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Assessment of Reserve Forest in Junnar Tahsil of Pune District, Maharashtra, India: A Remote Sensing Based Study

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Abstract:

Forest is the vital resources and provides needs of human as well as supports environment. Hence present study was done to assess the forest in Junnar tahsil to know the condition of reserve forest which is marked by forest department. IRS P6 LISS III satellite image has been used. In addition to this, Survey of India toposheets of 1:50,000 scale, forest management maps, Global Positioning System were used for the ground survey. Vegetation cover decreases from west to east over study area along with the decreased in rainfall amount. The forest over study area mostly control by the amount of rainfall and moisture availability in soil. We observed more than 70 percent barren land which may be the product of continues process of soil erosion. From the central part of study area toward east there is complete absence of green vegetation and observed barren land. Hence it is necessary to protect soil loss and increase the soil moisture by improving ground water table through the watershed management.

Keywords: Junnar, Maharashtra, Forest, Satellite imagery, Remote sensing

Introduction

Green house gases and global warming is the current environmental issue. Human activity and increasing interference of human in land cover changes is increasing with growth in population. Many studies show increasing demand of land basically leads to deforestation. "Deforestation is the conversion of forested areas to non-forest land use such as arable land, urban use, logged area or wasteland" (Manual, Forestry Department, 2007). During the last 100 years this has led to major changes in the African landscape (N. Gunlycke and A. Tuomaala 2011). Forests are vital global resources that need to monitor and assessment for sustainable management and conservation. Although many efforts are taking regarding forest management and forest conservation, the deforestation continues at a high rate to give space for other land uses such as agriculture, settlement, road and transportation and water reservoirs. Forest degradation is a process leading to a temporary or permanent deterioration in the density or the structure of the vegetation cover or its species composition (Grainer, 1993). N. Gunlycke and A. Tuomaala (2011) detected forest degradation in Marakwet district, Kenya, using remote sensing and GIS – in cooperation with SCC-Vi Agroforestry A Minor Field Study as a part of their master degree. They carried their investigation and mapping of deforestation in the study area during the 23 years period from 1986 to 2009 by using satellite data. The result indicates great changes in forest cover. During the 23 years period, 4149 hectares of forest have been cleared in the study area, representing a decrease of 14 percent. If nothing is done to prevent the ongoing deforestation, 45 percent of the forest in the study area will disappear until the year 2100. Food and Agriculture Organization of the United Nations defines deforestation as occurring where tree canopy falls below 10% in natural forest. On the basis of this definition and using forest inventories in different countries, expert estimates, forest department data and satellite remote sensing, the Global

Forest Resources Assessment (2000) (FAO, 2000) estimated a net decrease in forest area of 9.4 million ha year^{-1} from 1990 to 2000. This change was result of a 12.5 million ha year^{-1} net decrease in natural forest. Most of the deforestation Occur in tropics, while most of the natural forest regrowth occurred in Western Europe and Eastern North America, the total net forest cover change was positive for the temperate regions and negative for tropics regions (D. Kumar 2011). Extensive research on forest cover changes in tropical Asia is available for the period 1880-1980 (Flint and Richards, 1991). This involves an area of 8 million km^2 and 13 countries (India, Sri Lanka, Bangladesh, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Brunei, Singapore, Indonesia and Philippines). In this area as a whole, forest and wetland decline over the hundred year period by 131 million ha (47%). In India, Richards and Flint (1994) estimated a forest loss of 40% during 1880 to 1980. Important driving force were an increased in cultivated area by more than 42 million ha (40%), a staggering tripling of the population (increase of half billion people) and livestock increase of 193 million head (105%). Increasing food demand was often met through an expansion of cultivated area, often at the expense of forests (Lambin and Geist, 2006).

The study area

Junnar tahsil located at the northern part of Pune district. This tahsil is lies in western part of India. The geographical area of the tahsil is 1386.98 sq.km. (Fig. 1). Population of the tahsil is 3,69,810 out of which 345070 are living in rural areas (Census 2001). The physiography of this region has given rise to 3 major charastristics land forms viz. hills and ghat section, the foot hill zone and plain, extend of such features are over around 44, 40 and 16 percent area respectively (fig. 2). The main geological formation in the tract is Deccan trap. The area is drained by main two rivers viz. Kukadi and Meena. Pushpavati is the principle tributary of Kukadi river. Based upon physical characteristics of soil, they can be divided into four major groups viz. (1) Reddish brown light soil (70 %), (2) Coarse shallow soil (7%), (3) Medium black soil (22%) and (4) Deep black soil (1%). The area covered by different divisions shows a wide variation of rainfall patterns, primarily due to the peculiar physiographic configurations. The main average rainfall varies from about 3000mm at Talegher in west to about 1000mm at Junnar in the central region, to less than 500 mm at Ane in the east. About 60 percent of total geographical area comes under the drought prone.

Materials and methods

Data sets

Remote sensing and ancillary data

To assess forest area and spatial pattern over time, 22nd January 2010 IRS P6 LISS III satellite image has been used. In addition to this, Survey of India toposheets of 1:50,000 scale, forest management maps, Global Positioning System were used for the ground survey.

Pre-processing of the satellite data

It is necessary to correct the images geometrically, radiometrically and topographically before they could be used to assess forest cover. The IRS P6 LISS III datasets were downloaded from Bhuvan webside of NRSA, which are geometric corrected. False colour composite images were produced using several band combinations (Fig.4).

Image classification

Three independent resources were available to aid image classification viz. Survey of India topographic sheets; forest map and field survey. These data sets provided detailed information on vegetation and land use for carrying out supervised classification. By keeping main aim of the study, reserve forest area has been extracted from satellite image for the further analysis. The extracted satellite imageries were then classified and different land use and land cover categories were delineated on the basis of tone, texture, colour, pattern etc. Based on the investigation survey of the ground details and signatures, an interpretation key

has been developed to enable information extraction from the image. Around 30 percent part of ground truth collected during field visit was kept separate for the accuracy assessment. Information on the history of land cover change for the points visited was also collected for the interpretation of the images, particularly for the earliest ones. Owing to the availability of these data sets along with ground truth, a supervised classification was chosen to classify the satellite data (Reddy et al.,2008).

The selection of training sites was done considering representation of all digital categories of radiance according to the numeric values (spectral signature) and color composites. Some of these training areas were consistently delineated in each scene in order to minimize classification errors when performing change detection (Luque 2000). The statistical decision criterion of Maximum Likelihood was used in the supervised classification to assist in the classification of overlapping signatures, in which pixels were assigned to the class of highest probability. The classified map of reserve forest for the 2010 period is produced (Fig. 5). For accuracy assessment Overall Kappa Statistics are prepared for assessment of accuracy of the

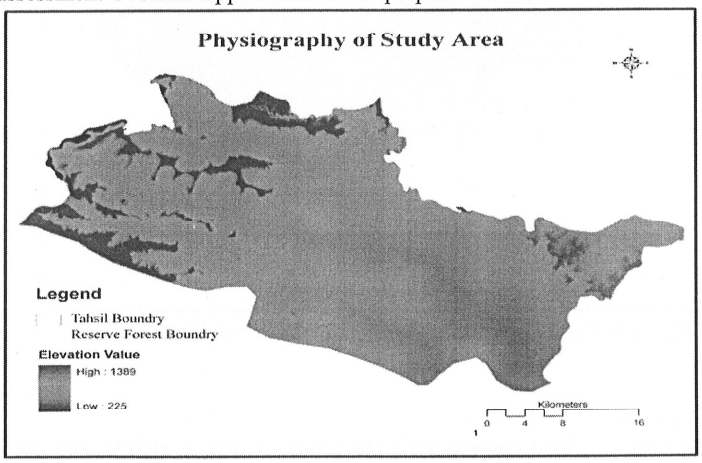

Figure 2. Physiography of Junnar Tahsil.

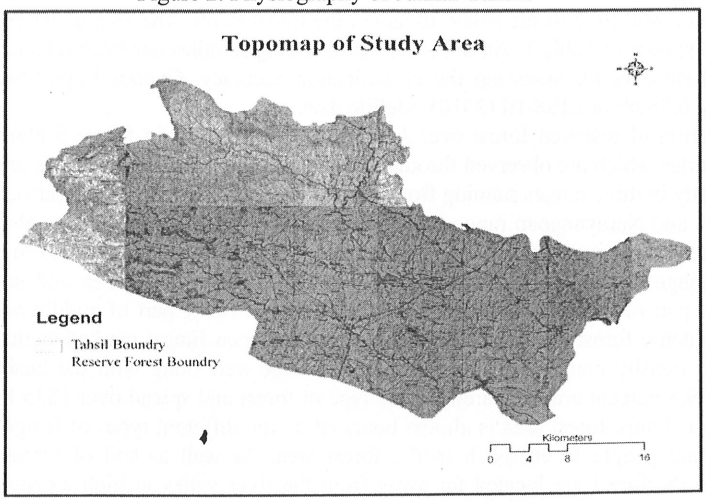

Figure 3. Topomap of Junnar Tahsil.

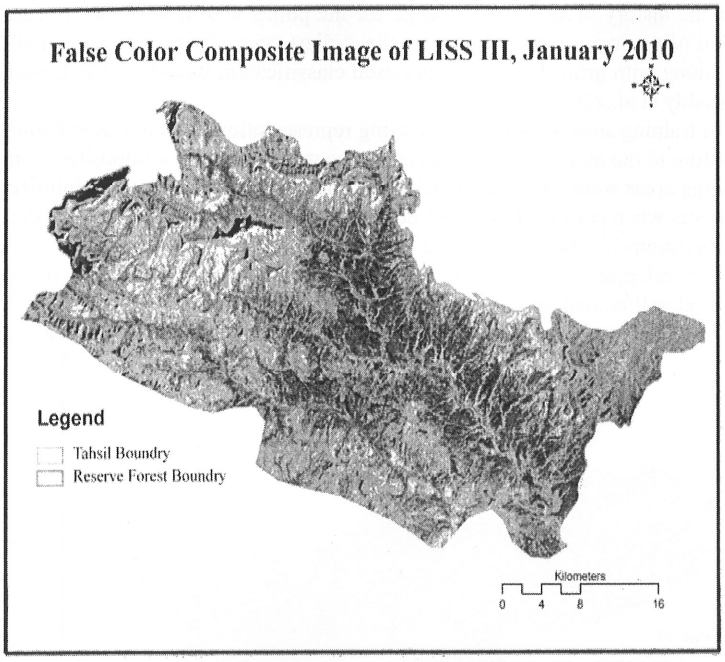

Figure 4. False Colore Composite of LISS III Satellite Image.

Results and discussion

Four major primary land cover types were delineated using satellite data viz., dense forest, open Jungal, scrub land and barren land (Fig. 5). The classification scheme is primary based on the main objective of the study, to assess the forest cover. The area under different land covers are shown in Table 1. An unbiased set of testing samples has been selected from the reference field data for assessing the classification accuracy, Overall Kappa Statistics comes out to be 0.9598 for LISS-III (2010) satellite data.

Distribution of reserved forest over Junnar tahsil has shown in figure 5 along with different categories which are observed through the satellite data. The forest area is unevenly distributed mostly in three ranges running from west to east viz. Otur range (northern), Junnar range (middle) and Narayangoan range (southern) over study area. These ranges also work as a water divider of major river basins. Dense forest mostly observed over western part of Narayangoan range around the Kukadeshwar (Origin of Kukadi river) area and secondly around western part of Otur range near Sablechiwadi village. Some part of middle rage also covered by the dense forest basically over western region. Open Jungal marked as the forest cover with less density compare to dense forest and large tree along with the bushes and scrubs. About 9.5 percent area acquired by this type of forest and spread over 1835 ha. land of reserve forest. Entire forest area is almost bounded by the different types of fringe which prevents surround people to encroach in the forest area. As well as soil of forest is not productive also the forest are located far away from the river valley at high elevated area, where scarcity of water prevent throughout the year, hence forest are not burdened with any

rights excepts that of the right of way and water. The privileges, granted to villagers consist of collection of small deadwood, thorns, grass, grazing, leaves, fruits and flowers.

Land Cover Class	Area (Ha.)	Area in %
Dence Forest	1900	9.78
Open Jungal	1835	9.45
Scrub Land	1605	8.27
Barren Land	14078	72.50
Total Area Under Reserve Forest	19418	100

Table 1. Area in Hectares under different Land Cover Classes

There is vast scope to improve vegetation cover. Hence it is necessary to protect soil loss and increase the soil moisture which are adversely affect the plats by improving ground water table through the watershed management to protect and increase in the vegetation cover. Plantation of xerophytes is another option to improve vegetation area, because such plants are capable to sustain in dry climate along with scarcity of water.

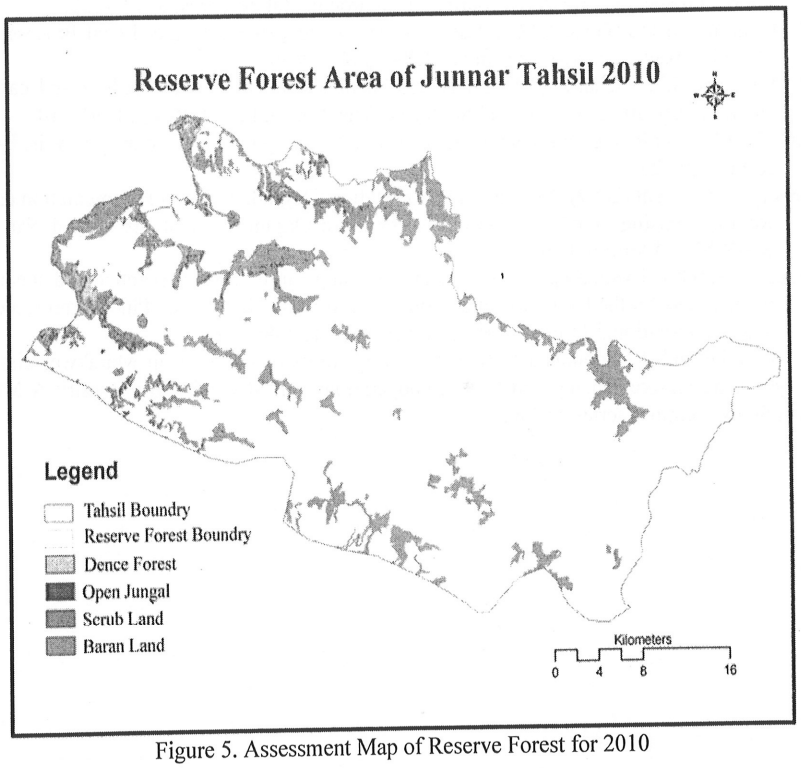

Figure 5. Assessment Map of Reserve Forest for 2010

Conclusion:

The forest are not burdened with any rights excepts that of the right of way and water. The privileges, granted to villagers consist of collection of small deadwood, thorns, grass, grazing, leaves, fruits and flowers. Forest of study area mostly control by the amount of rainfall and moisture availability in soil. Most of the reserved forest confined to the top of the hill ranges where slop is steep which is adversely affect to the formation of soil and it is helping to soil degradation. Therefore recently we observed more than 70 percent barren land which may be the product of continues process of soil erosion. Hence it is necessary to protect soil loss and increase the soil moisture by improving ground water table through the watershed management.

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