CANTHO UNIVERSITY

VULNERABILITY TO FLOOD IN THE VIETNAMESE MEKONG DELTA: MAPPING AND UNCERTAINTY ASSESSMENT

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Introduction

The Vietnamese Mekong Delta (VMD) is located at the end of the Mekong River (Figure 1) which is one of the 10th largest rivers in the world. It plays an important role, especially in terms of food security for not only Vietnam but also the world. However, the VMD is heavily impacted by the annual flood and even stronger after different projected climate change scenarios; particularly it is estimated the most vulnerable delta in the world. Beside, flood patterns would be changed due to climate change and sea level rise so flood hazards and flood risks also change. Therefore, the objectives of the study were:

(1) To identify priority areas for flood adaptation and mitigation,

(2) To provide an insight to local governments in the VMD in changes of future flood.

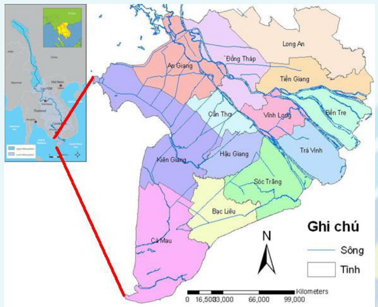

Figure 1. Location of study area, the VMD

Methodology

1. Hazard

In the future, there would be projected sea level rise (increase up to 30cm for the both East and West sea with reference to that in 2000 (scenario B2). In addition, there would be two scenarios projected for the water discharge in Katie, Cambodia, developed by Mekong River Commission; Scenario 1: Discharge projected according to the adjusted regional climate model without any development in the Upper Mekong Basin; Scenario2: Discharge projected as in Scenario 1 but with the development of the Upper Mekong Basin after 2030.

The results from 1D model were used to create (flood) hazard maps. There were many indicators to define flood hazard, including flood depth, flood velocity, flood inundation, flood frequency, etc. However, flood depth is the most important indicator. In addition, due to the limitation of the 1D model, the remaining indicators were not used (e.g. flood velocity, flood inundation, flood frequency). The hazards, therefore, were done by using only flood depth indicator.

2. Vulnerability

Flood vulnerability was assessed by using Coastal City Flood Vulnerability Index (CCFVI), with developing based on exposure, susceptibility and resilience to flood. The data were collected via available sources through the internet. Raw data of each indicator was standardized. Depending on positive or negative effect to vulnerability indicators were used Equation 1 or 2, respectively.

$$x_{normalised} = \frac{x_i}{x_{max}} \, (1) \quad x_{normalised} = 1 - \frac{x_i}{x_{max}} \, (2)$$

The standardized results of all indicators would be multiplied with weight of each indicator which depends on their importance to vulnerability in the VMD. The CCFVI were calculated by Equation 3.

$$Vulnerability = Exposure + Susceptibility - Resilience (3)$$

3. Risk

Flood risks were identified depending on hazard and vulnerability values (presented in Equation 4).

$$Vulnerability = Exposure + Susceptibility - Resilience (4)$$

4. Uncertainty

In the study, measurement of vulnerability uncertainty was done by using weight of indicators as an estimated parameter. The values of weight would be changed in range of weight ± 1. After that vulnerability values were identified based on changed weights.

Results

1. Hazard maps

Comparing to hazard map of the 2000-flood, hazard areas would increase about 4.82% and 2.59% in scenario 1 and scenario 2, respectively (Figure 2). There were insignificant increases of hazard in the future. However, high hazard would concentrated the coastal areas of the East sea where are rarely impacted by the annual flood.

2. Vulnerability

The provinces in the coastal areas along the East sea had higher vulnerabilities than other provinces due to sea level rise, long coastal line and storm surge. On the other hand, An Giang and Dong Thap had great experience for adaptation to flood so they got low vulnerabilities (Figure 3).

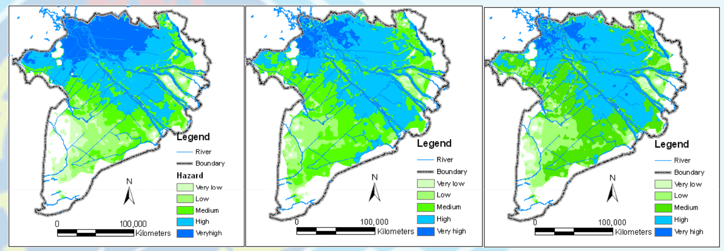

Figure 2. Hazard maps of recent large flood (2000) and future flood (2050) scenario 1 and 2 from left to right respectively.

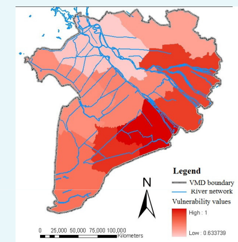

Figure 3. Vulnerability map of the VMD

3. Risk

In the future, risk areas would concentrate in the upstream of the VMD, along the Mekong and Bassac River due to annual flood while Tra Vinh province in the coastal area of the East sea due to sea level rise (Figure 4).

4. Uncertainty

Although there were changes of the vulnerability index (Figure 5), provinces along the coast of the East sea also would be the most vulnerable areas.

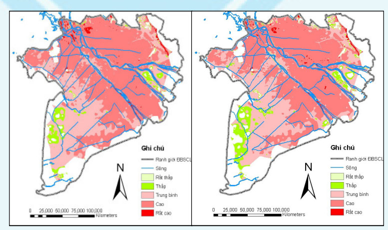

Figure 4. Risk maps of future flood (2050) scenario 1 and 2

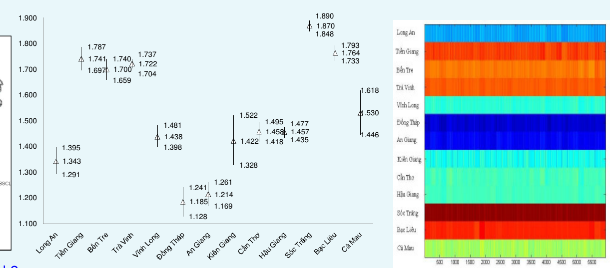

Figure 5. Uncertainty ranges of vulnerability of provinces in the VMD