

Developing a Nature Hazard Vulnerability Map of Yangyang and its Vicinity

양양의 자연재해 취약지 추정

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ABSTRACT

Yangyang, Gangwon-do has begun the clearing of upland forested areas for development. This process has caused great damage from natural hazards such as landslides and flooding for many years. Moreover, proper hazard prevention strategies have not yet been prepared. To provide useful information for developing hazard prevention strategies, this study attempted to detect areas vulnerable to flooding in Yangyang using data such as topology, meteorology, history, land use, soil, hydrology, and society. It was found that roughly 30% of the study area was vulnerable to flooding. Also it was discovered that where the vulnerability index was high, there was increased amounts of flooding. The most vulnerable areas were where forests were cut and near rivers. In addition, areas where frequent hazard events were reported had a high index of vulnerability. The results of this study will provide useful information in developing hazard prevention strategies

Keywords: flooding, vulnerability, land use

INTRODUCTION

Recently, the IPCC(Intergovernmental Panel on Climate Change) warned that the risk of natural hazards was getting more serious due to

climate change. Actually, extreme weather events such as flooding, drought, storms, flash floods, and unusually high or low temperatures are occurring worldwide and damages are getting greater and

greater. Among the diverse types of hazards, flooding is reported the most and its damage is one of the highest. Almost every year many countries, especially in south eastern Asia, have suffered from flooding. To prevent flood damage, land use management should be carried out carefully, and deforestation should be avoided where flood risks are high.

However, the clearing of upland forested areas for development has occurred in Yangyang, Gangwon-do, which has experienced severe damage from natural hazards such as landslides and flooding. To prevent the severe damage caused by these kinds of natural disasters, comprehensive hazard prevention strategies should be made. For developing a proper and efficient strategy plan against natural hazards, management priority areas should first be found. Therefore,

this study attempted to find areas vulnerable to flooding in Yangyang in order to provide useful information for land use management.

METHODS

1. Study Area

The study area was the Yangyang watershed, Gangwon-do. Gangwon-do has a hilly topography. The annual precipitation is 1,300mm, which belongs to the high precipitation range. Many hazards, such as flooding and landslides, have been reported in the area. One of the main reasons for hazards in Yangyang is unenvironmentally-friendly land use, such as deforestation. To examine land use changes in Yangyang, remotely sensed imagery was analyzed from the 1980s to 2000s.

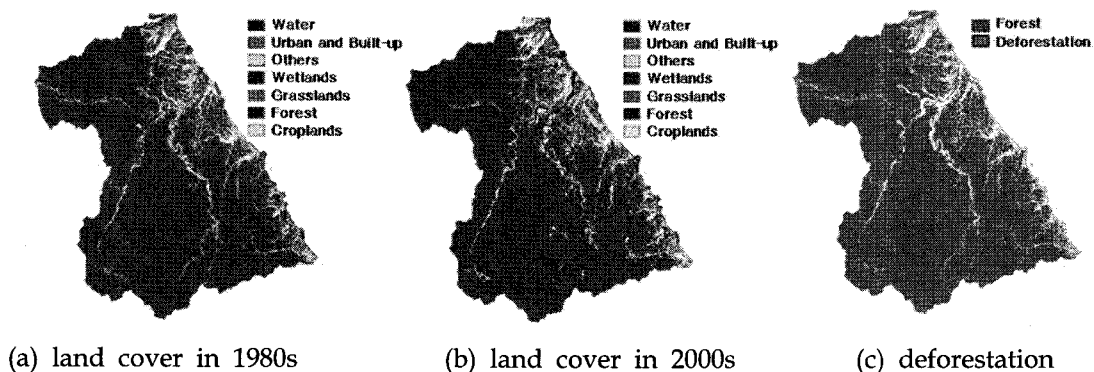


Figure 1. Land use changes in Yangyang. The red color in (c) shows the deforested areas from the 1980s to 2000s

However, 24.1km² of forested area in the 1990s and 37.2km² in the 2000s were cut to allow for other types of land use, such as agriculture and settlement(Figure 1). Land use changes from deforestation resulted in severe damage from natural hazards. Landslides and flooding have occurred almost every summer in recent years.

2. Estimation of Natural Hazard Vulnerability

2.1 factors and weight

Flood hazard vulnerability can be expressed as a summation function of all the related factors which play some role in flooding events. The factors can be topology, meteorology, history, land use, soil, hydrology, and society. Each of these factors can have sub-factors. Therefore, this study used a two-step approach in finding flood vulnerable areas using high level factors and low level factors. The high level factors considered in this study are land use, soil, society, hazard history, hydrology, meteorology, and topography. These factors have their own sub-factors: land cover and distance from river(land use), soil permeability and soil loss potential property (soil), population(society), property damage from flood events and return period(hazard history), stream order, flood amount

(hydrology), precipitation of 100 year return period and rain intensity(meteorology), and slope and elevation(topography).

Each of these factors have a different influence in causing flooding events, therefore, this study applied different weights for each factor using the AHP(Analytical Hierarchy Process) method. A survey was conducted with professionals in the field of natural hazards to determine the weight for each factor.

2.2 Flood vulnerability estimation and evaluation

After preparing the data layers for all of the factors, each factor was standardized because each factor has a different unit and range in value. Each factor was categorized into 5 levels: very low, low, medium, high, and very high. Then, all sub factors within the same high level factor were overlaid. Again, high level factors were classified further into five levels. After this, all high level factors were overlaid and finally, the vulnerable areas were found. Evaluation of the results were made by comparing the vulnerability level with flooding amount for the outlet of each sub-watershed. This evaluation showed where highly vulnerable areas have high flooding amount, which confirmed that the results

were reasonable.

RESULTS AND DISCUSSION

The output of the flood vulnerability estimation of this study has five levels of vulnerability: very low, low, medium, high, and very high (Figure 2). Areas designated as frequent flood areas include Mulji, Namdae, Dongmyung, Powol, Whasang, and Kwangjung stream.

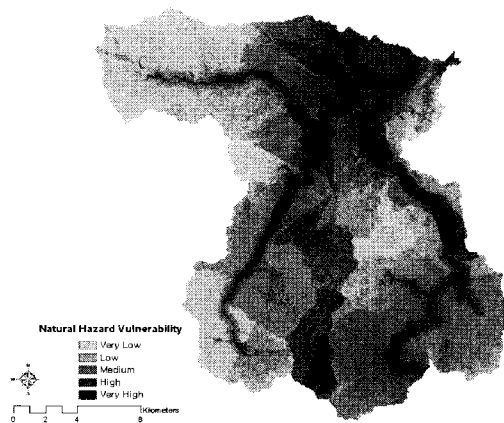


Figure 2. Flood vulnerable areas in Yangyang

The results show that areas near the river and areas that experienced deforestation are the most vulnerable to flooding. This indicates that land use plans should be carefully made, especially where landslides and flooding might occur. The results of this study provide useful information when developing local land use

plans and also when developing hazard prevention strategies.

CONCLUSION

This study estimated flood vulnerable area in Yangyang in order to provide useful information for the development of strategies to prevent flooding. It is necessary to develop strategies for disaster prevention since damages from natural hazards in the study area are continuously reported. Further analysis with more data should be implemented in the future.

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