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SHORT NOTE

Effect of Deforestation on Landslides in Nilgiris District – A Case Study

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Abstract Landslides in the Nilgiris are mainly due to rainfall, but human intervention in the form of deforestation and plantation has turned this into a calamity. Our study in the Nilgiris district of Tamilnadu help of the Global Land Cover Facility data reveals that there is a drastic reduction in forest cover and human interventions in the form of unplanned tea estates has resulted in the loss of natural ecosystem of Nilgiris which is causing massive and frequent landslides.

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Introduction

Landslides occur as a consequence of various triggering factors. Rainfall is one such factor. But the human intervention like deforestation may cause the soil to lose its capacity and ultimately lead to landslides during heavy rainfall. The Nilgiris in the Western Ghats entered an anxious era of landslides since the calamitous landslides of 1978. The frequency of landslides has increased in recent years with major slides occurring in 1993, 1995, 2002 and very recently in November 2007. The Nilgiris landslides have been demonstrated to be the reflection of pore pressure increase during the rainy seasons (Ramasamy *et al*., 2006). The major problem in Nilgiris district is deforestation. Between 1849 and 1992, the shoals were decreased from 8,600 ha to 4,225 ha (Newspaper article reference). Previous studies on deforestation and land use changes in Western Ghats (Jha *et al*., 2000) showed a loss of 25.6% in forest cover between 1973 and 1995 in the southern part. The present study aims to find the extent of deforestation in Nilgiris district and the increase of landslides due to deforestation.

Study area

Nilgiris district lies between 11° and 11° 55′ of north latitude and 76° 13′ and 77° 2′ of east longitude, with Kerala on the west and Karnataka on the north. The monthly average rainfall in the district is 94.20 mm. Apart from the forest area, the plantation crops of tea and coffee cover the bulk of the cultivable area with other medicinal and oil-bearing crops. The soil of the district falls under three major types namely, clay, clayey loam and loam with laterite sub-soil. The depth of the soil usually varies from one to three feet and that of the sub-soil from 10 to 14 feet. The sub-soil is invariably porous and soil erosion has become a major problem.

Materials and methods

The Global Land Cover Facility (GLCF) is the primary source of Orthorectified Landsat scenes for the years 1973, 1989, 1992 and 1999 which are co-registered in UTM projection using the WGS-84 datum. The following six classes were identified, namely, the water bodies, dense forests, open forests, degraded forests, grasslands and plantations. The definition for different forest classes used were; Dense forest – having a canopy cover > 40%, Open forest – having a canopy cover between 20 and 40%; Degraded forest – with < 20% canopy cover (this class also includes scrub vegetation and forest blanks). The method of maximum likelihood classification was adopted and the change detection statistics were extracted for different time periods of 1973–1989, 1989–1992 and 1992–1999. The detection of changes from initial state of 1973 to final state of 1999 was also reported to get an exact idea about how much deforestation has taken place over the last 26 years.

Results and discussion

As seen from the Table 1, 482.85 km^2 of dense forest was drastically reduced over a period of 15 years. This accounts for about 56.87% of reduction of thick dense forest. Not much change was reported for open forest but the amount of degraded forest has been increased to 24.94% which includes the Udhagamandalam town and the surrounding area. The wattle (*Acacia mearnsii/A. dealbata*) plantation in the southwest part of Nilgiris district was removed and resulted in an increase of about 482.76 km^2 grassland. Between 1989 and 1992, the reported changes were less with a maximum 180.39 km^2 reduction of open forest. As seen from Table 1, 23.56% of dense forest, 2.94% of open forest, 13.87% of degraded forest has decreased from 1992 to 1999. The overall changes between 1973 and 1999 shows that, about 446.05 km^2 of dense forest has been reduced which accounts for about 52.53%, nearly 197.4 km^2 open forest has been replaced which accounts to 18.57%. This results in increase of grassland to

Table 1 Land use changes

Land Use / Land Cover	*Landuse changes in km^2			
	1973–1989	1989–1992	1992–1999	1973–1999
Dense forest	–482.85	161.03	–124.23	–446.05
Open forest	9.27	–180.39	–26.28	–197.4
Degraded forest	67.06	32.76	–51.16	48.66
Grassland	482.76	–86.28	119.85	516.33
Plantation	–93.74	71.47	81.9	59.63
Water bodies	17.5	1.41	–0.08	18.83

*Positive and negative sign indicates increase and decrease in landuse respectively.

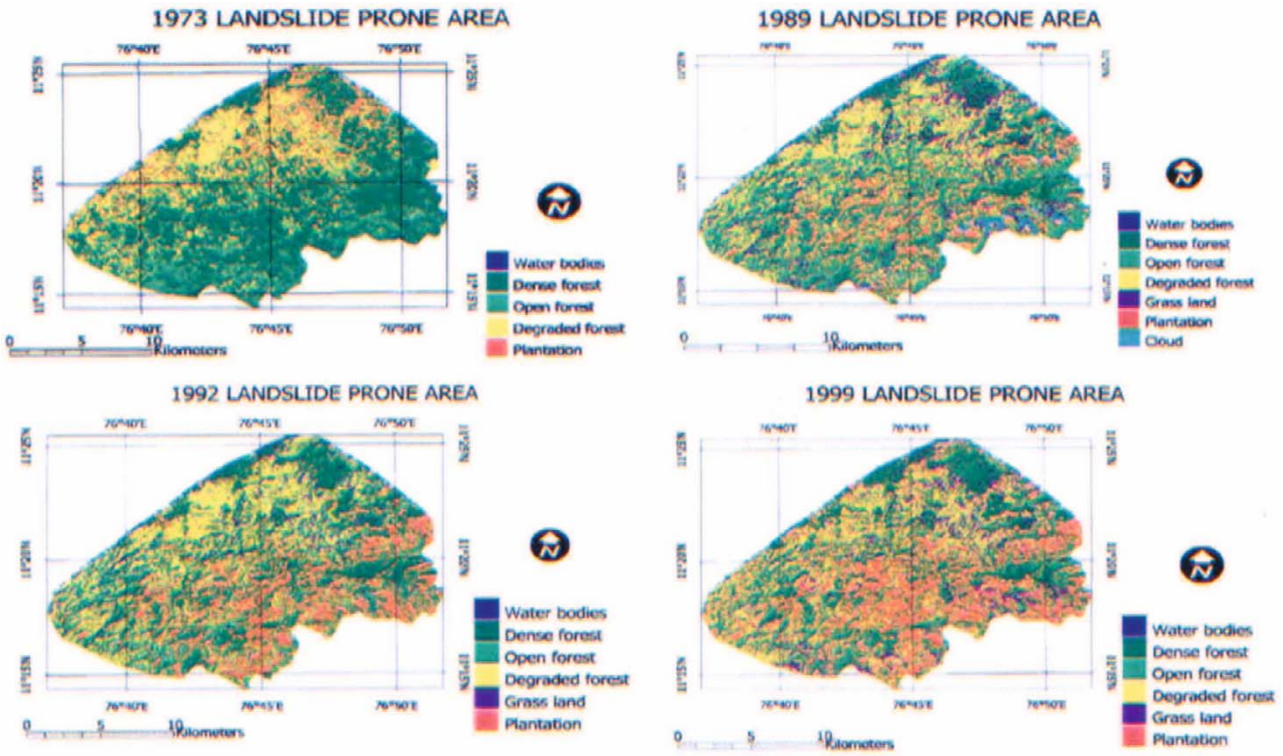

Fig. 1 Land use/Land cover map of landslide prone area during 1973, 1989, 1992 and 1999

about 516.33 km^2. The loss of dense forest cover is more pronounced between 1973 and 1989, as a result of which the degraded land and grassland increased during the period. The reduction of open forest reached the maximum during 1989–1992. The plantations, especially the tea estates were observed to be maximum during 1989–1999.

To study the impact of deforestation on landslides, the frequent landslide prone area was demarcated with reference to Geological Survey of India map, which includes 5 major slides and 14 other important slides forming an area of 330.56 km^2. The landuse/landcover map of 1973, 1989, 1992 and 1999 within that landslide prone area was prepared and is shown in Fig.1. 98.47 km^2 of dense forest has been reduced drastically within the landslide prone area of 330.56 km^2 between 1973 and 1999. As a consequence of this massive reduction, the tea plantations were increased to 55.10 km^2 and grassland to 37.19 km^2. Also the increase in degraded forest was 11.38 km^2 over a period of 26 years. When trees are cut down, their roots are no longer available to hold the soil together. A heavy rainfall is sufficient to make the rocks and boulders come hurtling down. The landslides in Nilgiris are mostly of this nature i.e. rainfall induced landslides. Though tea plantation is a far better soil binder on the hills, compared to vegetables like potato, tea gardens in the district are prone to frequent landslides because of the lack of proper drainage. All these plantations have short inadequate roots, leading to an increase in the number of landslides.

Conclusion

The present study of forest cover changes using multi-temporal remote sensing clearly shows the extent of deforestation. The land used for tea estates without considering proper drainage and slope

ultimately results in loss of natural ecosystem and ends in massive frequent landslips.

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