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The Nilgiris: Landslide Prone Zones and Human Influence on the Modification of Hill Environment using Geospatial Technology

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ABSTRACT

Landslides have wide range impact on the people of the affected area in terms of the devastation caused to material and human resources. The magnitude of destruction depends on the location of the landslide area. In the context of India it is a painful truth that most, if not all, the areas susceptible to landslide hazards are inhabited by the economically weaker section of the population who have neither the resources nor the expertise to organize rehabilitation measures of their own. One of the most difficult problems concerning landslide hazards in place like Nilgiris is dealing with existing urban areas where buildings are constructed on or close to a landslide. The ideal approach in this situation is to avoid further development in high-risk landslide prone areas, limit existing-use rights to rebuild, and limit the use of buildings. The most realistic approach is to avoid further development and use of buildings (building type) is consistent with the level of risk posed and the district plan maps clearly show landslide hazard zones.

Key words: Landslide, devastation, destruction, ecosystem,

INTRODUCTION

Nilgiris district is endowed with rich natural resources, which pose an imperative need to check the uncontrolled urban growth and denudation of forests to maintain the fragile ecosystem. the urban development in consonance with desirable ecological parameters and as well as to guide and monitor the spatial growth of the towns in the district and regulate the land use pattern in a conservative outlook to protect the ecology of the district, which is fragile in nature, the need for special techniques for planning and suggesting the corrective measures was felt absolute.

Before the appearance of Homo sapiens on Earth, the purely natural system ruled our planet. Many geophysical events such as earthquakes, volcanic eruptions, land sliding, and/or flooding took place threatening only the prevailing flora and fauna. Millions of years later, the human presence transformed the geophysical events into natural disasters. The transformation of these geophysical events into natural disasters occurred simultaneously with the appearance of the human system, when human beings began to interact with nature, when fire was discovered and tools were made from the offerings of the natural habitats. The evolution of humans left behind the age in which only nature existed. It provided the starting point of the interrelation of the human system with nature.

The human system itself was subjected to significant transformations, where the concept of work and hence of social division of work, production relations and economical political systems appeared. These transformations and their

links to the natural system have served as templates of the dynamics of natural hazards and therefore, Natural hazards are indeed geophysical events, such as earthquakes, landslide, volcanic activity and flooding. They have the characteristic of posing danger to the different social entities of our planet, nevertheless, this danger is not only the result of the natural vulnerability, and it is the result of the human systems and their associated vulnerabilities towards them (human vulnerability). When both types of vulnerability have the same coordinates in space and time, natural disasters can occur. Natural disasters occur worldwide however; their impact is greater in developing countries, where they occur very often.

MATERIALS AND METHODS

1. Problem statement

However some of the main issues related to environment and society are discussed here. The lack of awareness is one of the main issues among the public as well as the planners. The Department of Science and Technology, Government of India has suggested having raise awareness among policy makers & planners at state/district and user institution level through conducting training programmes/workshops. Also awareness should be created among community leaders and general public affected by landslide hazards about the cost-effectiveness and benefits of taking landslide hazard mitigation measures.

The other main issue is communicating the landslide hazard. There is no clear early warning system is readily available for landslides like Likelihood of the occurrence of an event, the size and in a location that would cause casualties, damage, or disruption to an existing standard of safety. There is no warning signs are clear indications of vulnerable slopes are no where designated in the hazard prone areas. The first responder's (local people) can take initiation in this regard with the help of Government officials to create awareness among the vulnerable community. The elements at risk should be identified and a risk quantification study can be implemented for these vulnerable sites, so that this information's can become vital in case of emergency response. As suggested by National Disaster Management Authority (NDMA), Government of India in the National Disaster Management Guidelines for landslides, from the funds available with the District Planning and Development Council in landslide prone areas, a part will be allocated for the implementation of landslide management schemes in the Nilgiri district.

2. Objectives

a. To survey the landslide occurrence zones along the road traffic between Mettupalayam and Ooty using GPS,
b. To determine the human influence on the modification of hills environment using SOI Toposheet and optical remote sensing data

3. Methodology

To study landslides, the Indian topographical maps of the entire Nilgiris district (13 topo sheets) have been converted into digital maps with the incorporation of necessary physical features. In the present problem, the road link connecting from foothill (Mettupalayam) to Ooty has been taken and the occurrence of landslides was tracked using GIS 20 Global Positioning System (GPS). All the landslide occurrences were transferred on to the digital map and re-registered all the points surveyed using GPS. To study the human influence on the hill environment, the sample points were taken using GPS. To identify the modification of hills environment using ISO Toposheet and optical remote sensing data were used to find change between two time periods 1990 to 2010.

4. Location of Nilgiris

The Nilgiris, popularly known as the "Blue Mountains" is a tiny district, with an area of 2545 sq.km, forms an integral part of the Western Ghats. It is located between 11° 10'N to 11° 45' N latitude and 76° 14'E to 77° 2' E longitude and its climate has aptly been described as "the cold tropical island rising above the warm tropical sea of South India". It is bounded on the north by Karnataka State, North West by Kerala State, on the South East by Coimbatore District and the North East by Erode District of Tamil Nadu. The entire district is hilly and is divided into two natural zones namely the Nilgiris plateau and the Wynad tableland. Nilgiri Hills of Tamil Nadu are located at the junction of the Eastern and Western Ghats, Udhagamandalam, popularly known as Ooty, the Queen of Hills, is a major tourist attraction of South India. The major country rock exposed at Nilgiri Hills are charnockites (granulites). They are enderbitic natured rocks essentially composed of minerals of quartz, plagioclase, potash feldspars (less), orthopyroxene, garnet and biotite. The rock is medium to coarse grained, greenish grey colored rock, polygonal granoblastic texture to foliated banding texture. The general strike of the granulites is N60°-70°E with steep dips (55°-75°).

RESULTS AND DISCUSSION

Figure 1 shows occurrence of landslides prone areas where collected using GPS along the road of Mettupalayam to Nilgiris, the recent and past landslide becoming frequent and rather an annually recurring phenomenon in one part or other of the district with the frequency gaining during the northeast monsoon, causing frequent road blocks, breaches of infrastructure, loss of lives and destruction of properties.

Landslides were severe during the two consecutive years 1978 and 1979 as well as in 2006, inflicting loss of life and damage to property. Unexpected rains triggered about a hundred landslides within an area of 250 square kilometers in the district during 1978 while nearly 200 landslides were recorded during 1979 and 30 landslides during 2006 in the Coonoor to Mettupalayam ghat road. Soil slips, earth slides, rock slips, rock falls, compound slides and land subsidence are common and Nilgiris is prone to all kinds of landslides. Because most of road cutting as well as railway track cutting are with steeply dipping rock formation (charnockite with soil covers) disposed towards the steep geomorphic slopes of the area. As a result there are more unstable conditions of the slopes and sliding may take place along the slope at any time. When the aerial extend of the steep slope is more, attention should be given for construction of retaining walls at the bottom.

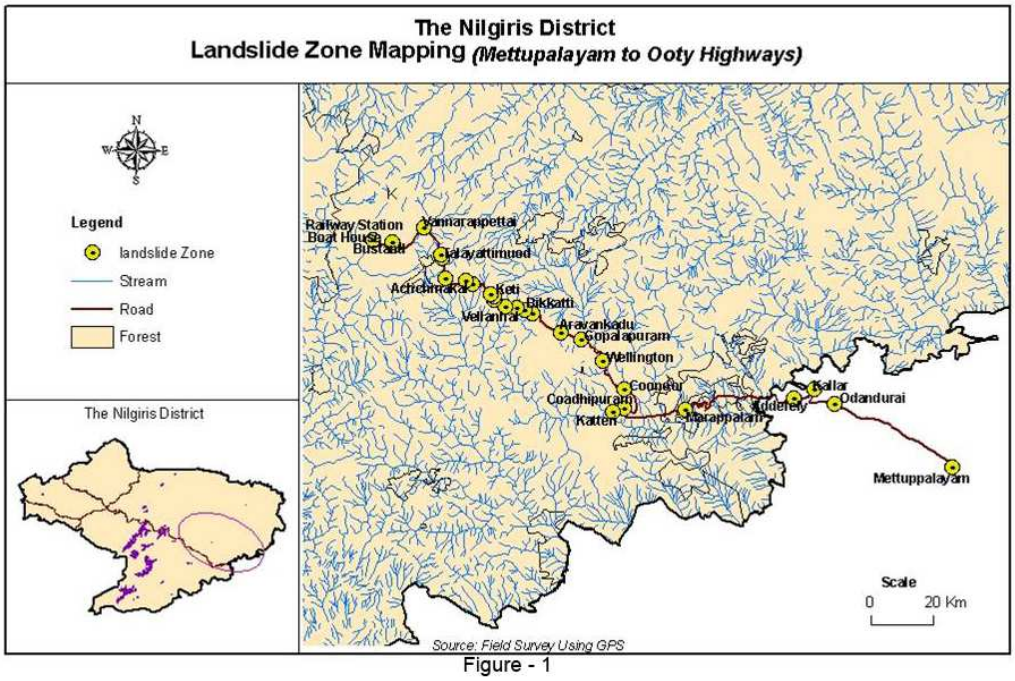

Figure - 1

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The area in which beds dip towards the slope with dip amounts more than 45 are unsafe and prone to landslides Nilgiris and Darjeeling hills are most affected by landslides due to same side steep slopes and steep dip formations. Whereas Yercaud hills of Salem, Kothgiri to Mettupalayam of Nilgiris Ghat section and Dehradun to Mussoorie hills track are free of landslides where beds are dipping into the hills and against the slope.

It is observed that while there were innumerable slides between Coonoor and Mettupalayam and the number of slides on the Kotagiri-Mettupalayam sector was negligible. Along the roads, the natural sholas or forests remain relatively undisturbed and geomorphic slopes are moderate to steep. The Geological reasoning behind these Ghat Sections are geomorphic slope and geological formationare dipping towards road sections and are in same direction in the former case. Whereas in the Kotagiri Section, Geological formations are mostly dipping against (or) oblique to the geomorphic slopes of area and thickness of weathered cover is very low.

Improper land use practices such as heavy tilling, agricultural practices and settlement patterns and withdrawal of toe support have contributed to creep in many cases. A common factor noticed in most of these vulnerable slopes are deforestation in the recent past, cultivation of seasonal crops and increase in settlements. Numerous and large sized master joints make the rock very weak and unstable and joints act as channel ways for the seepage of water. Sliding

may take place along joint planes dipping towards the slope. The study is to assess the human influence on the modifications as well as the natures' impact on hill environment. Increasing pressure on land for agriculture and monoculture plantations displaced an alarmingly high proportion of natural forests and grasslands leading to an extensive loss of biodiversity and turning the Nilgiris into a biodiversity "hotspot". In many hill areas, intensive human and livestock pressures along with indiscriminate felling of trees for commercial purposes have already led to loss of soil and rapid depletion and destruction of forest cover. In addition to this, water retention capacity and productivity of land have been adversely affected. These factors have impaired the ecology significantly, resulting in difficult economic condition for the hill people. Traditional agricultural practices, especially shifting cultivation, have also contributed to the destruction of forests and soil erosion. The unrestrained spread of monoculture (tea, coffee, eucalyptus etc) destroyed priceless tropical rain forests, mountain forests and grasslands, which have evolved over millions of years. Increasing pressure on urban amenities led to widespread and persisting water scarcity, congestion, and environmental pollution. This zone is a catchment area and during the northeast and southwest monsoon seasons, this region received heavy rainfall, which is followed by intermittent landslides, rock fall and other debris fall and the like. Due to the impact of heavy rainfall this is a common phenomenon affecting many inhabitants who lives along the slopes/ valley regions. This more often affects the road and rail network due to heavy landslides along the roadways disrupting traffic flow. This necessitates a land slide risk and vulnerability map of this so as to demarcate the most vulnerable zones for further gross-root level study.

5. Modifications in Hill Environment: The Nilgiris

The Nilgiri district in Tamilnadu is home to the splendorous Blue Mountains that are a part of a larger mountain chain known as the Western Ghats, sweeping across the states of Tamil Nadu and Kerala. The elevation of this mountain range varies between 2,280 to 2,290 meters, with the highest peak being Doddabetta at 2,623 meters. The Nilgiris have tea cultivation at the height of 1,000 to above 2,500 meters. This also produces eucalyptus oil and temperate zone vegetables. The Nilgiris have a cool and wet climate and the area is a popular summer retreat, with hordes of tourists from across the country flocking the heights in all excitement. The picturesque rolling hills of the Nilgiris remind one of the Downs in Southern England. The main town in the region is Udhagamandalam, which reflect a colonial aura with several buildings built on British style. The other major towns of the region are Coonoor, Kotagiri, Gudalur and Aruvankadu.

Table-1 depicts the results of modifications made by human on hill environment from 1990 to 2010 using geospatial technology. The changes are vast among the settlements and estates which are given in ha for all the taluks in Nilgiris district.

Table-1 Human Modification of Hill Environment (1990 to 2010)

S.No	Taulks Name	Settlements Ha	Estates Ha
1	Panthalur	29.2	82.4
2	Gudalur	15.6	74.9
3	Udhagamandlam	15.1	72.6
4	Kothagiri	30.6	29.4
5	Coonoor	12.0	62.1
6	Kundah	10.6	32.1

Source: Data Generated from Analysis

There are two national parks in the Nilgiris. Mudamulai National Park is in the northern part of the range at the junction of Kerala, Karnataka and Tamilnadu covering an area of 321 sq km. Mukurthi National Park lies in the Southwest of the range in Kerala, covering an area of 78.5 sq km The whole sweep of Western Ghats to the Northwest and Southwest come under the realm of India's first biosphere reserve, which is a home to number of bird species, including the Nilgiri Pipit, Nilgiri Woodpigeon and Nilgiri Blackbird. Nilgiris is also home to Toda people a tribe that has been living there for ages. High above the sea level, situated at the junction of the two ghat ranges of the Sahayadri Hills, Nilgiri district provides a fascinating view. Kerala on the west, the Mysore State on the north, and Coimbatore district on the east and south bound it. Headquarters of Nilgiris district is Udhagamandalam (also called as Ooty). Nilgiris means "Blue Mountains". The entire area of the Blue Mountains constitutes the present district of Nilgiri. The height of the hills in the Blue Mountain range varies between 2,280 and 2,290 metres, the highest peak being Doddabetta at a height of 2,623 metres.

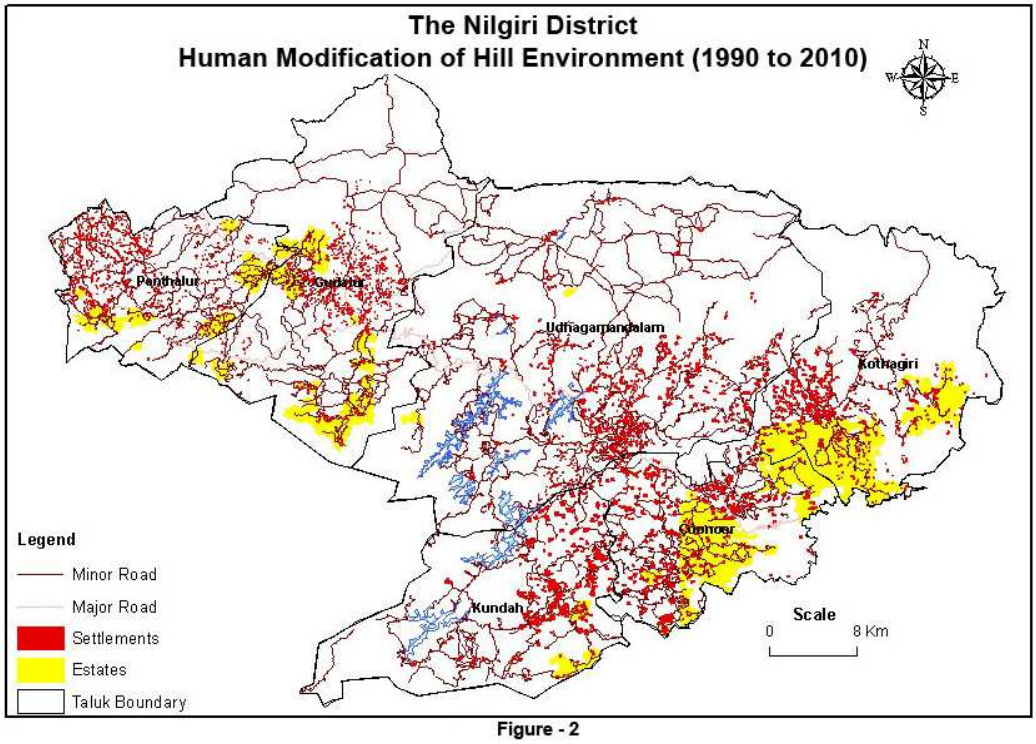

Figure - 2

Nilgiris derives its charm from its natural setting. The steep hills and fantastically narrow valleys with numerous rivers and rivulets running in all directions with a few fine waterfalls here and there provide beautiful scenery. The temperate and most equable climate further heightens the attractiveness of the place.

CONCLUSION

The pattern and nature of landslides occurrence in the Nilgiri hills are common in both the northeast and southwest monsoons. Irrespective of Vegetated or non-vegetated, steep or gentle slopes, all are prone to landslides during continuous over-saturation of over burden due to heavy rain. Comparatively Ghat slopes with inward dipping lithounits are seems to be safe. Increase in settlements at hill tops, both slope and rock dipping outwards from the ghat sections, continuous flooding on heavy rains, intercalation of clay layering in weathered zone are the characteristic features behind the Nilgiri landslides. The increase in the events of landslides Nilgiri may be due to seisomotectonically active Southern Granulite terrain of South India.

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