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Assessment of flood hazard areas using Analytical Hierarchy Process over the Lower Yom Basin, Sukhothai Province

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Abstract

Flood hazard map is essential tool to assess susceptibility of flood prone area. The present study focuses on an assessment of flood hazard areas in Sukhothai province of Thailand where it has suffered from flood in every year with different extents. Spatial analysis in GIS environment has been applied for the estimation of flood risk zones in which six relevant physical factors have been selected namely, rainfall amount, slope, elevation, river density, land use and soil permeability. The relative importance of physical factors has been compared in pairwise matrix to gain the weight values during the process of Analytical Hierarchy Process (AHP). The flood hazard zones have been mapped according to their weights. It has been found that Muang, Kongkrait, Khirimat and Sisamrong districts are identified as the high risk zones of flood.

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1. Introduction

Flood is one of the natural disasters that cause a damage worldwide [1]. In 2011, Thailand has also suffered from a massive flood event of their histories [2]. There were five tropical storms and three strong low-pressure systems that occurred between June and October 2011. The Chao Phraya River basin (CPRB), the largest basin in Thailand, has been flooded causing more than 700 people killed. The estimation of total damage loss by the World Bank was around 1.36 trillion baht.

Flood hazard map is a tool for assessment of flood vulnerability to understand a level of susceptibility to being harmed [3]. In order to identify a degree of the susceptibility, flood hazard map can be constructed on the basis of physical and ecological systems in the environment of Geographic Information Systems (GIS). GIS is effective tool to determine the high risk of flood prone areas down to small hydrological basins. In addition, GIS has its capability to manipulate multi-dimensional phenomena of natural hazards using spatial component [4].

The physical factors used in GIS needs to be associated with a procedure referred to as multi-criteria analysis (MCA) that weights the parameters logically. One of the methods to determine the relative importance of the factors is Analytical Hierarchy Process (AHP) [5, 6] that has been used in many applications [7, 8, 9] In this study, we aim to model a flood hazard area using spatial multi-criteria index to understand the relative importance of the parameters used. Then, the produced flood hazard map is compared and discussed with an observed flood extent from secondary data source.

2. Study area and data

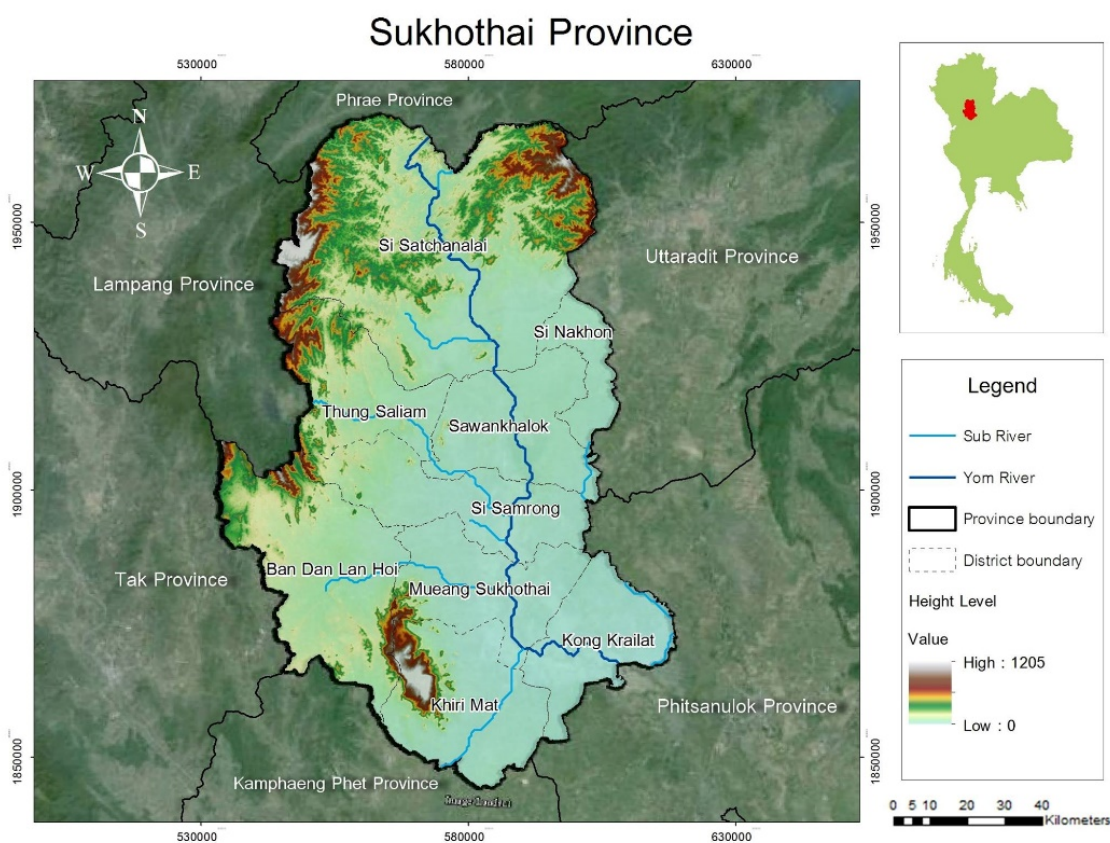


Fig. 1. Study area

Sukhothai province, Northern Thailand, where is lower part of Yom river has been selected as study area because the present study area has suffered from every flood, even though the flood extent are different in each year. In addition, the present study area has not yet been constructed a permanent dam. This may be interested area to model of flood in GIS environment without complicate factor of dam. Sukhothai province covers an area of 6,596 sq. km and it consists of nine districts. The Yom river flows through from the north to southeast of the province that tributary rivers mainly flow to meet the Yom river from the right side of river bank in the central and lower part of the province. Moreover, the northern part of the province is mountainous area which restricts the flood plain compared to larger river flat plain over the central and southern part of the province. The largest of mountainous

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