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Landuse and Landcover Analysis Using Remote Sensing and GIS: A Case Study in Somavathi River, Anantapur District, Andhra Pradesh, India

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ABSTRACT

Land use/land cover (LULC) pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. The increase in density of population is directly proportional to the land use/land cover. The present study shows the spatio-temporal dynamics of land use/cover of Somavathi river, Anantapur District, Andhra Pradesh India. Land use/land cover map was prepared in ArcGIS, ERDAS Imagine 9.3 through visual interpretation of IRS P6 LISS-III data and multitemporal of the area. The area in terms of LULC can be divided into following classes: Barren land, fallow land, forest, built-up land, agriculture land and water bodies. Landsat satellite imageries of two special time intervals, landsat thematic mapper (TM) of 2005-2006 and 2010-2011 have been obtained via global land cover facility site (GLCF) and earth explorer website and quantified the changes in the years 2005-2006 to 2010-11 over a length of 5 years. Supervised and unsupervised type methods have been employed using most chance techniques in ERDAS Imagine 9.3. The images of the area have been categorized into six exceptional classes, specifically forest, barren/wastelands, built-up, water bodies, agriculture and fallow land. The outcomes indicate that over the past 5 years, barren/wasteland, built-up land and fallow land have been changed by 1.22% (5.54 sq.km), 1.24% (5.54 sq.km) and 0.61% (2.77 sq.km) respectively, while agriculture and water bodies have decreased by 3.04% (13.86 sq.km) and 0.06% (0.28 sq.km) respectively of the total geographical area.

INTRODUCTION

Land cover refers to the surface cover of the ground, weather, vegetation, urban infrastructure, water, rocks, bare soil or other identifying, delineating and mapping. Land cover is essential for global monitoring studies, resource management, and planning activities. Identification of land cover establishes the baseline from which monitoring activities (change detection) can be performed, and provide the ground cover information for baseline thematic maps (Rawat et al. 2015). Land use describes how apparel of land is used such as for agricultural, residence, or industry (Riebsame et al. 1994). Land use/cover change detection is useful for better comprehend of landscape dynamic during a known period of time having sustainable management. Land use/cover change is an extensive and increasing process, primarily driven by natural phenomena and anthropogenic activities, which in turn causes changes that would impact natural ecosystems (Ruiz-Luna et al. 2003, Turner & Ruscher 2004). This study is helpful for better understanding for the land and resource management (Yuan et al. 2005, Brondizio et al. 1994). Land use and land cover processes do not always mean degradation of the land and change by various social causes. The social causes like increase of urban activity and industrialization lead to modification of landscape feature and adverse effects on the biological community and atmosphere (Riebsame et al. 1994, Ruiz-Luna et al. 2003, Turner & Ruscher 2004, Veeraswamy et al. 2017, Rajasekhar et al. 2017). Nowadays, remote sensing possess, in addition to satellite based systems, which get physical data on a repetitive basis with a process of GIS are frequently used for monitoring the land cover changes. It helps us to do research on the information spatially producing diverse modelling, thereby optimizing the whole planning process. Application of remote sensed information makes it possible to study the various changes in land cover in less time with higher accuracy (Sreenivasulu et al. 2014). Remote sensing and geographical information systems (GIS) are indispensable tools to originate precise and timely information on the spatial distribution of land use/land cover changes over large extent areas (Selcuk et al. 2008). Land is becoming a scarce resource due to vast agricultural and static pressure. Optimal use of land cover is essential for the selection, planning and ratification of land use schemes to meet the increasing human demands. This information also helps in monitoring the dynamics of land use resulting due to changing demands of increasing population (Sreenivasulu et al.

2014). In overall, the change detection studies of land use/ land cover are helpful for the future generation for proper planning and management activities of the present study area.

STUDY AREA

Somavathi river rises in the south eastern part of Anantapur district, a moderate drought affected region. The Somavathi watershed is located in the Survey of India Toposheet Nos: 57 J/3, 57 J/4, 57 G/3 and 57 K/1 on 1:50,000 scale and lies between north longitudes 77°48'25" to 78°02'45" and east latitudes 14°05'55" to 14°26'48" (Fig. 1). The watershed comprises total geographical area of 456 sq.km and covers parts of Obuladevuracheruvu, Gorantla, Amadaguru, Nallamada and Kadiri. Obuladevuracheruvu occupies more than half of the watershed area (52%) followed by Gorantla, Amadaguru, Nallamada and Kadiri (27%). Corresponding schematic diagram is shown in Fig. 1.

MATERIALS AND METHODS

Database preparation: IRS P6 LISS III satellite imagery at a resolution of 30m of 2005-2006 and 2010-2011 were used for land use/cover classification. These data sets were imported in ERDAS Imagine, satellite image processing software to generate a false colour composite (FCC). The layer stack selection in the image interpreter tool box was used to produce FCCs for the study area. The sub-setting of satellite images was performed in the extracting study area from both the images by taking geo-referenced outline boundary of the study area map as AOI (Area of Interest).

Land use/cover detection and analysis: The land use/cover analysis has been done by supervised classification method, with a maximum likelihood algorithm applied in the ERDAS Imagine Software and processed remote sensing image data. Based on the pixel size classification, the different classes were formed in the study area. The basic theory assumes that these probabilities are equivalent for all classes and that the input bands have normal distribution. However, this method needs long time of computation, relies heavily on a usual distribution of the data in each input band and tends to classify signatures. Based on the signature classification six land use/cover types are identified in the study area viz., (i) Forest (ii) Agricultural land (iii) Barren land (iv) Built-up land (v) Water bodies (vi) Agriculture Fallow Land.

RESULTS AND DISCUSSION

Analysis of landuse/landcover by using remote sensing data: In the present day, land use/land cover change detection is very important method in geospatial technology. The main use is to known about the present day earth surface features and previous features compiled. IRS P6 LISS III at a resolution of 30 m of 2005-2006 and 2010-2011 were used for land use/cover classification of the present study area. The satellite data were visually interpreted and after making a thorough study and a limited field check, various land use and land cover classes were categorized those include agriculture land, built-up land, barren/waste land, vegetation/scrub and water bodies. The change detection of the study area is diagrammatically illustrated in Fig. 2. The data are shown in Table 1 and Fig. 2 depict land use/ cover status and land use/cover change in different land use categories.

Agriculture land: In this class are included the crops and plantations. Total agriculture land in the study area decreased from 264.11 sq.km to 250.25 sq.km (57.92 % to 54.88 %). 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, groundnut and vegetables, etc. Dry cultivation includes bengal gram, redgram and groundnut, etc.

Forest/evergreen: Forest comprises of thick and dense scrub of trees. Vegetation/scrub is identified by their red to dark green tone and varying in size. They are asymmetrical in shape with smooth texture. The forests are found on the north west and north east parts of the study area. The overall area of vegetation increased from 38.17 sq.km to 38.45 sq.km (8.37 % to 8.43 %). The study area covers mostly the dense and scrub forest. The relative concentration of scrubs, bushes and smaller trees is predominant in this category. In the satellite image such vegetation/scrub is identified by green tone with smooth texture. These lands are subject to degradation, erosion or prickly bushes, such areas are identified by their yellowish tone and their association with uplands, and their asymmetrical shapes.

Built-up land: Built up land is composed of areas of exhaustive buildings with structures for different purposes. Much of the land is covered by structures and the overall area of built-up land increased from 9.63 sq. km to 15.17 sq.km (2.11 % to 3.33 %). In the study area major towns or villages are Obuladevuracheruvu, Gorantla Amadaguru, Nallamada and Kadiri.

Water bodies: It is consisted of both natural and artificial water features such as streams, lakes, canals, tanks and reservoirs. These features show black in colour in the satellite image. The shallow water and deep water features show in light blue to dark blue in colour. Tanks with plantation are recognized by the square/rectangle shape and blue colour tone. Small canals are identified in the vegetation area. Tanks are predominately concentrated in the middle part of the

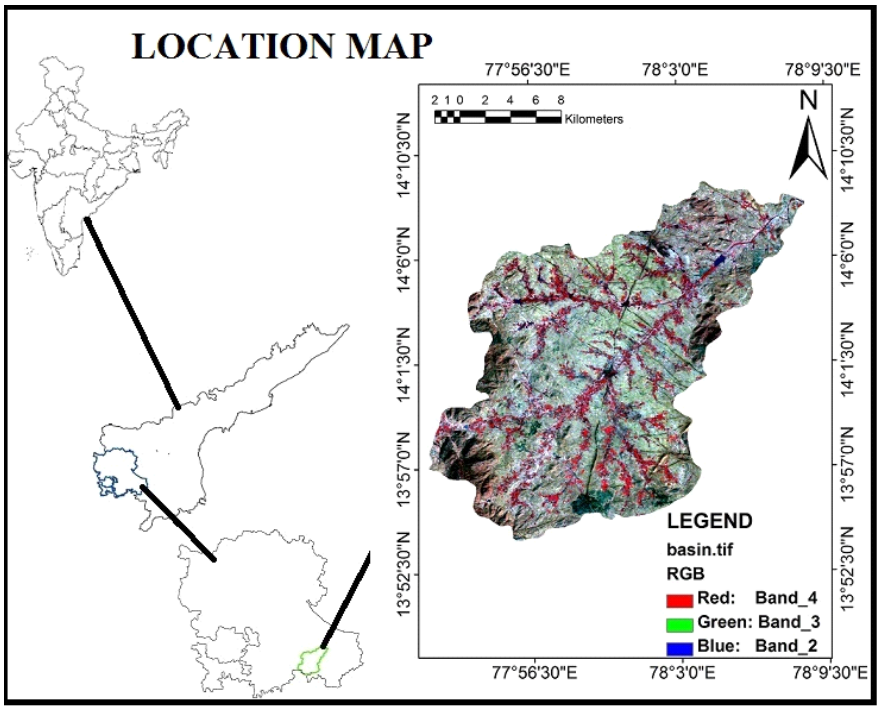

Fig. 1: Location map of the study area.

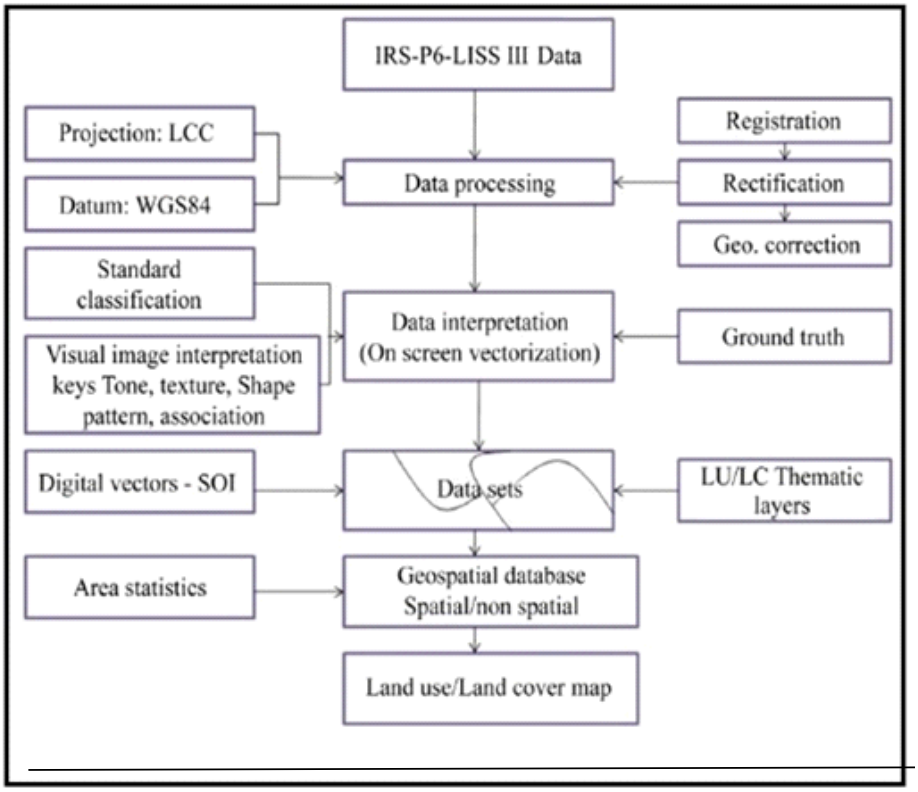

Fig. 2: Methodology for landuse/cover map of the study area.

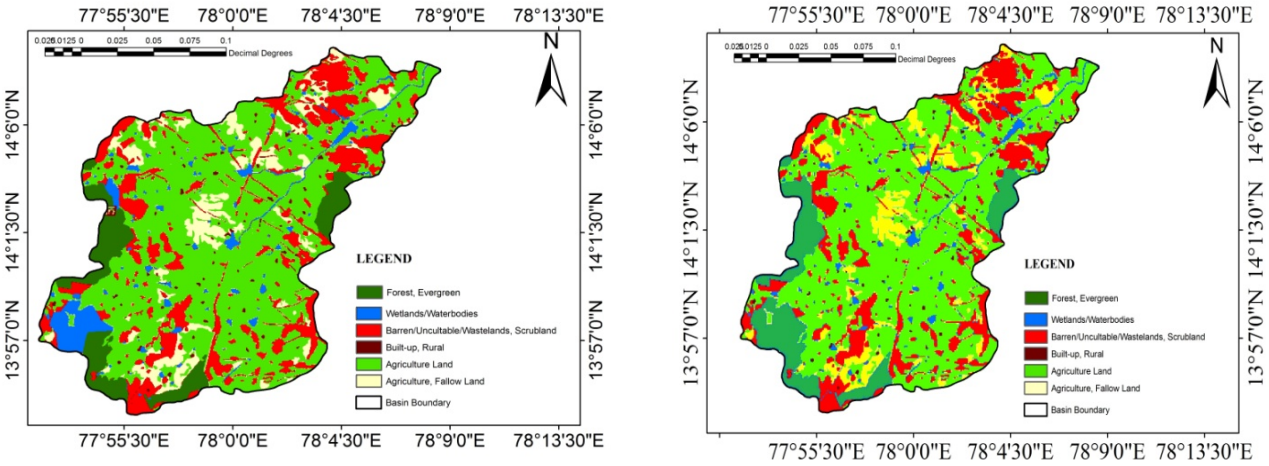

Fig. 3: Land use/cover status of the Somavathi river; (a) in 2005-06, (b) in 2010-11 (Based on IRS P6 LISS III Satellite Imagery).

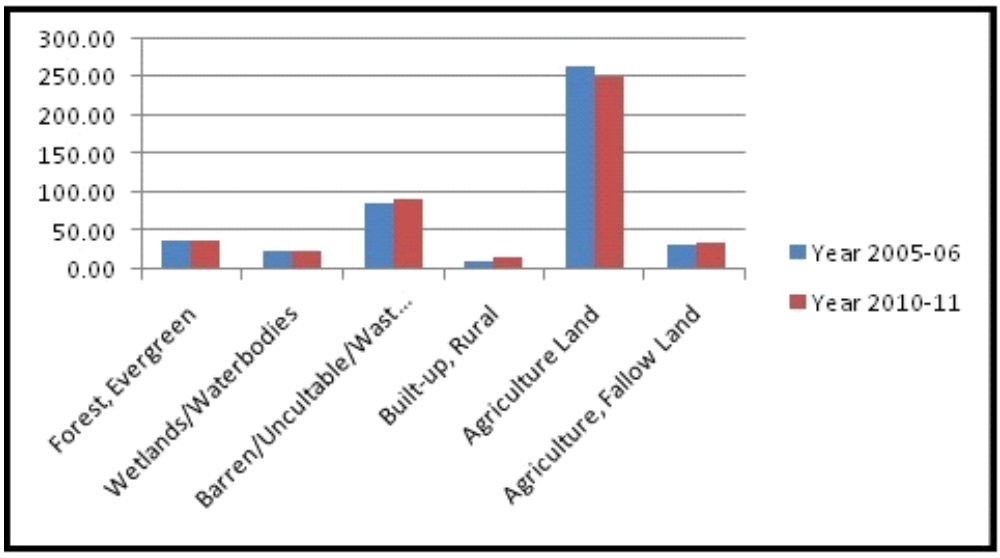

Fig. 4: Statistical representation of land use/cover change.

study area with few dry tanks spotted around in the eastern parts. Water bodies of the study area decreased from 24.22 sq.km to 23.95 sq.km (5.31 % to 5.25 %).

Barren/waste land: Lands, which do not aid any vegetation are referred to as barren lands or waste lands. Barren rocky, salt affected land, land with and without scrub, sandy area, sheet rocks and stony regions include in this group. Such lands are formed due to substantial properties of soil, temperature, rainfall and local environmental circumstances. The area of barren/waste land increased from 86.32 sq. km to 91.86 sq.km (18.93 % to 20.14 %) in the study area and is present in the south west part of the area.

CONCLUSIONS

The geospatial technology plays a vital role in quantifying changes of temporial phenomena in the present study area, not possible with any other conventional mapping. The present study reveals that majority of the land use in the study area is barren/waste land. The area under barren/waste land has increased by 1.22 % (5.54 sq.km) due to deforestation work during 2005-2011. The second major category of land area in the study area is agriculture which was decreased by 3.04 % (13.86 sq.km) due to vegetation, barren land and built-up land. The third major category of land area in the study area is water bodies, which also has decreased. Dur-

Table 1: Area and amount of change in different land use/cover categories in the study area during 2005-2011.

Landuse/cover Categories	sq.km	%
	2005-2006	
Forest, Evergreen	38.17	8.37
Wetlands/Waterbodies	24.22	5.31
Barren/Uncultable/Wastelands, Scrubland	86.32	18.93
Built-up, Rural	9.63	2.11
Agriculture Land	264.11	57.92
Agriculture, Fallow Land	33.55	7.36
	2010-2011	
Forest, Evergreen	38.45	8.43
Wetlands/Waterbodies	23.95	5.25
Barren/Uncultable/Wastelands, Scrubland	91.86	20.14
Built-up, Rural	15.17	3.33
Agriculture Land	250.25	54.88
Agriculture, Fallow Land	36.32	7.97

ing the study period (i.e., 2005-2010), built-up land has increased by 1.24 % (5.54 sq.km) due to rapid increase of urbanization and industrialization. Change detection is made possible only by geospatial technology with a less time, at low cost and with higher accuracy.

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