Pak. J. Bot., 42(6): 3967-3970, 2010.

A PRELIMINARY STUDY ON CLIMATE CHANGE CAUSING DECLINE IN FOREST COVER AREA IN DISTRICT CHAKWAL, PAKISTAN

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Abstract

The analysis of species density and species distribution based on the analysis of land cover characteristics is an important aspect in the process of understanding forest ecology. Therefore in the present study a GIS based approach was followed to produce different scale vegetation maps for a study area in district Chakwal. The prime forest areas in district Chakwal were identified for the study by integrating the areas of land cover change derived for the change in climate in the years 2005-6 and 2009-10 by the use of GIS mapping. Results show that the minimum temperature of the district increased from 9.4ºC to 9.9ºC during the period of 2005-06 to 2009-10, and the maximum temperature increased from 33.8ºC to 35ºC. The humidity changed from 69.1% to 70.3% followed by the rainfall decrease from 872mm to 557mm. These distinguished changes in the climate caused the decline in the forest area of the region. The total forest area was found to be around 698Km^2 in the year 2005-06, which declined to about 625 Km^2 in 2009-10. The study further demonstrates the utility of GIS technique for the assessment of land cover change areas particularly in the regions where significant climate change conditions are occurring and forests are being lost.

Introduction

The world is becoming hotter day by day, since the earth's temperature has risen up to 0.74ºC and is about to increase from 1.8ºC to 4ºC by 2100 (Anon., 2007). This change in climate is occurring due to increased urbanization, fuel burning and high emission rate of carbon dioxide, which traps into the atmosphere and cause global warming (Anon., 2010).Climate change is a disastrous issue which is impacting the world over a large scale, while the most vulnerable to climate change are the underdeveloped regions of the world, significantly the South Asian states for example Pakistan. The major impacts of climate change in South Asia will include the melting of glaciers in Himalayas and consequent increase in flooding, a pressure would build up over the natural resources and a resulting stress over the environment, disease outbreak, impacts on soil fertility, which will end up in erosion and reduced crop growth, this will correspondingly impact the economy and would be a cause of poverty. This all will impede the achievement of environmental sustainability by accelerating child mortality, disrupting the social system and damaging the vegetation (Pedro, 2000). The climate change activity has caused a loss of around $3.57 billion over the past 18 years. This is alarming, since this would cause the risks of sea level rise, glacial retreat, floods, temperature extremes and intensified droughts. Almost 23% of the country's land and 50% of the entire population is susceptible to these damages (Khan, 2009). The most disastrous impacts of the climate change are evident over the decline in the forest cover of Pakistan which were studied,

assuming a 0.3°C rise in temperature and a precipitation change of 0, +1 and –1% decade–1 with 1990 as the base year (Sidiqui *et al*., 1999).

The technique of GIS mapping plays an important role while determining the changes in land cover due to deforestation or forest degradation. One such study was carried out in Chitwan District in Nepal. One of the major forests of the region, the Terai Shorea Robusta forest showed a loss of 23% between 1976 and 1989. Besides this, overall there was a loss of 15% forest covers between the year 1976 and 2001 (Menaka *et al*., 2008).

Lying at the beginning of the Potohar plateau and the Salt Range, Chakwal is a barani district and the terrain is mainly hilly. Winter temperatures normally range between –4°C and 25°C, and summer temperatures average between 15°C and 40°C. The average rainfall is 22 to 25 inches (Ahmed *et al*., 2009). The forests which exist naturally, since Chakwal lies in the subtropical, semiarid zone, are dry deciduous scrub, consisting of the plant varieties which are typical of these kinds of forests- keekar, kau, phulai, sanatha, wild beri, gurgura and potaki. The underbush mainly consists of saryala, khawi, mesquite and kari. At present a total of 92382 acres of the district are under reserve forest and 57868 acres are under unclassed forest (DFO, Rawalpindi, 2010). The objective of this study was to highlight the impacts of climate change, on cover value of forest, by using GIS visualization technique through ArcGIS and to ascertain the impacts of climate change in order to forecast the future trends.

Materials and Methods

Pilot field survey was carried out to highlight the importance of problem. First the map of Chakwal was retrieved from DFO Chakwal, for the year 2005-06 and it was scanned. The map was then imported in ArcGIS software, after creating a shape file. Then Geo-referencing was done for it. After this, the map was digitized and the potential areas were marked. Then, the quantitative analysis of the map was done and the forest area was found for the year 2005-06.

Geographical coordinates were taken by using GPS, from the forest area of Chakwal District and a map was developed for the year 2009-10. This map was also digitized and its statistical analysis was carried out. The two maps were then overlaid in order to find out the difference between the forest areas of the two periods i.e., 2005-6 and 2009-10.

Results and Discussion

The GIS mapping the meteorological records of the Chakwal district showed that the climate of the region has been constantly changing and the temperature has been constantly rising. Most important finding of the study showed that there was a noticeable decrease in the forest cover due to increasing temperature and decreasing rain fall in the area. The minimum temperature of the area increased from 9.4ºC to 9.9ºC during the period of 2005-06 to 2009-10, while the maximum temperature increased from 33.8ºC to 35ºC. The humidity changed from 69.1% to 70.3%. While the rainfall decreased from 872mm to 557mm. such changes are directly impacting not only the forest ecosystem of the area but also the socio-economic environment of the region. Besides this, the changes in the forest landscape were also bringing about the changes in the topography of the district coupled with heavy degradation of the forests (Table 1).

Table 1. Decline in forest area due to climate change in district chakwal.

	Forest area (Km^2) 2005-06	Forest area (Km^2) 2009-10
No of polygons/Forest patches	23	25
Smallest patch	1.61	0.9
Largest patch	147.22	151.04
Total area	698.92	625.34
Mean	30.38	25.01
Standard deviation	42.84	32.37

Similarly Figs. 1 and 2 clearly indicate the decrease in forest cover for the years 2005-06 and 2009-10 respectively. Panta *et al*., (2008) showed that there was a loss of about 15% of the forest area in Nepal, during the period 1976 to 2001. Similarly different studies have also showed a substantial decrease in the forest areas of various regions due to factors as human activities and meteorological changes (Tole, 1998).

The maps provided in this study showed that how much forest cover has been degraded and how much remaining cover is required to be conserved, further they also provide with the rough estimate of the area that could be restored by the tree plantation and reforestation activities (Figs. 1,2,3). It is major issue of the developing countries that the issues such as fragmentation become prominent due to loss of forest cover (Nagendra *et al*., 2004). GIS mapping has been used many times to assess the decline in forest area as an indicator of forest degradation (Joshi *et al*., 2006). Therefore GIS mapping prove to be the most cost-effective tool for monitoring such landscapes. Ahmad (2007, 2009 and 2010) also stressed the need for conservation of native flora for future generations.

Since this study has exposed the process of degradation of the forest area during the tenure of 5 years, it could be useful while planning the agricultural reforms, development projects and constructing the highways in the district. The reliance of the local people on forest resources, would be most affected due to decline of forests, this will bring about poverty and increased disease incidences. Therefore the aim of the future study would be to divert the attention of the researchers, conservationists and donors, towards the management, conservation and protection of the forest resource.

Fig. 1. Forest cover in Chakwal District 2005-06.

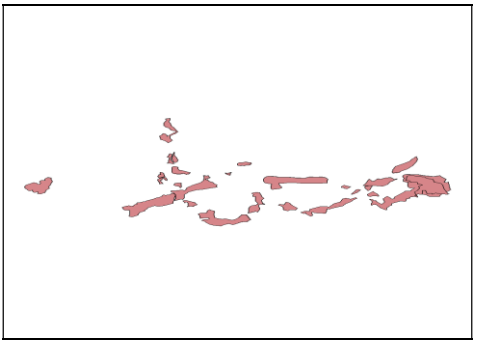

Fig. 2. Forest cover in Chakwal District 2009-10.

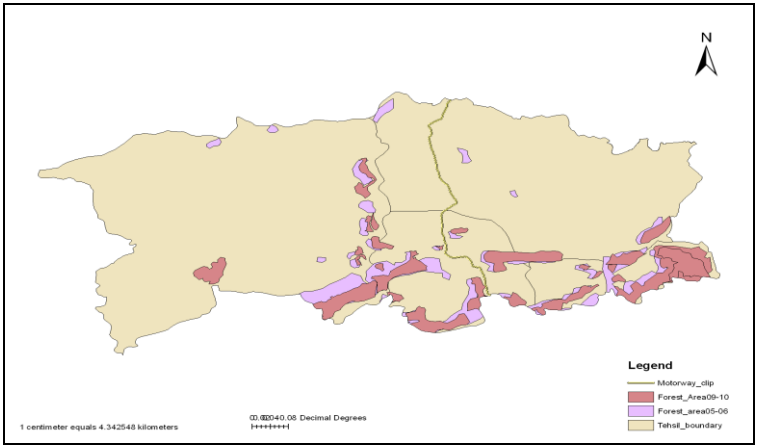

Fig. 3. Forest cover decline in District Chakwal of Pakistan during 2005-06 to 2009-10.

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(Received for publication 3 March 2009)