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A Study on Improvement Plans for Evacuation and Information communication Method through the Awareness Survey of Flood Damage

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Abstract
The cases of abnormal climate such as torrential heavy rain, storm, tidal wave, and drought have been more often observed due to climate changes caused by global warming. Particularly, localized heavy rain causes frequent flooding inside a city. It takes many lives and damages property and even threatens the safety of the residents in a flood risk. Nonetheless, the disaster countermeasures currently in use is nothing more than a code of conduct and even that is not well informed. Therefore, it can be said that disaster response system is not in place properly. Considering this current situation, the present study carried out a survey related to flood damage and found out that the residents in the areas vulnerable to flood have the poor awareness of disaster prevention and also disaster emergency system is insufficient. Therefore, this study was aimed to propose a guideline to water disaster prevention system by conducting a survey to know who citizens are aware of disaster response system.

Keywords: Shelter, Evacuation route, Consciousness Survey, Flood, Water Disaster

Introduction

1.1 Background and objective

As the whole world suffers from climate change, flood more and more causes loss of lives and damage to property. These days, people in the modern society are exposed to the danger of natural disaster as precipitation pattern (100mm/h) has notably changed due to localized torrential rain. Localized torrential rain, which is the most damaging one of many natural disasters, is a phenomenon that a great amount of rain falls concentrating on a certain area in a given short time period. Particularly its intensity of precipitation is threatening. The number of days of localized heavy rain was expected to increase from 2.7 days in 2010 to 3.6 days in 2020 and 4.5 days in 2020 [1]. To respond to flooding, many existing studies have stressed the importance of non-structural water disaster prevention system including water control measure, evacuation strategy, and rescue operation based on effective flood control facility [2]. Recent flooding is characterized with the elevation of concentrated outflow of rain water, forming sudden flooding. Therefore, it is very necessary to urgently prepare a measure to evacuate the residents in flood potential areas since those areas are always exposed to real accidents. Nonetheless, most of existing studies have focused on the economic loss due to loss of lives when a disaster breaks out and reduction factors related storm/flood damages, but few studies have paid attention to the residents' awareness of disaster prevention system information communication system when a disaster takes place. This study assumed that disaster prevention measure has been based on nothing more than a code of conduct and residents' awareness of disaster prevention measure is low. Therefore, this study carried out a survey of disaster response system with the residents living in Nokok-dong, Buk-gu, Daegu Metropolitan City, where is flood risk area and he residents experienced flooding 2 times in a row a year. Based on the findings from the survey, this study attempted to propose a plan to maintain flood disaster prevention system and eventually contribute to reducing loss of lives.

1.2 Scope and Methodology

As a research object, this study chose the residents living in Nokok-dong, Buk-gu, Daegu Metropolitan City to examine the residents' awareness of disaster response system in case of flood damage because the area had experience with flood damage. Nokok-dong is as large as 1.86㎢and 1129 population reside in the district. Since Nokok-dong experienced flooding 2 times in a row, July and August in 2010, the area was considered suitable for the awareness survey of flood disaster prevention system. The respondents were asked about their awareness of current evacuation shelter, evacuation route, accessibility, satisfaction with relief goods provided to refugee residents and preferred items during refuge.

2. The Characteristics of the Research Area and Flooding Response System

2.1 The Vulnerability of the Research Area to Flooding

A total of 15 flood-risk areas are designated in Daegu Metropolitan City according to by Countermeasures against Natural Disaster Act. By district, Buk-gu (Northern District) has the most flood-risk areas 5. Particularly, this district recently suffered from damages by localized heavy rainfall 2 times in a row and recorded flood damage on 9000㎡s land including about 60 houses. Geographically, the district

borders on Geumho River (national stream) and Sincheon stream, Donghwa stream, and Palgeo stream (local streams). Besides them, 8 more small streams flow in Buk-gu (Northern District). In the district, this study chose the flood-risk area that had experience water damages by both inland and river inundation in the past and is designated as flood-risk area. Briefly looking into the characteristics of flooding risk of the research area, it has a shape of a valley; localized heavy rain of 48.5mm/h peak flow(flood) of 20.73m3/s; and high possibility of sewer maintenance system clogged with inflowing earth and sand when raining. In addition, it has a high chance of flow reversal of river water, which can cause inundating risk [2].

2.2 Survey of the Flooding Response System

Nokok-dong experienced 2 consecutive flooding accidents due to the overloaded separator and the clogged screeners when localized heavy rain (75mm/h) occurred in July and August, 2010. Consequently, 62 building units and 118 vehicles were waterlogged and 14 people were injured as the first damage. As the second, damage, 82 building units and 48 vehicles were flooded and 8 people were injured [3]. The Disaster and Safety Countermeasures Headquarter of Buk-gu, Daegu Metropolitan City made efforts against flooding disaster by issuing the residents' disaster evacuation guideline and installed the guiding signs and boards for evacuation shelter and route (Figure 1). The issues describe the period of possible flooding accident due to abnormal heavy and torrential rainfall and the procedure of resident evacuation to minimize loss of lives. Figure 1 displays in diagram the residents' evacuation guideline and procedure issued by Nokok-dong office. According to them, announcement is broadcasted first to the residents when flooding is expected with the water level of Geumho River rising up by heavy rain. When flooding breaks out, evacuation announcement is broadcasted to the residents and they are guided to the first evacuation shelter. The disaster countermeasures are divided for 2 scenarios: when flooding lasts long and when it comes to end. In case that flooding (is expected) lasts long, they are guided to evacuate to the second evacuation shelter and relief work is served to them.

Figure 1:Residents Disaster Preparedness Actions Signs in Nogokdong, Buk-gu, Daegu

2.3 The Current Status of Evacuation Shelter and Route in Target Area

Figure 2: Designation of Shelter and Evacuation Routes in Nogok-dong, Buk-gu, Daegu

Currently, there are 3 evacuation shelter (Kim, Lee, and Cho) in the Northern District of Daegu Metropolitan City. Table 1, below, shows the capacity, size and location of the evacuation shelters currently in preparation and Table 2, above, shows the current status and evacuation routes of the present evacuation shelters.

Table 1:Designation of Shelter in Nogok-dong

Classification	Owned by kim	Owned by cho	Owned by lee
capacity	about 100 person	about30 person	about40 person
area	1, 101.00㎡	464.00㎡	182.00㎡
location	altitude 48m	altitude 43m	altitude 42m

In the first flood-risk area in Nokok-dong, 59 residential buildings including 2 basement buildings for residential purpose were waterlogged and 38% of the town including part of the roads was damaged in the last floods. Looking into the characteristics of those evacuation shelters and evacuation routes, it is known that evacuation is only possible because the width of the path is narrower than 2 meters in the mountain area and the ground of the path is not leveled off. Therefore, vehicles like an automobile can't have access to them. Furthermore, it was found that travel between the villages was limited because the road located in the center of 'a' seen in Figure 3 was flooded, which isolated the residents located in the middle of the roads (1, 2, and 3).

Figure 3:Topography and Flooding Simulations in Nogok-dong, Buk-gu, Daegu[2]

3. The Survey of the Flood-Experienced Residents' Awareness of Flood Damages

3.1 The Summary of Survey

Table 2: Survey of Gender and Age Distribution

Classification	31~40 Age		41~50 Age		51~60 Age		65Older Years	
	Male	Female	Male	Female	Male	Female	Male	Female
Number of Person	2	0	5	0	7	4	5	7
Rate	6.7 %	0	16. 6%	0	23. 4%	13.3 %	16. 6%	23.4 %

The items of the survey are categorized into 3 areas: evacuation shelters; awareness of evacuation routes and accessibility; and emergency contact system in disaster. Nokok-dong was selected as the research area. 30 residents were randomly sampled without consideration of sex and age. The proportions of the samples by sex and age are as follows: males (63%) and females (37%), and those who are in their 51-60 at age take 37% of the total respondents and followed by those (40%) at their 65 or older as seen in Table 2.

3.2 The Composition of the Questionnaire

Table 3: Contents and Classification of Survey

Classification	Contents
Awareness Response to Flood	The presenceof flooding experience. The awareness of evacuation facilities when flooding happened. The awareness of evacuation routes when flooding happened.
Shelter and Evacuation Route	The propriety of evacuation facilities. The cause of unaccessibility to the shelter. User satisfaction level of the evacuation facilities. The problems of evacuation facilities. Satisfaction level of the evacuation facilities' function.
Method for Information Delivery in Disaster	Types of communication tools. Preference of the communication tools. The recognition existence of communication tools.

The questionnaire is mainly divided into 3 areas of question: awareness of and response to flood; evacuation facility and routes; and information communication system in disaster. First, the part of the awareness of and response to flood, the flooding consist of the questions about experience with flood accident, evacuation facility and evacuation routes. As for evacuation facility and routes, the respondents were asked about the adequacy of evacuation facility; reasons for not having access to the facility; satisfaction with the use of evacuation facility. Last, the sampled residents were asked to answer about their opinion on information communication system: kind, awareness, and preference.

4. Analysis of Survey Result

4.1 The Residents' Experience with Flood Damages and Awareness of Evacuation Shelter

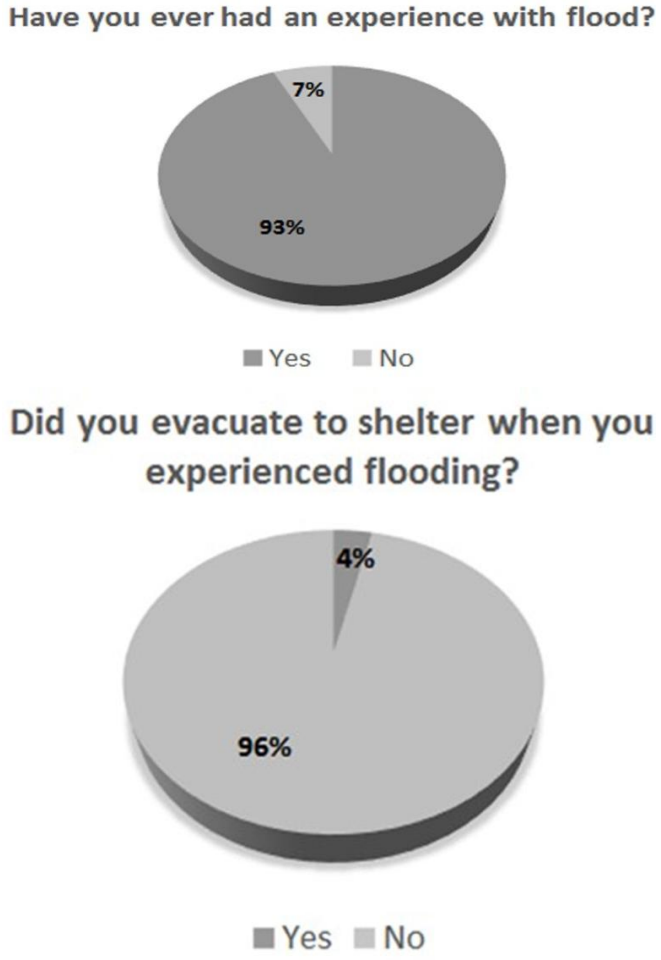

Figure 4:Awareness Response to Flood

According to the results of the survey, only 2 out of 30 respondents answered they hadn't experienced flood (Q: Have you ever had an experience with flood?). And only one of 28 (flood-experienced) respondents had actually evacuated to an evacuation shelter. It was found that most of the refugees had been isolated on a top before evacuating to the shelter or were not aware of the location of the evacuation shelters. Some of the evacuation routes were as narrow as 2 meters and of unpaved roads, so they were not appropriate for evacuation. In addition, a few of residents were not clearly aware of the evacuation shelters and even those who answered they knew the evacuation shelters referred to civil emergency shelters. The civil emergency shelters were located within the research area and they are not suitable as evacuation shelter for flood damages.

4.2 The Awareness of Evacuation Shelters and Routes in the Flood-Risk Area

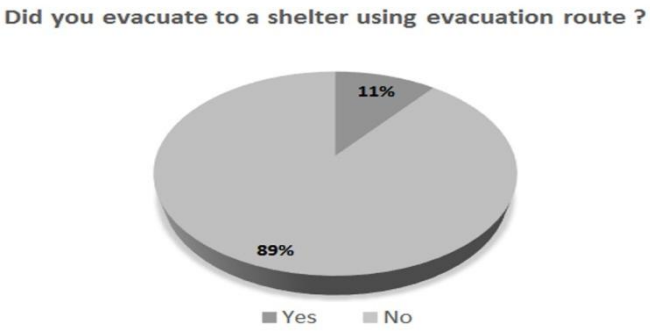

Figure 5:The Experience of Shelter and Evacuation Route

To the question "Did you evacuate to a shelter using evacuation route?" in figure 5, 25 respondents answered 'No" while only 3 said, "Yes". According to the results, it was known that the residents had a very low awareness of not only the evacuation shelters but also the evacuation routes.

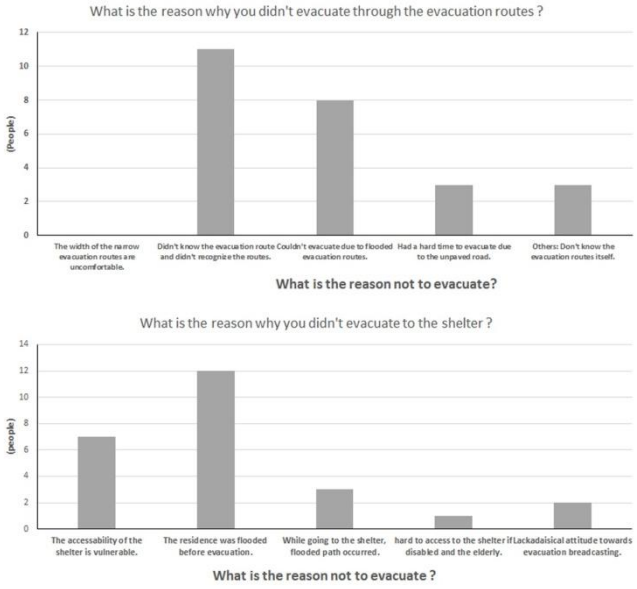

Figure 6: The Reason why didn't Refuge to the Shelter and Evacuation Route

Moreover, as seen in Table 5, most of the respondents explained that the reason why they failed in evacuating and using the evacuation route was that they didn't know where the evacuation shelters and the routes were or isolated even before evacuation. "I was isolated even before trying to evacuate' was the most reason for evacuation failure and 'I didn't even know there was an evacuation route' was the most reason for evacuation failure through the route. Some plans can be suggested like below to improve the low awareness.

1) Establishment of Pre-Evacuation System for Residents in Flood-Risk Area
It is to evacuate the residents to an evacuation shelter in a flood-risk area in advance when flood is expected. At present, there are the guiding signs for the residents' evacuation action in diagram in Nokok-dong.
Using it, advance evacuation will prevent the residents from being isolated in flood.

2) Designation and Management of Evacuation Routes and Orientation and Training about Them
Evacuation routes should be clearly designated and widely announced to elevate the residents' awareness of them. In addition, the public servants in the flood-risk area should provide the residents with education and training about the evacuation routes.

4.3 The Residents' Awareness of Disaster Information Communication Methods in Disaster

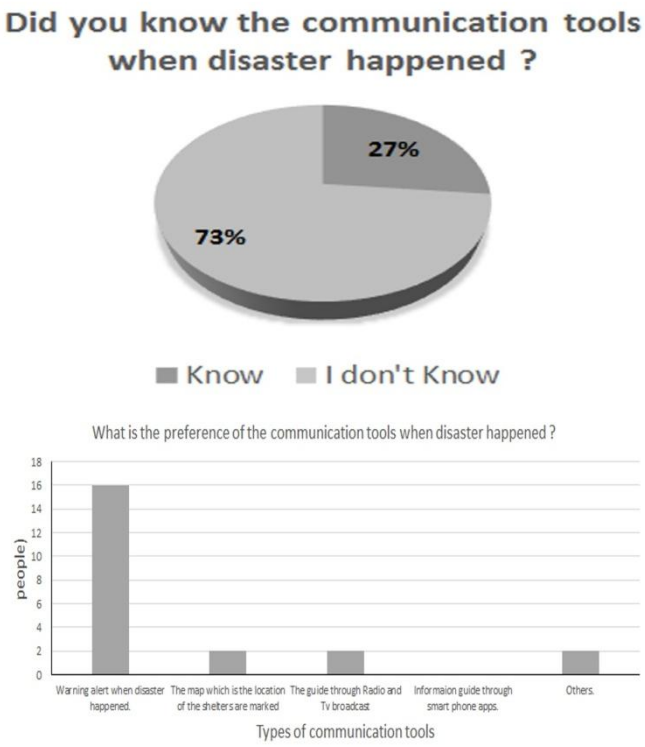

Figure 7:Types of Communication Tools in Disaster

The survey asked 28 residents with the experience of flood damage "Do you know what means of information communication is used in case of disaster?" It turned out that only 7 out of 28 respondents knew it and the rest 21 answered they didn't know what communication means is used in disaster. And this question "Which information communication methods do you prefer to choose in case of emergency?" was asked to the 21 respondents who answered they knew the information communication methods that was used. In the survey of the awareness of the residents, evacuation shelters and evacuation routes were asked about because it was thought that their awareness of emergency contract system was as important as evacuation facility. As seen in Table 8. The results of 'the residents' awareness of information communication methods in disaster' showed that only 8 residents answered "I know" and the rest 22 said, "I don't know". It indicates that the residents could be panicked in an real situation of disaster because of not knowing the information communication methods. The results of 'their preference to the means of information communication in disaster' showed that more than a majority of respondents (N=16) mentioned 'warning siren for the breakout of a disaster' and it was followed by 'It is good for a public servant to visit a house directly and tell where to evacuate', which is understandable when considering that most of the residents are senior citizens in the flood-risk area.

Conclusions

With the residents in Nokok-dong, Buk-gu, Daegu Metropolitan City, where suffered two flood accidents in a row, July and August in 2010, the present study conducted a survey of awareness regarding flooding. In the survey, the respondents were asked about evacuation shelters and routes, accessibility, and the information communication means in a disaster.
This study found out that 93% of the residents in the flood-risk area experienced flood damages and 96% of the flood-experienced residents couldn't evacuate to an evacuation shelter. In addition, it turned out that most of the residents who failed to evacuate to the evacuation shelter or use evacuation route were isolated in flood while traveling to the evacuation shelter. Moreover, they lacked in the knowledge of the evacuation routes. The responses to information communication means (presence and preference) demonstrated that 75% of the residents were not aware of information communication means. And the residents answered that 'warning siren' is the most appropriate tool for warning the breakout of a disaster. In conclusion, this study verified that the residents in the flood-risk area have a low awareness of flood prevention countermeasure' and even didn't know the whereabouts of evacuation shelters and routes despite 2 consecutive flood accidents. It found a serious weakness in the current disaster response system. Accordingly, this study found it a need to conduct a survey with water victims' awareness of disaster response system and to develop a study into the extent where it can propose disaster prevention standards.

Acknowledgments

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