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RESEARCH ARTICLE

LANDUSE AND LAND COVER ANALYSIS USING REMOTE SENSING AND GIS, A CASE STUDY OF KHAMMAM DISTRICT, TELENGANA STATE, INDIA

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ABSTRACT

Land is the most important natural resources on which all activities are based. The increase in population and human activities are increasing the demand on the limited land and soil resources for agriculture, forest, pasture, urban and industrial land uses. Information on the rate and kind of changes in the use of land resources is essential for proper planning, management and to regularize the use of such resources. Advances in satellite sensor and their analysis techniques are making remote sensing systems realistic and attractive for use in research and management of natural resources. Land use maps are valuable tools for agricultural and natural resources studies. The various categories of land use in the area recognized are forest, agriculture, Settlement, Fallow Land, Salt affected land, water bodies and reeds. Agriculture is the major land use categories in the study area due to the one of fertile soil of the world. The objective of this paper is land use land cover analysis of Khammam district, Telengana State.

INTRODUCTION

Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. It has also been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO, 1997a; FAO/UNEP, 1999).

Land use is a product of interactions between a society's cultural background, state and its physical needs on the one hand and the natural potential of land on the other (Balak and Kolarkar, 1993). Land use is the intended employment of land management strategy placed on the land cover by human agents or land managers to exploit the land cover and reflects human activities such as industrial zones, residential zones, agricultural fields, grazing, logging and mining among many others (Zubair, 2006). On the other hand, land cover is defined by the attributes of the earth's land surface captured in the distribution of vegetation, water, desert and ice and the immediate subsurface, including biota, soil, topography, surface and ground water and it also includes those structures created solely by human activates such as mine exposures and settlements (Lambin *et al*., 2003; Baulies and Szejwach, 1997). Remote sensing and GIS are now providing new tools for advanced ecosystem management. GIS involves mapping data and interpreting the relationships among that data and making inferences. 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). Remote sensing techniques have been used to monitor land use changes; this has an important role in urban development and the determination of water quality parameters. It is also very useful for the production of land use and land cover statistics which can be useful to determine the distribution of land uses. Using Remote sensing technique to develop land use classification and mapping i.e. a useful and detailed way to improve the selection of areas of a region (Selcuk, 2003). Land use refers to man's activities and the varied uses which are carried on over land and land cover refers to natural vegetation, water bodies, rock/soil, artificial cover and others noticed on the land. The methods of land-change science include remote sensing and geospatial analysis and modeling, together with the interdisciplinary assortment of natural and social scientific methods needed to investigate the causes and consequences of LULCC across a range of spatial and temporal scales.(Robert Pontius, 2013; Uma Maheswari *et al*., 2015). Land use and land cover classification is based on the scheme developed by National Remote Sensing Centre (NRSC, 1995).

Study Area

Khammam district (Fig-1) lies in the eastern part of the Telangana state, extends between 16°46'09''N to 18°37'45''N

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latitudes and 79°48'01''E to 81°18'51''E longitudes, Encompasses an area of 13,132 Km^2. The district entered into the mineral map of India and attained distinct place in coal mining. The district enjoys a unique place in the state with the presence of extensive green forests and by rivers with lyrical names like Godavari, Kinnerasani, Sabari, Munneru and Wyrac. The average annual rainfall of the district is 1061 mm, monthly rainfall ranges from nil rainfall in November, December and January to 283.1 mm in July. It also abounds in mineral wealth backed by many power projects and notable industries. In 2011, the district had population 2,797,370.

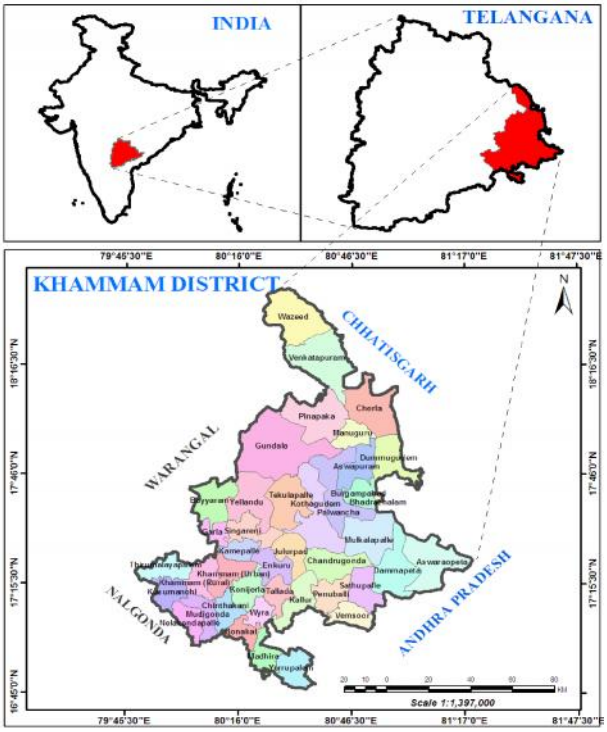

Fig 1 Location map of the study area

DATA BASE AND METHODOLOGY

The IRS-R2 LISS IV image of 2012 and Survey of India topographic map (1:50,000 scale) are the primary input for classification and mapping the resources. ERDAS imagine has been used for image processing operations. Techniques like stratification, directional filtering, layered approach, composition, aggregation and refinements are applied wherever necessary to improve the quality of mapping. Thematic maps of land use/land cover, drainage and Infrastructure have been extracted from satellite image and topographic map as well, incorporating the ground truth. The integration of spatial data, manipulation and analysis are carried out using Arc GIS software.

DATA ANALYSIS AND DISCUSSION

Land is one of the most vital accepted natural resource. The landuse pattern and its spatial distribution are the major rudiments for the foundation of a successful land use strategy required for the appropriate development and organization of any area. The land use map prepared through remote sensing data and their spatial distribution is shown in Figure - 2 and their area is given in Table - 1. Land cover mapping serves as a basic inventory of land resources for all levels of organization, environmental agencies and private industry throughout the world. The various land use patterns are depicted in the study area using the onscreen visual interpretation of the Satellite imagery of IRS Resourcesat-2 LISS-IV, Spatial Resolution 5.8m.

A mixture of land use / land cover classes like agriculture, settlement, Salt affected Land, Water body and Sandy areas etc. were identified and mapped using visual interpretation keys such as color, tone, texture, pattern, size and shape. Based on the ground truth data, land use and land cover map of Khammam district.

Table - 1 Land Use / Land Cover Statistics - 2012

Description	Area (Km^2)
Agriculture Plantation	540.72
Aquaculture / Pisciculture	2.04
Agriculture - Crop Land	5959.48
Forest Plantation	205.94
Forest	4533.75
Built up (Urban)	28.75
Built up (Rural)	296.55
Mining / Industrial	63.49
Transportation	7.81
Barren Rocky	12.88
Scrub Land - Dense	16.11
Scrub Land - Open	605.42
Gullied / Ravenous	2.85
Salt Affected Land	6.31
Sandy Areas	0.59
River / Stream / Drain	335.18
Reservoir / Tanks	288.08
Lakes / Ponds	2.83
Canal	16.32

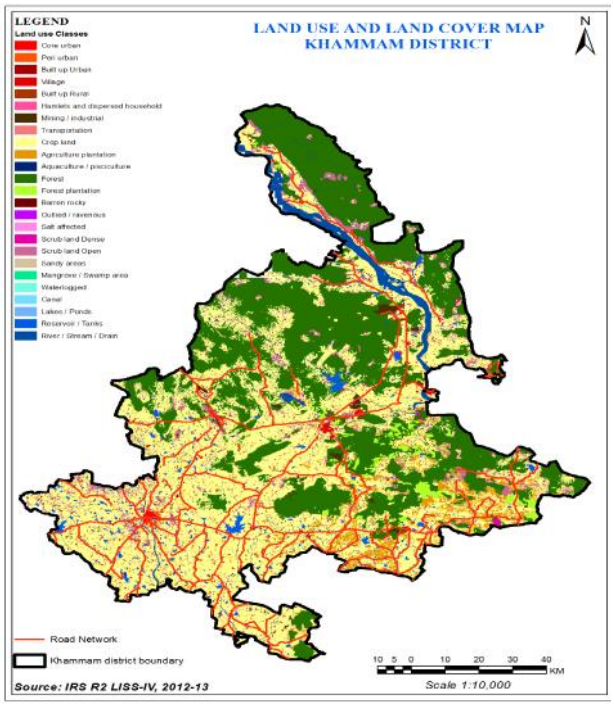

Fig 2 Land use and Land cover map of study area

Detailed accounts of these land use /land cover classes of the study area are described in the following section.

Agricultural Land

The agricultural land use is a function of land productivity and land utilization practices over a period of time. It is defined as the land primarily used for farming and production of food, fiber, and other commercial and horticultural crops. Agricultural land covered 5961.52 Km^2, or 46% of the study area. Plantations appear in dark-red to red tone of different sixes with regular and sharp edges indicating the presence of a fence around it. Depending on the location, they are exhibit a dispersed or contiguous pattern. Plantations covered 540.72 Km^2, or 4.18%, Aquaculture / Pisciculture covered 2.04 Km^2, overall agricultural land occupied in the study 50% (Fig-3). Khammam District is endowed with Agro climatic and soil conditions in which a wide range of horticulture crops like mango, banana, cashew, coconut, oil palm, cocoa, pepper etc. are grown. Production and distribution of various kinds of fruits, vegetables and flowersand their seeds are the major activities supported by the horticulture Department.

Forest

Forest areas bearing an association predominantly of trees and other vegetation types (within the notified forest boundaries) capable of producing timber and other forest produce. They comprise of thick and dense canopy of tall trees, which can be evergreen, semi evergreen or deciduous (moist/dry/thorn). Evergreen forest includes both coniferous and tropical broadleaved evergreen species and predominantly remains green throughout the year. Semi-evergreen is a forest type that includes a combination of evergreen and deciduous species with the former dominating the canopy cover. Deciduous forest types are of predominantly composed of species, which shed their leaves once a year, especially during summer. Total area under forest has been estimated to be 4739.69 Km^2, (37%) for the entire study area. The forest area spreads over Bhadrachalam, Manuguru, Bergampahad, Kothagudem, and Yellandu. Important forest produce are teak, bamboo, eucalyptus, beedi leaves, honey, tamarind, nux vomica etc.

Built Up

It is an area of human habitation developed due to non-agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. There are major cities in the study area Khammam, Kothagudem, Manuguru, Bhadrachalam, Paloncha, Madhira and Aswaraopeta. The covered urban area (Core urban, Peri urban) of 28.75 Km^2, (0.22%), the rural built up area covered 296.55 Km^2 (2.29%), mining and industrial area covered 63.49 Km^2. Hence, the total area under built up area covered 3 percent of the total study area.

Waste Land

In the study area, main categories of waste lands are prominently observed and are in the form of dense scrub, open scrub, gullied/ravenous, salt affected and sandy areas. Dense scrub covered an area 16.11 Km^2, open scrub 605.42 Km^2 prevail in the north eastern part of the district. The Gullied or Ravenous land covered an area of 2.85 Km^2. Total barren rocky or stony wasteland spreads over an area of 12.88 Km^2. The total wasteland in the district covered 644 Km^2 of area and represents 5 percent (Fig-3) of the total area of the district

Water Bodies

It is an area of impounded water, areal in extent and often with a regulated flow of water. It includes man-made reservoirs/lakes/tanks/ canals/, besides natural lakes, rivers/streams and creeks. River, streams covered 335.18 Km^2, reservoir, tanks occupied in 290.91 Km^2, canal covered in 16.32 Km^2. The total geographical area under this category was 642.41 km^2 which comes out to be 5% of the study area.

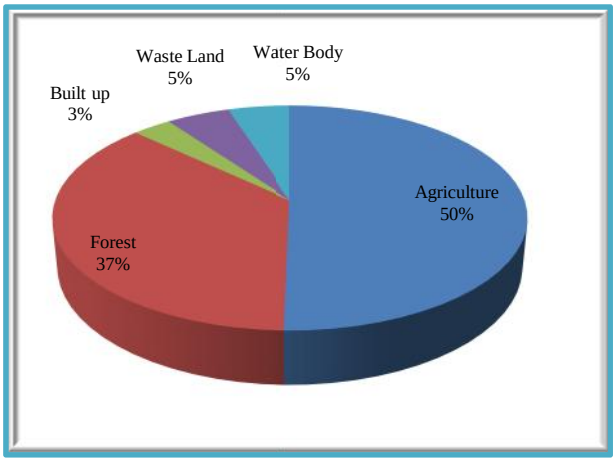

Fig 3 Pie chart of the Land use and Land cover

CONCLUSION

The present study revealed that remote sensing and GIS techniques can be effectively used for development of land use/land cover plan map. The present study also found that remote sensing coupled with GIS can be effectively used for real time and long term monitoring of the environment. The baseline information generated on land use/land cover pattern of the area would be of immense help in formulation of policies and programmes required for developmental planning of the area.

Land use/land cover mapping and changes are depending on the physical conditions, which are mainly driven by socio-economic factors. They can be mainly characterized by the changes of cultivated land and construction land, which are strongly inter-related with human construction behavior.

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