Land use and Land Cover Analysis using Remote Sensing and GIS: A Case Study in and around Bramhamgarimatam, Kadapa District, Andhra Pradesh, India

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Abstract

Land use/land cover analysis were determined in bramhamgarimatam village, Kadapa disrtrict, Andhra Pradesh by using remote sensing and geographical Information System(GIS) technology. These include Survey of India (SOI) topographic sheets of 57J9,57 J12, 57J14 and 57N1&57N2 of 1:50,000 scale and satellite image IRS P6 geocoded data of 1:50,000 scale. The land use and land cover analysis in and around Rajampeta area has been attempted based on thematic mapping of the area consisting of built-up land, agriculture land, water bodies, forest and waste land using the satellite image. In this study area major natural resource is forest. Because of human activities the extent of the land under forest is getting reduced. In the same way land used for cultivation is also decreasing. But at the same time land under built up area is decreasing. The result shows that forest lands are well distributed in the Western part towards the middle of East of the study area and it covers 106 sq. km (38 per cent). Uncultivated land occupies 122 sq. km, Cultivated land occupies 24 sq. km (24%).water bodies occupy 66 sq. km (21%) and Built-up land occupies 3000 sq. m (1.%). Well developed dendritic drainage pattern is there in the study area.

Keywords - *Land use / Land cover, Remote sensing, Geographical Information System(GIS), Bramhamgarimatam etc.,*

I. INTRODUCTION

The study of land use/land cover (LU/LC) changes is very important to have proper planning and utilization of natural resources and their management. Remote sensing has become an important tool applicable to developing and understanding the global, physical processes affecting the earth [2]. Recent development in the use of satellite data is to take advantage of increasing amounts of geographical data available in conjunction with GIS to assist in interpretation [3]. GIS is an integrated system of computer hardware and software capable of capturing, storing, retrieving, manipulating, analyzing, and displaying geographically referenced (spatial) information for the purpose of aiding development-oriented management and decision-making processes [4]. Remote sensing and GIS have covered wide range of applications in the fields of agriculture [5], environments and integrated eco-environment assessment [6]. Several researchers have focused on LU/LC studies because of their adverse effects on ecology of the area and vegetation. knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, destruction of important wetlands, and loss of fish and wildlife habitat. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels [7].The land use/land cover pattern of a region is an outcome of natural and socio – economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure[8]. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare [9].This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation mapping has greatly increased research on land use land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become an important priority.

Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management [10]. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time;

such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996). A total of three thematic maps such as location, drainage and land use and land cover maps were prepared based on image interpretation studies with limited checks. The land use-land cover pattern falls under the broad categories of built-up land, cultivated land, forest land, water bodies and uncultivated lands [11].In this study area major natural resource is forest. Because of human activities the extent of the land under forest is getting reduced. In the same way land used for cultivation is also decreasing. But at the same time land under built up area is decreasing. The result shows that forest lands are well distributed in the Western part towards the middle of East of the study area and it covers 106 sq. km (38 per cent). Uncultivated land occupies 122 sq. km, Cultivated land occupies 24 sq. km (24%).water bodies occupy 66 sq. km (21%) and Built-up land occupies 3000 sq. m (1.%). Well developed dendritic drainage pattern is there in the study area.

II. OBJECTIVES

1. To study the present status of water resources, natural resources, land resources, soil productivities, cropping patterns, forest cover etc, using satellites data, collateral data and field data.

2. To prepare the thematic maps namely location, land use/ land cover, and drainage.

3. To prepare action plan for land resources and water resources.

III. MATERIALS AND METHODOLOGY

Brahmamgari Matham Brahmamgari Matham is a village in Kadapa district of the Indian state of Andhra Pradesh. It is located in Brahmamgari Matham mandal of Rajampet revenue division. It is a pilgrimage centre. Kandimallayapalle is located 60 km away from Kadapa. It is well facilitated with roads. The preferable route from Kadapa to Kandimallayapalle is via Mydukur. From Mydukur, the distance is 37 km. The nearest railway station to Brahmamgari Matam is Kadapa. Kandimallayapalle is 60 km from Kadapa. The nearest airport is Kadapa airport. The present study area is located between $78^{0}47^{I}$ 33^{II} to $79^{0}02^{I}33^{II}$ E longitude and $14^{0}42^{I}$ 06^{II} to $14^{0}52^{I}56^{II}$ N latitude the study has made use of various primary and secondary data. These include Survey of India (SOI) topographic sheets of 57J9,57J12, 57J14 and 57N1&57N2 of 1:50,000 scale and satellite image IRS P6 geocoded data of 1:50,000 scale.

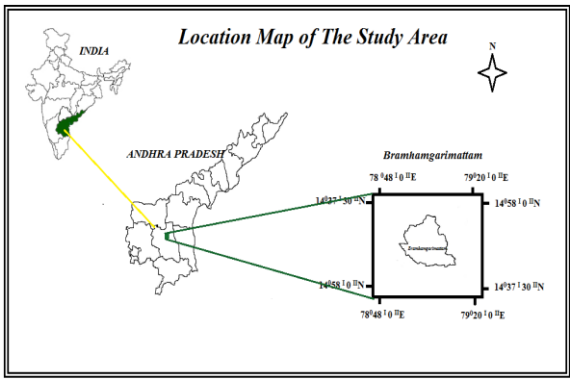

Fig 1 : Location Map od the Study Area

IV. METHODOLOGY

The Indian Remote Sensing Satellite (IRS) data was visually and digitally interpreted by using the image interpretation elements (such as tone, texture, shape, pattern, association etc.) and ArcGIS software was used for processing, analysis and integration of spatial data to reach the objectives of the study. Adequate field checks were made before finalization of the thematic maps. The main goal of this study is to extract the land use/land cover changes and categories of the study area.

A. Preparation of thematic map

These maps are the true representation of earth's phenomena such as spatial distribution of natural resources existing at the time of survey (Ravi Gupta, 2003). In the present study satellite image (IRS P6) which is a true record of the various environmental resources information on the base map. These map showing spatial distribution of forest, agriculture, soil, water resources etc., and prepared by visual interpretation of the satellite imagery. Visual interpretation is carried out based on the image characteristics like tone, size, shape, pattern, texture etc. in conjunction with existing map/literature. These pre-field thematic maps are modified substantiated and confirm after limited field checks.

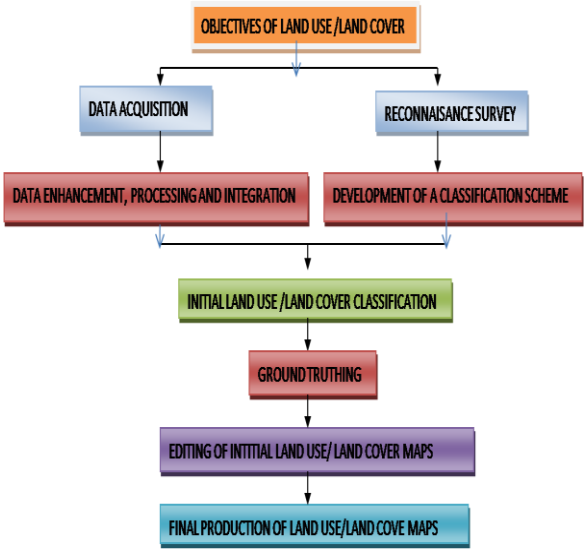

Fig 2: Cartographic Model

V. RESULTS & DISCUSSIONS

A. Analysis of Land use / Land cover by Remote Sensing Data

The land use / land cover categories of the study area were mapped using IRS P6 LISS III data of 1: 50, 000 scales. The satellite data was visually interpreted and digitally classified after making thorough field check, the map was finalized. The various land use / land cover classes were interpreted further. Six categories of land use / land cover classes were identified by this study. The land use and land cover classes in the study area include built-up land, water bodies, cultivated land, uncultivated land and forest land (Table1). Detailed accounts of these land use / land cover classes of the study area are described in the following section.

Table 1: Land use/ land cover classification of Bramhamarimattam

S. No	Feature Class	Area in Sq. km	Percentage
1.	Water bodies	66	21%
2.	Forest Land	106	33%
3.	Built-up land	3	1%
4.	Cultivated land	24	7%
5.	Uncultivated land	122	38%

1. Built–up land

Built–up land includes educational, health and socio-economic facilities like: games/ sport viewing centers and shops etc. These features are identified with their dark bluish green tone in the core and bluish tone on the periphery. They have a typical coarse and molted texture. These areas are also associated with the network of canals, roads and railway lines. In the study area, Bramhamarimattam town is an urban centre, located in the northern part of the study area, Kadimollapalle situated in central part of the study area.Narasanna palli was found in western part of the study area. Thotlapalle,Somireddy palli and Gangi reddypalli are located in northern part of the study area. Some smaller settlements and tiny towns are also found in the study area. The total area covered by the major and minor settlements in the study area constitutes 3000 sq.m or 1per cent of the study area respectively.

2. Water bodies

Both man-made and natural water features are included in this category; they are rivers, streams, lakes, tanks and reservoirs. The deep water features appear in black tone in the satellite imagery. The shallow water and deep water feature appear in light blue to dark blue in colour. Maderu and penneru & sagileru are the major rivers of the study area. The numerous major and minor tanks, lakes and canals are identified. The reservoir is found in the western part of the study area. The water bodies share about 66 sq. km (21 per cent) of the total study area.

3. Cultivated land

All the cultivated land with or without crops orchards and plantations are considered in this class. This land use class is further subdivided into two sub-classes they are wet land (crop land) and dry land. Crop lands are the agricultural lands under crop. In the study area the crop lands have wet cultivation and dry cultivation. Wet cultivation includes food crops such as paddy, wheat, etc. were present on either side of the Penneru River .Dry cultivation includes trees orchards, groundnut, etc and the areas which have this type of cultivation is noticed at kadimollapalli and narasannapalli areas. The cultivated land share about 24 sq. km(24 per cent) of the total study area.

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7. Forest Land

Forest, comprises of thick and dense canopy of trees. These lands are identified by their red to dark red tone and varying in size. They are irregular in shape with smooth texture. The forests are found on the Westren parts of the study area. The total area under this category is about 106 sq. km (33 percent). The forest land in the study area distributed maximum amount of the classification. The study area covers mostly the dense and scrub forest. The relative concentration of scrubs, bushes and smaller trees are predominant in this category. In the satellite image such forest are identified by green tone with smooth texture. The forest areas are Kottakota dasaripalli Reserved forest, Lankamalla Reserved forest, Velikonda hills & sitaramapuram Reserved forest, etc.

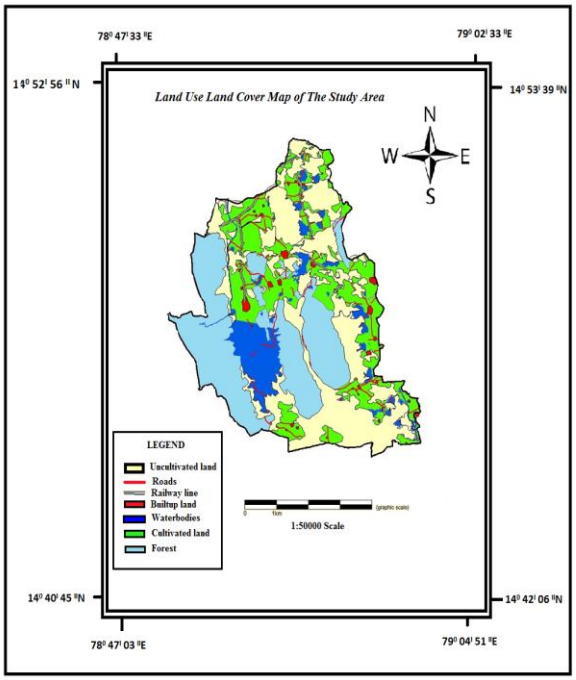

Fig 3: Land use Land cover map of the study area

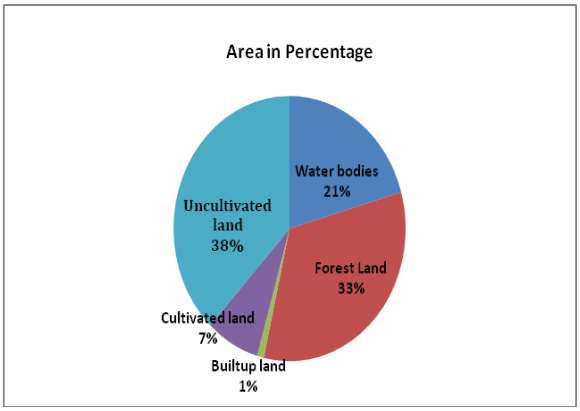

Fig 4: graphical representations of Land use Land cover feature classes

B. Analysis of Drainage by Remote Sensing Data

The arrangement of streams in a drainage system constitutes the drainage pattern, which in turn reflects mainly structural/ or lithologic controls of the underlying rocks. The area of study encompasses a miscellany of drainage patterns; however, dendritic drainage pattern is the most dominant type and occupies more than 95% of the area. Even though, difference in stream lengths and angle of connection, yet they are in general characterized by a treelike branching system, which is a dendritic drainage pattern that indicates homogenous and uniform soil and rocks. Radial drainage patterns also exist in the study area. They appear either as one-set or two-sets of Radial drainage patterns are develop surrounding areas of high topography where elevation drops from a central high area to surrounding low areas.

Table 2: Stream Order and Number of Streams

S. No	Stream order	No. of streams
1.	I	471
2.	II	114
3.	III	24
4.	IV	4
5.	V	1

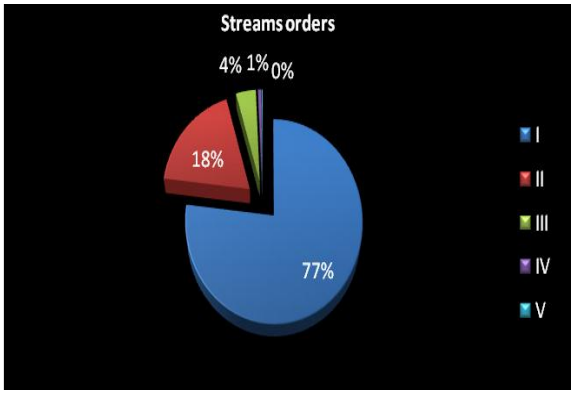

Fig 5: Graphical representation of stream orders

1. Stream Order (U)

Stream order is a method for classifying the relative location of a reach (a stream segment) within the river basin. The applied method followed the procedure that modified by Stahler (Okeke et al. 2006). Stream order 1 has one connected edge, and then at the confluence of two1st -order streams assigns the downstream reach of order 2, and so on for the rest orders. In the study area has 5-stream orders, and thus a map was obtained using GIS system. In addition, the used GIS system enabled calculating the number of reaches in each order.

2. Stream Number (NU)

The count of stream channel in its order is known as stream number. The number of streams decreases as the demarcated watershed has the following stream orders and stream number. In the study area four stream orders have been calculated. In the study area 471 first order streams, 114 second order streams, 24 third order streams and 4 fourth order streams,1 Fifth order streams were calculated.

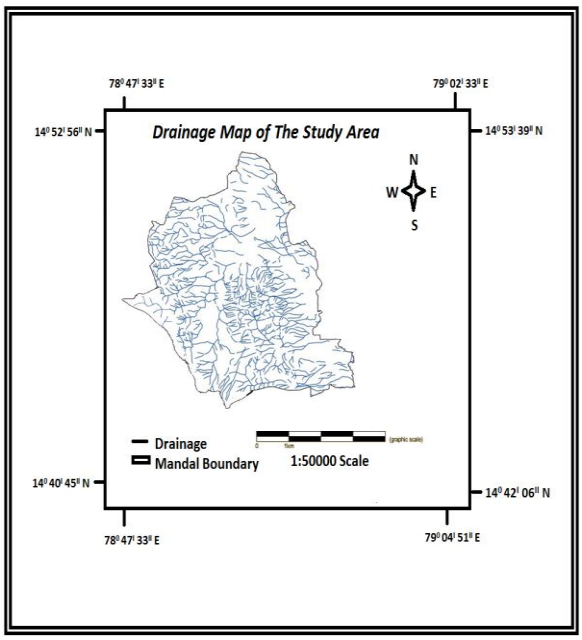

Fig 6: Drainage Map of the Study Area

VI. CONCLUSION

This work focuses on Land use Land cover analysis of Bramhamgarimattam mandal, Kadapa District, Andhra Pradesh, India, using Remote Sensing data and GIS technology. Our results clearly show that Land use Land cover analysis is significant in this study area. There is significant expansion of built-up area noticed. The forest land in the study area distributed maximum amount of the classification. On the other hand there is decrease in cultivated land and water spread area. Majority of the streams (crisscross pattern) was present in the southern part of the study area. This study clearly indicates the significant impact of population and its development activities on Land use land cover change. The study area also affected with the lack of water resources for agriculture. This study proves that integration of GIS and Remote Sensing technologies is effective tool for spatial analysis. The quantification of Land use Land cover analysis, lithology and drainage pattern of Bramhamgarimattam is very useful for environmental management groups, policymakers and for public to better understand the surrounding.

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