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LAND USE/COVER DYNAMICS IN THE GODAVARI WATERSHED USING GEOSPATIAL TOOLS

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Abstract:

The Godavari isthe largest river in south India. In the entire watershed, the progress of industrialization is very slow. The Majority of the population (rural) depends on agricultural or agro base industry.The land use/cover pattern of a region is a consequence of natural and socio-economic factorsand their application bya human being in time and space. The land is used for crops,forests, mining, transport, housing, entertaining, manufacturing and cost-effective. The unused lands arean unproductive wasteand i.e. barrenand fallow (temporary and permanent)land. The present study provides a status and change of Land use Land cover dynamics in The Godavari river basin using satellite imageries from LandsatTM. The geospatial tools have been used to assess (a) the changes in land use land cover from 2005 to 2015; (b) changes along the terrain topography. A supervised classification was implemented in our approach. The finalclassification product provided identification and mapping ofdominant land cover types as well as land use. The highest change accord in crop land, increasing 190247 km2 (60.82%) to 197828 km2 (63.53%), the area of Scrubs land, decrease 15167 km2(4.85%) to 10298 km2 (3.29%). The highest change accord in the Altitude of 300 to 400m, less than 1.5 degree slope and Southeast direction. The lowest change accord in the Altitude of above 1000m, above 26.50 degree slope and North direction.

Keywords:*Land use, Land cover,Remote sensing, Image classification, Godavari Watershed.*

Introduction:

The land is necessary for human survival because it's available forthe human with living space (Bhagawat, 2011). The scientist Stamp in the Britain is given acontribution regarding land use mapping study. Stamp 1962 defined the concept ofland use. The land provided the all necessary and legitimate needs of the country (Stamp, 1930). According to Nanavaticonservation ofland is also connected with land use (Nanavati, 1951). This needs strong scientific, rationaland economic preparation to use available resource of land, onanother side we have to maintain ecological and socio-economicbalance (Mohammad, 1980).

Remote sensing data has been used for land use/land cover mapping as well as change dictation in different parts of the India (Gautam and Narayanan, 1983; Sharma et al., 1984; Jain, 1992; Brahabhatt et al., 2000).The present day remote sensing data provide the changedetection (LULCC) and monitoring of earthsurface resources (Aher and Dalvi, 2012).The land use is the resultof a combination of bothnatural genesis and human influenceswhich have been brought to bear on it in the past and of thosewhich are still active in the present (Vink, 1975). Satellite remote sensingimagery and it's coupled in GIS environment for land use/landcover analysis is a key to many diverse applications such asenvironment, forestry, hydrology and agriculture (Parlhad and Deore, 2010). Watershed management tools useful for any areasof natural resource management (Deshmukh et al., 2012) planningand monitoring depend onaccurate information about the landcover in a region.The accurate representation of terrestrial vegetation is a keyrequirement for global change research (Jung et al. 2006;Lambin et al. 2001).The vegetation map is an essential basemap for managing natural resources as vegetation provides abase for all living beings and plays an essential role inaffecting global climate change, such as influencing terrestrialCO2 (Xiao et al. 2004). In the vegetationprotection and restoration programs, it is necessary to obtainthe current status of vegetation cover and change (Egbert et al. 2002; He et al.2005). The traditional methods such as field surveys,literature reviews, map interpretation and collateral andancillary data analysis, are not effectiveto acquire vegetationcovers because they are time-consuming, date lagged andoften too expensive. The present years remote sensing (RS)techniques are being widely used for vegetation mapping as well asmonitoring and change dictation (Boyd et al., 1999; Ingram, 2005; Lu et al., 2004;Maynard et al., 2007;Dadhwal etal., 2009) identification of the vegetation types using spectrometer (spectral reflectance of the vegetation) (Zianis et al., 2005).

Chen and Wang, 2008 studied the remotely sensed spectral signatures are used forunderstanding the nature of vegetationcharacteristics,however it is affected by various factors like vegetationcomposition, soil characteristics, atmospheric conditions,topography and moisture content. Remotesensing has been the only feasible way of acquiring vegetationinformation over vast areas at a reasonable cost andacceptable accuracy due to repetitive data collection at afeasible effort (Lu, 2006). The developments in sensortechnology have allowed the acquisition of remotelysenseddata at a various range of scales ranging from coarse spatialresolution of 500 m (e.g.,NOAA AVHRR, MODIS) tomedium spatial resolution of 20_30 m (e.g., Landsat TM,Landsat ETM+, SPOT HRVIR) as well as high spatialresolution of less than 5 m (e.g., Ikonos, QuickBird,LIDAR,and others). The coarse spatial resolution optical sensors suchas NOAA AVHRR (Donget al., 2003) and MODIS (Bacciniet al., 2004) have been useful for mapping vegetation at theglobal, continental, national and regional scale, because ofspatial resolution, image coverage andhigh frequency in dataacquisition (Lu, 2006).

The medium resolution of satelliteimagery such as Landsat TM is used at regional level vegetation mapping. The optical moderateresolutionsensors like Landsat Thematic Mapper (TM) has been themost frequently used RS data for vegetation mapping and change detection(Hall et al., 2006; Heiskanen, 2006; Ingram, 2005; Lu, 2006; Lu et al.,2004). Chakraborty et al. 2009 studied land use land cover dynamics in umngotwatersh Meghalaya using geospatial tools. The present research paper an attempt has been made to estimate the LULCC from 2005 to 2015 in the Godavari river basin.

Study Area:

The river Godavari originate atTrimbakeshwar in the Nashik district of Maharashtra, at an altitude of 1,067 m about 80 km from the Arabian Sea.The area of Godavari basin lies between 73°24' to 83°4' east longitudes and 16°19' to 22°34' north latitudes. The total length of river Godavari from its origin to outfall into the Bay of Bengal is 1,465 km. Its major tributaries joining from the right are the Pravara and the Manjra whereas the Purna, the Penganga, the Wardha, the Wainganga, the Indravati and the Kolab joins from left. The river Godavari basin spreads over states of Maharashtra, Telangana, Andhra Pradesh, Chhattisgarh and Odisha in addition to smaller parts in Madhya Pradesh, Karnataka and Union territory of Puducherry having a total area of 3, 12,816 Sq.km. It's cover near about 9.5% of the total geographical area of the India.The basinextend over the states of Maharashtra (48.7%), Andhra Pradesh and Telangana (23.7%),Chhattisgarh (12.4%), andOdisha (5.7%) in addition to smaller parts in Madhya Pradesh (7.8%),Karnataka (1.4%), and Union territory ofPuducherry (0.01%).The basin is bounded bySatmala hills, the Ajanta range and the Mahadeo hills on the north, by the Eastern Ghats on the south and the east and by the Western Ghats on the west. The major part of the basin is covered with agricultural land accounting to 63.53% of the total area and 1.07% of the basin is covered by water bodies as per the 2015 LULC (Source by Author).The geographical setting of the basin is shown in Figure 1.

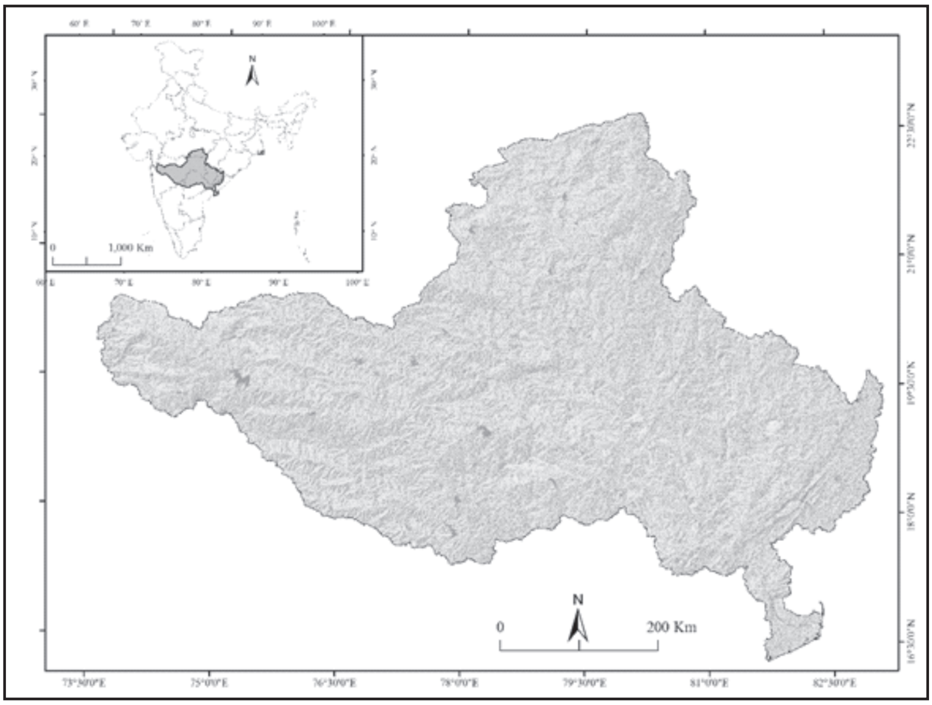


Fig. 1. Location map of Study area

Objectives

The prime aim of present study is to prepare a LULC map of the river Godavari watershed areas in order to LULCCthat have taken in 2005 to 2015 using changedetection method.The study the LULCC along topography. The following specific objectives are pursued inorder to achieve the aim of the study.

· To determine the land use/land cover change.

· To analyze the land use/land cover change along topography of study area.

Materials and Methods:

Landsat TM FCC (December, 2005 and 2015) were used for present study. The Landsat TM image was first mosaicked in Erdas Imagine software 15.2 before projecting it to UTMWGS 84 coordinate system. The study area was extracted bysub setting from the whole image. The flowchart (fig. 2) of the research methodology can be divided into five stages: (i) preparation of reference maps for gathering the existing and relevant information in the spatial form, (ii) pre-fieldclassification of the satellite data, (iii) create a separate layer of Aspect, Slope and Altitude using SRTM 30m DEM, (iv) Land use/Land cover changes (LULCC) from 2005 to 2015,(v) Land use/Land cover changes (LULCC) along topography. The present classification and methodology (fig.2)is performed based on the standard LULC classification method. After that Change Detection methodology was done for the images to find out the changes that have taken placein the study area using Erdas Imagine software 15.2. The feature classes were identified based on the visualinter pretation of the satellite imagery coupled with filed checks. These data sets were digitized and analyzed to obtain land use/land cover statistics for the areas under each of these categories for both the 2005 and 2015 years created. The eleven group of Altitude data are create, the raster data converted to polygon after that created polygon super impose on LULC 2005 and 2015. After that LULCC dictation formed on different altitudes (fig.3). The above method use in case of Slope(Eight group) and Aspect(Eight group) represent the fig. 4 and 5.

Fig. 2. Flow Chart of Research Methodology

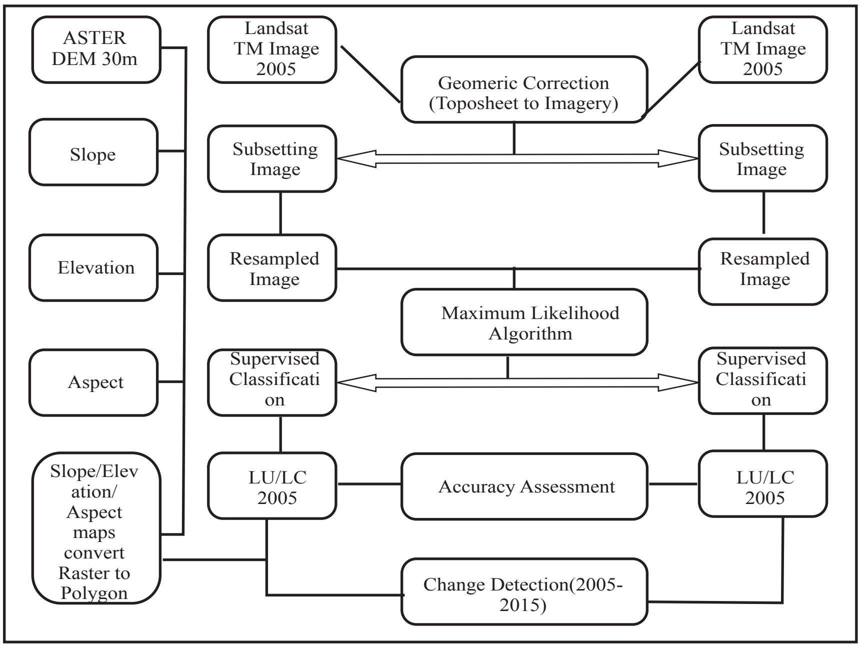
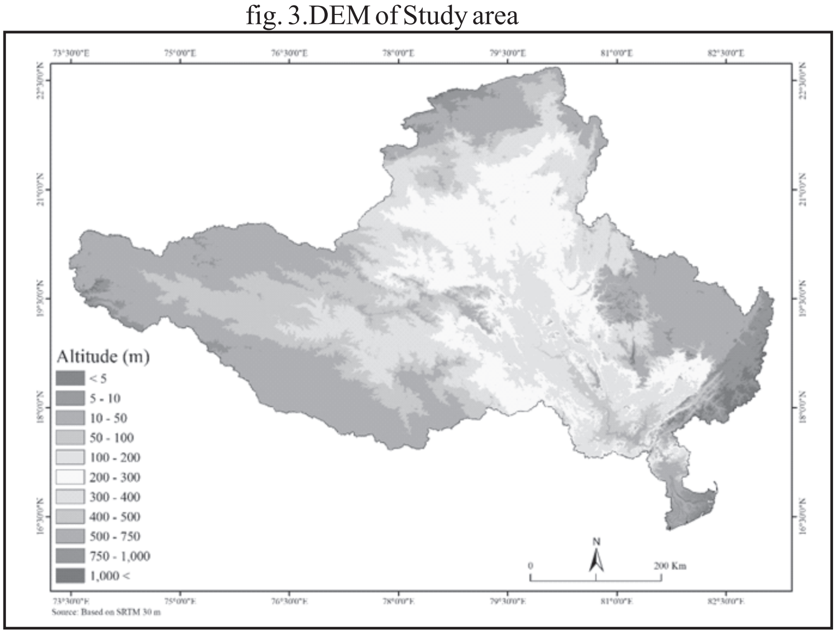


fig. 3.DEM of Study area



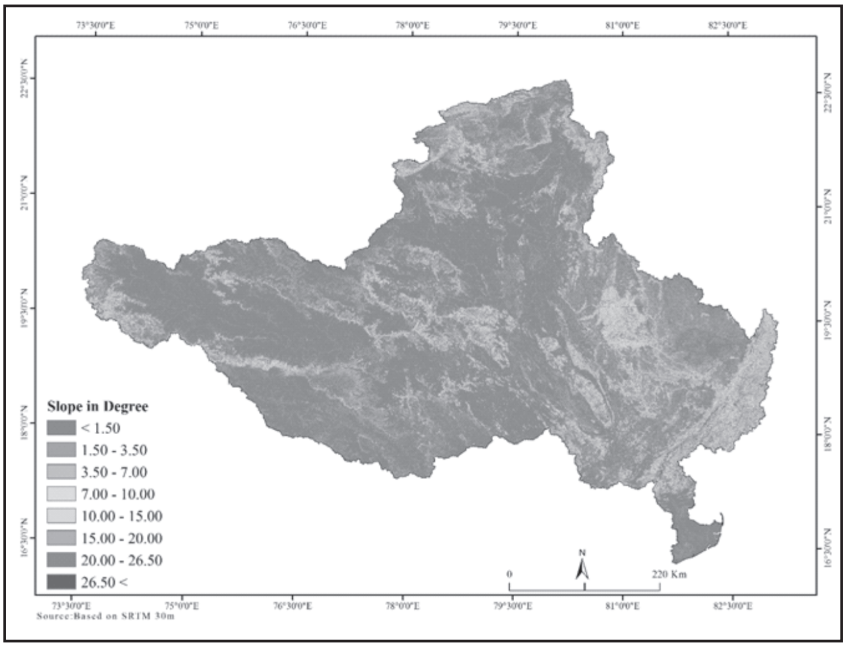


Fig. 4.Slope map of Study area

Result and Discussion:

The upper part of the Godavari watershedis occupied by the Deccan Traps containing minerals, hypersthene, augite, diopside, enstatite, magnetite, epidote, biotite, zircon, rutile, apatite and chlorite. The central part of the Godavari watershedismainlyArchean granites and Dharwars composed of phyllites, quartzites, amphiboles and granites. The lower part of the middle basin is occupied mainly by the Cuddapahs and Vindhyan group aremetasediments and rocks of the Gondwana group. The Cuddapahs and Vindhyangroupare quartzites, sandstones, shales, lime stones and conglomerates. The Gondwanas are principally detritals with some thick coal seams. The Eastern Ghats dominate the lower part of the watershed and are formed mainly from the Khondalites which include quartz- feldspar- garnet- silllimanite gneisses, quartzite, calc-granulites and charnockites. In the coastal region the tertiary Rajahmundry sandstones crop out. The figure 3 represent the altitude division of the study area. The vegetation distribution map referred from image classification isconsidered accurate if it provides a true representation of theregion it describes (Foody 2002; Weber 2006). All themajor forest classes (viz.dense forest, open forest, scrubs) were classified. Along withforest, other land use/ cover classes (viz. crop land, fallow land,wetland, settlement and water bodies) found inthe Godavari watershed.The table 1 gives the statistics of the study area generatedfrom the classified output of the Landsat TM data of image 2005 and 2015. The major portion of the LULC is dominated by cropland and forest. The highest change accord in crop land, increasing 190247 km2 (60.82%) to 197828 km2 (63.53%), the area of Scrubs land, decrease 15167 km2(4.85%) to 10298 km2 (3.29%). The area of crop land, wetland, water body and settlement are increase from 2005 (fig. 6) to 2015 (fig.7). The area of dense forest, open forest, scrubs land and Fallow land are decrease form the entire period. Within the ten years the development of agriculture is in progress, impact of that cropland are increase and scrubs land is decrease. The entire watershed major city are lactated so the settlement area are increase. It is observed that some areas lying as dense forests have regenerated to open forest and vice versa. The present study highlight the LULCC along topography.

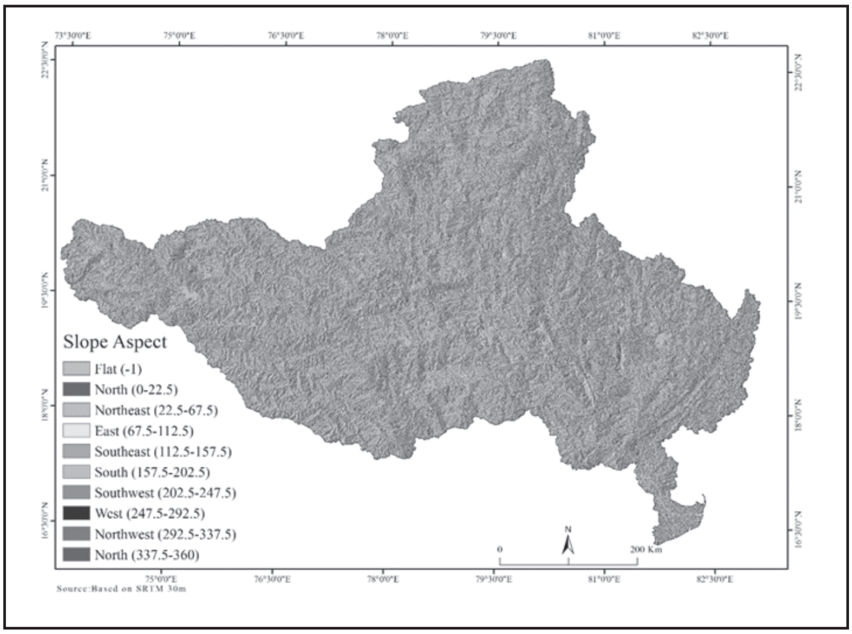
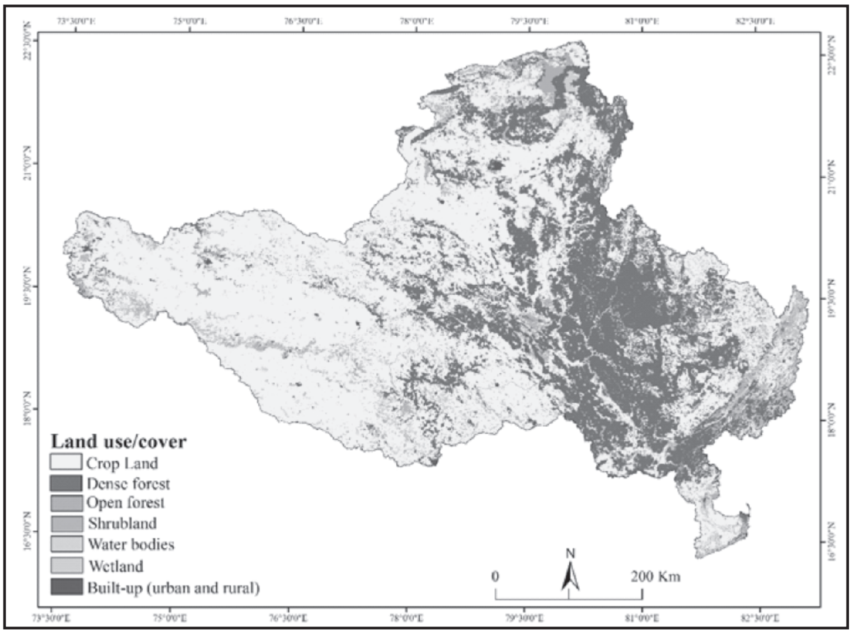


Fig. 5.Aspect map of Study area

Table 1. Statistics of the Study area



Sr. No	Land Use/Cover Classes		2005		2015		Difference in Percentage
			Area (Km ^{2})	Per cent of totalarea	Area (Km ^{2})	Per cent of totalarea	
1	Vegetation Class						
	a	Dense Forest	60194	19.24	59090	18.89	-0.35
	b	Open Forest	32359	10.34	31788	10.16	-0.18
	c	Scrubs	15167	4.85	10298	3.29	-1.56
2	Agricultural Land						
	a	Crop Land	190247	60.82	198728	63.53	2.71
	b	Fallow Land	8790	2.81	6339	2.03	-0.78
3	Wetland Land						
	a	Wetland Land	359	0.11	507	0.16	0.05
4	Settlement						
	a	Settlement	3225	1.03	3352	1.07	0.04
5	Water Bodies						
	a	Water Bodies	2475	0.79	2714	0.87	0.08

Fig. 6. Land use/cover map of the year 2005.
Fig. 7. Land use/cover map of the year 2015.

ASTER 30m DEM of the Godavari watershedwas classified into altitudinal ranges to find out the changes at different altitude. The majority of an area in the watershed falls in the altitude range of 500-750m (fig.8a). The most active zone for the human activities is found to be at a height of 200-750m. Although changes are found to occur at the lower altitude. Creation of slope map of Godavariwatershed using DEM. The changes in the various slope categories (Eight groups) were found out by overlaying the change map with the slope map (fig. 8b). The maximum changes in all the years are found to occured in 0-20 degree slope class. The data of DEM converted to Aspect map to find out the change with respect to different direction. The maximum change accord on the east, southeast, south and southwest (fig.8c) the direction because of the branches of the Indian monsoon (southwest and south east) rainfall direction and sunrise direction.

Fig. 6. Land use/cover map of the year 2005.

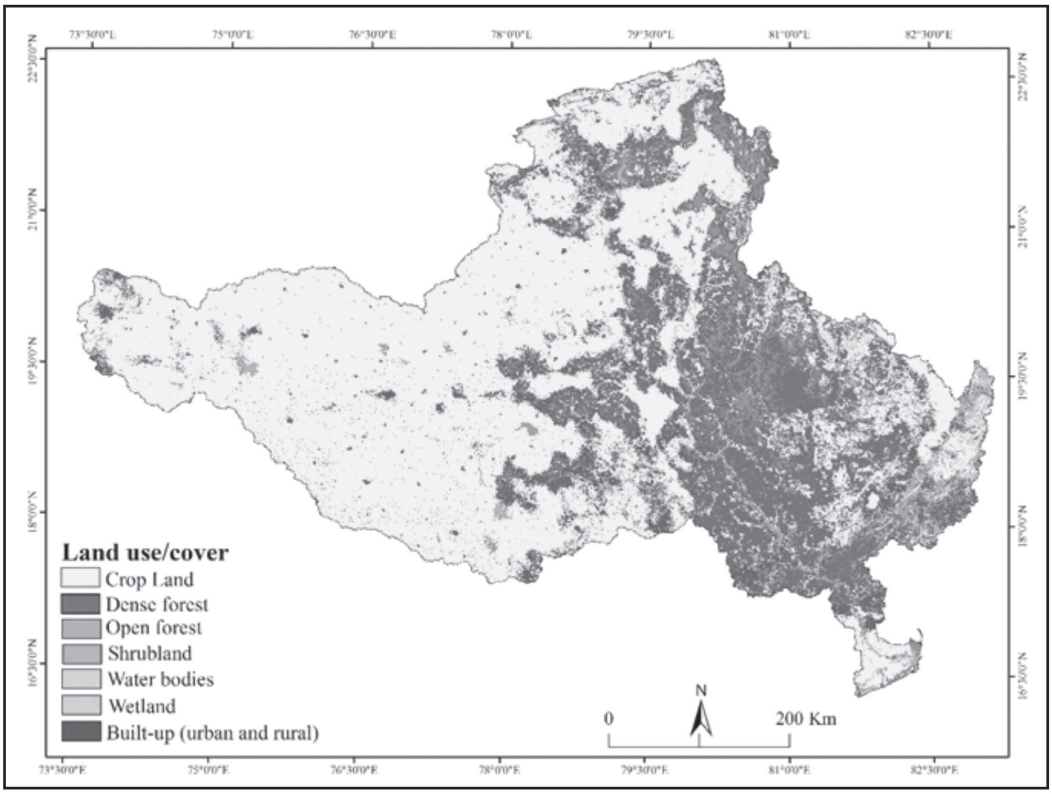
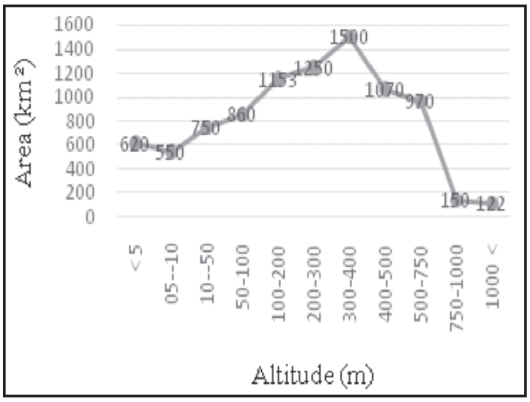
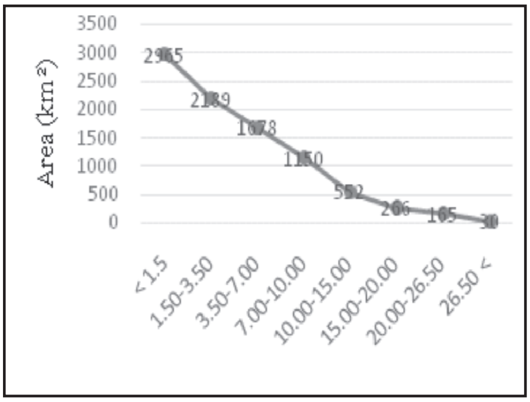


Fig. 7. Land use/cover map of the year 2015.

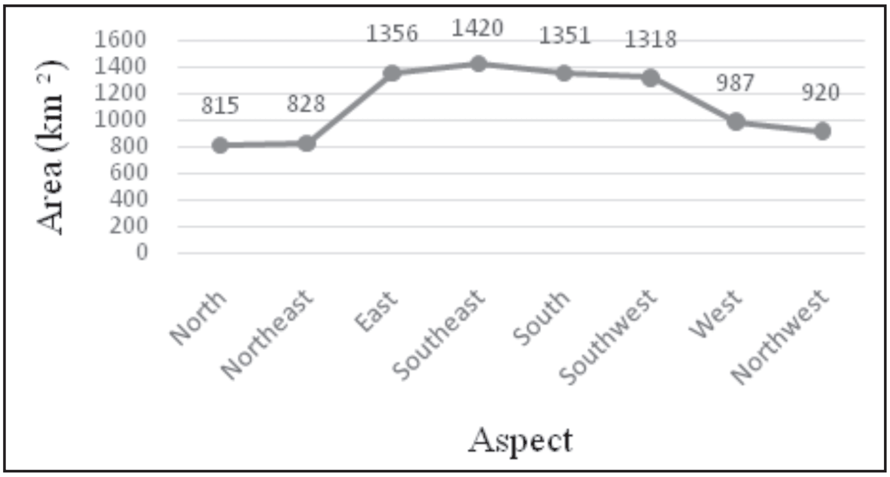
ASTER 30m DEM of the Godavari watershedwas classified into altitudinal ranges to find out the changes at different altitude. The majority of an area in the watershed falls in the altitude range of 500-750m (fig.8a). The most active zone for the human activities is found to be at a height of 200-750m. Although changes are found to occur at the lower altitude. Creation of slope map of Godavariwatershed using DEM. The changes in the various slope categories (Eight groups) were found out by overlaying the change map with the slope map (fig. 8b). The maximum changes in all the years are found to occured in 0-20 degree slope class. The data of DEM converted to Aspect map to find out the change with respect to different direction. The maximum change accord on the east, southeast, south and southwest (fig.8c) the direction because of the branches of the Indian monsoon (southwest and south east) rainfall direction and sunrise direction.





a. LULCC at different altitude ranges

b. LULCC along slopes



c. LULCC along aspect

Fig. 8a-c Land use / Land cover changes along topography.

Conclusion:

The study clearlyestablished that the satellite remote sensing data attached with Erdas Imagine software can be a powerful tool for mapping andevaluation of LULCC of a givenriver Godavari watershed.The present study demonstrated the effective role of the spatial technologies in land use/cover types. The results of land use/cover mapping from remote sensing imagery represent well with the actual land cover community composition. The optimal use of satellite imagery in land use/cover change mapping is effective when it is accompanied with fieldwork. The increased areas under crops and settlement and associated Land use pattern are causing a disturbance in the watershed with booth (positive and negative) side.Human activity such as agriculture and settlement are developed. The facility of irrigation and industrialization increase cropland and settlement.

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