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Geomatic based detailed study of landuse of Palar River Basin

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ABSTRACT

Land use and land cover change is a major issue in global environment change, and is especially significant in rapidly developing regions in the world. Fast LULC change have resulted in degradation of its ecosystems and affected adversely the environment. It is urgently needed to monitor its LULC changes and to analyses the consequences of these changes in order to provide information for policymakers to support sustainable development. Land use practices are influenced by water and land availability, and land capability and suitability tempered by socio-economic conditions. Aerial photographs of 1980, Landsat satellite Thematic Mapper (TM) data of 1998 and IRSIC satellite LISS sensor data of 2006 have been interpreted to generate the land use map of Upper Palar Basin, and data of 1988 and 1998 used for the total Palar Basin. While the classification scheme for the Upper Palar Basin study focussed on irrigation intensity (intensely irrigated, less intensely irrigated and dry crop) and forest density classes the total basin study focussed on mapping kharif, rabi and double cropped areas and forest types (evergreen, degraded, etc.). Such maps for different time periods enable detection of location and extent of land use changes, a necessary input to sustainable management. © 2009 Trade Science Inc. - INDIA

INTRODUCTION

The human society is closely depending on natural resources. On the other hand the earth suffers growth of population, deforestation, depletion of natural resources and these resources are becoming always more scare. The change detection of land-cover and landuse (LCLU) has been applied in many different countries and ecosystems of the world, for example, in Canada[1], United States of America[2], Kenya[3], Thailand (Crews-Meyer, 2004), Cameroon[3] or in Madagascar[4]. Different approaches have been used to understand where LCLU changes are occurring and to study the driving forces of these changes[5]. Currently, in many parts of the world, human activity is the major force in shaping LCLU change although the underlying physical structure of landscape may constrain CLU[1,6]. For example, soil conditions or terrain slopes may make the cultivation of some crops difficult. Therefore, an integration of biophysical and human factors in the explanation of LCLU dynamics remains as an important research[7]. Many studies have conducted spatial predictions based remotely sensed data[8-15]. Few studies have been conducted on estimations of forestry relevant variables using spatial lmodels, although a large number of spatial-statistical and prediction models are available in the literature[16-19] Goovaerts (1997) Masellj and Chiesi (2006), Buddenbaumet al. (2005), Berterretche et al. (2005), Tuominen et al. (2003), and Zhanget al. (2004) applied geostatistical models to estimate forest variables, such as leafarea index, and toclassifyforest lands based on remote sensing data. Gilbert and Lowell (1997) used kriging to predict stem volume in a 1500 ha balsamfir (Abies balsamea) dominated forest. Prediction based on 5.6m and 11.3m radius plots resulted in a RMSE of 54% (of the mean) and 39%-46%, respectively.

Methodologically, the accuracy rate of the predicted variable could be improved by incorporating close field observations as predictors in spatial modeling.

STUDY AREA

Physiography

The Palar River originates in Nandhi Durg, Kolar district at an elevation of 800 m above MSL in eastern part of Karnataka state, through Kolar and Bangarupet taluks where it forms the very large Bethamangal tank which is the main source of water supply to Koalr Gold Field and Bharath Earth Movers Limited. It leaves Karnataka border and flows through Andhra Pradesh for a small distance in Kuppam taluk in Chitoor district and enters North Arcot district of Tamil Nadu and passes through west of Vaniambadi Town and flows into the Bay of Bengal east of Maduranthagam and south of Mahabalipuram.

The total area of Palar Basin is 18,300 sq.km which includes an area of 3,123 sq.km in Karnataka state and an area of 4,267 sq.km in Andhra Pradesh. It lies between N latitude 12°14'00" – 13°37'00" and E long 77°48'40" – 80°14'40". The basin is bordered on the north by Swarnamugi river basin of Andhra Pradesh state and Cooum river on the eastern side and Varahanadhi river from 37 to 135 km. The basin covers in Tamilnadu the Vellore, Thiruvannamalai, Kancheepuram and Chengalpattu districts.

Hydrometeorological characteristics

Climate

The climate of the basin is characterized by 4 distinct seasons viz., south-west monsoon from June to September, the north-east monsoon from October to December. The winter period is during the months of January and February and hot weather period from March to May.

Rainfall

There are 29 raingauge stations located in the Palar River Basin Area in Andhra Pradesh State. There are 39 raingauge stations located in and adjacent to basin boundary and inside Tamil Nadu State having influential area in the basin. Out of this 33 stations have long term data of over 20 years. The monthly and annual rainfall data of these rain gauge stations are available for varying period from 1901 to 1998. The weighted average monsoon rainfall of the basin considering the different rain gauge stations for the period 1901 – 02 to 1988 – 89 in six sets have been worked out. The weighted average monsoon maximum and minimum rainfall is found to be 1,395 mm and 460 mm respectively. The basin receives most of the rainfall from the south-west and north-east monsoons as such June to December is considered as monsoon period and January to May as non-monsoon period.

Temperature

The monthly mean daily temperature observed at Vellore IMD observatory, located in the Central region of the basin, ranges from 18.2°C in the month of January to 38.4°C in the month of May.

Wind speed

The average wind speed is generally moderate ranging from 4.9 km/hr during Oct to 9.9 km/hr during July as observed in Vellore IMD observatory. Increase in wind speed occurs only during the cyclones, which occur mostly in November. From May to September winds are generally from South-westerly, West, and Northerly direction. In October to December wind blows from Northeast and East direction.

Sunshine

The hours of day light during summer is more when compared with that of winter and monsoon periods. No sunshine hours data are available as such the same have been computed from the cloud cover observed at Vellore IMD observatory.

METHODOLOGY AND MATERIALS

The land cover/ use map of the basin was mapped from the IRS IC satellite LISS sensor data of 23 m resolution and Panchromatic data of 5.8 m resolution obtained in 1998. The two data sets were digitally merged using ERDAS image analysis system and the hard copy imagery was generated, and visually interpreted into the defined land use/cover classes. The interpretation was substantially supported by ground data.

The mapping was done in 1:50,000 scale. This map was then scanned and digitized, and registered with the administrative map and other thematic maps of the basin in the GIS environment.

RESULTS AND DISCUSSIONS

The land use map of the Palar Basin from 1998 satellite data is shown in Figure 1. The classification scheme is shown in TABLE 1.

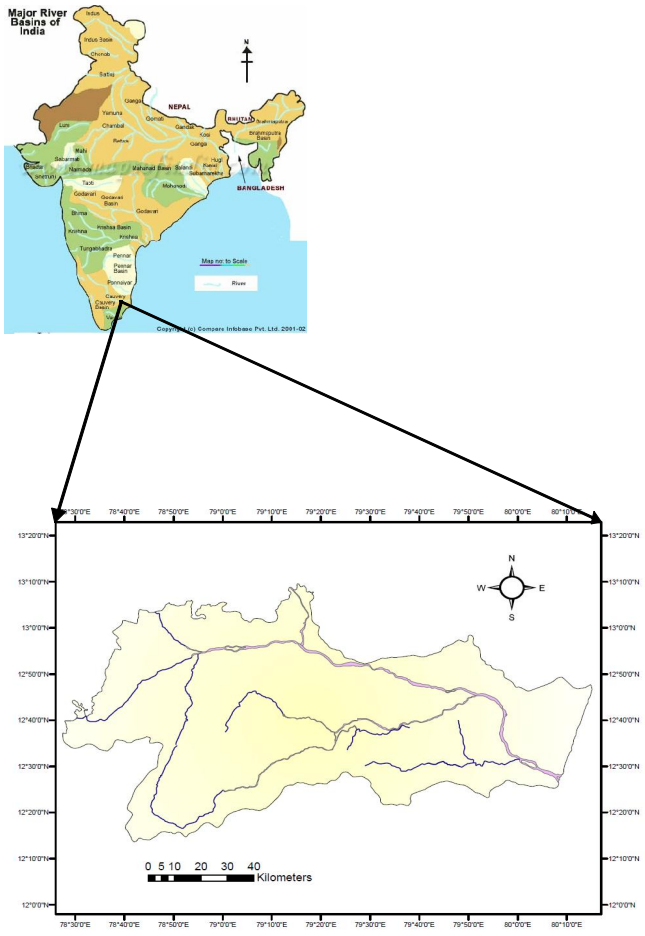

Figure 1 : Location Map of Palar River Basin

Built up areas

Man-made constructions covering the land surface are included under this category. Human settlements - cities, towns and villages - comprising residential areas, roads, industrial and commercial complexes are included in this category. The total Built up area in the present study comprise about 83.1 Km² (0.85%), Refer Figure 2.

TABLE 1: Land use/ cover Distribution in Palar Basin

Land Use Category	Area in Sq.km	% of Total
1. Built-up land		
1.1 Major settlements	83.1	0.85%
2. Agricultural land		
2.1 Kharif	156	1.42%
2.2 Rabi	1,387.4	12.54%
2.3 Double cropped area	4,788.8	43.24%
2.4 Plantation	124.7	1.14%
2.5 Fallow	552.3	5.03%
Sub-Total	*7,000.2*	*63.84%*
3. Forest		
3.1 Evergreen/ semi-evergreen	430	3.90%
3.2 Deciduous	1,263.0	11.54%
3.3 Degraded	620.4	5.65%
3.4 Forest blank	2.1	0.02%
3.5 Forest plantation	18.24	0.10%
Sub-Total	*2,300.9*	*20.21%*
4. Wasteland		
4.1 Sandy	204.7	1.86%
4.2 Barren rocky	55.36	0.50%
4.3 Waterlogged	6.7	0.06%
4.4 Salt affected	127.8	1.16%
4.5 Land with or without scrub	550.7	5.02%
Sub-Total	*940.3*	*8.60%*
5.Water bodies	600.1	5.40%
Total	*1,0936.6*	*100.00%*

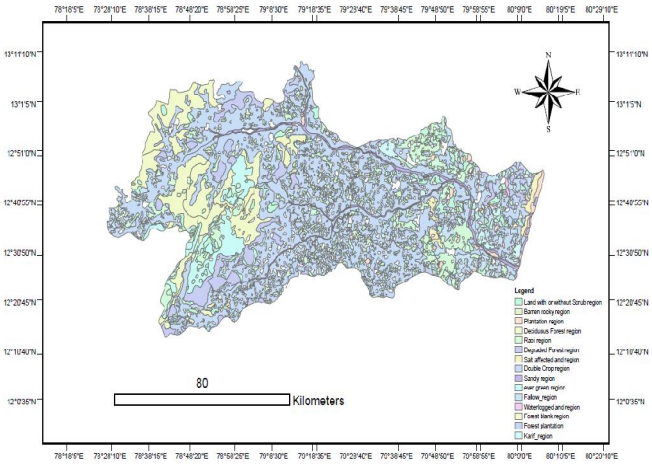

Figure 2 : Landuse/ Landcover map of Palar River Basin

Agricultural land

Land used for raising agricultural crops, vegetables, fruits and fodder is categorized as agricultural land; fallow and plantations are also included in this category. Mixed and multiple cropping systems generate confu-

sion in spectral signatures, and multi-temporal data is generally used for detailed classification of crop lands. *Area* under standing crops is classified as crop, and divided into two broad categories of kharif and rabi crops, the separability depending on spectral and crop calendar/association differences. Double crop areas have crop cover in both seasons. Plantations in Palar Basin include pine apple, grapes, gueva, mango and banana orchards and cover the area about *7,000.2 Km²* *(63.84%)*. The percentage of Kharif, Rabi, Double cropped area Plantation, Fallow land is shown in The Figure 3.

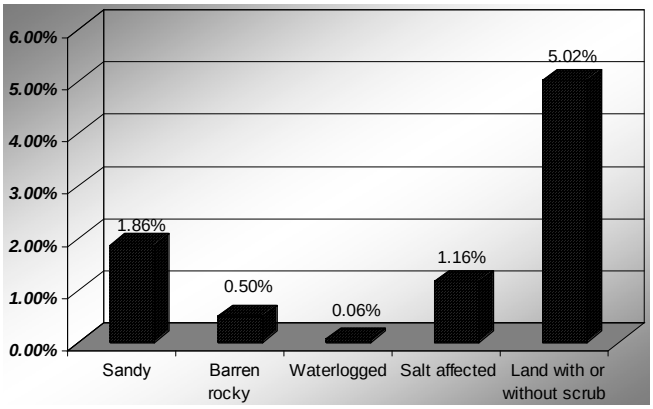

Figure 3 : Features in built up area with percentage

Wastelands

Waterlogging and soil salinization represent adverse impact of natural drainage congestion or inappropriate water management. About 940.3 Km² (8.60%) are occupies by waste lands.

Water bodies

Palar River and tributaries are dry during most of the year, and hence shown as sandy area, though the river edge is delineated. The water bodies cover about 600.1 Km² (5.40%) area of Palar River Basin, Refer Figure 4.

Forest land

This category includes all the areas that are notified as forests with or without crown area density of 10 per cent. Degraded forest has less than 20 percent tree cover. Forest plantations consist of a variety of trees within and outside the notified forest areas, and are typically fine uniform textured, due to homogeneity of tree species, compared to coarse texture of natural forest. The forest lands comprise about *2,300*.9 Km² *(20.21%)*, Refer Figure 5.

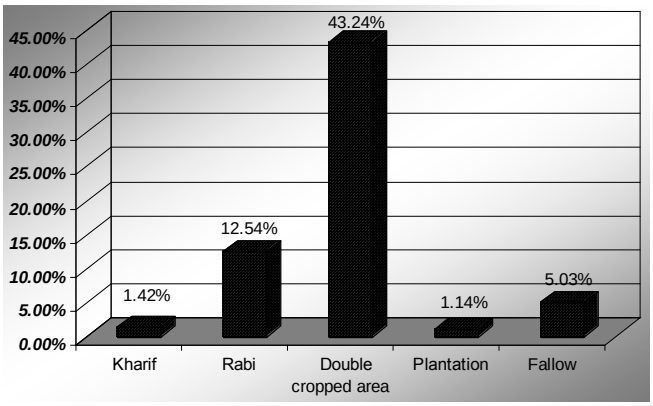

Figure 4 : Crop pattern in study area with percentage

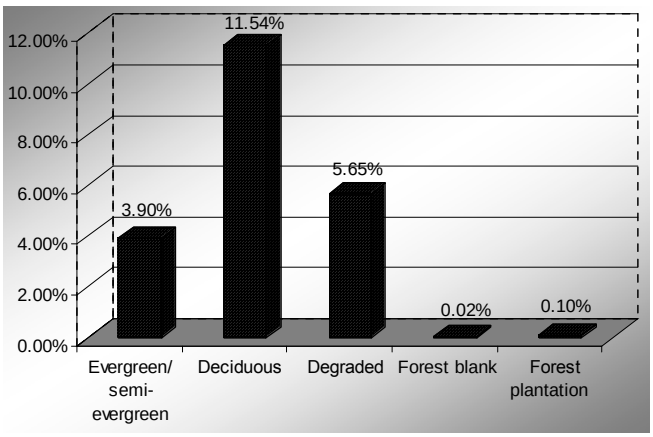

Figure 5 : Types of forests in study area with percentage

CONCLUSION

The Remote sensing data is efficient in studying the landuse features. A detailed study on landuse was carried out in the present work which enables that 63.84% of the total area fall under agriculture, further the detailed agricultural land was studied which shows that about 43.24% is under double cropped area. The forests constitute about 20.21% area of the total study area under that Evergreen forests constitute 11.54%. The total percentage of waste land in the study area is 8.60%, including Land with or without scrub of about 5.02%.

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