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Improvement of Flood Disaster Information Map using the Spatial Inundation Data

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Abstract

Abnormal weather patterns around the globe are causing local torrential rain, which in turn, result in heavy human and property damage. Designated shelters and evacuation routes are provided to the public to mitigate damage but the survey indicates that more than half of them are located in areas that were flooded or have signs of flooding in the past. Objective of this study is to suggest consideration and improvement about location problem of current set shelters and lack of evacuation routes' provision. For this, survey and analysis were conducted for 60 designated shelters and around 40 evacuation routes in Gangseo-gu, Seoul, which was selected as high-risk district prone to natural disasters in 2011, and eventually suggest new ways to designate shelters and evacuation routes.

Keywords: Shelter, Evacuation Routes, Flooding Forecast Map, Flooding Inundation trace Map, Flood-Disaster Information Map

1 Introduction

1.1 Background and objective

Changes in rainfall patterns sparked by extreme weather patterns around the world and environmental issues associated with global warming have become a hot public issue. Various disasters caused by such environmental changes oftentimes lead to serious human and property damage, which can be mitigated by providing concrete and accurate information [1][2]. Aware of such, Seoul City provides map on flood and storms as well as information on shelters, evacuation routes and areas at risk of flooding when a rain pours by more than 95mm/h in Safe Seoul (safecity.seoul.go.kr) homepage [3]. The map providing information on flood and storms by Seoul City, however, does not provide enough information on shelters and evacuation route or are just inappropriate [4][5]. This study aims at surveying and observing shortcomings of shelters in Gangseo-gu and suggesting alternatives for improvement by referring to flooding inundation trace maps, flooding forecast maps and shelters to avoid flood damage.

1.2 Scope and methodology

This study gathered data from Gangseo-gu, which is the district selected as high-risk district prone to natural disasters in 2011, with the goal to classify and identify problems associated with flooding shelters and evacuation routes in Seoul [4]. It particularly focused on evacuation during flooding in shelters based on literature survey and preceding studies [6] by the research team and surveyed evacuation routes in addition. The study referred to flooding inundation trace maps, flooding forecast maps, flooding shelters and evacuation routes provided by Safe Seoul [3] to identify 60 shelters and around 40 evacuation routes, revise existing spots and routes, designate new shelter facilities and make improvements in existing routes as seen in Fig. 1.

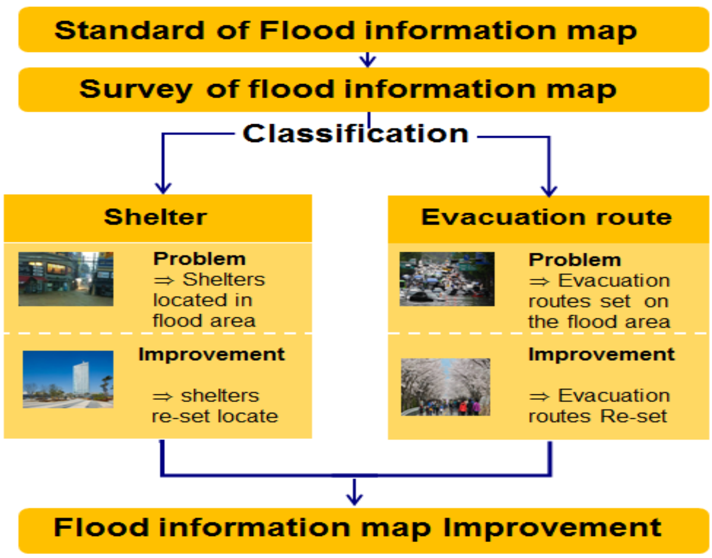


Fig 1. Flow of the study

2 Survey on Flood Information Map

2.1 Survey in provided cases of storm and flood information map

Fig 2. Flood Information Map of Seoul

Flood information map (figure 2.) by Seoul City is provides information on various disaster situations such as flood damage, snowplow, shelter, storm and evacuation routes in a web [3]. It also provides information on preventing flooding by sharing flooding in inundation trace map and forecasting flooding. Gangseo-gu has 60 flooding shelters of which 36 are in senior citizens centers and 24 in schools.

2.2 Standard of shelters' location and evacuation routes

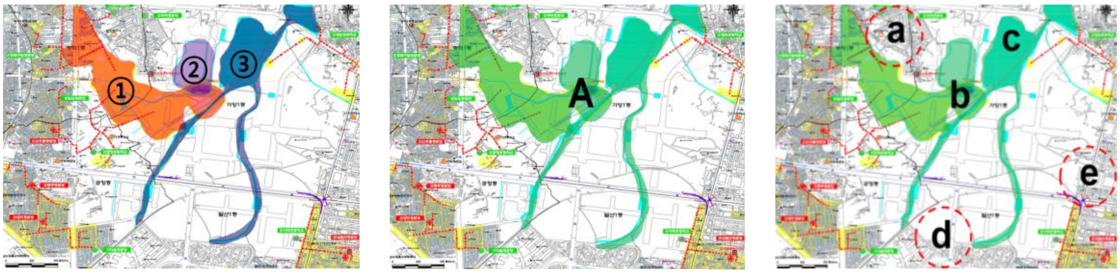
This study surveyed shelters located in five 'dongs' (Bang-hwa 1, 2-dong, ebalsan 1, 2-dong, Hwagok1-dong) classified as high-risk 'dongs' out of 22 'dongs' in Gangseo-gu. It also focused its survey on 60 shelters and around 40 evacuation routes to divide the area into high-risk ones and low-risk ones.

Table1. Flooding Information on Evacuation Route and Shelter

Classification			Shelters No.																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Flood prediction	2010	Evacuation Routes	o		o		o	o	o		o		o	o	o		o	o	
		Shelter	o		o		o	o	o		o		o	o	o		o	o	
	2011	Evacuation Routes	o									o	o						
		Shelter	o									o	o						
Flood experience	Evacuation Routes		o			o			o		o	o			o	o	o		o
	Shelter			o	o	o				o		o				o			o
No path	Evacuation Routes			o	o		o	o		o				o				o	

Extra survey on flooding vulnerability of evacuation routes in addition to flooding survey on risk in shelters that was covered in preceding studies is summarized in Table 3 below. 17 shelters prone to flooding out of 60 shelters surveyed were then classified and their evacuation route identified.

3 Improvement of Location and Evacuation Routes in Flood Information Map



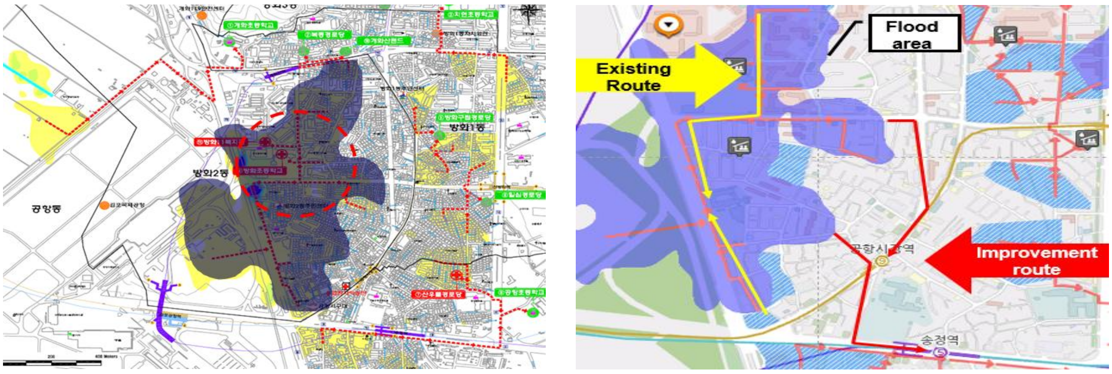
a. Shelter Area Setting b. Risk Area Merging c. Risk Position

Fig 3. Concept of Selecting Method of Shelters

A new way to divide shelters and evacuation routes as far as shortcoming of shelters and evacuation routes in areas with flooding history and traces was suggested to improve location and routes in storm and flood information map.

First, location of shelters in areas with flooding history and traces. One of the ways to solve the problem is overlap flooding-related geometric information in ①, ②, ③ as shown in Figure. 3(a). ① is where shelter is located in an area likely to see flooding and ② is where shelter is located in an area that was flooded more than twice. ③ is where shelter is designated in an area with a flooding inundation trace. ①, ②, ③ figure information can be merged into a single A as shown in Figure. 3(b) and geometric information can be used to segregate high-risk areas. Overlapping of geographical information, buildings in which shelters and emergency routes can be located and their location based on data already established can be used to exclude b and c found in high-risk areas as shown in Figure.3(c) and select a, d and e as candidate sites.

Second, designation of evacuation routes in areas with flooding history and trace. One solution is to designate flooded evacuation route as shown in Figure. 4(a) as high-risk area. The area designated in figure. 4(b) is close to Bang-hwa Elementary School in Bang-hwa2-dong, which is notorious for flooding in Gangseo-gu. Designating the classified area as high-risk area with flooding history or inundation trace as shown in Figure 4(b) can let the public view it as an obstruction. Routes perceived as an obstruction are dropped out as route identification is shut off and is excepted from route selection candidate. Evacuation routes around areas shut off are then surveyed to select the route closest to the shelter. Route conditions and safety are surveyed and confirmed before it is set as the final evacuation route as shown in Figure. 4(b).



a. Designation of Evacuation Route 'high-risk' Areas **b. Newly Improved Evacuation Routes**

Fig 4. Concept of Selecting Method of Evacuation Route

4 Conclusion

This study surveyed and classified selection of shelters' location and evacuation routes based on areas likely to be flooded and those with flooding inundation traces in Gangseo-gu, Seoul, which is one of the high-risk district prone to natural disasters in Apr. 2011. Standard of classification is flooding history and inundation traces and based on this, shelters and evacuation routes are classified. Accordingly, the study surveyed 60 shelters and around 40 evacuation routes in Gangseo-gu, and classified them according to flooding history and inundation traces, which led to the selection of 17 shelters with frequent flooding history. Among them, location of shelters in areas occupying more than 53% was classified as high risk area and around 41% did not even present evacuation routes. This shows that the existing flood and storm information map does not provide full or appropriate information on evacuation routes and problems associated with selecting shelter location. Hence, one of the ways to improve process of selecting shelter location and evacuation route is to develop automation model using GIS program, which will hopefully improve local government's ability to provide technical information and properly counter disasters.

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