

GEOSPATIAL FLOOD VULNERABILITY FOR DECISION SUPPORT SYSTEM

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ABSTRACT: Every year, most area in Thailand were severely submerged. The assessments of the spatial vulnerability, as well as their impacts on people and physical damages within a region, have been needed in order to characterize and map spatial distribution for rehabilitation after disaster. Accordingly, geospatial flood vulnerability is a one of methodology for providing necessary information to support decision and policy makers for allocating resources, including preparedness, mitigation, disaster response funding, and infrastructure improvement. The study has recently applied this methodology to examine and to assess the potential effects on flood vulnerability in Phra Nakhon Si Ayutthaya province, which is the area of well-known cultural heritage, major paddy field and one of affected area. Spatial information of inundated area, derived from space technology, is a main data to be used for flood vulnerability because of a reliable information and high degree of accuracy with rapidly and repetitively. These data have been spatially analyzed and integrated with other indices from various data sources of physical and social effects, such as land use, heritage, school, household and population density, including flood's compensation, to generate mapping of flood vulnerability for decision support system.

1. INTRODUCTION

Flood is a costly hazard a major loss of human lives, including the destruction of socio-economic effects. Phra Nakhon Si Ayutthaya, or Ayutthaya as widely known, is a one area which has fully been submerged every year. Their impacts on people and damages have been needed to characterize and map of spatial vulnerability in terms of physical, social, and economic vulnerabilities. Accordingly, geospatial flood vulnerability has been utilized for providing necessary spatial information to support decision and policy makers. There are crucial to the effectiveness and efficiency for flood hazard assessment with a high degree of accuracy and reliable. Flood prone area, derived from space data integrated with auxiliary data in geographic information systems (GIS), are particularly effective for identification and mapping of flood vulnerability to prioritize and to assess the impacts of flood to people living in the area with respect to the socio-economic effects in support of flood rehabilitation. Therefore, geospatial information also enables the authorities, decision-makers and planners to monitor and to evaluate effectiveness of rehabilitation and compensation for flood sufferers.

As a result, the study has been attempted to integrate flood hazard, in terms of flood frequency and space-based data, with socio-economic data as well as the communes living in their areas in a GIS environment for flood vulnerability, in Phra Nakhon Si Ayutthaya province. The final result was flood vulnerability, to be used for reducing physical and socio-economic effects and to support decision-making in rehabilitation and relief activities.

2. OBJECTIVES

To examine and to assess the potential effects on flood vulnerability in Phra Nakhon Si Ayutthaya province

3. STUDY AREA

Phra Nakhon Si Ayutthaya (or Ayutthaya), the area of well-known cultural heritage, is in the central of Thailand, which is located in the flat river plain of the Chao Phraya river. The presence of the Lop Buri and Pa Sak rivers makes the province a major rice farming area. Ayutthaya's people were originally farmers.

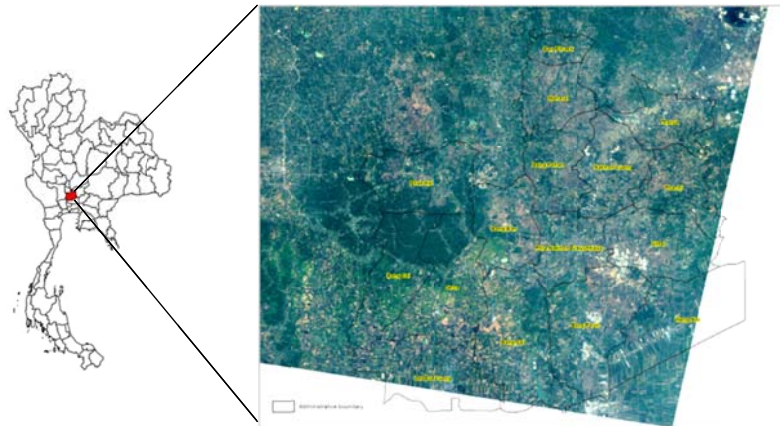


Fig. 1 THEOS image over Ayutthaya (prior flood)

4. METHODOLOGY

The study has been examined spatial analyst of GIS technology to assess physical, social, and economic vulnerability from flood. It could be divided into 3 steps as follow.

Step I - Data collection and manipulation: All data of physical, social, economic data, both spatial and non-spatial data, are available from relevant authorizes, were collected, which was collated in geo-database. The GIS contains of land use, school, hospital, cultural heritage, factory, demographic, including summary report of damage from flood situation of Disaster Mitigation Center, Department of Disaster Prevention and Mitigation (DDPM). Moreover, flood prone area derived from space based data during 2006-2010 and houses' enumeration by using pinpointing from high resolution satellite data were integrated and analyzed to generate flood hazard exposure and vulnerability indicators, represented in the GIS applications.

Step II – Data analysis: Spatial analyst of GIS technology has mainly been utilized to assess flood vulnerability of physical, social, and economic effects. Spatial information of flood prone areas as the degree of damage is a main data to be used for flood vulnerability. These data have been spatially analyzed and integrated with other indices. The results of each function obtained from GIS technology were then verified through vulnerability assessment.

Step III – Data visualization: The vulnerability of each effect was to be generated maps of physical, social, and economic vulnerability. Their maps, then, were to be overlaid and presented mapping of flood vulnerability for decision support system.

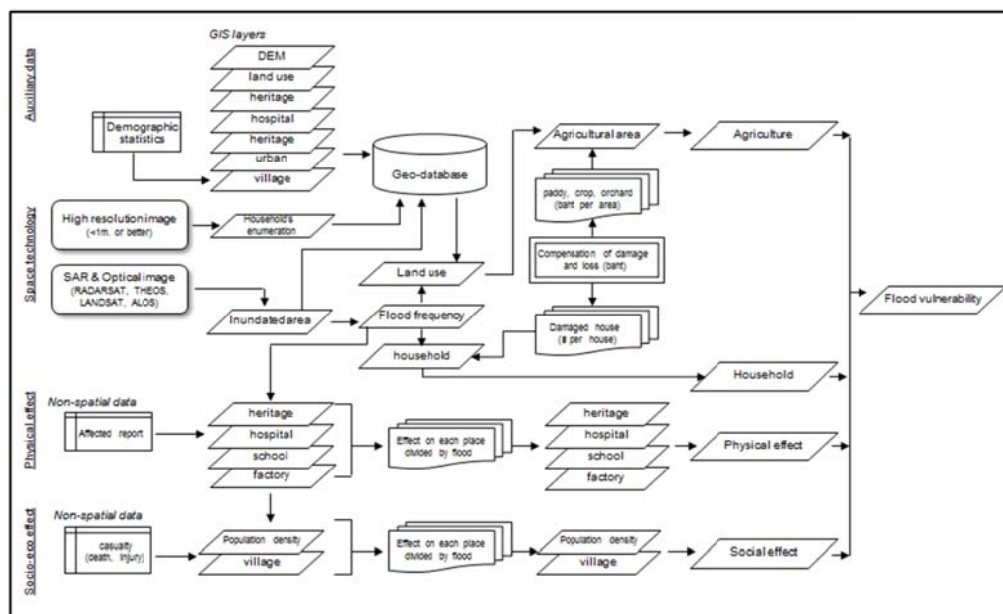


Fig. 2 Geospatial flood vulnerability for decision support system

5. RESULTS

The results of the study were divided into 3 sections are as follow.

5.1 Physical Vulnerability

Flood prone area, during 2006-2010, was utilized to assess flood frequency as a degree of damage area. The results revealed that an area of 257,145 hectares over all districts was severe submerged, especially the western part of Ayutthaya usually covered by flood. However, some areas of 23,838 ha in the central Ayutthaya were dry because the great places, such as cultural heritage, pagodas, religious building, including downtown, are located in the area.

Flood frequency was used to be geospatial data for query locations of affected places. All places, then, were divided into 5 degrees of damage, as shown in Table 1 and Figure 3. It showed that at least 100,000 of affected places had critically been hit by flood.

Table 1 A number of affected places suffered from flood

Flood frequency	Affected Places						
	House	School	Hospital	Religious place	Heritage & tourist	Factory	Total
1-year	48,855	475	506	604	57	827	51,324
2-year	36,939	350	328	430	27	658	38,732
3-year	8,661	132	135	156	8	232	9,324
4-year	1,336	87	72	101	2	98	1,695
5-year	269	37	31	41	1	36	415

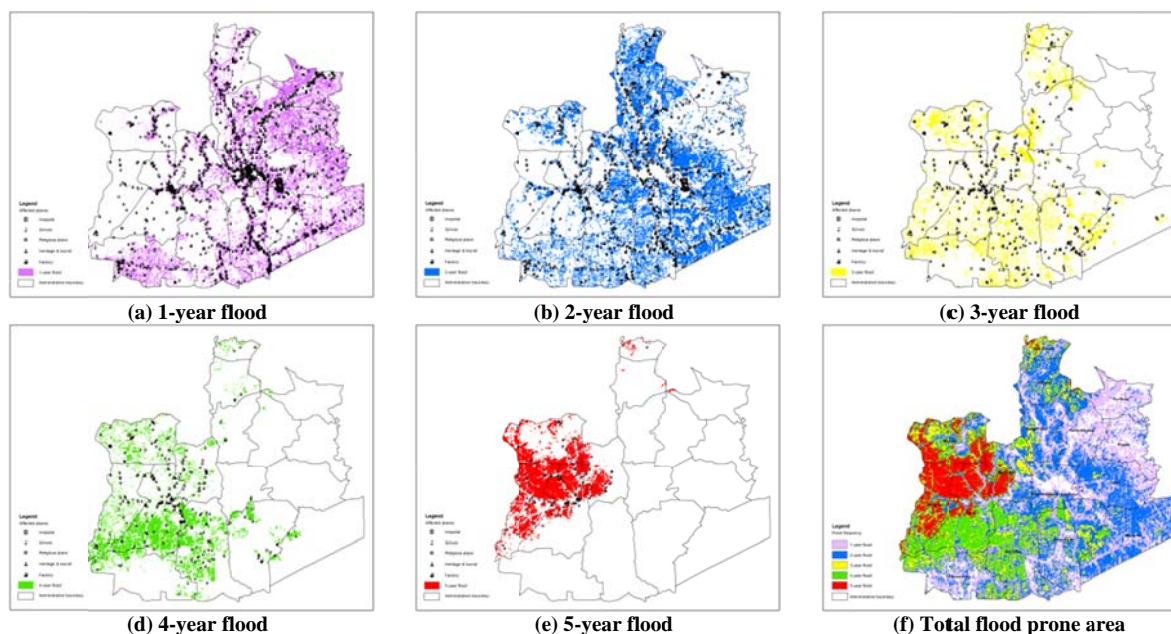


Fig. 3 Geographic distributions of affected places over flood frequency

5.2 Social Vulnerability

Demographic data is mainly utilized for exploration to assess affected people from flood. The total population was 775,157 (as of 31 Dec. 2009), divided by an area of 2,547.32 square kilometer yields a density of 304.31 people per sq.km. In case of flood, the study showed that the highest population density found in Phra Nakhon Si Ayutthaya district with 648.82 people per sq.km., Tharuea (342.89), and Bang Pahan (277.93), respectively. The affected people was found in female than male (Figure 4a-b). While DDPM's report noted that 29 flood victims which most of them or 51% with a head of the family were deceased, as shown in proportion of casualties with Figure 4-c.

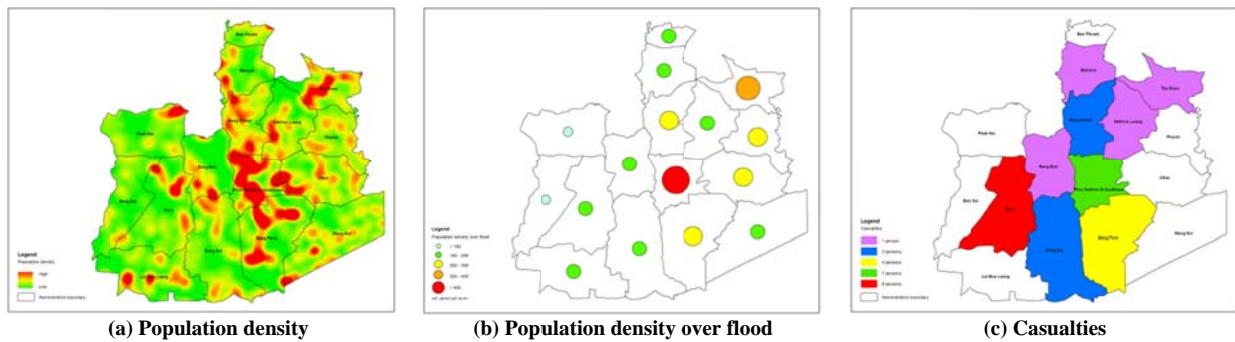


Fig. 4 Population Density and casualties from flood

5.3 Economic Vulnerability

Flood rehabilitation are required and needed to recover in the affected area. Thus, the Cabinet has allocated budgets for compensation of house, agricultural products, and casualties. First, for damage house, a 20,000-THB have been allocated for each house. The residents affected by the flood in province which account for 105,743 houses are expected to receive this financial aid. Total houses' compensation was 2.11 billion THB (or 7.04 million USD). Next, a 5,000-THB compensation money have been provided for each family. The study found that, the values of compensation more than 152 million THB (5 million USD approximately) are expected to be given to those whose homes have been severely damaged. In case of casualties, a 25,000 THB have been provided to flood death's victims and if they were a head of the family, their family would receive a 25,000 THB. So the compensation of casualties was 2.2 million THB (or 73,000 USD). Figure 5-a,b showed the geographic distribution of social's compensation. Third, the losses of agricultural products, the Cabinet's policy has provided the allocation of budgets for paddy, crop, orchard, fish farm, and shrimp farm with 606 837 912 3,406 and 9,098 THB per rai (or 3,787.5 5,231.25 5,700 21,287.5 56,862.5 THB per ha), respectively to relief for flood-affected farmers. Thus, the existing land use in 2009 has been applied to assess affected area which is characterized mainly by paddy. The results revealed that the highest compensation was located in paddy field with 1.73 billion THB (or 57 million USD), orchard (173 million THB), and aquaculture (125 million THB), and crop (a half million THB), respectively. The total economic compensation was up to 2.03 billion THB or 67 million USD (Figure 5-c).

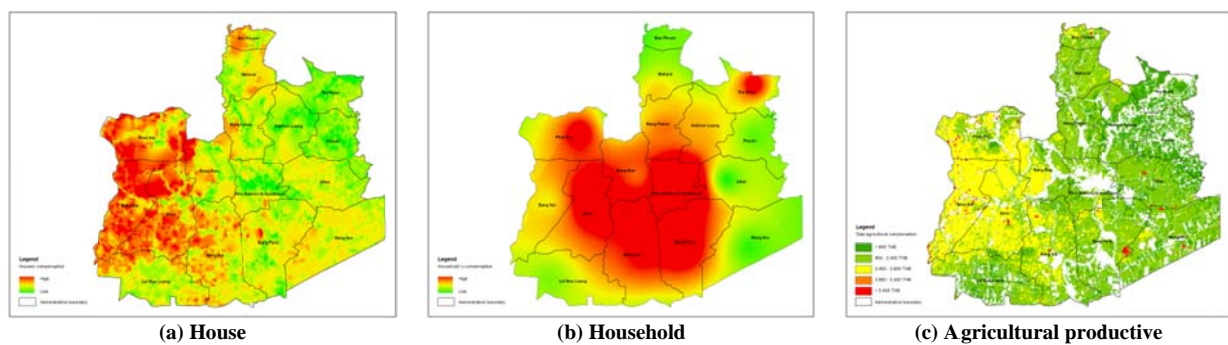


Fig. 5 Compensation of losses from flood

Three maps of physical, social, and economic effects were overlaid to make flood vulnerability, the map revealed that the high flood vulnerability was mostly found in Phra Nakhon Si Ayutthaya, Bang Pa-in, Bang Pahan, Sena and Bang Sai districts with an area of 39,061 ha. The moderate vulnerability was most areas of Bang Ban, Bang Sai, Phakhai, Wangnoi districts with 188,703 ha. The low vulnerability was located in the Lat Bua Luang, Nakhonluang, and Phachi districts with 29,183 ha. The map was as shown in Figure 6.

