Review:

Understanding Households' Perceptions of Risk Communication During a Natural Disaster: A Case Study of the 2011 Flood in Thailand

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This study investigated households' perceptions of risk communication during the 2011 flood in Thailand, which was the most devastating in Thailand since 1942 and affected 12.9 million people. The study aim was to analyze the determinants of people's perceptions of early warning communication and its efficacy. It also examined key determinants in various aspects, including the accessibility and efficacy of warnings regarding the potential hazard from electrocution, household hygiene, and life and property issues. This study used the 2011 Flood Livelihood Survey of Thai households, conducted by the Thai National Statistical Office from July to December 2011. The results demonstrated that some household characteristics, head of household, and communication and transportation problems during the flood affected warnings regarding accessibility and the perception of warning efficacy during the 2011 flood in Thailand. The results also demonstrate the key factors in successful risk communication, i.e., flood experience and community interrelationship. It is also essential to provide comprehensive and useful information such as safety and health instructions, using the proper channels to disseminate information to the target audience.

Keywords: risk communication, flood, flood warning, warning access, warning efficacy

1. Introduction

In 2011, Thailand was confronted with the most devastating flood since 1942, before a flood prevention system had yet been developed [1]. Although the 2011 flood did not reach central Bangkok, just like the 1942 flood, it generated great damage and loss to many sectors, including the agricultural, industrial, economic, and social sectors. The damage and losses were estimated at USD 46.5 billion [2] and 3.9 million households with 12.9 million people were affected by this disaster [3].

The year 2011 began with floods in the southern part of Thailand before spreading to other regions. An untypically large volume of rainfall from five tropical storms and heavy monsoons caused a large flood area [4]. When the rainfall increased in the following months, the situation became critical before peaking in October due to several continuous monsoons. The floodwaters reached the Bangkok Metropolitan region in October [5], eventually impacting 61 of Thailand's 77 provinces (**Figs. 1** and **2**).

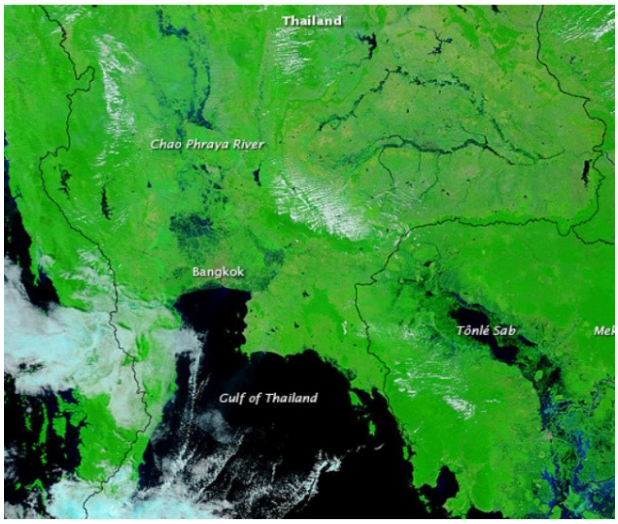
Generally, flood disaster disrupts livelihood, human, and societal activity [6], The 2011 flood caused unexpected damage to the area, resulting in several disruptions to the manufacturing sector, local businesses, and residents' livelihoods. More than 700 casualties were reported, with the major cause of death being drowning [7].

After the crisis, many reports analyzed and synthesized the situation to absorb the lessons of the disaster, and to develop a plan and potential solutions for possible future disasters. One of the critical problems identified was inadequate communication. For instance, the Health Systems Research Institute of Thailand reported that there had been a great deal of conflicting information from various sources. It also mentioned that mass media contents during the flood lacked any surveillance warning and were very difficult to understand [7].

According to Sendai Framework for Disaster Risk Reduction 2015–2030, raising public awareness and understanding and disseminating accurate and non-sensitive disaster risk, hazard, and disaster information by the media is key to achieving effective and efficient disaster risk management. Similarly, it is important to establish necessary mechanisms, including health and safety standards, to ensure an adequate focus on disaster risk management [9].

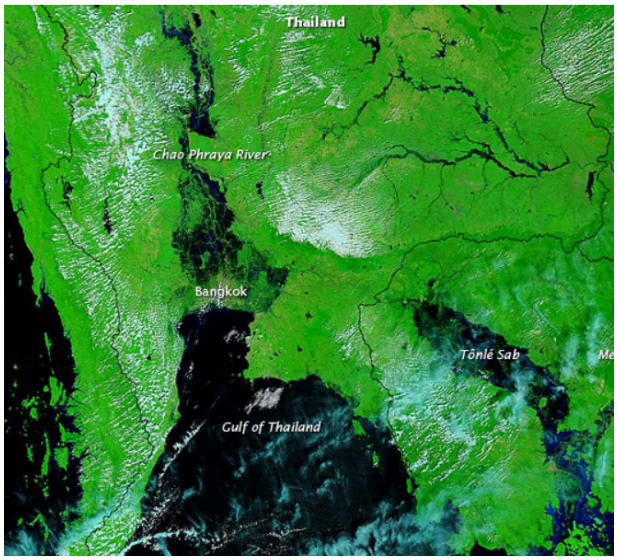
During the 2011 flood, the Department of Disease Control listed key communication areas, including water hygiene, hazard from electrocution, disease from fungus, and animals [4]. Important information for people in the inundated area was associated with safety and health issues to support their decision-making during the flood. Similarly, flood surveillance warnings by raising public awareness play an important role in the effectiveness of emergency response [10].

Contributing to building a resilient regional community against disasters, SATREPS (Science and Technol-



Source: NASA Earth Observatory [8]

Fig. 1. Central region of Thailand in November 2008 (before the 2011 flood).



Source: NASA Earth Observatory [8]

Fig. 2. Central region of Thailand during the 2011 flood in November 2011.

ogy Research Partnership for Sustainable Development) is a Japanese government program that promotes international joint research targeting global issues. Since 2018, it has supported a project for Regional Resilience enhancement by establishing Area-Business continuity management at industrial complexes in Thailand (Area-BCM project). This project aims to build a resilient regional community against disasters by visualizing disaster risks and introducing Area-BCM. The project involves community research as one of the main tasks for integration with studies of disasters, businesses, and Area-BCM establishment. Therefore, in this study, the concept of risk communication and lessons learned from the 2011 flood will be input into the project, to share information that is vital for saving lives, protecting health, and minimizing harm to self and others, as well as changing beliefs and/or behavior [11].

2. Literature Review

2.1. Risk Communication

Risk communication commonly refers to a social process by which people become informed about hazards, are influenced to change their behavior, and can participate in decision-making regarding risk issues in an informed manner [12]. This includes a range of communication capacities through the phases of preparedness, response, and recovery from a disruptive event to encourage informed decision making, positive behavioral change, and the maintenance of trust [13], which may assist in raising awareness, encouraging protective behavior, and increasing public knowledge about hazards and risks [11].

The risk communication objectives are to inform and educate people regarding the risks and risk assessment in general, encouraging personal risk-reduction behaviors, providing direction and behavioral guidance in disasters and emergencies, and involving the public in risk management decision-making and in resolving health, safety, and environmental controversies [14].

Risk communication is considered a communication process in which a form of communication, represented by the traditional model of communication that generates a message, goes through a channel to a receiver [15]. This process must have a defined intention and designated media/communication channel, in order to target its primary audience [16].

To succeed with risk communication, the target audience's characteristics are important. It is essential to analyze audience characteristics to create a better mode of communication with them. The characteristics that may affect risk communication are experience of the risk, education level, age, gender, occupation, geographic area, and news exposure, all of which affect the appropriate content [10]. For example, concerns regarding family, career, and retirement could differ between age groups, while content for those with higher education could use more complex concepts. To disseminate risk information to those who have no experience with the risk, it is necessary to first build their awareness [15].

Media is a key facilitator in disaster awareness as well as preparedness to reduce the risks from natural disasters. While the media is providing warnings and updated information on the crisis situation to support people's decision making during the natural disaster, there is a risk of disseminating an inaccurate picture of the situation, particularly in the framing of emergency responses [17].

Trust of the information sources, accessibility to such sources, and clear information are important to people's perception. In an emergency situation, television, radio, and community are the main information sources [11, 15, 18, 19], with each requiring trust, accessibility, and clear

communication. For instance, television was considered one of the most reliable channels, compared with other information sources [18]. Radio broadcast was an effective and reliable channel for the community to receive fast and accurate information about the disasters [20].

2.2. Flood Warning

Floods can cause many risks to health and safety [10]. For example, they can cause severe morbidity and even mortality from, for example, drowning, accidents, electrocution, communicable diseases and infections, chronic diseases, poisoning, and animal bites [21, 22]. In such situations, appropriate information and advice are necessary to establish a flood warning system.

Early flood warning is the provision of advance warning of conditions that are likely to cause flooding to property and a potential risk to life. The main purpose of flood warning is to save lives by allowing people, support, and emergency services time to prepare for flooding. The secondary purpose is to reduce the effects and damage caused by flooding. There are key factors that may be involved in a flood event, such as [10]:

1. Local representatives who coordinate a community response to flood fighting and evacuation, obtaining relief funding and additional resources (people, equipment, etc.)
2. Community members who may assist with evacuation, issuing warnings to neighbors/friends etc.; temporary measures to reduce flooding and protect property. In particular, interpersonal communication can be used to disseminate warning signals [23].
3. Media (television, radio, other) for reporting and relaying information and warnings.
4. Disaster experience: persons who have experienced a natural disaster may accrue certain benefits that promote preparation activities and attempt to minimize loss of resources during subsequent disaster threats [24].

In Thailand, various communication channels are always utilized for flood warning. Traditional media (television and radio) are suitable means of disseminating information at the national level. Local communities also play an important role in communicating to specific areas, such as the local broadcasting tower. Similarly, an informal warning system, where people communicate with their networks, is significant for the effectiveness of official flood warning systems [25]. In previous studies, flood information provided by traditional media has been nearly as important as the local media, apart from television [26–28].

3. Methodology

In this study, we focused on individuals' socioeconomic and demographic characteristics that determined the accessibility and quality of the flood warning in 2011. These factors of effective risk communication can be applied for disseminating disaster risk, hazard, and disaster information in order to reduce the number of people affected by disaster.

We used the data from a survey of the livelihood of Thai households, conducted by the National Statistical Office of Thailand (NSO) from July to December 2011. The survey utilized an enumeration area list from the 2010 Population and Housing Census to design the sample frame. There were 36,910 samples from 61 provinces representing 5.3 million households living in flooded areas from July–December 2011 [3]. For this study, we specifically selected households that were directly affected by the 2011 flood and did not evacuate from the flooded area in order to eliminate any external factor from evacuation. The selected samples were those who received risk-related information at their accommodation, not the evacuated shelter/accommodation, to avoid information bias at different places. Thereby, in this study, the selected sample represented 3,207,260 households.

The dependent variables in this study are listed in two steps: (1) the households' accessibility to warnings (whether target samples had been informed) and (2) households' perception of the warning quality (how they rated their quality). If the heads of household receive a warning, how would they rate the quality of each of the following: (1) early flood warning; (2) hazard of electrocution warning during the flood; (3) hazard of water hygiene warning during the flood; and (4) life and property warning during the flood. The key dependent variables have been generated into two dummy variables: warning access (warning received or not received) and perception of warning efficacy (poor and moderate or good).

A logistic regression analysis was employed for the analysis. The first group of parameters was the household characteristics, including the region (Bangkok, Northern, Northeastern, Central, Southern region), number of household members, having flood experience (never, having flood experience), possession of electronic communication devices (radio, television, computer, telephone, and fax), and level of community interrelationship (none, low, moderate, high).

The second group of the parameter comprised the characteristics of heads of household, including gender (male and female), age (20–39, 40–59, 60 and over), education (lower high school and other, high school or diploma, bachelor's and higher), and occupation (agriculture and non-agriculture). The final set of variables were communication problems during the flood (such as telephone or internet being out of service), transportation problems during the flood (commuting problem during the highest flood duration).

Table 1. Number (thousands) and percentage of the sample by warning accessibility and perception of warning efficacy.

Type of Warning (N = 3,207.3)	Not Received	Received			Total
		Poor	Moderate	Good	
Surveillance before flood	966.1	131.7	1,056.70	1,052.70	3,207.30
	30.10%	4.10%	32.90%	32.80%	100.00%
Electrocution during flood	1,220.80	113.3	1,094.40	778.8	3,207.30
	38.10%	3.50%	34.10%	24.30%	100.00%
Hygiene during flood	1,157.70	106.6	1,108.00	834.9	3,207.30
	36.10%	3.30%	34.50%	26.00%	100.00%
Life and property during flood	1,225.50	117.5	1,073.20	791	3,207.30
	38.20%	3.70%	33.50%	24.70%	100.00%

Source: Author's estimation

4. Results

4.1. Overview

The sample included households that had been directly affected by the 2011 flood and did not evacuate from the flooded area. The sample size thus included 3,207,260 households (weighted number).

Nearly 70% of the sample received a surveillance warning before the flood and approximately $1/3$ were satisfied with this warning. Regarding the warning during the flood, more than 40% of the sample had access to the warning and approximately $1/4$ of them were satisfied with each warning during the flood (**Table 1**). The sample consisted of households living in central, northern, and northeastern regions for each group, at a proportion of approximately $1/4$.

Most of the sample responded that they had received all types of warning and nearly $2/3$ had perceived the warning as having moderate efficacy on every issue. The majority of the sample were male, aged 40–59, with elementary level education or below. The mean household size was 3.3 members, with approximately 40% involved in agriculture, while 97.5% of households possess a television, followed by radio.

More than half the sample had had experience of small floods before 2011. Approximately half rated their community interrelationship at a moderate level; 64.3% had transportation problems during the flood, while there were few cases of communication problems (**Table 2**).

Before applying the logistic regression analysis, we administered collinearity tests using a tolerance test and the variance inflation factor (VIF) test to avoid multicollinearity (**Table 3**).

4.2. Before the Flood: Surveillance Warning

In the first model, we explored determinants affecting households' surveillance warning accessibility. The results demonstrated that households in Bangkok metropolitan area (reference group) were more likely to access surveillance warnings before the flood than households in other regions. This may have been because Bangkok residents were the last group to experience the flood inundation, approximately nine months after the first news about the flooding [29].

Therefore, this group had more media exposure than the residents of other regions, who had limited time to prepare before the flood.

Higher household leader education, households with more members, non-agriculture, television possession, flood experience, and a higher level of community interrelationship were more likely to obtain surveillance warnings.

Interestingly, older females were more apt to obtain surveillance warnings, perhaps due to their vulnerability. Older people in particular are at greater risk of flood fatality than younger people [30], so those groups could be treated as the priority during disaster preparedness.

In the second model, we only selected households that received surveillance warnings. The results demonstrate that households living in the central, north, and northern regions were more likely to perceive good communication at 1.3–2.2 times those living in Bangkok. In addition, households with fewer members, radio or television possession, agriculture occupation, flood experience, and moderate–high community interrelationship were prone to have more positive perceptions.

This could imply that the messages of surveillance warnings are more suitable for receivers living outside Bangkok and the southern region and who are accustomed to water management, such as the agriculture group, while it is more difficult for groups with different characteristics to understand the messages (**Table 4**).

4.3. During the Flood: Livelihood Warning

4.3.1. Electrocution Warning Accessibility and Perception of Warning Efficacy

This model analyzed warning accessibility during the flood and found that Bangkok household (reference group) had a greater possibility of accessing an electrocution warning during the flood than others, while older, female, more educated household leaders, households with more members, television possession, flood experience, higher community interrelationship, and communication or transportation problems also tended to access such warnings. This result is similar to the surveillance warning accessibility model. Communication and transporta-

Table 2. Percentage and number of sample characteristics (N = 3,207,260).

Sample characteristics	Percentage	N
I. Household characteristics		
Region		
Bangkok	9.50%	304,690
Central	28.70%	920,484
Northern	27.50%	881,997
Northeastern	26.30%	843,509
Southern	8.00%	256,581
Household members		
Mean = 3.333, Min. = 1, Max. = 13	–	
Flood experience	57.40%	1,840,967
Electronic communication devices possession		
Radio	80.30%	2,575,430
TV	97.50%	3,127,079
Computer	38.40%	1,231,588
Telephone or fax	74.90%	2,402,238
Level of community interrelationship before flood		
None	15.40%	493,918
Low	11.50%	368,835
Moderate	47.20%	1,513,827
High	25.90%	830,680
Level of community interrelationship during flood		
None	10.50%	336,762
Low	10.50%	336,762
Moderate	45.90%	1,472,132
High	33.10%	1,061,603
II. Characteristics of head of household		
Gender		
Male	69.20%	2,219,424
Female	30.80%	987,836
Age		
20–39	12.90%	413,737
40–59	51.20%	1,642,117
60 and over	35.90%	1,151,406
Education		
Elementary and below	75.70%	2,427,896
High school diploma	19.70%	631,830
Bachelor's and higher	4.40%	141,119
Occupation		
Agriculture	39.50%	1,266,868
Non-agriculture	60.50%	1,940,392
III. Problem during flood		
Communication problem	4.20%	134,705
Transportation problem	64.30%	2,062,268

Source: Author's estimation

Table 3. Collinearity statistics test.

Independent Variables	Collinearity Statistics	
	Tolerance	VIF
Model 1: Warning accessibility		
Central	0.311	3.219
Northern	0.295	3.391
Northeastern	0.298	3.360
Southern	0.527	1.897
Household members	0.969	1.032
Flood experience	0.862	1.161
Radio	0.906	1.104
TV	0.944	1.060
Computer	0.797	1.255
Telephone fax	0.848	1.179
Low community interrelationship before flood	0.643	1.556
Moderate community interrelationship before flood	0.454	2.203
High community interrelationship before flood	0.484	2.066
Male	0.939	1.065
40–59	0.372	2.685
60 and over	0.344	2.910
High school diploma	0.811	1.234
Bachelor's and higher	0.905	1.106
Agriculture	0.831	1.203
Model 2: Perception of warning efficacy		
Central	0.333	3.002
Northern	0.283	3.539
Northeastern	0.279	3.588
Southern	0.621	1.610
Household members	0.970	1.030
Flood experience	0.813	1.230
Radio	0.913	1.095
TV	0.958	1.043
Computer	0.735	1.361
Telephone fax	0.866	1.154
Low community interrelationship during flooding	0.463	2.161
Moderate community interrelationship during flooding	0.221	4.520
Male	0.938	1.066
40–59	0.362	2.762
60 and over	0.333	3.006
High school diploma	0.795	1.257
Bachelor's and higher	0.888	1.126
Agriculture	0.815	1.227
High community interrelationship during flooding	0.224	4.459
Communication problem	0.980	1.020
Transportation problem	0.775	1.290

Source: Author's estimation

tion may positively affect electrocution warning accessibility because people who have both problems would have to be active in risk communication, thus seeking out more risk information to support their lives in crisis. Meanwhile, as they live in the vulnerable area, they could obtain more frequent warnings from local organizations, such as a local broadcasting tower or influential local person.

In the following model, as in the previous analysis, we only selected households for which receiving an electrocution warning during the flood shows that households in the central, north, and northeastern regions, with female household leaders, radio possession, agriculture, flood experience, and higher community interrelationship were more likely to have a more positive perception. Furthermore, communication problems negatively affect perception (**Table 5**).

Table 4. Logistic regression analysis of surveillance warning accessibility and Perception of warning efficacy before the flood.

Variables	Surveillance warning			
	Accessibility (N = 3,207,260) (Received warning = 1; Not received warning = 0)		Perception of efficacy (N = 2,241,149) (Good = 1; Moderate & Poor = 0)	
	S.E.	Exp(B)	S.E.	Exp(B)
I. Household Characteristics				
Central	0.005	0.330*	0.006	1.274*
Northern	0.006	0.771*	0.006	1.840*
Northeastern	0.006	0.528*	0.006	2.193*
Southern	0.006	0.235*	0.008	0.750*
Household members	0.001	1.016*	0.001	0.986*
Flood experience	0.003	1.376*	0.003	1.365*
Radio*	0.003	0.871*	0.004	1.023*
TV*	0.008	1.915*	0.010	1.225*
Computer*	0.003	0.816*	0.003	0.933*
Telephone fax*	0.003	0.855*	0.003	0.977*
Low community interrelationship*	0.005	1.834*	0.006	0.701*
Moderate community interrelationship*	0.004	2.694*	0.005	1.052*
High community interrelationship*	0.004	3.361*	0.005	2.566*
II. Characteristics of head of household				
Age 40–59	0.004	1.141*	0.005	0.943*
Age 60 and up	0.004	1.169*	0.005	1.003
High school diploma	0.004	1.222*	0.004	1.021*
Bachelor's and higher	0.007	1.297*	0.007	1.075*
Agriculture	0.003	0.958*	0.003	1.006
Constant	0.010	1.067	0.013	0.332*
Nagelkerke R^2	0.114		0.118	

* $p < .05$

4.3.2. Hygiene Warning Accessibility and Perception of Warning Efficacy

The results of these models are almost the same as the electrocution warning model, except that in the perception of warning efficacy, we found some different effect direction in male household leaders, who are more likely to have a positive perception than female leaders. This shows the gap between genders whereby male household leaders seem to have lower expectations of hygiene warning. On the other hand, more highly educated household leaders tend to take this more seriously than less educated groups.

We also found a more positive effect of television, telephone, and fax possession, and transportation problems on the perception of hygiene warning efficacy (**Table 6**).

4.3.3. Life and Property Warning Accessibility and Perception of Warning Efficacy

The results from the analysis of life and property warning are also not very different from the Electrocution warning model, although some differences in terms of higher educated household leaders and computer possession did positively affect perception of warning. This implies that less-educated leaders are more likely to expect life and property warning messages than more educated leaders, and they could be considered the vulnerable group due to their lower social status. Furthermore, computer possession positively affected perception of life and property warning efficacy, and it is possible that computer access during the flood could be a benefit by allowing a more comprehensive information source about life and property warning than television possession, which shows negative effects (**Table 7**).

4.4. Summary

After analyzing all models, we found the key variables that positively affected both warning accessibility and efficacy in every issue are flood experience and higher community interrelationship. Moreover, we displayed some factors that are suitable for each type of warning concerning the issue, accessibility, and message efficacy. This is summarized in the table below (**Table 8**).

5. Discussion

This study confirmed the important role of socioeconomic and demographic factors in terms of accessibility to risk communication and households' perception of warning efficacy. To ensure appropriate risk communication, it is necessary to understand the analysis of prone-to-disaster affected people [15]. This study has filled the literature gap in this respect.

Table 5. Logistic regression analysis of electrocution warning accessibility and Perception of warning efficacy during the flood.

Variables	Electrocution warning			
	Accessibility (N = 3,207,260) (Received warning = 1; Not received warning = 0)		Perception of efficacy (N = 1,986,495) (Good = 1; Moderate & Poor = 0)	
	S.E.	Exp(B)	S.E.	Exp(B)
I. Household Characteristics				
Central	0.005	0.403*	0.006	1.072*
Northern	0.005	0.630*	0.006	1.573*
Northeastern	0.005	0.783*	0.006	1.769*
Southern	0.006	0.237*	0.010	0.430*
Household members	0.001	1.017*	0.001	0.972*
Flood experience	0.003	1.265*	0.003	1.495*
Radio	0.003	0.867*	0.004	1.046*
TV	0.008	1.710*	0.011	0.980
Computer	0.003	0.908*	0.004	0.977*
Telephone fax	0.003	0.928*	0.004	0.994*
Low community interrelationship	0.005	1.653*	0.008	0.467*
Moderate community interrelationship	0.004	2.523*	0.007	0.744*
High community interrelationship	0.004	3.478*	0.007	1.626*
II. Characteristics of heads of household				
male	0.003	0.923*	0.003	0.977*
age 40–59	0.004	1.092*	0.005	0.857*
age 60 and up	0.004	1.113*	0.006	0.880*
high school diploma	0.003	1.158*	0.004	1.012*
bachelor's and higher	0.006	1.391*	0.008	1.002
agriculture	0.003	1.000	0.003	1.098*
III. Problems during flood				
Communication problem	0.006	1.359*	0.007	0.864*
Transportation problem	0.003	1.378*	0.004	0.993
Constant	0.011	0.549*	0.015	0.461*
Nagelkerke R^2	0.111		0.114	

* $p < .05$

Firstly, some factors affected warning access and perception of warning efficacy in the opposite way, e.g., region, age, radio possession, communication, and transportation problems during the flood. This might imply risk communication intention in different contexts. Those living in Bangkok more frequently obtained warnings as they were the latest group to be affected by the flood [1]. However, they rated the flood as having poorer quality.

While 61.6% of non-Bangkok residents had flood experience, most Bangkokians did not (only 18%). The difference in flood experience between groups may have affected their perception. This is similar to Zaalberg et al.'s study that people with flood experience have stronger emotions (negative and positive) and received more social support due to past flooding. Moreover, they worry more about future flooding, perceive themselves as more vulnerable to future flooding, perceive the consequences of future flooding as more severe, and have stronger intentions to take adaptive actions in the future [31].

Likewise, radio audiences for risk warnings are lower because radio could be replaced by local broadcasting towers, which play an important function [26–28]. However, those who listen to the radio perceive the warning more positively due to the quality of radio messages. Computer access also fulfills some missing content from traditional media in terms of life and property instructions.

In terms of age group, older heads of household were more likely to have easier access to risk warnings. However, they expected better information than younger groups, so they were apt to have more negative perceptions about the warnings given.

Similarly, people who had communication and transportation barriers during the flood were better informed about risk details, as they were in the risk area. However, they suffered more from the disaster and required more useful information, which negatively affected their perception of warning efficacy.

Some factors strongly affect both dependent variables. As a result, television possession greatly impacts the audience, a result that supports previous research that television is an important channel for risk communication as it is always up to date and highly trustworthy [11, 15, 18, 19].

Moreover, our study results seem to display the role of community interrelationship. The higher the community interrelationship, the better the warning accessibility and efficacy. These results are consistent with the study of

Table 6. Logistic regression analysis of hygiene warning accessibility and Perception of warning efficacy during flood.

Variables	Hygiene warning			
	Accessibility (N = 3,207,260) (Received warning = 1; Not received warning = 0)		Perception of efficacy (N = 2,049,538) (Good = 1; Moderate & Poor=0)	
	S.E.	Exp(B)	S.E.	Exp(B)
I. Household's Characteristics				
Central	0.005	0.467*	0.006	1.092*
Northern	0.005	0.801*	0.006	1.492*
Northeastern	0.005	0.945*	0.006	1.785*
Southern	0.006	0.287*	0.009	0.492*
Household members	0.001	1.013*	0.001	0.965*
Flood experience	0.003	1.269*	0.003	1.492*
Radio	0.003	0.883*	0.004	1.015*
TV	0.008	1.701*	0.010	1.091*
Computer	0.003	0.895*	0.004	0.977*
Telephone fax	0.003	0.904*	0.004	1.008*
Low community interrelationship	0.005	1.675*	0.008	0.520*
Moderate community interrelationship	0.004	2.681*	0.006	0.812*
High community interrelationship	0.004	3.638*	0.006	1.810*
II. Characteristics of head of the households				
Male	0.003	0.921*	0.003	1.030*
Age 40-59	0.004	1.113*	0.005	0.884*
Age 60 up	0.004	1.145*	0.005	0.940*
High school diploma	0.003	1.160*	0.004	1.013*
Bachelor and higher	0.006	1.426*	0.008	0.915*
Agriculture	0.003	1.005	0.003	1.108*
III. Problem during flood				
Communication problem	0.007	1.456*	0.007	0.837*
Transportation problem	0.003	1.424*	0.004	0.956*
Constant	0.011	0.477*	0.014	0.404*
Nagelkerke R^2	0.118		0.115	

* $p < .05$

Abunyewah et al., which observed that community participation mediates the relationship between information sufficiency and intention to prepare [32].

In other words, community participation is not only the outcome of information sufficiency but also the basis to influence public intentions to prepare for flood hazard.

Therefore, active community participation is a core element of risk communication to the public. In accordance with Mathbor's suggestion [23], it is important to enhance community preparedness for disasters and in building social capital. There are three stages involved in creating and developing social capital. First, bonding within communities; the second is bridging between and among communities; and the third is linking communities through ties with financial and public institutions. Their cumulative effectiveness has proved crucial in mobilizing a community's resources, expertise, professionals, and volunteers, before disaster strikes [23].

Based on the result of the study, more specific information should be provided when communicating to urban areas, while that provided to rural areas should promote dissemination and accessibility.

Finally, households' flood experience is also an important factor in risk communication as disaster experience can increase disaster awareness and consequently preparedness action. Those who do not have such experience may have difficulty perceiving the risk associated with a particular natural hazard [33].

6. Conclusion

The 2011 flood in Thailand caused unprecedented devastation and impacted a wide area too swiftly to prevent huge damage to the economic zone and communities. Hence, it is important to study certain factors to reduce loss and damage, including the risk communication approach, for better handling of the same situation in the future.

The effectiveness of risk communication is not only concerned with information reach to the target audience, but also considers whether information matches audience needs in crisis conditions. It is essential to provide comprehensive and useful information such as safety and health instructions, using appropriate channels to disseminate to the target audience. This study may suggest some details that can be used for disaster management based on its results.

Table 7. Logistic regression analysis of Life and property warning accessibility and Perception of warning efficacy during flood.

Variables	Life and property warning			
	Accessibility (N = 3,207,260) (Received warning =1; Not received warning =0)		Perception of efficacy (N = 1,981,740) (Good =1; Moderate & Poor=0)	
	S.E.	Exp(B)	S.E.	Exp(B)
I. Household's Characteristics				
Central	0.005	0.467*	0.006	1.092*
Northern	0.005	0.801*	0.006	1.492*
Northeastern	0.005	0.945*	0.006	1.785*
Southern	0.006	0.287*	0.009	0.492*
Household members	0.001	1.013*	0.001	0.965*
Flood experience	0.003	1.269*	0.003	1.492*
Radio	0.003	0.883*	0.004	1.015*
TV	0.008	1.701*	0.010	1.091*
Computer	0.003	0.895*	0.004	0.977*
Telephone fax	0.003	0.904*	0.004	1.008*
Low community interrelationship	0.005	1.675*	0.008	0.520*
Moderate community interrelationship	0.004	2.681*	0.006	0.812*
High community interrelationship	0.004	3.638*	0.006	1.810*
II. Characteristics of head of the households				
Male	0.003	0.921*	0.003	1.030*
Age 40–59	0.004	1.113*	0.005	0.884*
Age 60 up	0.004	1.145*	0.005	0.940*
High school diploma	0.003	1.160*	0.004	1.013*
Bachelor and higher	0.006	1.426*	0.008	0.915*
Agriculture	0.003	1.005	0.003	1.108*
III. Problem during flood				
Communication problem	0.007	1.456*	0.007	0.837*
Transportation problem	0.003	1.424*	0.004	0.956*
Constant	0.011	0.477*	0.014	0.404*
Nagelkerke R^2	0.112		0.119	

* $p < .05$

Finally, the study demonstrates the key factors in successful risk communication, which are crisis experience and community interrelationship. Therefore, the planning for risk reduction should take those factors into consideration to learn and attain benefits from personal experience and create higher community relationships to generate effective risk communication.

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Table 8. Summary direction of effect in logistic regression analysis of warning accessibility and Perception of warning efficacy.

Variables	Warning issues							
	Surveillance		Electro.		Hygiene		Life	
	1	2	1	2	1	2	1	2
I. Household's Characteristics								
Central	−	+	−	+	−	+	−	+
Northern	−	+	−	+	−	+	−	+
Northeastern	−	+	−	+	−	+	−	+
Southern	−	−	−	−	−	−	−	−
Household members	+	−	+	−	+	−	+	−
Flood experience	+	+	+	+	+	+	+	+
Radio	−	+	−	+	−	+	−	
TV	+	+	+		+	+	+	−
Computer	−	−	−	−	−	−	−	+
Telephone fax	−	−	−		−	+	−	
Low community interrelationship	+	−	+	−	+	−	+	−
Moderate community interrelationship	+	+	+	−	+	−	+	−
High community interrelationship	+	+	+	+	+	+	+	+
II. Characteristics of head of the households								
Male	−	−	−	−	−	+	−	+
Age 40–59	+	−	+	−	+	−	+	−
Age 60 up	+		+	−	+	−	+	−
High school diploma	+	+	+	+	+	+	+	+
Bachelor and higher	+	+	+		+	−	+	+
Agriculture	−	+		+		+	+	+
III. Problem during flood								
Communication problem			+	−	+	−	+	−
Transportation problem			+		+	−	+	−

Note: 1 represents Model 1, determinants of warning accessibility,
2 represents factors of Perception of warning efficacy.
"+" is positive effect and "−" is negative effect.

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