Effect of Mughal Road on Land Use / Land Cover of Sukh Saria-A Catchment Area of Rambiara Nallah, Shopian

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Abstract
The present study was carried out to analyze the effect of Mughal road on dynamics of land use/land cover using geospatial techniques of remote sensing and GIS on Sukh Saria- a catchment area of Rambiara Nallah in Hirpora of Shopian Distract, Kashmir. During the 20 years time period, an unprecedented decrease in dense forest area has caused a key land use change which has occurred due to construction of the famous Mughal road. This has led to increasing emissions of CO_2 into the atmosphere which in turn leads to climate change. However, the challenges of climate change can be effectively overcome by terrestrial carbon sequestration.
Keywords: Land use, land cover, remote sensing, catchment, carbon sequestration

Introduction
Land is the most important natural resource which embodies soil, water and associated flora and fauna involving the total ecosystem. Land cover refers to physical and biological cover over the surface of land, including water, vegetation, bare soil, and/ or artificial structures (believes land use involves both the manner in which the biophysical attributes of the land are manipulated and the intent underlying that manipulation-the purpose for which the land is used (Ellis and Pontius Jr., 2006. Turner *et al.* (1995). Land cover is also used to describe different natural habitats, deserts, forests, woodlands, glaciers and water bodies as well as habitats manipulated by man. Though humans have been modifying land to obtain food and other essentials for thousands of years, current rates extends and intensities of land use and land cover change are far greater than ever in history, driving unprecedented changes in ecosystem and environmental modification at local, regional and global scales (Xieo *et al.,* 2006). These changes encompass the greatest environmental concerns of human populations today, including climate change, biodiversity loss and the pollution of water, soil and air. Therefore, land use and land cover are two essentials unfolding the terrestrial environment in connection with both natural as well as anthropogenic activities (Bender *et al.*, 2005, Mendoza *et al.*, 2010).
Forest roads are the most costly structures in forestry. Inefficiently constructed forest roads can cause severe environmental impacts including road surface erosion and sediment yield (Fu *et al.*, 2010), pollution of waters, direct loss of habitat by conversion of artificial land cover into an artificial surface (Geneletti D., 2003) and indirect loss of habitat by the fragmentation of an ecosystem into smaller and more isolated patches (Chomitz *et al.*, 1996). Large areas of forest are destroyed during road construction which not only results in economic losses, but changes the conditions of the environment (Jadczyk, 2009).Road effects take place in the contexts of environmental settings, their history, and the state of engineering practices, and must be evaluated in those contexts for best management approaches.

Remote sensing plays an important role in generating information about the latest land use land cover pattern in an area and its temporal changes through times. The information being in digital form can be brought under geographical information system (GIS) to provide suitable platform for data analysis, update and retrieval. The study focuses on the effectiveness of satellite data for land use/land cover change of the study area due to the construction of a famous mughal road.

Study Area

The study area lies at an altitude of 2546 m above the mean sea level within geographical coordinates of 33° 39'55"N and 74° 39' 40"E (Figure 1). The study area is located at the bank of Rambiara Nallah, within the heart of Hirpora wildlife sanctuary. The climatic conditions of the study area are somehow different from Kashmir valley. The temperature is in between 6°C to 27°C in summers and the winters are chilly with heavy snowfall. Sukh Sarai is very beautiful in its natural beauty, which comprises of western mixed coniferous forests and deciduous sub-alpines scrub forests, also the presence of pastures and meadows beautify the area and provide a grazing site during summers.
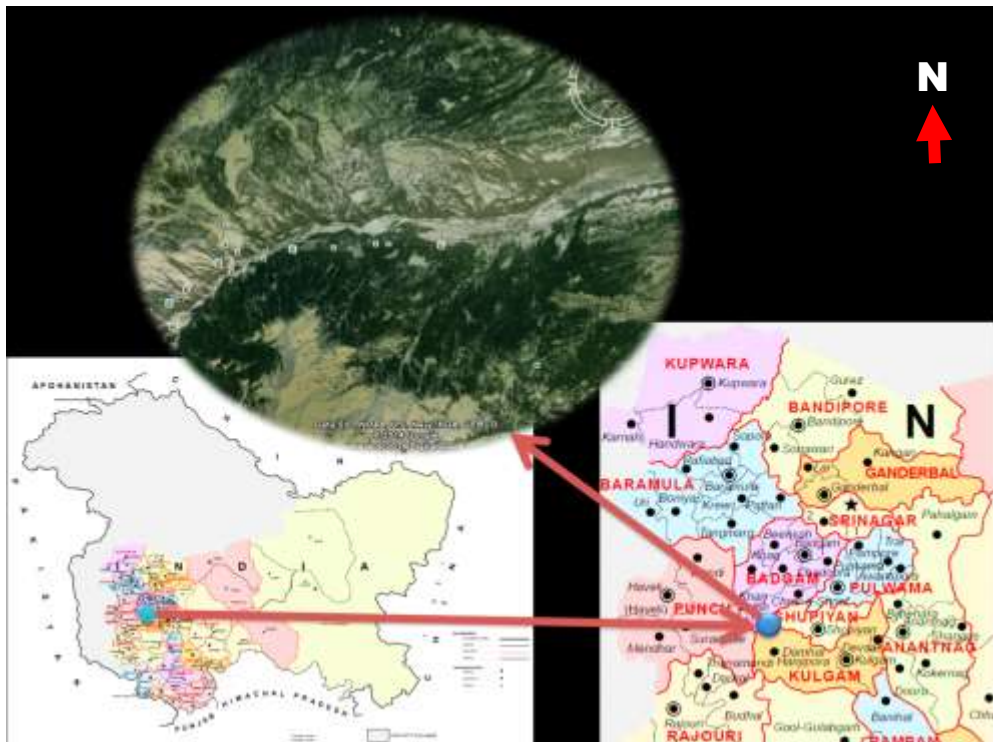

Figure 1: Location map of study area

Materials and Methods

IRS-IC LISS III with 23.5 meter resolution acquired on 25 October 2010 and Landsat Thematic Mapper data of 25 October 1990 were used as source data. The scheme adopted for land use/ land cover classification is the level I and II of NRSA with local modification. The area of Sukh Sarai were accordingly divided into six classes namely, dense forest, sparse forest, scrub land, pasture land, waste land, and water bodies. The remotely sensed data was geometrically corrected using toposheets as references. On screen digitization approach was used. During the

computation of change detection of area under Land use/ land cover categories, the percentage change of the total area was calculated , which is the change of area in a particular category divided by total area of catchment multiplied by 100.

Results and Discussion

In the present study, the Study area was classified using on screen digitization technique into 06 land use/ land cover classes. The composition and distribution of land use/land cover types of images included: dense forest, sparse forest, scrub land, pasture land, waste land, and water bodies. The land use/ land cover map shows the spatial and temporal variation in the area (Table 1; Figure 2 and 3).

Table 1: Land use/ Land cover data of study area as depicted/ extracted from satellite images.

S. No	Landuse/ Land cover classes	Area in 1990 (Hectares)	Percentage	Area in 2010 (Hectares)	Percentage	Percentage change
01	Dense forest	96	30.57%	**56**	17.82%	**-12.73**
02	Sparse forest	**138**	43.94%	**46**	14.64%	**-29.29**
03	Scrub land	45	14.33%	**136**	43.31%	**28.98**
04	Pasture land	24	7.64%	65	20.70%	13.05
05	Waste land	**0**	0%	6	1.91%	1.91
06	Water bodies\	11	3.50%	**5**	**1.59%**	**-1.91**
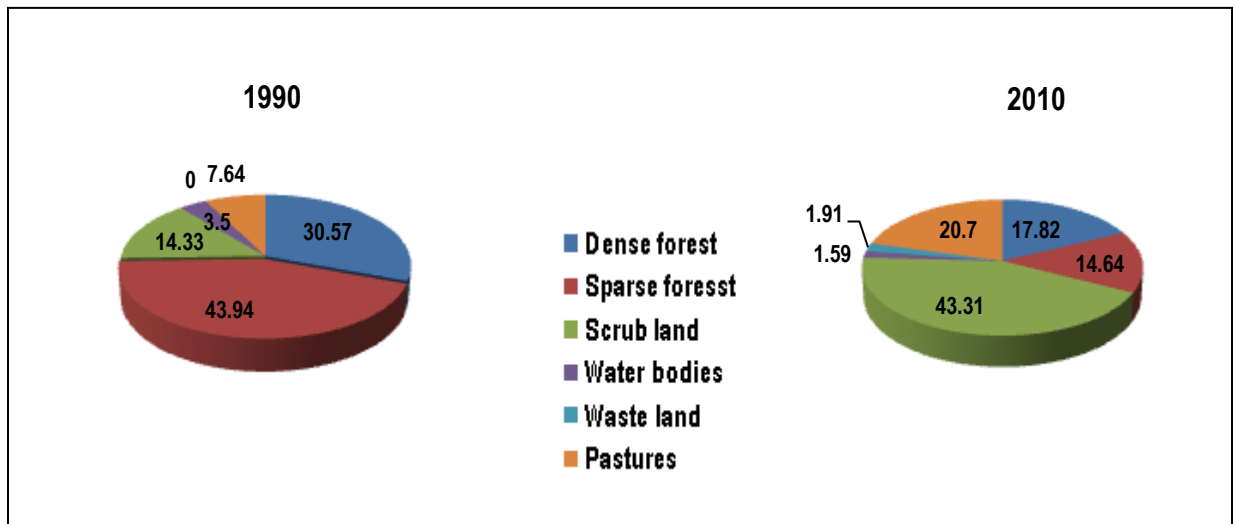
Figure 2: Land use/land covers percentage change
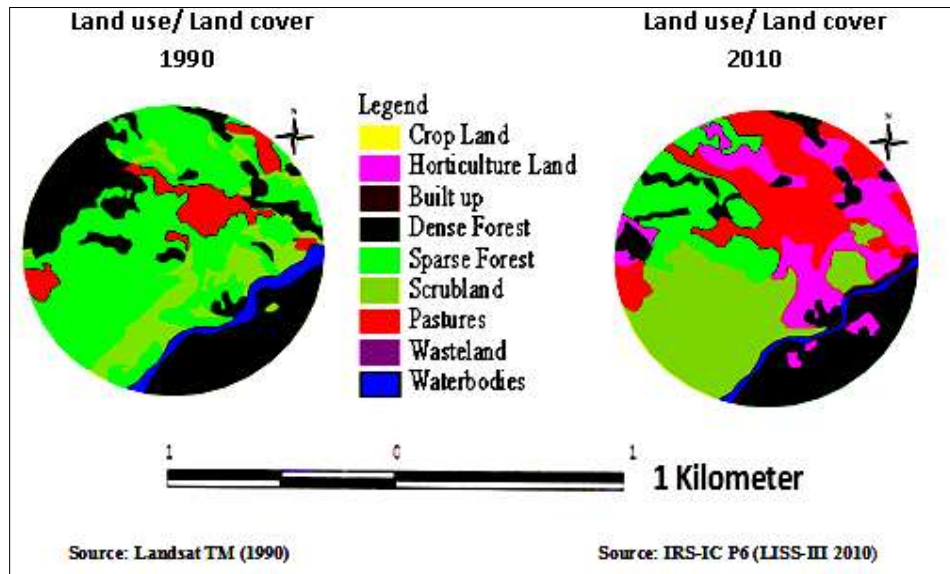
Figure 3: Satellite images shows land use/land cover maps

The present study reveals that scrub land has shown a noticeable increase from 14.33% in 1990 to 43.31% in 2010 respectively, which contributes about an increase of 28.98% from last two decades. This increase may be at the cost of decrease of forest cover due to construction of Mughal road, tourism. These findings are in agreement with the findings of (Gunilla *et al.*, 2000). During study it has been found that the largest pasture land is present which contributes about 20.70 percent of the total area, which acts as a grazing site in summers as the tribal's and nomads take their livestock to these areas because of pleasing temperature. This increase in pasture land is mainly due to the conversion of grass land, woodland and forest into pastures. These findings are in agreement with findings of (Houghton, 1994; Williams, 1994). Waste lands were absent before the construction of mughal road was 0 ha in 1990 and 6 ha in 2010.This increase is due to the conversion of forest land into waste land by the way of deforestation. These findings are in collaboration with the findings of (Kaul *et al.*, 2009). Dense forests have also shown a decreasing trend of about 17.82 percent of the total area has shown in fig.2.This decrease in the forest area is mainly due to natural factors, population pressure and increasing demands of people for timber, fuel wood, land for settlement, roads (Mughal road), agriculture etc have lead to declining of the forest area. These findings are in alliance with the findings of Sparse forests have shown a decreasing mode 43.94 percent in 1990 to 14.64 percent(Sen, 2002; Sharma and Roy, 2007; Farooq and Rashid, 2010). This decrease in sparse forest is mainly due to population expansion, increasing demand of the people for firewood, fuel wood and other minor forest products. These findings are in conformity with findings of Nussar, 2000 and Sen, 2002. Lack of employment opportunities also compels the people to depend on forests (Sharma *et al.*, 2009). Water bodies have also shown an alarming decrease from 11 ha in 1990 to 5 ha in 2010 respectively. This decreasing area of the water bodies may be due to land transformations. These findings are in compliance with the findings of Fazal and Amin, 2011.

 Conclusion
The key finding of the present study includes the immense degradation of dense forests, decrease in water bodies, increase in pasture land and scrub land. These changes have clearly depicted that the negative impacts of mughal road construction along the catchment of Rambiara Nallah- a forest area. Therefore, forest road managers should

consider not only the total road cost but also environmental impacts i.e. climate change, biodiversity loss, soil degradation, water pollution caused by road construction and use. However, carbon sequestration acts as a one of the effective tool for management of forest ecosystem. Therefore, carbon sequestration is truly a win-win strategy in this regard. Thus, it becomes imperative that the government should prepare working plans for the effective management.

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