THE ANALYSIS OF FLOOD RISK AWARENESS AT RESIDENT LEVEL IN MEKONG RIVER BASIN ~focusing on the evacuation behavior~

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ABSTRACT

Mekong River basin has some specific characteristics, such as the fact that the economy is growing rapidly and benefits of fertilization of land for agriculture and fishery are brought by flooding. However in 2000, big flood attacked the downstream area. A lot of people were killed by the flood. In 2006, in mountainous areas, Lao PDR suffered from flash floods. Some people were killed by these floods.

For human damage reduction, “Self Help” and “Mutual Support” are important. One of its activities is evacuation behavior. In this study, the evacuation behavior is focused and occurrence and expansion of flood damage is analyzed.

Two survey areas were selected for this study. One is Luang Namtha in northern part of Lao PDR which was recently reported to be damaged by flash flood and other is Phnom Penh which is frequently hit by flood in rainy season.

At first, expected factors of occurrence and expansion of flood damage were set up by document survey. Then, Questionnaire survey to residents was carried out in two survey area for identification of expected reasons. In addition, interview with residents and community leaders about condition of damages and countermeasures for flood was also held in the field survey. Finally, measures to improve the condition that resident can evacuate safely and adequately were studied and suggested based on the results of field survey and identification of reasons.

As the reasons that residents did not evacuate, distance to the evacuation site from houses and danger of evacuation route were pointed out. Therefore, an appropriate distance to the evacuation site from houses is suggested.

Keywords: Evacuation behavior, Questionnaire survey, Distance to the evacuation site

INTRODUCTION

It is said that there are three items crucial for reducing damage from all kinds of disaster; “Self Help”, “Mutual Support” and “Public Assistance”. These items mean necessary awareness had and activities done for disaster damage mitigation by residents, community and local government. In Kobe (Hanshin-Awaji) Great Earthquake that occurred in 1995, it can be said that about 65% of survivors were saved through "Self help" activities while about 30% of them were saved through "Mutual Support" activities. Hence, it should be noted that "Self-Help" and "Mutual Support" are indispensable for disaster mitigation.

The evacuation behavior that is one of the important "Self Help" and "Mutual Support" activities is necessary for human damage reduction. It should be done adequately and surely. However, it is not certain that residents follow a warning even if they are recommended evacuation by warning in the

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necessary occasion, because sometimes residents have a little awareness about evacuation. To solve such situation, removal of obstacle causing residents' negative evacuation behavior and giving needed condition that motivate evacuation are required. Therefore it is necessary to grasp residents' basic conception of evacuation behavior.

STUDY AREA

Historically, flood has been regarded as "Benefit" by people in Mekong river basin. However, it can not be denied that in the past flood has brought serious damage which had been aggravated by rapid economic growth, the change in living environment, river development, and climate change by global warming.
Most of the floods in the Mekong River Basin can be classified into two types. The first type is a flash flood that occurs in a mountainous area. The second one is a continental type flood.
As a case study area, Mekong River basin which has the above-mentioned characteristics was selected. As survey region, two areas are selected. First region is Luang Namtha in northern mountainous area of Lao PDR which suffered from flash flood in 2006. Second region is Phnom Penh the capital of Kingdom of Cambodia as an urban area which suffered from a big flood in 2000.
For the flood of 2006 in Luang Namtha, Lao PDR, 4 people were killed, 21 houses were collapsed, the inundated area approximated 10km^2 and 1,916 households were affected (MRC, 2007).
The flood in 2000 inundated the area on the both side of Tonle Sap River in northern part of Phnom Penh, and on the left side of Basacc River for long time. In the whole country, approximately 7,000 houses were collapsed. The duration of inundation was about for 4 months. 347 people were killed in the country. Economic-loss was 150 billion US$ and about 3.5 million people were affected. (ADRC, 2002)

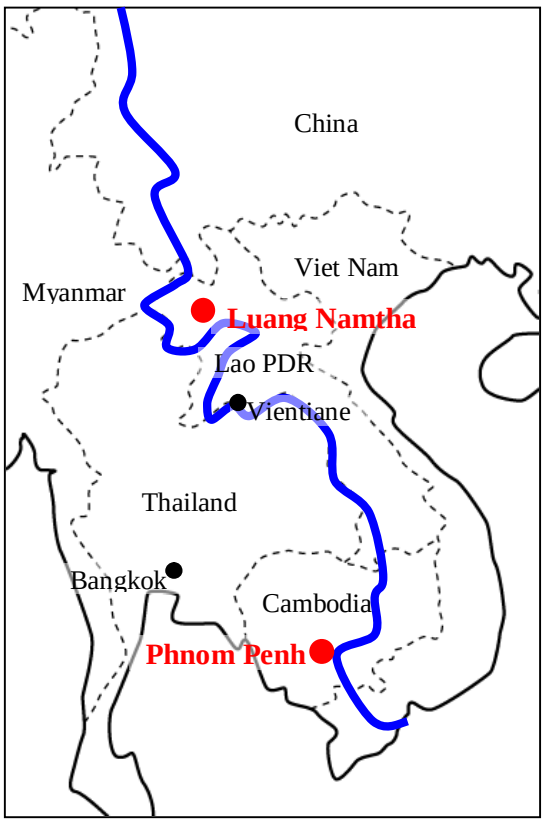

Fig. 1 Map of the survey areas

OBJECTIVES

In this study, the following concrete objectives were considered.

- ✓ Identification of reasons of evacuation behavior of residents by carrying out a questionnaire and interview survey to the residents and community leaders as a field survey
- ✓ Assessment of evacuation behavior controlled by some conditions
- ✓ Identification of flood management to promote effective flood evacuation for residents

FIELD SURVEY

Preparation for questionnaire survey
Reasons of occurrence and expansion of the flood damage are assumed. Reasons should be set on the assumption that it can be identified by the questionnaire and interview survey. As an item which

should be considered, the evacuation behavior of the resident was selected. It has an important role for damage reduction. When a necessary evacuation behavior was not carried out or evacuation behavior was under the imminent situation, the possibility of occurrence and expansion of the flood damage increases. In addition, it is very likely that vulnerability of residents and community for flood disaster lead to the occurrence and expansion of flood damage. Therefore, the following three points about evacuation behavior and vulnerability are set up as the pillar item.

✓ A reason causing that resident judged by him or herself evacuation was not necessary
✓ A reason causing that a resident could not evacuate even he or she intended to
✓ Vulnerability of resident for the flood damage

To reduce the flood damage focusing on the evacuation behavior, it is necessary to identify the reason that residents do not evacuate in flood time. However, residents who did not evacuate were under the various circumstances. Therefore, among residents who did not evacuate, they can be classified into 2 groups. One is residents who judged evacuation was not necessary. Another one is those who could not evacuate because of some obstacles. Such classification was made in some studies which surveyed the flood risk awareness of residents. (NIED 2006, YOSHITANI 2008)

Questionnaire survey

- Questionnaire style
  - In Lao PDR; Distribution and collection style through the chiefs of villages
  - In Cambodia; Individual interview style by author and interpreter
- Target people
  - In Lao PDR; Residents in flooded 3 villages in Luang Namtha province
  - In Cambodia; Residents in flooded 2 areas in Phnom Penh city
- Survey period
  - In Lao PDR; 12^{th} ~ 15^{th} on May 2008
  - In Cambodia; 19^{th} ~ 22^{nd} on May 2008
- Outline of survey

The outline of the questionnaire survey in Luang Namtha, Lao PDR and Phnom Penh, Cambodia is shown in Table 1.

- Structure of questionnaire

The structure of the questionnaire was categorized into 3 sections as shown below.

SECTION 1: The information on respondents

Q1; Age
Q2; Gender
Q3; Number of family people
Q4; Occupation
Q5; Period of living
Q6; Structure of house
Q7; Number of experience of flood
Q8; Number of experience of evacuation

Table 1 The outline of the questionnaire survey

CONTENT	VALUE			NOTE
	TOTAL	Lao PDR	Cambodia	
Population	1,811	639	1,172	
Number of Questionnaire distributed	201	100	101	(a)
Number of respondents	193	92	101	(b)
Ratio of respondents	96%	92%	100%	(b)/(a)

SECTION 2: The information on flood damage, their evacuation behavior and the reasons for their behavior

Q1; Suffered from flood damage or not
Q2; The kind of flood damage (only for respondents who suffered from flood damage)
Q3; Evacuated or not
Q4; Place that evacuated (only for respondents who evacuated)
Q5; Reasons for evacuating (only for respondents who evacuated)
Q6; Did not evacuate or could not (only for respondents who did not evacuate)
Q7; Reasons that did not evacuate (only for respondents who did not evacuate)
Q8; Reasons that could not evacuate (only for respondents who could not evacuate)

SECTION 3: The expectation on future flood disaster mitigation measures based on the reason of evacuation behavior

Q1; Awareness for flood disaster mitigation measures

- The outline of result of questionnaire

Respondents in Luang Namtha, Lao PDR were from almost every generation distributed closely. However most of the respondents are males who are the heads of the family. The families with 4 to 6 members accounted for almost half. About the occupation, the farmers accounted for 83%. Regarding the period of living, over 30 years and from 10 to 19 years were in the majority. There were few people with living period from 20 to 29 years. As for the house structure, wooden house accounted for 85%, a brick or concrete house was around 10%. The most commonly observed house type was high-floored 1-story wooden house. The high-floored (pilotis) type house, even through it is 1-story, has a function of 2-story-house during floods. About the flood experience, the memory of residents almost corresponded with the actual numbers of flood occurrence. The residents who had evacuation experience were around half of all respondents. On the evacuation behavior in 2006 flood, the rate of the residents who evacuated was 52%, the residents who did not evacuate accounted for 48%. Among the residents who did not evacuate, 57% of them did not evacuate consciously, 38% of them answered that they could not evacuate due to some kind of obstacles.

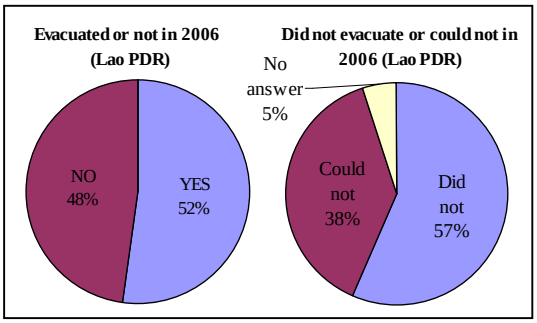

Fig. 2 The Ratio of evacuation behavior in 2006flood, Luang Namtha, Lao PDR

Respondents in Phnom Penh, Cambodia were from almost every generation distributed closely. On the other hand, the numbers of female respondents exceeded that of male. Regarding the number of people in a family, the families with 4 to 7 members accounted for almost half. About the occupation, manufacturing industry and service industry had the highest rates among various kinds of occupation. Regarding the period of living, 10 to 29 years accounted for nearly 80%. As for the house type, 96% of the houses in the area were made by wood. Only 2% were made by bricks or concrete. Most of 1-story houses were high-floored ones like in Lao PDR. About the flood experience, 70% of the respondents experienced only one flood. This flood occurred in 2000. Although the inundation has occurred almost every year, they recognize only the flood in 2000, one of the largest floods with flood disaster. Furthermore some of the respondents who have actually experienced flood while 2000 answered as "Never experiences". It indicates that flood was not recognized as "flood disaster". About the evacuation experience, the respondent with an evacuation experience was 38%. About evacuation behavior in 2000 flood, 37% of respondents evacuated and 63% did not evacuate. All the respondents who answered “did not evacuate” did not evacuate consciously. There was no respondent who could not evacuate by some obstacles, even though they wanted to evacuate.

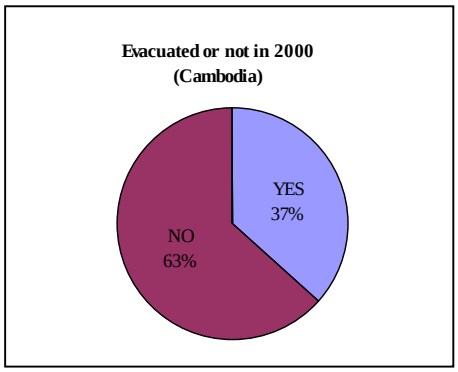

Fig. 3 The ratio of evacuation behavior in 2000 flood, Phnom Penh, Cambodia

Interview survey

In Luang Namtha, Lao PDR, interviewing the chief of the village was carried out. Its main contents were;

(1) The scale of the village

(2) The past flood damage

(3) The flood damage in 2006
(4) Warning issued or not
(5) Villagers evacuated or not in flood time
(6) Current flood disaster mitigation measures.

The interview survey in Phnom Penh, Cambodia was carried out with questionnaire survey. The situation of the flood and awareness for the flood disaster was confirmed by directly talking to the residents.

Investigation of flood situation

In both survey areas, Lao PDR and Cambodia, investigation of the flood situation at survey points in each village gave some information on inundation area and inundation depth. The inundated area maps were drawn according to such information. Location of houses of the respondents and that of the evacuation site are also drawn in this inundated area map. From the map, damage situation of all respondents at the flood time can be known. It could be classified by (1) inundation depth, (2) extent of inundation (above/below floor level), (3) the distance to river and (4) the distance to an evacuation site from houses. Resident awareness for flood disaster from various viewpoints can be analyzed.

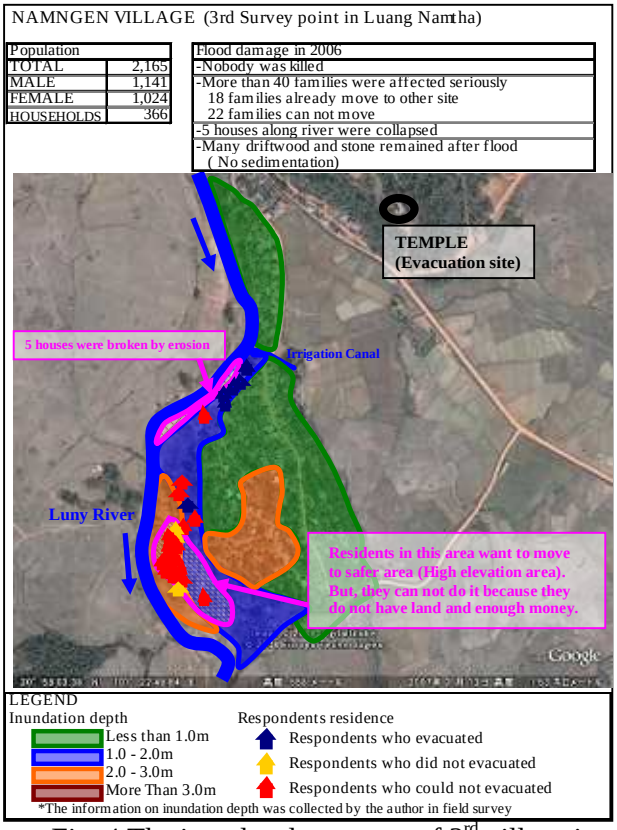

Fig. 4 The inundated area map of 3rd village in Luang Namtha, Lao PDR

RESULTS OF SURVEY

It was the appropriate to use the statistical data to identify the expected reasons objectively. Therefore, the result of questionnaire survey to residents was mainly considered to identify the expected reasons, the result of interview to chief of villages and residents was also considered as the supplemental information.

Table 2 shows the result of identification of reasons. In Lao PDR, main reason was about problem of evacuation site. In Cambodia, many various reasons were identified. In the table, ratio that the reason was chosen in questionnaire is also shown.

Table 2 The result of identification of reasons

The reason that residents did not evacuate		Lao PDR Flash Flood	Cambodia Continental Flood
1-1	False of warnings	× (5%)	○ (92%)
1-2	Inundation would be prevented by facilities	× (9%)	○ (91%)
1-3	No experience of damage	○ (36%)	○ (93%)
1-4	Neighbors did not evacuate	× (13%)	× (79%)
1-5	The evacuation site was too far. The evacuation route was dangerous	○ (36%)	○ (95%)
1-6	Evacuation site had already been crowded	× (5%)	○ (89%)
1-7	Refuge life might be inconvenient and hard	× (9%)	○ (73%)
1-8	Livestock and property might be stolen	× (13%)	○ (94%)
1-9	The level of flood would be a beneficial flood that had been observed annually	-	○ (94%)
The reason that residents could not evacuate			
2-1	Warnings was not issued	× (13%)	-
2-2	Residents could not receive warning	× (0%)	-
2-3	Unknowing where the evacuation site was	○ (53%)	-
2-4	Difficult to take all family member	○ (67%)	-
2-5	Rain and wind was too strong	× (7%)	-
The reason of the damage expansion			
3-1	Vulnerable people were left behind on the dangerous place.	×	×
3-2	Residents suffered from flood, when they went and watched the river and farmland.	×	×
3-3	A lot of poor people lived in dangerous river side.	○	○
3-4	The houses of the poor people was vulnerable to rain and wind	×	○
3-5	Some facilities for flood protection were collapsed and did not work well.	×	×

○:Identified △:New fact is discovered ×:was not identified -:Out of the target

ASSESSMENT OF EVACUATION BEHAVIOR

Some reasons were identified by the results of questionnaire survey and interview survey. However, each resident was exposed to different situations in the flood time. There was some difference in awareness and behavior among villagers. Evacuation behavior was also controlled by some conditions.

Therefore, evacuation behavior of residents was assessed by 4 conditions, (1) Inundation depth, (2) Inundation above/below the floor level, (3) The distance to river from houses, and (4) The distance to the evacuation site from houses.

Among these conditions, "(4) the distance to the evacuation site from houses" has a relation with residents' evacuation behavior. Fig. 5 shows the ratio of evacuation to the evacuation site classified by distance to the evacuation site. The evacuation rate sharply lowers at the distance of 800m or more. Most of the residents with distance up to 800m went to the evacuation site.

All residents in more than 800m did not go to the evacuation site.

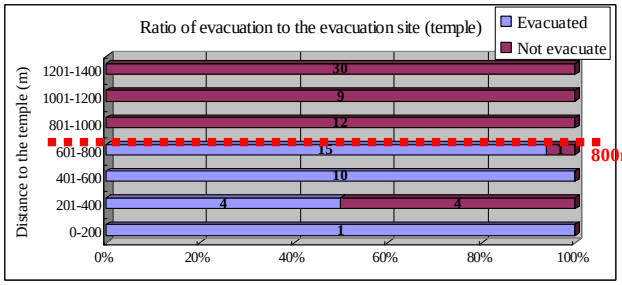

Fig. 5 The ratio of evacuation to the evacuation site classified by distance to the evacuation site

CONCLUSION

Some expected reasons were identified, and identified reasons in two countries were classified into common reasons and those peculiar to each country. Based on these results, conclusion is shown as below.

i. As common reason in both countries, Lao PDR and Cambodia, "No experiences of flood damage", "Evacuation site was too far" and "Evacuation route was dangerous" are identified as a reason for not evacuating.

ii. Main reasons in Lao PDR are problems of evacuation site. On the other hand, main reasons in Cambodia are matters of refuge life and residents' underestimation of flood occurrence and its scale as well as the problems of evacuation site.

iii. According to the result of assessment of evacuation behavior, it is clear that upper limit of distance from the residents' house to the evacuation site is 800m. Generally, 800m distance seems to be a psychological border whether people intend to walk or not. For example, in Japan, price of condominium decreases very much when its distance from train station becomes over 800m (Sakairi Sangyo Corporation, Ltd). Hence from this study, 800m is suggested as the standard of the distance to an evacuation site from houses.

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REFERENCES

Asian Disaster Reduction Center (ADRC), 2002, Asian Disaster Reduction Center.
Junichi YOSHITANI et al., 2008, International Centre for Water Hazard and Risk Management, Japan.
Mekong River Commission (MRC), 2007, Mekong River Commission.
National Research Institute for Earth Science and Disaster Prevention (NIED), 2006, Project Team for Research on Social Systems Resilient against Natural Disasters, Japan.
Sakairi Sangyo Corporation, Ltd., Sakairi Sangyo Corporation, Ltd, Japan (in Japanese).