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Original Article

Forest land cover variation and catchment status in the BAMNI sub watershed of *Hasedo* river basin in central INDIA

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Abstract

Bamni sub watershed is one of the important watersheds at Hasdeo river basin in central India. It covers 1567.09 sq km area and is situated between 680-716 m elevations. IRS 1-D LISS III image analysis of October, 2008 of sub watershed shows that the catchment has a total 25.58% land cover as dense forest, 23.19% is open forest, 34.20% is non forest, 0.59% is scrubland and 16.44% is water bodies. The catchment of Bamni sub watershed is dominated by Sal forest which entail Sal Forest (278.30 km2), Sal Mixed forest (53.49 km2), Mixed Miscellaneous forest (55.36 km2), Dry Deciduous forest (9.59 km2) and Teak forest (4.24 km2). Under the catchment of this sub watershed area agriculture land without crop has been recorded 53.85% and agriculture land with crop has been 46.15%. The local population settlement of the catchment is distributed very unevenly. The whole Bamni area shows a pattern of sustainable utilization of the natural resources.

Key-words Bamni sub watershed, Land cover, Sal forest, Hasdeo river basin, Remote sensing.

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Introduction

The Hasdeo river flows from Sonhat, Koriya district of Chhattisgarh and joins Mahanadi in Janjgir Champa district of Chhattisgarh in Central India and it flows upto a length of 333 kms. Hasdeo river basin has eight watersheds and located between the northern latitude of 210 45' to 230 23' and eastern longitude of 820 00' to 830 03'(fig 1). The Bamni is one of the important sub watershed and it is distributed in 1567.09 sq km area. Bamni sub watersheds is situated in north-west side of the Hasdeo river basin. The Bamni river originates from the western part of the watershed and covers approximately 113 km distance before joining the river Hasdeo. It is a perennial water source and the shape of the drainage is dendritic. This sub watershed has most of the part comes under dry deciduous forest type. Sal (*Shorea robusta*) is a dominant species with high forest tree variation diversity followed by Teak (*Tectona grandis*), Haldu (*Adina cordifolia*), Saja (*Terminalia tomentosa*), Salai (*Bosewellia serata*), Mahul (*Bauhinia vahlii*), Semal (*Bombax ceiba*), Mahua (*Madhuca indica*), Aonwla (*Phyllantus emblica*), Harra (*Terminalia chebula*) and Ber (*Zizyphus zuzuba*). Bamboo species (*Dendrocalamus strictus* and *Bambusa bambos*) abundantly grow in the area and are two of the important species used by local population. The paddy, maize and legumes are common agricultural crops in the catchment. The climate of the area is sub tropical with medium to high elevation. There are three distinct seasons namely winter (1st November to 15th February), summer (1st April to 14th June) and rainy (15th June to 15th September). The region is covered by the southwest monsoon with average rainfall of 1400 mm. The mean monthly temperature fluctuates between 10.3°C (in January) to 41.1°C (in May). The average relative humidity varies from 49% to 93%. The approximate evaporation losses on exposed and unexposed water bodies account for 50% of total rain received. The natural resource utilization pattern in sub watershed is purely under sustainable pattern and there is no much anthrogenic pressure.

Material and Methods

In this study forest type variation mapping and monitoring in whole catchment of the Bamni sub watershed has been done through remote sensing. In the first step, the simple image pre-processing was carried out including image enhancement and geometric correction. Enhancement techniques were applied to satellite image in order to increase visual distinctions between features and increase the amount of information that can be visually interpreted from the data. This procedure includes various techniques. IRS 1D image was enhanced using high pass filtering. The collected data provides the

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actual condition including forest cover and its classification, soil and wasteland area. To locate ground features on imagery a geometric correction procedure is used to register each pixel to coordinates. Ground truth was collected with the help of Survey of India (SOI) topographic maps, forest compartment maps and satellite imagery which cover the entire area for preparing base map, drainage etc. IRS satellite 1-D LISS III image in four bands of spatial resolution 23.5 m with path 102 row 55 of October 2008 was used. Visual interpretation of imagery was carried out on false colour composites in order to stratify forest types. GIS applications were used for assessing the data for interpretation. Different forest land cover types with special reference to dense forest type and non forest type was studied.

Results and Discussion

Bamni sub watershed (1567.09 km2) is one of the important parts of Hasdeo river basin (fig 2). It is located between 230 05' to 230 12.5' north latitude and 820 07' to 820 30' in north- west direction with elevation value of 680-716 m. msl. Hasdeo river basin covers 10405.99 km2 areas. It is nearly peer shaped towards its upper and central part and funnel shaped in lower part. It is located between the north latitude of 210 43' to 230 32' and eastern longitude of 820 07' to 830 03' (fig 1). Bamni has rich natural forest cover along its catchment. The soil of the area is fine loamy and clayey mixed. In some places of the basin along the flow line, soil erosion is severe and it is due to the mines patches and industries especially in Chirmiri and Malajkhand areas. Balaselvakumar *et al.* (1990) have made on assessment the forest variation study at Arjuna basin of Tamilnadu the use of using remote sensing technique to analyse better forest land management for sustainable development. Shrivastava *et al.* (2002) have assessed large scale deforestation in Sonitpur district of Assam and also analysed the forest pattern loss in Brahmaputra basin. Gautam *et al.* (2003) have analysed the spatial and temporal changes for land cover in a mountain watershed covering an area of 153 km2 in Central Nepal and observed an increased pattern of broad leaf forest and conifer forest from 1976 to 2000.

In Bamni, sub watershed forest land is classified in various categories: The dense forest (DF) area covers 401.01 sq kms and Open forest (OF) area is 536.03 sq. kms, Scrublands (SBL) and waterbody (WBD) covers 8.80 and 257.74 sq kms respectively. Table 1 shows the details of forest land cover area (in sq kms) and its percentage.

(SF- Sal Forest, SMF- Sal Mixed Forest, MMF- Mixed Miscellaneous Forest, DDF- Dry Deciduous Forest, TF- Teak Forest)

The Bamni sub watershed has the following area under non forest land cover type distribution which is mostly used for

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agriculture purposes by the local population (Table 2).

In the sub watershed total non-forest land cover area is 536.039 sq kms in which 53.85% area is barren land or wasteland which is commonly not used for agriculture purpose. In this sub watershed sufficient area comes under mines marked category. The 46.15% area is agricultural land used for farming; for food production and for commercial as well as horticultural crop production. Soil is mainly red and yellow sandy coloured. The soil requires irrigation and double crop can be cropped with the irrigation facility. Variation in soil distribution in sub watershed area is shown very clearly due to undulated structure. The maximum part of the sub watershed is at high elevation. Paddy is mainly grown on this plain area. In some parts black soil formed from the basalt is highly fertile soil. The total population in the sub watershed area is 3,07,200 (Census, 2001) in which rural population is 1, 86,716 (66.77%) and urban population is 1, 20,484 (33.23%). This data shows that forest land is very much acquired by rural inhabitants for their agriculture purposes. Most of the urban people work in the coal mines situated near Katghora, Manendragarh and Baikunthpur. Most of the coal mines are situated in the forest area of river catchment and that is why the forest is destroyed by the population pressure. Singh and Singh, (2010) have analysed the upper Hasdeo sub watershed and found that forest has very high diversity of tree species. Bamni sub watershed shows a sustainable development pattern and multiple utilisations of natural resources by its local populace. Vogl *et al.*, (2008) have analysed that watershed science recognizes that human and natural systems exist in linked social-ecological systems with complex interactions between human decisions and ecosystem functioning which effects the sustainable development. Chaudhary *et al.*, (2008) observed that forest land is one of the most important natural resource and forest land use/ land cover planning with spatial distribution helps to make better watershed management strategies in forest area. Effective management of forest and other natural resources in turn requires an understanding of the variability in time and space of these resources and the role of human cultures and institutions in bringing those variations (Naiman *et al.*, 1997).

The results showed that integration of remote sensing and GIS were found to be effective in monitoring and analysing land cover patterns and in evaluating urbanization impact for future watershed management and its sustainable development.

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Table1. Forest land cover distribution in Bamni sub watershed

Sl.No.	Forest land cover distribution	Area (in sq. Kms.)	% area
01	Dense forest (DF)	401.01	25.58
02	Non Forest (NF)	536.03	34.20
03	Open Forest (OF)	363.49	23.19
04	Scrubland (SBL)	8.80	0.59
05	Water bodies (WBD)	257.74	16.44
	Total	1567.09	100

Table 2. Non forest land cover type distribution in Bamni sub watershed

Sl.No.	Non Forest land cover distribution	Area (in sq. Kms.)	% area
01	Agriculture land without Crop (ALWC)	288.658	53.85
02	Agriculture land with Crop (AWC)	247.381	46.15
	Total	536.039	100

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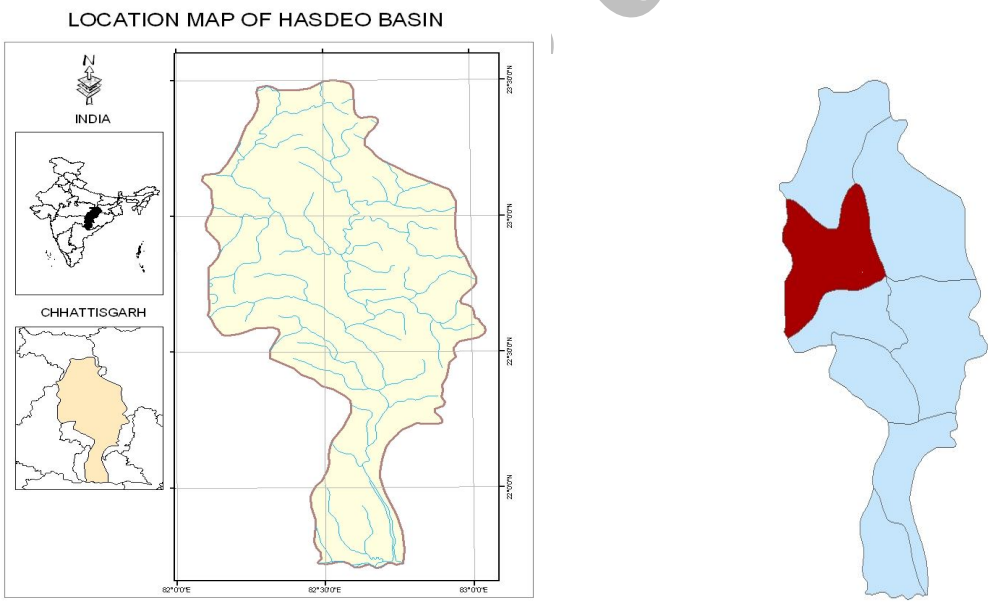

Fig 1. Location map of the hasdeo basin

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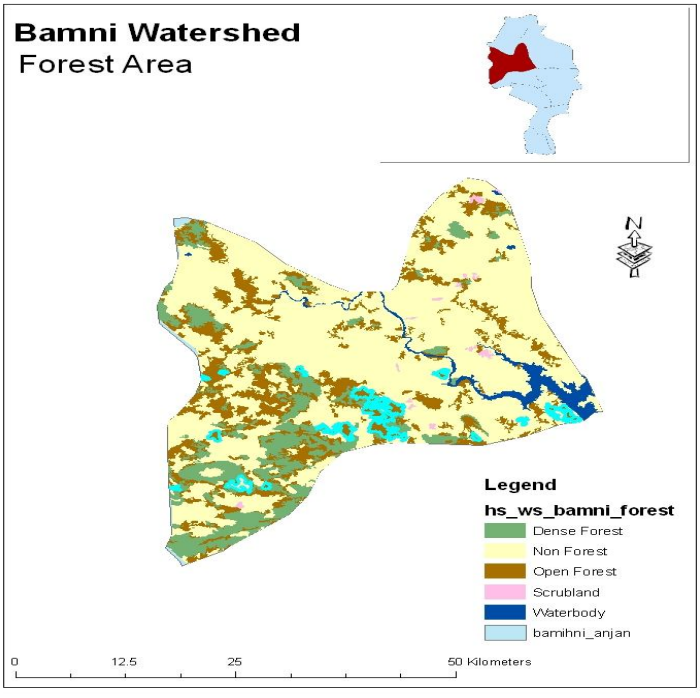

Fig 2. Bamni sub watershed in hasdeo basin

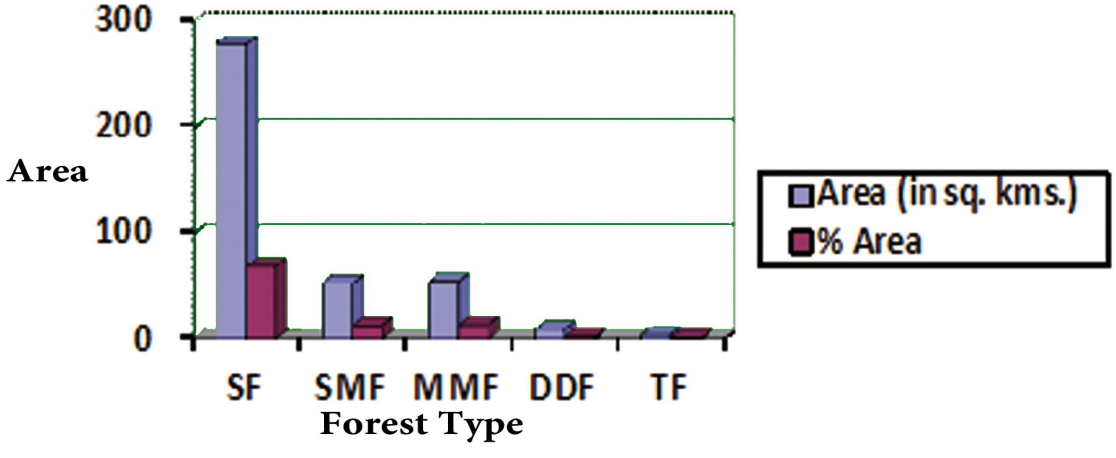

Fig 3. Dense forest (DF) covers distribution in Bamni sub watershed