

Forest Vegetation Analysis and Land Cover Assessment in Tan Sub Watershed of Hasdeo River Basin, Chhattisgarh, India

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SUMMARY

Hasdeo river basin is one of the important basin area of the Chhattisgarh state for its natural resources as well as its catchment biodiversity. The Tan sub watershed comes under upper western part of Hasdeo river basin. This sub watershed has 21% forest cover. The exploding population pressure has created the adverse condition in the total ecosystem of this region. In the present study satellite image of the year 2008 of IRS P6 LISS3 was interpreted for detecting the forest vegetation pattern and land use class in the basin. In this sub watershed has vegetation and land covers are classified into dense forest, non forest, open forest, scrublands and water bodies. The dynamics of forest vegetation pattern and land use class has been assessed by creating the database of the maps and subsequent analysis under GIS domain. The ground truth analysis has been verified through field observations and site specific observations.

The study revealed that total dense forest land cover area is 35.48%, non forest cover is 25.09%, open forest is 21.42% and water bodies are distributed in 18.02% area. The local people mainly dependent on forest produce. They also do farming of paddy and some indigenous millet. PCA analysis of the sub watershed indicates that forest vegetation, river flow direction, settlement and water bodies are well distributed in the whole catchment.

Key words: Tan sub watershed, Forest vegetation, Land use pattern, Remote sensing, PCA.

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1. INTRODUCTION

Forest resources in India have been immense verities and these forests play an important role to maintain the ecosystem of the Indian peninsular. These forests are the major factors for natural resource creation and invention. However, with some external interference, exploiting population pressure and growing need of fuel woods, industries, food, fodder etc. start to change the scenario of ecosystem by depleting and degradation of forest. This Hasdeo basin is situated in the Maikal range of Central India and it covers the major portion with natural resources. From 200 msl to 1200msl altitude with important peaks of this basin is looking young geologically and fragile environment. Damaging factors for forest and water resources such as encroachment, over grazing, extraction of fuel wood, fodder and timber, construction activities on steeps creates a harsh situation for Hasdeo basin to conserve their status. Environmental degradation of this basin affects the whole Central Indian climate due to soil erosion, siltation, air pollution and flood affects in the down streams.

The present study is the part of the Hasdeo basin to show the status of forest vegetation and land cover of Tan sub watershed (an important tributary of Hasdeo) by using RS & GIS techniques with ground truth information (Singh and Singh, 2010, Pant et al, 2000, Kristensen et al, 1997, Singh et al, 2011). The satellite data are very useful and inexpensive for estimating changes in the value of forest vegetation and land cover analysis at the local level. In many cases, remote sensing from satellites may be the only economically feasible way to gather regularly land-cover information with high spatial, spectral, and temporal resolution over large areas (Verstraete et al.,1996; Seidl et al., 2000). The vegetation changes are often the result of anthropogenic pressure (e.g. population growth) and natural factors such as variability in climate (Guerra et al., 1998; Janetos and Justice, 2000, Miller et al., 1998, Memon and Bawa, 1997, Rigrose et al, 1997).

The satellite based data used in this study has advantages over alternative data-collection methods. PCA is related to factor analysis and can be used to transform a set of image bands such that the new bands are uncorrelated with one other and are ordered in terms of the amount of image variation they can explain (Clark, 2001). Principal component analysis (PCA) was carried out to identify band images which carry the most genuine information about the full band set for digital analysis and/or color compositing (Chaves and Kwarteng, 1989; Beaubien, 1994; Clark, 2001).

However, number of studies carried out by using aerial photographs and satellite imageries to find the forest vegetation and land cover of the different areas, these data gives the better accuracy and complete figures of the area (Vittala et al, 2008; Lillesand and Kiefer, 2002; Gosain, 2004, Arya et al, 2010, Brown, 2010, Gautam, 2002, Thapa and Chapman, 2010).

2. STUDY AREA

Tan sub watershed is situated in western part of the Hasdeo basin in between 22⁰34' N to 22⁰47' N latitude and 82⁰00'E to 82⁰37' E longitude. This sub watershed covers 870.44sq km area(fig1). Most of the part situated in Korba district in which 35% area under Katghora tehsil, 55% area under Pali tehsil and rest 10% area under Korba tehsil. The total population of the area is 2.67 lacs (CoI, 2001). The area consists of hilly and mountainous terrain with minimum elevation of 423 m to maximum elevation of 702 m in the sub watershed. The climate is generally sub-tropical characterised by summer and rainy months. The whole area is depending upon the monsoon. The temperature varies from 24.7⁰ C to 44⁰ C in summer and 11.4⁰ C to 26.4⁰ C in winter and the relative humidity recorded 25.5 to 93% in the area.

The geological structure of the sub watershed is gondwana super rock which covers most part of the sub watershed. The soil of the area is almost fine – loamy and rest area has clays soil. Forest vegetation consisting of Sal (*Shorea robusta*) and its allied species viz, Bija (*Pterocapus marsupium*), Saja (*Terminalia tomentosa*), Haldu (*Adina cordifolia*), Mahua (*Madhuca indica*), Tendu (*Diospyros melanoxylon*), Babool (*Acacia nilotica*) etc. The vegetation in several and the Sal forest in particular of the sub watershed area have heavily degraded by human activities.

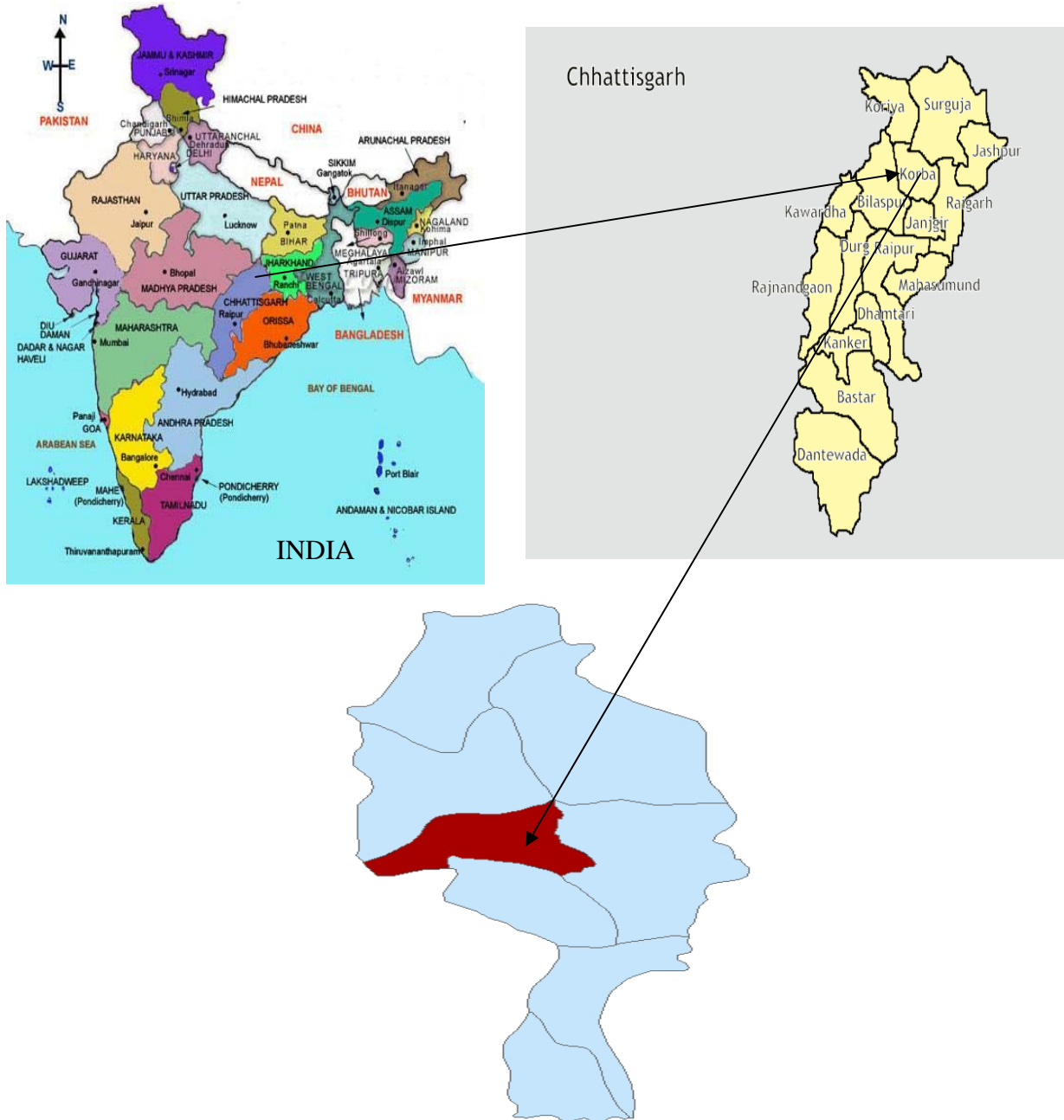


Fig 1. Location map of Tan Sub watershed in Hasdeo basin

3. METHODOLOGY

The satellite data of year 2008 was interpreted stereo specially and visually shown in conjunction with SOI toposheets, ground truth information is obtained by the image. Ground truth study was carried out to develop the interpretation key preparation of the satellite image and a forest land cover type classification has been developed as Dense Forest, Non Forest, Open Forest, Scrubland and Water bodies.

Meanwhile Non Forest is classified as Agriculture land without Crop (ALWC) and Agriculture land with Crop (AWC). This study gives the actual condition of the forest vegetation and land cover status. In the study we have also use the Principal Component Analysis (PCA) technique to show the land use pattern of the sub watershed.

3.1 Data and Material used

- Survey of India (SOI) toposheets
- IRS –P6 LISS 3 false colour composite image
- Site specific interviews
- GIS software like ERDAS 9.3

4. RESULT AND DISCUSSION

4.1 Principal Component Analysis (PCA) of Tan sub watershed:

In this study we use Principal Composite Analysis (PCA) as valuable method to define the land use pattern of the Tan sub watershed.

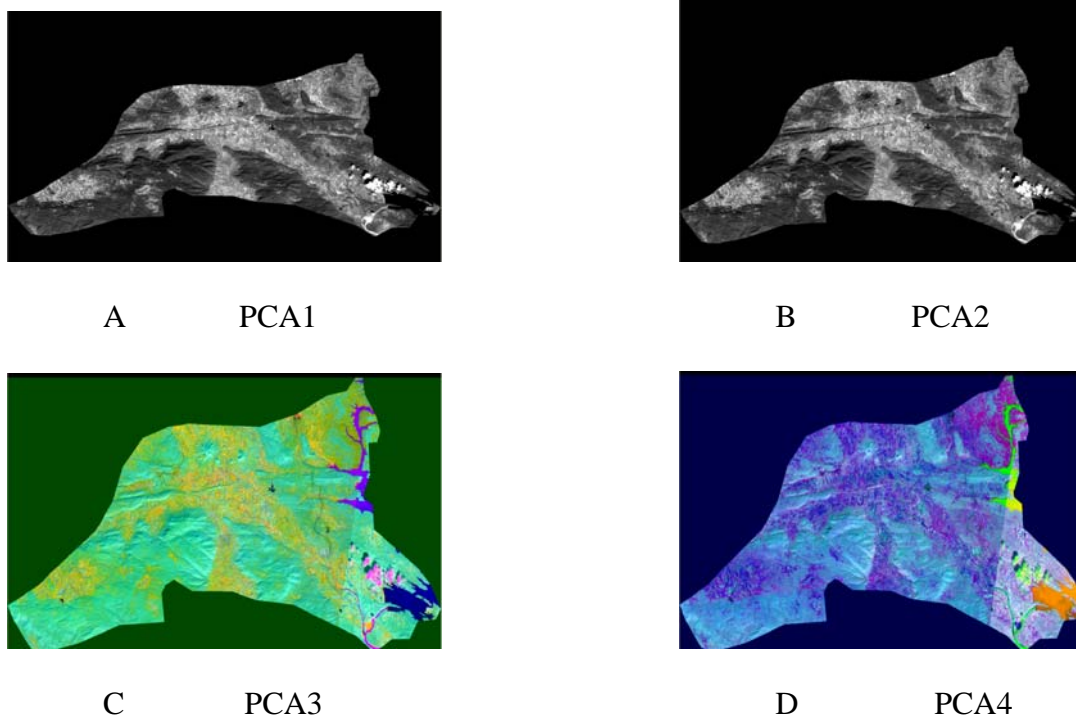


Fig 2. PCA of Tan sub watershed

Image composite of the year 2008 of IRS P6 LISS 3 for PCA study in the sub watershed indicate that in PCA1 and PCA2 (fig 2 A & B) images settlement, open land and its elevation pattern and soil distribution pattern are clearly visible. But both the images are

unable to provide exact identification of attributes. these images shows the forest and open area are equally distributed. In PCA3 (fig 2 C) green colour indicates the forest vegetation and yellow colour represents the open area with water bodies and land with different moisture level. In PCA4 (fig 2 D) image of the sub watershed attributes are clearly visible. The light blue colour shows the forest area, yellow indicates the river flow direction. In this study PCA showed noticeable structure of the land use pattern of the sub watershed

4.2 Forest Vegetation status:

The forest land cover map of Tan sub watershed (fig 3) reflects the status of the land cover class and forest vegetation in the year 2008. The analysis (table 1) shows that dense forest has been subjected to maximum distributed yet in the area but as total area calculation of the sub watershed this ratio is very less due to heavy exploitation of the forest resources. Sal is one the important timber species in our country. Most of the Sal Forest is found in this sub watershed. Dense Forest is very rapidly converted into Open Forest area and the population pressure increases day by day for their necessasities in this sub watershed. In this sub watershed Open Forest and Scrubland areas have been converted into agriculture land due to heavy encroachment and mining activities which is carried out in the Northern part of the sub watershed.

Table 1. Forest Land Cover classification in Tan sub watershed

Forest Land Cover Class	Area (in sq. Kms.)	Percentage area
Dense forest	308.808	35.48%
Non Forest	218.357	25.09%
Open Forest	186.406	21.42%
Scrubland	00.00	0.00%
Water bodies	156.869	18.02%
Total	870.44	100%

TAN SUB WATERSHED
FOREST AREA

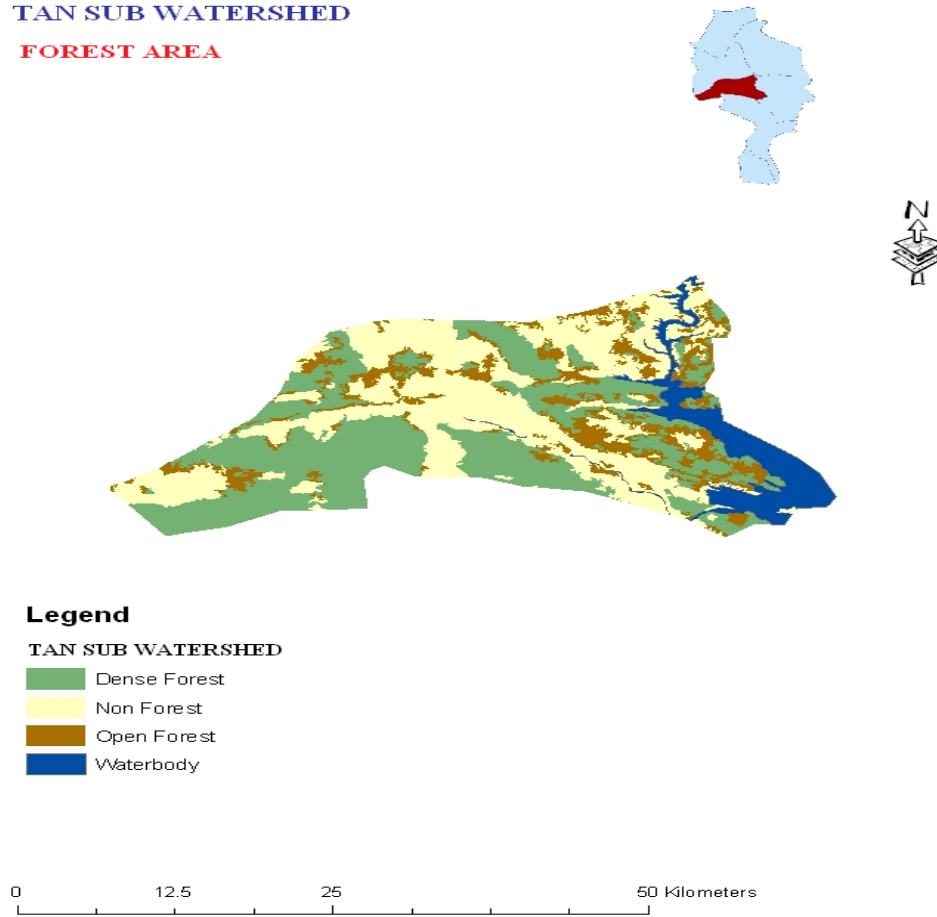


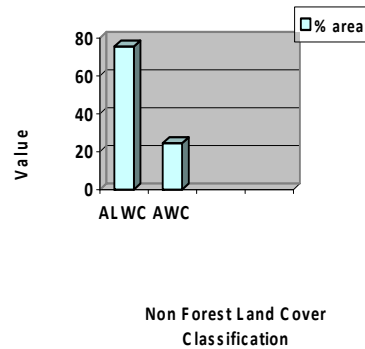
Fig 3. Forest land cover map of Tan Sub watershed

4.3 Classification of forest land cover class and forest vegetation types:

The classification of the forest land cover class study in Table 1 shows that maximum Dense Forest is distributed in 308.808 sq kms (35.48%) area in the sub watershed. Dense forest defines the area as 0.6 to 0.8 canopy density. Followed by Non Forest and Open Forest as 218 sq kms (25.09%), 186.406 sq kms (21.42%). Scrubland is absent. Water bodies covers the Tan river, some part of Hasdeo river, ponds, springs, wells and waterholes of the sub watershed is totally distributed in 156.869 sq kms (18.02%) area. These water bodies provide water for the sustainable development and livelihood production in the sub watershed. Fig 4 shows that Non Forest land cover is classified in Agriculture land without crop (wastelands) which is 75.44% of the area and agriculture land with crop is only 24.56%.

This data shows that for the increasing population the agriculture land is very less for their food. Most of the land is forest land in which tribal population resides mostly and they are totally dependent upon the forest produces fisheries and handicrafts. Due to mining area in some part of the sub watershed makes the area very commercial and unpleasant for

environment. Dust of the mines slowly and slowly increase the mortality rate of the forest vegetation and decrease the fertility of the irrigated land.



*ALWC- Agriculture land without Crop and AWC- Agriculture land with Crop

Fig 4. Non forest land cover classification

5. CONCLUSION

The forest cover degradation is mainly occurred due to the increase in population pressure for food and other forest resources, natural disasters like forest fire, etc. In the recent years, many large development projects including highways, railway lines, mega dams, canals/power plants and mines have intruded into this biodiversity treasure trove. The study indicate that this Tan sub watershed is still very rich in dense forest point of view and compare to the other forest areas in its neighbor the population interface is low and therefore, the deforestation rate is minimum.

The indication of denudation of forest, clear felling of natural forests for raising commercial plantation, soil erosion leading to silting of reservoirs and reduction in their life span and the adverse effects of floods, landslides encroachment of forest land and poaching of wild life has already seen in the Tan sub watershed in the recent years. However, better watershed management practices will be followed for the sustainable development and healthy forest ecosystem is the one of the big affinity to this sub watershed area.

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