieving canter near the area until the inundation of flooding became normal.

2.2 Bang Phlat District, Bangkok

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

Bang Phlat district was declared flood disaster zone. Based on the field survey, it was found that the selected communities were fully submerged from the end of October to November and the water level was approximately 100-120 centimeter. The local temple, Wat Ruak was changed to be a relieving center but most of residents evacuated to other places, such as relative's house and some residents moved to live near their workplace.

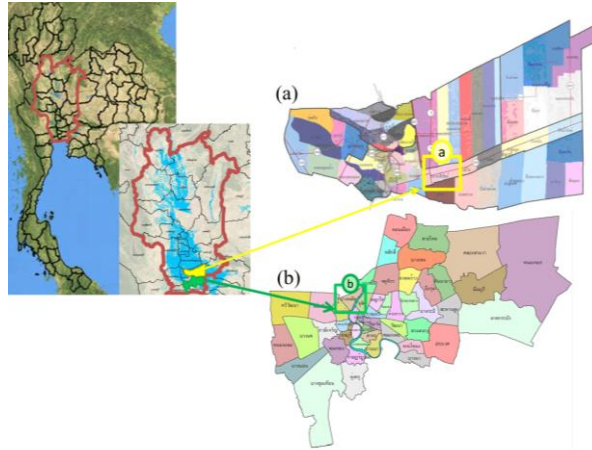


Figure 1 Locations of selected area (a) Rangsit City Municipality, Pathumthani province and (b) Bang Phat District, Bangkok

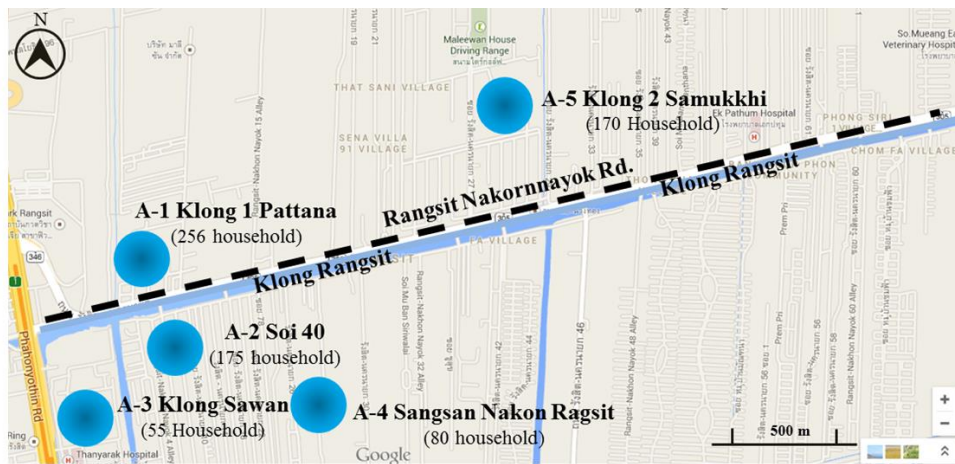


Figure 2 Locations of selected communities, Rangsit City Municipality in Thayaburi District in Patumthani province

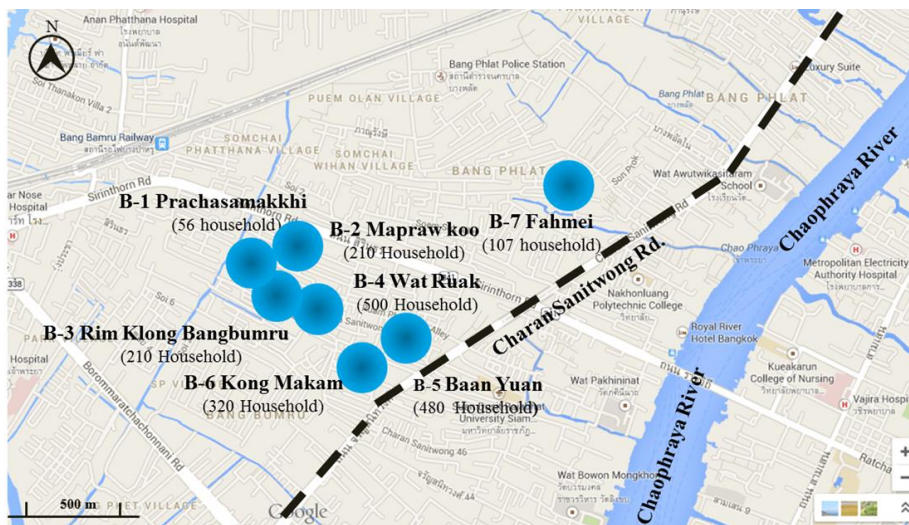


Figure 3 Locations of the selected communities in Bang Phlat District in Bangkok

3. Resilience indicators

Indicators to show level of community resilience to flooding are examined.

3.1 How to find the resilience indicators

In the interview to community leaders and residents and focus group discussion, at first, the topic ‘what is normal situation?’ was discussed. Then, the process to come back to the normal situation and essential elements and obstacles to come back to the normal situation was discussed.

3.2 Indicators

From this discussion in the interview and the focus group discussion, most of people’s perspective about normal situation is ‘to stay at house in the same environment, to have the same income and have the same gathering with neighbors as before the flooding.

In order to recover a house to the same environment as before the flooding, repairing damaged part of houses, cleaning houses, buying new furniture are essential. Therefore, three indicators; 1) Period to repair a house, 2) Period to clean a house and 3) Period to buy new furniture, are proposed as indicators.

Additionally, one obstacle to be pointed out is waste in community. A Waste mountain in each community was generated aftermath of flooding that consisted of solid waste and daily waste. The huge of waste had been raised into the significant problem of communities. Residents living near the waste mountain say that their life didn’t come back until the waste was moved out of the community. Therefore 4) Period of waste management can be one indicator of community resilience.

From the discussion, it is found that people consider that social networking such as gathering with neighbors is very important part of their normal life. Such gathering is usually held at local business, such as hair salon, food store, grocery etc. Such local

business is dominant elements in Thai communities. Hence reopening local business is essential for them to come back to normal situation and indicator 5) Period to reopen local business can be one indicator.

At the last, 6) Period to recover income is important indicator as well as other ones.

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| <ol style="list-style-type: none"> 1) Period to repair a house 2) Period to clean a house 3) Period to buy new furniture 4) Period of waste management 5) Period to reopen local business 6) Period to recover income |
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Box1 List of indicators

4. Effect Factors on Community Resilience

4.1 How to find the resilience factors

After the above six indicators are developed, effect factors on these indicators were discussed in the interview and focus group discussion. For example, about indicator 1) period to repair house, how they repaired their houses are asked. From the discussion, the numbers of effect factors on each indicator are found. Causal chain in each indicator is described in Figure 4 to 9 respectively. Tables 1 to 6 explain how each factors effect on each indicator. The number in Table 1 to 6, such as 1.1, corresponds with same number in Figure 4 to 9 respectively.

4. 2 Period to repair a house

Based on the field survey, it was found that almost all houses were submerged by flooding in each community. From the discussion, six main effect factors can be pointed out, That is; 1) Housing tenure, 2) Number of workable household members, 3) Level of damage on house, 4) External Aid, 5) Internal Aid and 6) Financing (see Table 1, Figure4).

Table 1 Factors that influence period 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 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: Prachasamakki, B-2: Mapraw koo, B-3: Rimklong Bangbamru, B-4: Wat Ruak, B-5: Baan Yuan, B-6: Kong Makam, B-7: Fah Mei)

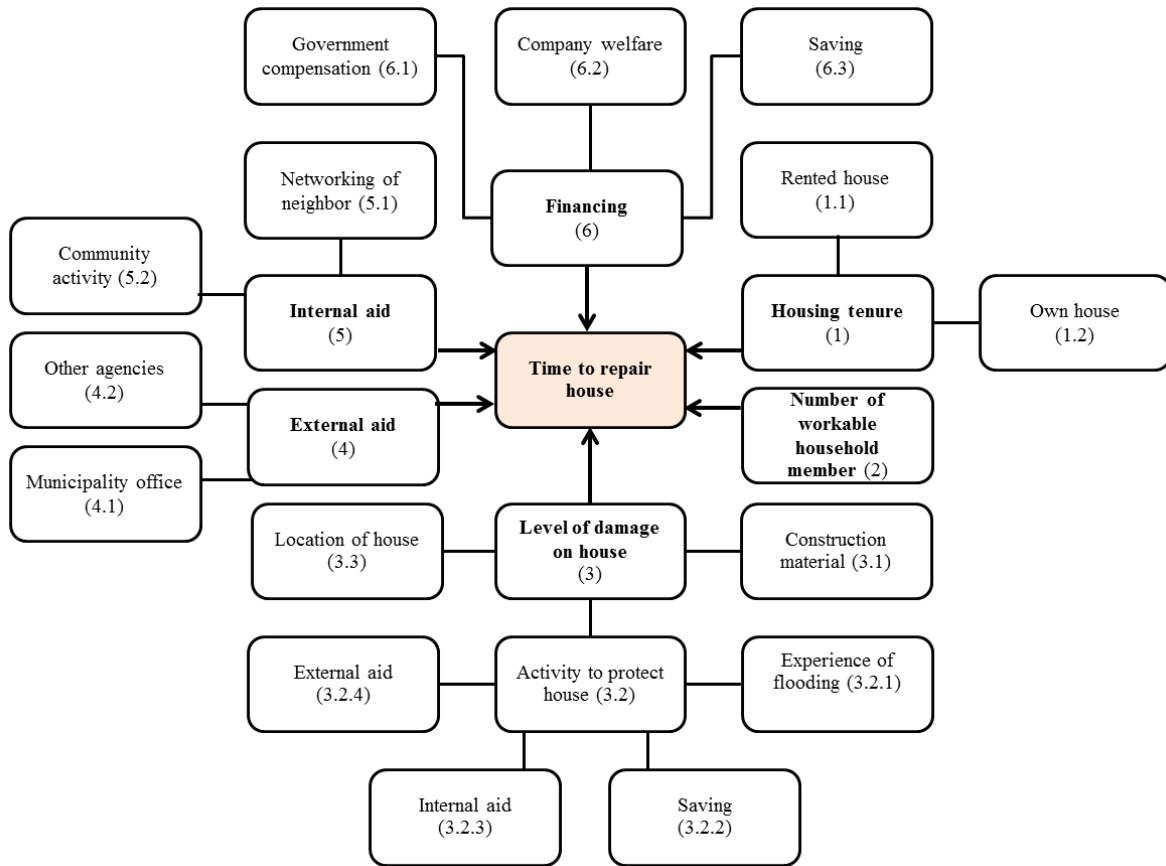


Figure 4 Casual chain of period to repair house

4.3 Period to clean a house

Cleaning a house was the first activity that had been done in aftermath of flooding. Actually, people started cleaning their houses when the water level was dramatically decreased. Cleaning house is separated into two parts; cleaning house interior and

furniture and then removing waste out to the garbage site in each community. From the discussion, three main effect factors are found out, That is; 1) Number of workable household member, 2) Saving and 3) Level of defilement of house interior and furniture (see Figure 5, Table 2).

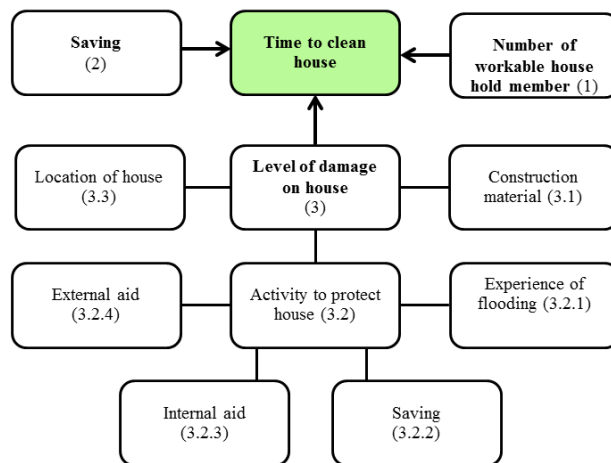


Figure 5 Casual chain of period to clean a house

Table 2 Factors that influence period 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 approximately 1,000 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:

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4.4 Period to manage waste

Regarding waste management, those are, to clean within community and to move out waste's mountain from each community to dumping site of

the area, two main effect factors were found; 1) Internal aid and 2) External aid (see Figure 6, Table 3).

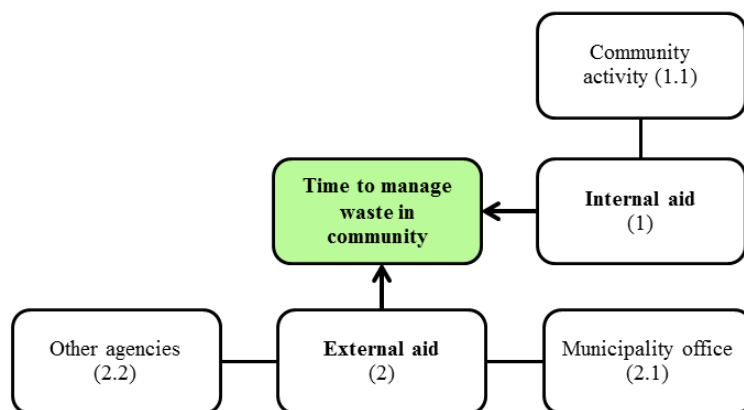


Figure 6 Casual chain of period for waste management

Table 3 Factors that influence on period of waste management

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)

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4.5 Period to buy new furniture

Not only a house was damaged but also furniture in the house was affected in the inundation of flooding. There found two main effect factors; 1) Financing and 2) Level of damage of furniture. For example, level of damage of furniture in construction materials section, brick house could

prevent the water from flowing into house than wood frame house. Therefore, residents had more time to move their belongings upstairs. Simultaneously, some residents had the strong protection activities such as piling up sandbag, pumping up water. Therefore they also had time to move the belongings (See Figure 7, Table 4).

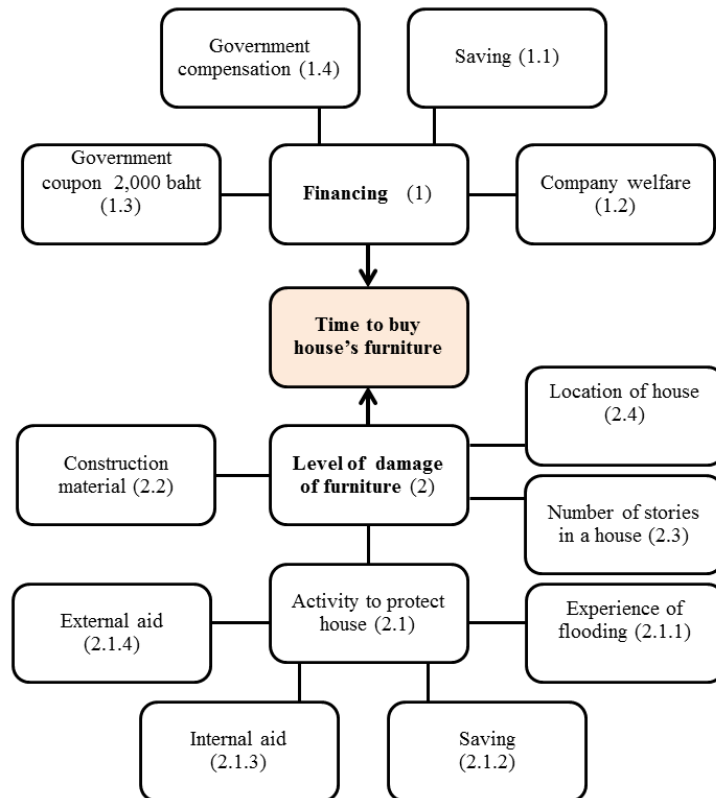


Figure 7 Casual Chain of period to buy new furniture

Table 4 Factors that influence on period to buy new furniture

Resilience factors of buying house's furniture	
1. Financing	
1.1 Saving	Using saving money for buying furniture 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 coupon 2,000 baht	Residents used coupon 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:

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4.6 Period to recover income

Not only evacuated residents but almost all residents got the impacts on income because they could not work properly during the flood. The effect factors on household's income are 1) Damage level of workplace, 2) Having a business competitor outside of flooded area or not, 3) Types of occupation in formal and informal sector, 4) Employment status. The types of occupation were

truly affected in revenue of residents. Residents worked in the public organization or big private company; this group earned their income normally from pre to post of the flooding. On the other hand, the informal sector such as food street vendors and working at home people, they lost the job opportunity and also income from the initial stage of flooding until the recovery time (see Figure 8, Table 5).

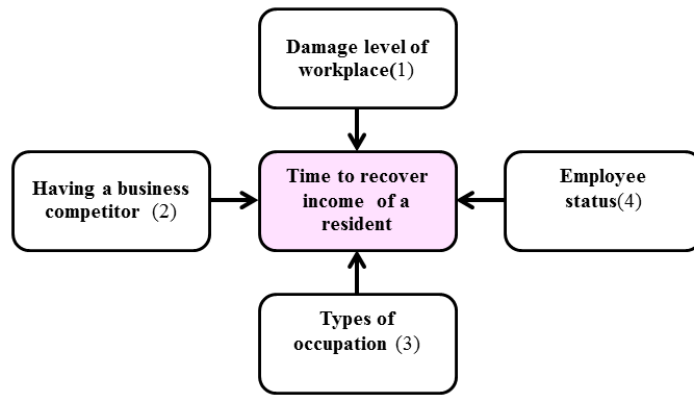


Figure 8 Casual chain of period to recover income

Table 5 Factors that influence on period 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 public 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)

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4.7 Period to reopen local business

Typically local shop owners run their small business in their own house. When the flooding was approached to communities, all local businesses were disturbed. Three effect factors are found from the discussion as follows; 1) Financing, 2) Damage

level of shop’s equipment and 3) Damage level of store (see Figure 9, Table 6).

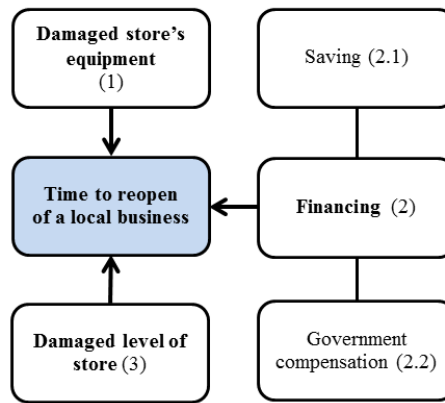


Figure 8 Casual chain of period to reopen of local business

Table 6 Factors that influence on period to reopen local business

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)

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5. Discussion

In this study, main indicators of community resilience to flooding and its effect factors are examined by case study in two areas in central part of Thailand. As a result, six indicators are proposed and a number of factors are proposed for each indicators.

Before the survey, only some indicators were expected, such as period to repair a house, period to clean a house and period to recover income. However, some unexpected indicators were found from discussion with residents, such as period of waste management and period to reopen local business. The indicator period to reopen local business' is supposed to be a specific in the case

studied community, where is lower-to-middle income community and still exists neighbours strong relationship. Other indicators are expected to be applicable to other communities.

Regarding with effect factors, some factors are pointed out in the previous conceptual studies, such as financial status like saving and internal and external aid. On the other hands, some new items, such as housing tenure and types of occupation are pointed out. These indicators are expected to be applicable to other communities in Thailand.

As the future study, quantitative research, such as questionnaire survey, are required to make sure that which factors has bigger impact to community

resilience in order to make proposal to enhance community resilience against flooding in Thailand.

REFERENCES

Bruneau M., Chang E.S. Eguchi, T.R., George, L. C, O'Rourke, D. T. ,Reinhorn, A. M., Shinozuka, M.,Tierney K., Wallace, A.W., Winterfeldt, D., 2003. A Framework to Quantitatively Assess and Enhance the Seismic Resilience of Communities, *Earthquake Spectra*, 19(4): 733-752.

Chang, E.S. and Shinozuka M., 2004. Measuring Improvements in the Disaster Resilience of Communities, *Earthquake Spectra* ,20(3): 739-755.

Cimellaro G. P., Reinhorn, M A., Bruneau, M., 2010. Framework for analytical quantification of disaster resilience, *Engineering Structure*, 32(2010): 3639-3649.

Cutter, L.S., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., Webb J., 2008. A place-based model for understanding community resilience to natural disasters, *Global Environmental Change*, 18 (2008): 596-606.

Kate, R.W., Colten, C.E., Laska, S. and Leatherman, S.P., 2006. Reconstruction of New Orleans after Hurricane Katrina: A research perspective, *Proceeding of National Academy of Sciences of United States of America*, 103(40): 14653-14660.

Milman, A. and Short A., 2008. Incorporating resilience into sustainability indicators: An example for the urban water sector, *Global Environmental change*, 18 (2008):758-767.

Schelfaut, K., Pannemansa, B., Craatsa, I., Krywkow, J., Mysiakd, J. and Coolsa, J., 2011. Bringing flood resilience into practice: the FREEMAN project, *Environmental Science and Policy*, 14(2011):825-833.