GUIDELINES FOR COMMUNITY MANAGEMENT IN LANDSLIDE RISK AREAS OF EAST – COAST OF THE GULF OF WATERSHED, THAILAND

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ABSTRACT: The Objectives of this study is to find landslide risk areas and communities that might be affected by landslides as well as to establish the guidelines for community management in landslide risk areas of the East – Coast Gulf Watershed. Landslide statistics and factors are investted. The landslide risk factors are employed together with the geographic information system to prepare, analyze and map landslide risk area. It has been established that there are four levels of landslide risk: high, moderate, low and no risk. Study results reveal four levels of landslide risk: high, moderate, low and no risk, covering areas of 150.84, 711.35, 2,508.65 and 9,736.37 square kilometers, respectively. High risk areas are mostly in the mountain, surrounded by the moderate and low risk areas. It was found that only one village, Ban Chantapae, Chanthakhlem sub-district, King Amphoe Khao Kitchakut, Chanthaburi province, was in the high risk area. Three villages were in the moderate risk area: namely Ban Pak Phraek, Huai Thapmon sub-district, King Amphoe Khao Chamao, Rayong province, Ban Mu Dut and Ban Amphawa, Khlong Khut sub-district, Tha Mai district, Changthaburi province. When the one-kilometer buffer zone was established around the high and moderate risk areas, it was found that 139 villages were susceptible to the landslide risk. The Community Management in the landslide risk areas was based on the combined site survey together with the analyses of land use map, geology map, and soil group map. It was found that management of communities within the high and moderate landslide areas should involve planting of vegetation and engineering structure especially on steep slope. Moreover, landslide risk data analysis system should be carried out for the monitoring and warning in such areas. Communities already identified within the landslide risk area should be continuously monitored to avoid further natural disaster.

1. INTRODUCTION

1.1 Statements of The problems

Thailand suffered a lot from natural disasters each year. One is landslides disaster that caused a heavy life and property loss in risk areas. Landslide occurs when the masses of rock, soil surface and debris are moved down slopes. Landslides, whether can be very small or large. Those might be moved through slow or high speed. However, landslides as a disaster event, is formed by several physical and human factors together namely: rainstorm, topography, geology and landuse. In this paper, we concerned to the landslide of rock areas and factors causing disaster. Dynamic behavior and relationship between the components, the media for the interaction between them. Considering the structure such as : Engineering Structure and Bio-engineering (vegetative cultivation) and the components in different levels of landslide disaster, these are high, moderate, low and no risk. Finally the landslide risk areas map can be produced as an essential guidelines for community management

1.2 Objectives

1.To produce landslide risk areas map of the East-Coast Gulf Watershed.

2. To establishing guidelines for community management in landslide risk area of the East-Coast Gulf Watershed.

1.3 Scope and Study Area

- The study was focused on East-Coast Gulf Watershed of Thailand, covers the areas of Chon Buri province, Rayong province, Chanthaburi province and Trat province.
- Factors affected to landslide disaster namely: rainfall, geology, slope, soil group, and landuse.
- The analysis for community management that used for analysis, are Water control, Excavation, Restraining Structures, and Bio-engineering respectively.

2. METHODOLOGY

2.1 Materials

In this study, the materials and data used as guidelines for community management in landslide risk areas are as follows:

2.1.1 Topographic map at scales of: 1:250,000 and 1:50,000.

2.1.2 Lands use map derived from classified satellite image map.

2.1.3 Satellite data: Landsat-5 Thematic Mapper(TM) both digital data and hard copy were provided by the Geo-Informatics and Space Technology Development Agency (Public Organization). Data was acquired on January 11, 2000 and March 4 and 17, 2000.

2.1.4 Geology map: 1:500,000 scales.

2.1.5 Rainfall: Monthly average rainfall 1971 to 2000. (source: Organization of the Meteorological Department)

2.1.6 Soil group map at a scale of: 1:250,000.

2.1.7 Slope map derived from DEM

2.1.8 Processing instruments: ArcView GIS Version 3.1a, ArcView Spatial Analyst, ArcView 3D Analyst.

2.2 Methodology

The prediction steps for landslide risk areas in East-Coast Gulf Watershed can be categorized as 2 categories as follows:

In order to find landslide risk area and villages, the two processing steps have to be performed.

2.2.1 Data collection, administrative boundary, soil group map, geology map, village points, were directly digitized to GIS as input. The rainfall, slope map derived from contour lines interval 20 meters, and landuse map, were analyzed, the results were then input to GIS.

2.2.2 Remote Sensing and GIS were applied, LRF model (Landslide Risk Factors) was generated, and output as landslide risk areas were presented. By using relationship from the previous landslide, the main factors were found as: geology, slope, soil group, landuse, and rainfall. However, this study was use raster format, determining grid size is 30x30 meters.

LRF = Landslide index / Average of landslide index

When : Landslide index = % frequency of factors / % area

% frequency of factors = (areas of sub factor occurred landslide x 100) / areas of landslide

% area = (areas of sub factor x 100) / total area

2.2.3 Add LRF volume into attribute data for each factor (sub factor) under such main factor. For instance, main factor: landuse sub factor as forest, agricultural area, urban area etc. Perform weighting for each factor that are geology, slope, landuse, soil group and Rainfall to 5, 4, 3, 2 and 1, Respectively. Summarized LRF volume from factors and classified to four levels of landslide risk: high, moderate, Low and no risk.

2.2.4 Create buffer zone for high and moderate landslide risk levels, given as 1 kilometer.

2.2.5 Overlay landslide risk area map with village points. Given the results to corresponding levels of village in landslide risk area.

2.2.6 Mapping village in such a level of landslide risk areas.

To study guidelines community management in landslide risk areas.

1. Query the village that are high and moderate risk levels.
2. Field surveying the village in risk area in considering with geology map, slop map, and landuse map. As well as establishing the guidelines for village management in landslide risk areas.

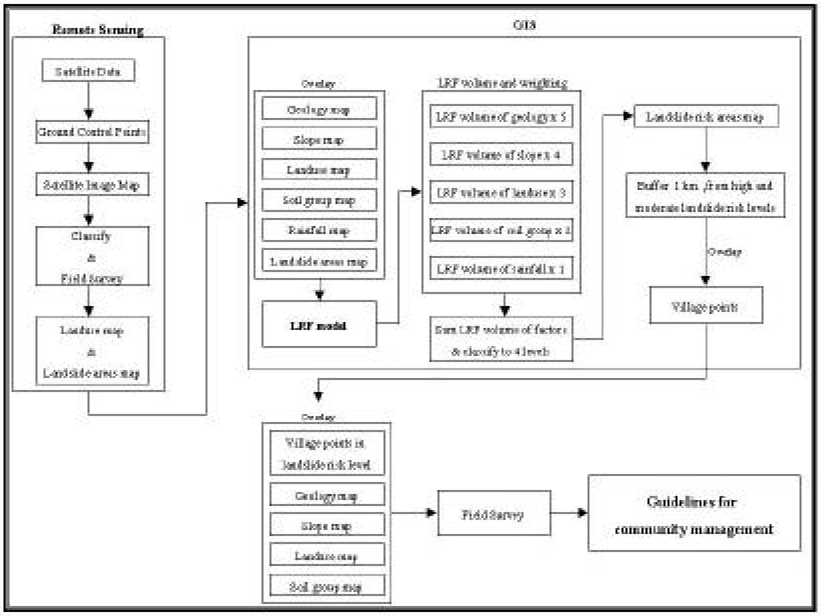

Figure 1: An integrated framework for guidelines community management.

3. RESULTS

The technique on the integration of LRF, Remote Sensing and Geographical Information System is conducted to guidelines for community management in landslide risk areas of East-Coast Gulf Watershed. This study consists of 3 main steps. Firstly, using Remote Sensing technique to study landuse pattern. Secondly, to find Landslide Risk Factors model (LRF), and lastly, is to generate guidelines for community management.

3.1 The characteristics of land use

According to satellite image interpretation, it can be categorized into 4 rank, the first rank of landuse is mostly occupied by agricultural area accounting to 8,671.31 square kilometers or 66.13 percent of watershed. It was classified as paddy, horticulture, aquaculture etc. The second rank of landuse is forest that occupying 4,372.01 square kilometers or 25.95 percent. The third of landuse is urban area is about 488.91 square kilometers or 3.73 percent. The last rank is water body estimated about 271.61 square kilometer or 2.07 percent.

3.2 Landslide risk areas

Study results reveal four levels of landslide risk: high, moderate, low and no risk, covering areas of 150.84, 711.35, 2,508.65 and 9,736.37 square kilometers, respectively. High risk levels are mostly in the mountain, areas surrounded by the moderate and low risk areas. These is only Chantapae village, Chanthaburi province, was in the high risk area. There were three villages that categorized to moderate risk level, Pak Phraek village, Rayong province, Mu Dut and Amphawa village, Changthaburi province. Eventually, one kilometer buffer zone, was established around the high and moderate risk areas, it was found that 139 villages were susceptible to the landslide risk.

3.3 Guidelines for community management

In this study, it was found that management of communities for the high and moderate landslide areas in 4 villages depending on the combining of site survey together with the analyses of land use map, geology map, and soil group map. The results show that Bio-engineering is the most suitable.

4. CONCLUSIONS

Remote sensing and geographic information system were applied with parameters from landslide risk factors to ensure as guidelines for community management. The results derived from this study can be applied to land use planning. Relevant organizations in government sector and public sector, can prepare strategic plans for protection and reducing on the impact on life and the assets of government in these watershed areas. The advanced prediction information about landslide disasters, can be used for risk management

5. SUGGESTION

To Provide more accuracy results, the following issues should be conducted.

5.1 Landslide risk data analysis system should be carried out for the monitoring and warning in such areas.

Landslide risk area should be monitored frequently, information concerned natural disaster have to be identified and update.

5.2 Community in the risk areas should be awared in advance.

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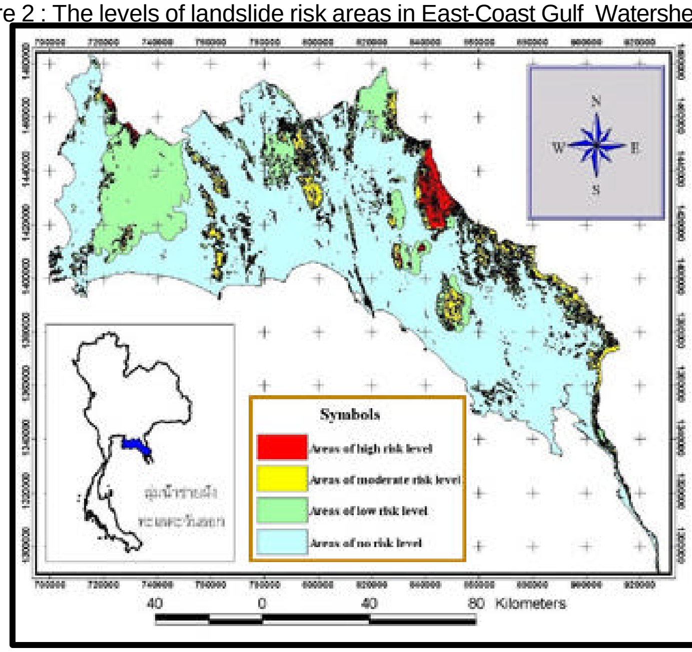
Figure 2 : The levels of landslide risk areas in East-Coast Gulf Watershed.



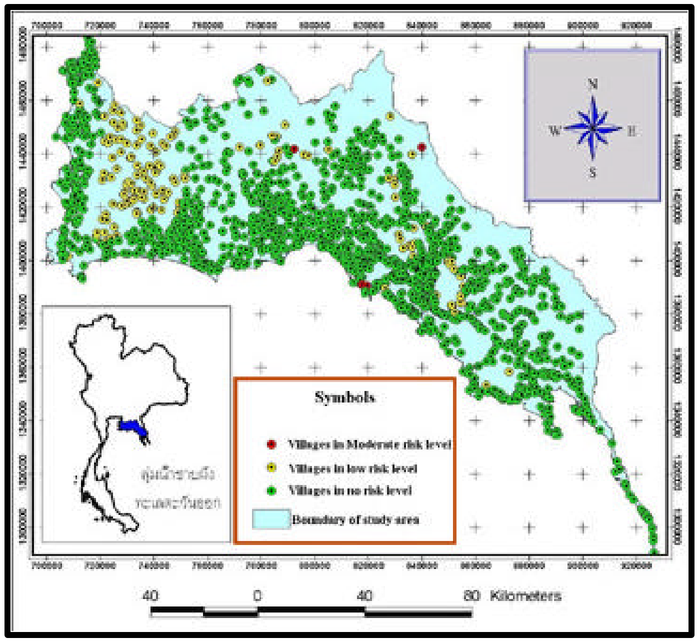


Figure 3 : The village points classify from landslide risk levels.