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Planning of New Railway Network For Nilgiri District Using GIS

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Abstract- *The Nilgiri district is one of the severe to very high landslide hazard prone areas of India and the district is well known for land slide threat . Unprecedented rains triggered about a hundred landslides within an area of 250sq.kms in the district during 1978. Nearly 200 landslides were recorded during 1979 and causing loss of life and severe damage to property. A total of 28 landslides of medium to large size occurred on the Nilgiri district. Transportation lines such as roads and railroads in Nilgiri district are often prone to landslides which may occur on cut or natural slopes. Due to the landslides that are occurring frequently the roads and railroads are often blocked for usage. The present railway network in Nilgiri district covers a distance of 41.8 km. The route starts from Mettupalayam and ends in Ooty. It does not cover the entire part of Nilgiri district.*

This project aims to delineate the areas susceptible to landslide hazard and to find a optimal route which covers the entire part of Nilgiri district. In the present study GIS (Geographical Information System) is used to evaluate the several criteria for spatial problems and to find a optimal railway route for Nilgiri district. In this study Analytical Hierarchy process (AHP) and Weighted Linear Combination (WLC) is used to produce the landslide susceptibility map for the Nilgiri district. To assess the landslide susceptibility, eight factors which affect the landslide occurrence were selected. They are slope, soil type, geological type, rainfall intensity, land cover/land use, distance from drainage, distance from lineaments and distance from road. The landslide susceptibility index (LSI) was calculated using the WLC technique based on the assigned weight and rating given by the AHP method.

A new railway network is formed by the spatial multi-criteria decision making process using GIS software.

Index terms - Landslide susceptibility, analytical hierarchy process (AHP), Geographical Information System (GIS), Landslide susceptibility index (LSI), spatial multi-criteria analysis.

I. INTRODUCTION

It is widely used in different applications. Experience shows that GIS is an efficient tool for solving optimization tasks with spatially distributed linear objects such as railways, roads and pipelines.

Planning rail routes is related to an evaluation in detail of physiographic factor, landscape, engineering geological and other requirements for the investigation area. It also includes determining the length of the route, calculation of intersections with rivers, roads and railways which are considered as mountain relief complexities. Consideration of the railroad construction costs, which depends on geological structure and land covers (rocks, marshland etc.,) and many others require detailed spatial multi-criteria analysis [1].

Locating rail stations and railway network planning involves specialized resource allocation and laying routes. They are complex problems and they depend on multiple factors. The solutions of these complex problems, in order to make decisions, require sequences of processes for factors and criteria. These things need to be processed to obtain relevant information[1].

This project aims to find a optimal route which covers the entire part of Nilgiri district.

II. STUDY AREA

Nilgiri district is one of the oldest mountain ranges. The Nilgiri Hills are part of a larger mountain chain known as the Western Ghats. Nilgiri is hilly district with an area of 2565 sq. kms and is situated in the northwestern part of Tamil Nadu state. It is bordered by the states of Karnataka in the north, Kerala in the west and south and by the districts Erode and Coimbatore of Tamil Nadu in the north east respectively. The total population of the Nilgiri district is 735,394 as per the Census 2011. It is bounded between 11° and 11° 55′ of north latitude and 76° 13′ and77° 2′ of east longitude. It is situated at an elevation of 2000 to 2,600 meters above MSL.

Fig.1. Nilgiri district

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III.OBJECTIVE OF THE STUDY

The study has been carried out with the following objective:

To find a new railway network covering the entire Nilgiri district using GIS technology considering the influence of various economic, ecological and technical factors.

IV.DATA AND METHODOLOGY

1. Digitization

Digitizing is the process by which coordinates from a map, image, or other sources of data are converted into a digital format in a GIS. This process becomes necessary when available data is gathered in formats that cannot be immediately integrated with other GIS data.

2. Geo-referencing

Georeferencing is the process of aligning geographic data to a known coordinate system so that it can be viewed, queried and analyzed with other geographic data. There are various GIS tools available for Georeferencing and in this project Arcview software is used. One can georeference a set of points, lines, polygons, etc. To georeference a feature in Arcview, select Register and Transform icon and then mark control points in the active theme. Enter the latitude and longitude of the selected point in the table and select the source theme followed by that click transform theme. The image is transformed to the required latitude and longitude.

3. Spatial Analysis – Model Builder

Model Builder is a tool in the Arc View Spatial Analyst extension that helps you create a spatial model of a geographic area. A spatial model records the processes, such as buffering or overlaying themes, required to convert input data into an output map. Large models can be built by connecting several processes together.

4. Weighted overlay

By using multi criteria decision making process, the weightages for various criteria's and alternatives are found out and those weightages are taken into account during the analysing process.

The Weighted Overlay Process creates a discrete grid theme that combines multiple input themes. The output theme represents the weighted influence of multiple features in a geographic area. Each of the input themes is assigned a percent influence based on its importance. Values within the themes are reassigned to a common evaluation scale. This allows unlike measurements, such as temperature and rainfall, to be converted to common values that can be added. This process is often used in site suitability studies where several factors affect the suitability of a site.

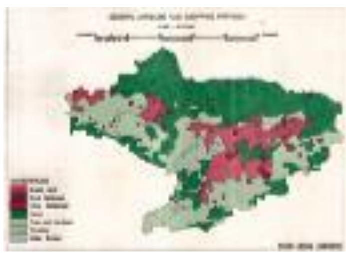
5. Analysis and Result

Finally, suitability assessment for laying new railway route has to be made and choice is to prefer the best one. Optimal railway route is selected and proposed. For the proposed railway route cost estimation has to be done.

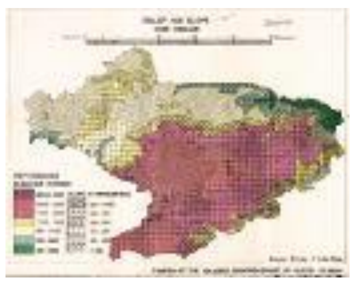
A. Data collection

In this study eight factors which affect the landslide occurrence were selected. They are slope, soil type, geological type, rainfall intensity, land cover/land use, distance from drainage, distance from lineaments and distance from road. The maps that are collected for this project are as follows:

1. Land use/land cover map

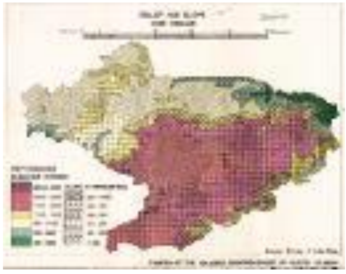


2. Slope map



3. Soil map

4. Drainage map



5. Geology map

The various maps were collected from Survey of India, Chennai at a scale of 1:50000. The rainfall data was collected from the district Collectorate office, Ooty. The administrative map was collected from the www.cencesindia.gov.in website and the population data are given as attribute data.

V.RESULTS AND DISCUSSION

In this study the various maps were digitized and geo referenced using Arcview. The digitized maps were given various weightage based on Landslide Susceptibility Index. Then the maps were overlayed using model builder to get the final landslide susceptibility map.

In this method, the landslide susceptibility index (LSI) value for each considered pixel was computed by summation of each factor's weight multiplied by class weight (or rating). The factor's weight, class weight and consistency ratio of various factors is given in Table 1. From the calculation, it was found that the LSI had a minimum value of 0.0573, and a maximum value of 0.2593. The LSI represents the relative susceptibility of a landslide occurrence.

Therefore, the higher the index, the more susceptible the area is to landslide. There are five different zones in the landslide susceptibility map. These are very high (VHS), high (HS), moderate (MS), low (LS) and very low (VLS) susceptibility zones.

Based on the above landslide susceptibility map the regions that are susceptible to high landslide are found out and it will be used to provide a solution to prevent landslide in that particular region. In the present railway network most of the regions are under high susceptible region so it is advisable to provide a new railway network to avoid accidents due to landslide. The newly formed railway network is shown in the figure 3. It covers the major city such as kotagiri, Coonoor, Ooty, Gudalur and Pandalur.

Fig 3. Railway Network for Nilgiri District

VI. CONCLUSION

In this study the landslide susceptibility regions were identified and it was divided into five categories such as very high (VHS), high (HS), moderate (MS), low (LS) susceptibility zones. Based on the above susceptibility map the new railway network covering the entire Nilgiri district was formed. It covers the major city such as Kotagiri, Coonoor, Ooty, Gundalur and Pandalur.

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