A Study of Community Decisions for Taking Action in Flood Risk Reduction Activities:

Case Study in Ayutthaya Land Use Comprehensive Plan, Phra Nakhon Si Ayutthaya Province, Thailand

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The intentions of local people towards disaster preparation are important in defining the readiness for responding in the disaster resilience approach. This research applied a questionnaire survey to local community members who live in the area of the Ayutthaya land use comprehensive plan. There are seven aspects in this study which relate to the decision to prepare and participate in flood risk reduction activities; these are (1) reliability of information, source of information and transparency, (2) experience, fear and anxiety toward flooding, (3) leadership and performance of service providers, (4) expectation toward compensation and help, (5) effect from other people, (6) expectation of damage and loss, and (7) familiarity and current flood management. In addition, there are seven types of activities, which are (1) sharing information, (2) checking survival kit, (3) evacuation planning, (4) applying sandbags or water pumps for flood protection, (5) donating to flood victims, (6) volunteering to help communities in flood mitigation or response, and (7) volunteering to help local government in flood mitigation or response. This study applies multinomial logit regression analysis to explain how influencing factors effect the possibility of community members participating in flood risk reduction activity. The output of this study shows that reliability, sources and transparency of information; effect from other people; familiarity with flood situations; the success of the current flood management; and experience, fear and anxiety of the respondent toward flood situation, all affect the respondents' decision to prepare flood risk reduction activities, while risk perception affects the intention to participate in local activities.

Keywords : *flood risk acceptability, community-based disaster risk reduction, participation, resilience.*

1. Introduction

People, community and local government are necessary in flood disaster risk reduction, both during normal non-flooding periods and during floods, especially in flood prone areas, and are important in fostering a sense of disaster resilience. People who live in flood prone communities are expected to become first-hand respondents in taking action, using their own resources, during the initial period a flood incident. Thus, the intention of local people to prepare and participate in Community-Based Disaster Risk Reduction is important for increasing their coping capacities, either through personal or collective action. The objective in this study is to analyze local people's decision to taking action in flood risk reduction activity.

2. Consideration towards flood risk acceptability in the disaster resilience approach

The concept of resilience was first introduced in 1973 by C.S. Holling and related to an ecological approach (Holling, 1973, 1996; Gunderson et al., 2002)[1] and later applied to other disciplines, such as engineering, social studies (Folke et al., 2002)[2], psychology and disaster management. Resilience is how a system reacts to disturbances by absorbing and bouncing back to equilibrium after the disturbance. (Holling, 1973:17 [3]. Components of resilience include redundancy, diversity, efficiency, autonomy, interdependence, adaptation and collaboration in the case of system resilience (Godschalk and David R., 2003;136-143)[4]. In the case of disaster management, resilience refers to the ability to continue after a disaster situation and to regain the ability to restore back to the state prior to the disaster event (Masuda, 2011)[5] Thus, in disaster management, resilience could be separated into two phases as follows; (1) pre-disaster and disaster phase or ecological resilience; which is when a system "absorbs" or reduces damages due to disaster by its own resources, which are through efforts of preparation, mitigation and response. And (2) post-disaster phase, or engineering resilience, are focused toward the efforts that foster the phase of "bouncing-back" from the residual damage that the system could not absorb.

Risk acceptability had firstly emerged in the industrial safety field to minimize residual risk by applying both structural and non-structural measures to reduce damage to humans, property, services and systems. Risk acceptability considers the probability of disaster occurrences, hazards and other factors (UNISDR, 2007)[6]. Risk acceptability is related to decision theory, which is relevant to attitudes, voluntary and involuntary risk-taking, aversion to catastrophic risk between determination of likelihood and occurrence, and social attitude (Geiger, 2005)[7]. Factors that affect attitudes towards flood risk acceptability are age, income, occupation, education, flood experience, perception between flood risk and non-flood risk, information (Zhai and Ikeda, 2008)[8] social norms, risk perception, fear and anxiety, self-responsibility, damage expectation and trust in administrative bodies (Motoyoshi, 2006: 125)[9]

This research applies multinomial logit regression analysis based on criterias that relates to risk acceptability for analyzing the intention of community members to carry out preparation and intention to take action in flood risk reduction activities. These factors are personal characteristics, expectation, risk perception, information, and level of flood inundation; all are consider as influencing factors in this study. To determine the relationship between flood risk perception, attitudes of respondents, personal characteristic and intention to take flood risk reduction activities (i.e., sharing information, checking survival kits, evacuation planning, applying sandbags or setting up water pump for flood protection, and donating to flood victims) and intention to participate in Community-Based Disaster Risk Reduction (i.e., becoming a volunteer to help communities in flood mitigation activities and response, and becoming a volunteer to help local government in flood mitigation activities and response activity). This research was applied in the implementation area of the Ayutthaya land use comprehensive plan during January-March in 2014, and there are 250 respondents in this study.

3. Case Study

(1) Study area

The implementation area of the Ayutthaya land use comprehensive plan is located in the central area of Phra Nakorn Si Ayutthaya Province. This area was established in AD 1350 as a capital city in the ancient era. Because of the historical aspects and potential of industrial development in Phra Nakhon Si Ayutthaya Province and Patuhm Thani Province, the tourist industry and residential development have become important in this area. There are four major characteristics of land use types here, which are historical preservation area, residential area, commercial and agricultural area (see fig. 1 and fig.2) This area is located in a flood prone area, which is affected due to annual floods, especially during the rainy season. Ayutthaya has been afflicted by flooding five times between the years of 2005 and 2012 (GISTDA; 2013)[10], in which

the inundated area became larger each year (see fig. 3 and fig. 4)

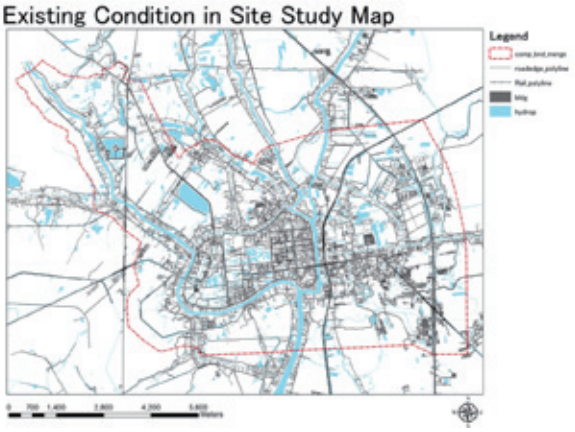

Fig.1 Location of study area

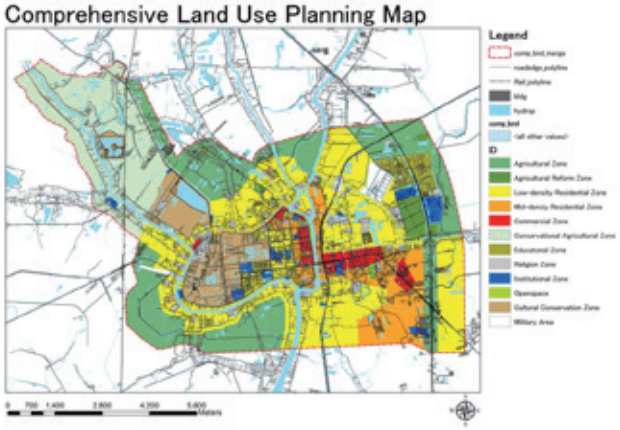

Fig.2 Land use planning in study area

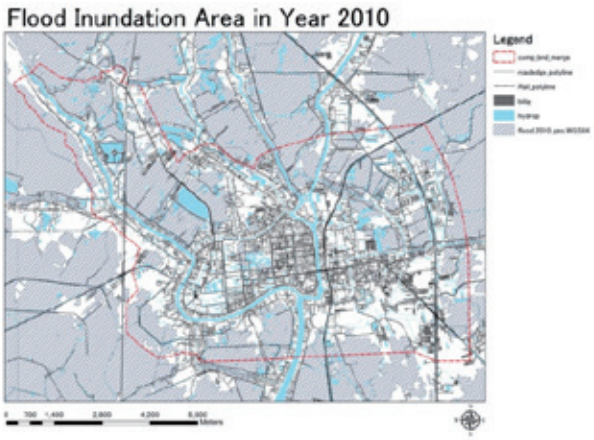

Fig.3 Area of flood inundation in 2010

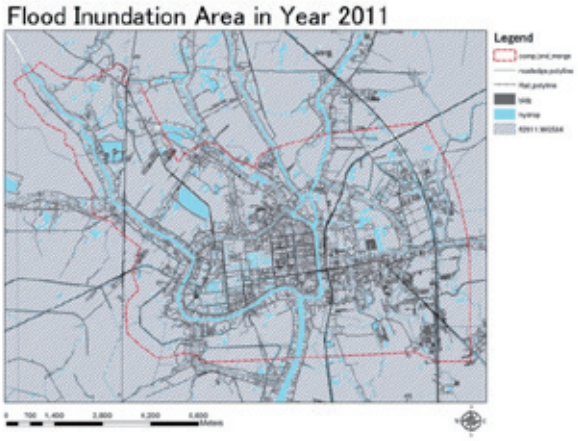

Fig.4 Area of flood inundation in 2011

(3) Respondents' data

A questionnaire conducted in January – March 2014 elicited 250 respondents in total. The basic information of respondents can be summarized as follows; just over half of respondents are female; there are 164 female respondents, which is equal to 66.4% of total respondents. The highest frequency of respondents' age was 20-30 years, with 115 respondents making 46.4 % of total respondents in this case study. Second is the age group of less than 20 years old, there are 83 respondents which is 33.5 % of the total respondents in this case study. Most of the respondents perceive that they live in a flood prone area. There are 146 respondents, which is equal to 60.1 % of all respondents, who think that they are living in flood prone area. Second are the respondents who are not sure that they are living in a flood prone area or not (49 respondents, which is equal to 20.2 % of total respondents) and respondents who thought that they are not living in a flood prone area. The level of inundation that respondents could cope with and could carry on doing daily activities in decreases as the level of inundation increases. The output shows that the average amount of days that respondents could handle in flood situations is approximately two to three days from the flood occuring. Most of the respondents could do daily activities for five days after the flood had raised up to approximately 30 centimeters, and they will respond in a day after the flood had raised higher than 90 centimeters. (see fig.5)

Table 1 Basic data of respondents

Aspects	Quantity	Percentage
Sex of respondents		
Male	83	33.6
Female	164	66.4
Age of respondents		
Less than 20 years old	83	33.5
20-30 years old	115	46.4
30-40 years old	30	12.1
40-50 years old	16	6.5
50-60 years old	4	1.6
Do you think that you are living in flood prone area		
Yes	146	60.1
No	49	20.2
Not sure	48	19.8

Source: Author, 2014

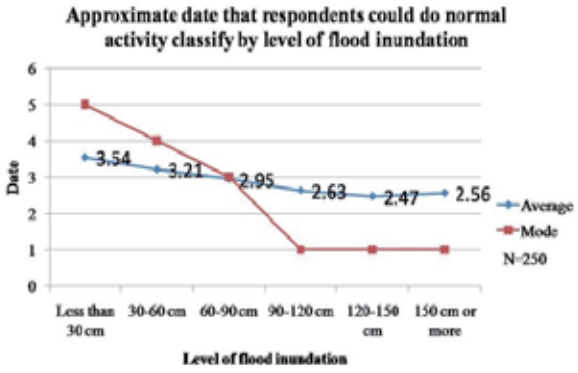

Fig. 5 Number of days that respondents start to respond

There are seven types of flood risk reduction activities in this study (Table 2), the results have shown that most respondents decide not to carry out flood risk reduction activities during a normal non-flooding period. Respondents do not typically participate in community activities such being a volunteer to help local government in case of flood mitigation and response (38.2%), applying sandbags or water pump for flood protection (41.2%) or evacuation planning (36.5%). While respondents tend to share information to friends or relatives toward flood risk reduciton (40.7%), check survival kits (34.8%), donate to flood victims (43.8%), and volunteer to help local government in case of flood mitigation and response (40.0%). Regarding to the output of data, it shows that most respondents are deciding to take action in normal periods, or they decide not to take action.

Table 2 Decision to prepare and participate in flood risk reduction activities

Aspects	Not apply		Apply when confromt to flood		Appy since disaster might occur		Apply in normal period	
	Qty.	%	Qty.	%	Qty.	%	Qty.	%
Sharing information	74	29.8	14	5.6	59	23.8	**101**	**40.7**
Checking survival kit	78	31.2	21	8.4	64	25.6	**87**	**34.8**
Evacuation planning	**91**	**36.5**	18	7.2	52	20.9	88	35.3
Applying sandbags or water pump for flood protection	**103**	**41.2**	18	7.2	41	16.4	88	35.2
Donate to flood victims	82	32.9	16	6.4	42	16.9	**109**	**43.8**
Being a volunteer to help community in case of flood mitigation	75	30.0	25	10.0	50	20.0	**100**	**40.0**
Being a volunteer to help local government in case of flood	**95**	**38.2**	20	8.0	42	16.9	92	36.9

Source: Author, 2014

Intention to take action toward flood risk reduction activities in community is defined by a score (0 represents not influential and 10 is highly influential). (Table 3) The classification of score for each factors showed that expectation of damage and loss causes respondents to take part in flood risk reduction and preparation activity (Average = 6.09, SD=2.521), second is experience, fear and anxiety toward flood situation (Average= 5.94, SD= 1.918), and third is the effect from other people (Average= 5.37, SD= 2.045).

Table 3 Basic data of respondents

Aspects	**Average**	**SD**
Reliability of information, source of information and transperency	5.42	1.964
Experience, fear and anxiety toward flood	5.94	1.918
Leadership and performance of service provider	4.71	2.176
Expectation toward compensation and help	5.37	2.045
Effect from other people	5.54	2.065
Expectation of damage and loss	6.09	2.521
Familiarity and current flood management	5.38	2.264

Source: Author, 2014

4. Analysis

To analyze the intention of the respondents to take action in flood preparation and response, this study applies a multinomial logit model to analyze how each influencing factor affects the decision of community members to take responsive action.. In this study, there are seven influencing factors (score from zero to ten) and seven flood risk reduction activities. (not taking action, taking action when confronted with disaster, taking action since receiving information or annoucement from government, and taking action in normal period). This study employs the logit model to predict intention to take action in exponential form. Odds ratio or exponential Beta determine the occurrence of the outcome of interest. Odds ratio could measure in terms of exponential of beta value (Exp(B)) in the logit regression model. (Exp(B) <1 represents that exposure is associated with lower odds of outcome; Exp(B)=1 represents that exposure is not associated with odds of outcome, and; Exp(B)>1 represents that exposure is associated with higher odds of outcome). The multinomial logit regression model is shown below

Probabilty of occurrence of Y: $P(Y) = \beta + \beta 1X1 + \cdots + \beta pXp \ (Y \in 0,1);$ ---1.
in linear probability model
(Y=0 represents "no", and Y= 1 represents "yes")

Probability of occurrence of Y: $log\left\{\frac{\Pr\ (y=1|x)}{1-\Pr\ (y=1|x)}\right\} = \beta 0 + \sum_{i=1}^{n} \beta iXi + \varepsilon$ ---2.

in logit model

Where
- Pr (y) = possibility of occurrence of y
- $\beta 0$ = constant
- β = coefficient
- x = independent of variables
- n = number of variables

Odds ratio in terms of Y: $P(Y = 1|X) = \frac{\exp\ (\beta+\beta 1X1+\cdots.+\beta nXn)}{1+\exp\ (\beta+\beta 1X1+\cdots+\beta nXn)}$ ---3.

According to equation number three, it can implys that if the increasing value of variable X by one point of score, the probability of occurrence of Y=1 will changing equal to exp(β)

The result in table 4 shows that some influencing factors are affecting the decision of community members to take flood risk reduction activities, but in depends on the situation. It also depends on types of activities. According to the output of analysis by applying multinomial logit regression analysis, as shown in table 4, most of the influencing factors become predictors in this study. However, this study focusses only on predictors that have an exponential of beta value (Exp(β)) or odds ratio higher than 1, representing that increasing one score of influence factor will increase the possibility of times that respondents likely to decide to do flood riks reduction activitiesDescriptions between influential factors and intention to take action toward flood risk reduction activities are described as follows;

(1) Intention to take action in normal period

Accroding to table 4 factors that relate to experience, fear and anxiety toward flood situation; and leadership and performance of service provider, significantly affect the respondents' decision to share information ($\text{Exp}(\beta)_{\text{experience}}$=2.227, sig.=0.000), do evacuation planning ($\text{Exp}(\beta)_{\text{experience}}$=1.664, sig.=0.009), and donate to flood victims ($\text{Exp}(\beta)_{\text{experience}}$=2.031, sig.=0.001). Meaning that factors that are relevant to

experience, fear and anxiety toward flood situation cause respondents to become approximately 1.5-2.0 times more likely to take action per one score increase. Meanwhile, factors that are relevant to leadership and performance of service providers are affecting the decision of respondents to setup sandbags or water pumps for flood protection ($\text{Exp}(\beta)_{\text{leadership}}$=1.242, sig.=0.048), meaning that respondents are approximately 1.2 times more likely to take action per one score increase. While effect from other people insignificantly affects the decision of respondents to take action during normal periods, and expectation of damage and loss does not significantly influence respondents' decision to take flood preparation in normal periods. Activities such as evacuation planning, donating to flood victims, becoming a volunteer to help the community and becoming a volunteer to help local government in flood mitigation and response have become the most predictable activities based on the factors applied in this study.

(2) Intention to take action when respondents perceive threats of flood disaster

Factors that are relevant to effects from other people; and familiarity and current flood management affecting the decision of respondents to take action in flood risk reduction activities significantly affect the decision of respondents to share information ($\text{Exp}(\beta)_{\text{other people}}$=1.346, sig.=0.026), do evacuation planning ($\text{Exp}(\beta)_{\text{other people}}$=1.353, sig.=0.024), setup sandbags or water pump for flood protection ($\text{Exp}(\beta)_{\text{other people}}$ =1.370, sig.=0.027), and become volunteer to help community ($\text{Exp}(\beta)_{\text{other people}}$=1.383, sig.=0.021), ($\text{Exp}(\beta)_{\text{familiarity}}$=1.424, sig.=0.027). Meaning that the effect from other people causes respondents to become approximately 1.2-1.4 times more likely to take action per one score increase. Factors that are relevant to familiarity and current flood management causing respondents to become volunteers to help communities in flood mitigation and response is approximately 1.4 times more likely per one score increase. Other influencing factors are when communities members perceive that they might be taking risk by flood. Other factors such as reliability of information, source of information and transparency; expectation of compensation and help insignificantly affect the decision of respondents to take flood risk reduction activities. Moreover, factors such as leadership and performance of service provider; and expectation of damage and loss reflect a low possibly of the respondent taking action when they perceive threats of flood disaster. Nevertheless, although some influencing factors insignificantly affect the decision to take responsive action, activities such as sharing inforamtion, checking survival kits, evacuation planning, donating to flood victims, and becoming a volunteer to help local government in flood mitigation and response, they are becoming more predictable activities based on the factors which are applied in this study.

(3) intention to take action when confront to flood disaster

Factors that are relevant to experience, fear and anxiety toward flood situation and reliability of infomation, and source of information and transparency of information cause respondents to donate to flood victims ($\text{Exp}(\beta)_{\text{experience}}$=2.131, sig.=0.050), and become volunteers to help local government ($\text{Exp}(\beta)_{\text{reliability of information}}$=1.472, sig.=0.047). Meaning that increasing consideration of respondent in experience, fear and anxiety toward the flood situation raises the probablilty of respondents deciding to donate to flood victims to approximately 2.1 times per one score increase. Factors that are relevant to reliability of information, source of information and transparency raise the probability of respondents deciding to get involved in local flood risk reduction activities with local government by 1.4 times per one score increase for this factor. Factors relevant to leadership and performance of service provider; expectation toward compensation and help from other sectors; expectation on flod damage and loss; and familiarity of flood situation and current flood management, affect the respondents' decision to take flood risk reduction activities but insignificantly affect the respondents' decisions to take action toward flood risk reduction. Although factors that relate to reliability of information, expectation toward flood situation; effect from other people; expectation of damage and loss, possibly make respondents approximately 1.5 time more likely to take action per one score

increase, activities that relate to setting up sandbags or water pumps for flood protection become the most predictable activities based on these factors applied in this study.

Table 4 Multinomial logistic regression analysis between influence factors and decision to take action

Factors	Decision to take action					
	When confront to disaster		When perceive to take risk		Normal period	
	Exp(β)	Sig.	Exp(β)	Sig.	Exp(β)	Sig.
Sharing information	B=-1.78, Sig.0.170		B=-1.19, Sig.0.122		B=0.20, Sig.0.762	
Reliability of information, source of information and transperency	*1.419*	*0.159*	*1.155*	*0.403*	0.888	0.453
Experience, fear and anxiety toward flood	*1.579*	*0.149*	*1.359*	*0.175*	**2.227**	**0.000**
Leadership and performance of service provider	0.571	0.004	0.803	0.102	0.960	0.738
Expectation toward compensation and help	*1.172*	*0.496*	*1.046*	*0.788*	0.924	0.605
Effect from other people	*1.156*	*0.517*	**1.346**	**0.026**	0.882	0.290
Expectation of damage and loss	0.774	0.183	0.717	0.014	0.743	0.022
Familiarity and current flood management	0.669	0.042	0.916	0.545	0.861	0.247
Checking survival kit	B=-1.58, sig.0.181		B=-1.13, sig.0.132		B=0.79, sig.0.231	
Reliability of information, source of information and transperency	*1.036*	*0.876*	*1.217*	*0.182*	*1.054*	*0.722*
Experience, fear and anxiety toward flood	0.830	0.461	0.982	0.927	*1.229*	*0.265*
Leadership and performance of service provider	0.801	0.199	0.816	0.087	0.997	0.977
Expectation toward compensation and help	*1.214*	*0.345*	*1.007*	*0.959*	0.840	0.200
Effect from other people	*1.072*	*0.724*	*1.160*	*0.232*	0.844	0.141
Expectation of damage and loss	*1.165*	*0.404*	0.868	0.234	0.898	0.359
Familiarity and current flood management	0.925	0.635	*1.192*	*0.161*	*1.067*	*0.571*
Do evacuation planning	B=-1.99, sig.0.096		B=-1.80, sig.0.020		B=-0.01, sig. 0.991	
Reliability of information, source of information and transperency	*1.169*	*0.441*	*1.099*	*0.530*	*1.021*	*0.885*
Experience, fear and anxiety toward flood	*1.263*	*0.380*	*1.084*	*0.693*	**1.664**	**0.009**
Leadership and performance of service provider	0.737	0.064	0.897	0.375	*1.085*	*0.464*
Expectation toward compensation and help	0.921	0.668	0.932	0.629	0.738	0.030
Effect from other people	*1.189*	*0.395*	**1.353**	**0.024**	0.855	0.168
Expectation of damage and loss	0.891	0.509	0.778	0.044	0.766	0.029
Familiarity and current flood management	0.911	0.568	*1.184*	*0.194*	*1.077*	*0.512*
Setup sandbags or water pump for flood protection	B=-3.43, Sig.0.007		B=-1.41, sig.0.081		B=-0.28, sig.0.638	
Reliability of information, source of information and transperency	*1.216*	*0.429*	*1.079*	*0.621*	0.790	0.090
Experience, fear and anxiety toward flood	0.804	0.430	0.944	0.787	*1.333*	*0.102*
Leadership and performance of service provider	*1.014*	*0.938*	0.824	0.134	**1.242**	**0.048**
Expectation toward compensation and help	0.933	0.752	0.910	0.535	0.883	0.322
Effect from other people	*1.145*	*0.464*	**1.370**	**0.027**	*1.060*	*0.580*
Expectation of damage and loss	*1.201*	*0.346*	0.881	0.303	0.857	0.153
Familiarity and current flood management	*1.022*	*0.909*	*1.140*	*0.363*	0.981	0.853
Donate to flood victims	B=-5.06, Sig.0.04		B=-0.26, sig.0.735		B=0.51, Sig.0.437	
Reliability of information, source of information and transperency	0.848	0.493	*1.385*	*0.086*	*1.084*	*0.581*
Experience, fear and anxiety toward flood	**2.131**	**0.050**	*1.030*	*0.901*	**2.031**	**0.001**
Leadership and performance of service provider	*1.178*	*0.389*	0.904	0.476	*1.072*	*0.518*
Expectation toward compensation and help	*1.049*	*0.837*	0.967	0.848	0.720	0.019
Effect from other people	0.758	0.135	*1.223*	*0.174*	0.897	0.356
Expectation of damage and loss	0.914	0.745	0.619	0.001	0.621	0.000
Familiarity and current flood management	*1.071*	*0.688*	*1.045*	*0.768*	*1.034*	*0.759*
Be volunteer to help community	B=-4.01, sig.0.001		B=-0.97, sig.0.207		B=0.26, sig.0.683	
Reliability of information, source of information and transperency	*1.307*	*0.158*	*1.236*	*0.228*	*1.021*	*0.883*
Experience, fear and anxiety toward flood	0.885	0.604	0.775	0.276	*1.096*	*0.602*
Leadership and performance of service provider	0.813	0.143	0.926	0.588	0.986	0.893
Expectation toward compensation and help	0.992	0.961	0.865	0.401	0.853	0.219
Effect from other people	*1.294*	*0.122*	**1.383**	**0.021**	*1.085*	*0.459*
Expectation of damage and loss	*1.218*	*0.262*	0.753	0.033	0.923	0.476
Familiarity and current flood management	*1.055*	*0.718*	**1.424**	**0.027**	*1.065*	*0.563*
Be volunteer to help local government	B=-2.91, sig.0.018		B=-0.38, sig.0.624		B=0.72, sig.0.265	
Reliability of information, source of information and transperency	**1.472**	**0.047**	*1.234*	*0.250*	*1.064*	*0.662*
Experience, fear and anxiety toward flood	*1.207*	*0.495*	0.722	0.169	*1.266*	*0.177*
Leadership and performance of service provider	0.858	0.305	0.984	0.911	*1.105*	*0.343*
Expectation toward compensation and help	0.873	0.456	*1.021*	*0.904*	0.890	0.345
Effect from other people	*1.045*	*0.788*	*1.266*	*0.092*	*1.022*	*0.842*
Expectation of damage and loss	0.838	0.325	0.688	0.007	0.706	0.003
Familiarity and current flood management	*1.070*	*0.694*	*1.276*	*0.125*	0.948	0.609

Remark : **Bold with underline** represents that influence factors are significantly predictable

: *Italic with underline* represents that influence factors are insignificantly predictable

Source: Author, 2014

5. Conclusion and discussion

Ayutthaya Comprehensive plan is located in a flood prone area that is vulnerable to annual excessive torrential rainfall, river flood and tropical storms. Local people have tried to prepare to increase their capacity towards flood mitigation and preparation. Moreover, respondents perceive that they are taking risk due to flooding. The result of multinomial logit regression analysis and odds ratio toward influencing factors and intention to take flood risk reduction activities are dependent on flood incident and perceived information of respondents. This study shows that influencing factors become more predictable when the situation becomes severe (from normal or non-disaster period (22 predictable factors; 4 predictable with significant level in all response activities), when community members perceive that they might be taking risk, (26 predictable factors; 5 predictable with significant level in all response activities), and when community members confront the flood incident (28 predictable factors; 2 predictable with significant level in all response activities). There are three factors that could predict the decision of respondents to take action are (1) reliabilility of information, source of information and transparency (18 predictable factors), (2) effect from other people (16 predictable factors), and (3) familiarity and successfulness of current flood management (14 predictable factors), which cause respondents to decide to take action. However, although these influential factors could possibly predict the decision of respondents toward flood preparation, some of them are not significant. The reason is there might be other influencing factors which indirectly effect the decision. Also this study was conducted in a normal period, people's answers may well be different during flood periods. This case had shown that factors that are relevant to reliability of information, source of information and transparency of information, affect the decision of community members to take action. Thus, increasing accuracy and precise information to community members is important to community members when they perceive that they might take flood damage. Moreover, accomplishment of flood projects also influences community members to take part in flood preparation and response. Thus, government sectors, either central government or local government, have to make effort to drive and opeate flood risk reduction activities as much as possible if they need community members to take part with them to achieve tasks in Community-Based Disaster Risk Reduction.

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