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Assessment Of Land Use / Land Cover (LU/LC) Changes In Kaddam Watershed.

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ABSTRACT
Assessment of Land use/land cover changes mapping is one of the important task for watershed planners and researchers. The changes in LULC map provide the information about anthropogenic activities over a period of time in the region. In this context, the paper is reveals that, using multi temporal satellite data sets used of years 1989, 2001 and 2009 (Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+)) and applied Normalized Differenced Vegetation Index (NDVI) and change detection method using software's to know the spatial and temporal distributions in the study area. The temporal results represented that increased and decreased trend of spatial patterns in water bodies, agricultural lands, fallow lands and barren lands. These studies are also helpful to researchers and planners, reasons behind the changes in land cover to land uses, assess hydrological parameters impacts on study area previously and present, assess climate changes impacts in the feature of the study are while using any hydrological models.
KEYWORDS: NDVI, Themtic Mapper, ERDAS, Change detection, ARCGIS.

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I. INTRODUCTION

Land use is defined as the type of human activity taking place at or near the surface (Cihlar et al., 2001). Land cover is defined in the FAO/UNEP LCC(S) as the bio physical features one can observe on the surface of the earth (Gregorio et al., 2000). Land use/cover change is a dynamic process taking place on the bio-physical surfaces that have taken place over a period of time and space is of enormous importance in natural resource studies (Rawat, et al., 2015). Land use/land cover (LU/LC) information and change assessment are used in various resource sectors like agriculture mapping and planning, urban and rural surveys, environmental studies and operational planning (Plabita Barman and Dulal Goswami 2015). Its knowledge helps to bridge the gap in better understanding of relationship between cropland, forestland, settlement, wetlands etc. with the morphology of the river flowing through the area (Kotoky et al. 2012). Consequently, quantifying and understanding the extent and spatial distribution of LULC is crucial to assess environmental changes at various scales (Phukan et al. 2013). For these activities to derive the latest technologies i.e., remote sensing has an important contribution to make in documenting the actual change in land use/land cover on regional and global scales from the mid-1970s (Lambin et al., 2003). Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy (Kachhwala,1985) in association with GIS that provides suitable platform for data analysis, update and retrieval (Chilar, 2000). Remote sensing and GIS have been proved to be an efficient tools for mapping and quantifying the spatial extent of land use/ land cover for any area (Plabita Barman and Dulal Goswami 2015). In this context, advances in multi spectral and temporal remote sensing satellite data sets provide easy to estimate various spatially and temporal changes in land use/land cover. However, estimation of spatial and temporal changes in land use/land cover based on the number of classes and classification techniques of the remote sensing images. Remote sensing imageries used to obtain reliable and accurate land use and land cover (LULC) information still remains a challenge as it depends on many factors such as complexity of landscape, the remote sensing data selected, image processing and classification methods, etc (Ramita Manandhar et al., 2009). There are several methods to prepare LU/LC but the common change detection methods include the comparison of land cover classifications, multi-date classification, band, arithmetic, simple rationing, vegetation index differencing and change vector analysis (Jomaa and Kheir, 2003). Over the last decade, the normalized difference vegetation index (NDVI) differencing method and classification method are widely used as a change detection method and provides detailed information for detecting and monitoring changes in land use-land cover (LULC). NDVI classification is found to be suitable in such cases where the analysis is carried out using either past imageries or present imageries with no ground truth data (Chandra Bose et al., 2012).

II. STUDY AREA

The Kaddam watershed lies between latitudes 190 05'- 190 35' N and longitudes 780 10' - 780 55' E. The areal extent of the study area is 2656.25 km^2. The study area is located at Adilabad District falling under Telangana state, India.

Fig.1 Location map of study area

III. PREPARATION OF FCC IMAGE AND METHODOLOGY

A remote sensing system consists of a sensor to collect the reflected or emitted radiant energy from the terrain; the energy is recorded for different materials in different wave lengths. Every material on earth shows its own strength of reflection in each wavelength when it is exposed to the Electro Magnetic waves. Sensors aboard a platform are capable to acquire the strength of reflection and radiation in each wavelength of bands. The nature of these different bands had to be considered to make a decision as to which three band combination would be most helpful for classification and visual interpretation (Hussien Ali Oumer, 2009). The Band 4 reflective infrared wavelength (0.76-0.90 μm) is absorbed by water (appearing dark) and reflected by vegetation (appearing bright), while mid-infrared bands 5 (1.55-1.75 μm) and 7 (2.08-2.35 μm) contrast well, revealing differences in types and conditions of vegetation and soil (McHugh, 2009). Landsat-TM images represent valuable and continuous records of the earth's surface during the last 3 decades (USGS, 2014). Moreover, the entire Landsat archive is now available free-of-charge to the scientific public, which represents a wealth of information for identifying and monitoring changes in manmade and physical environments (Chander et al., 2009; Bastawesy, 2014). Presently to quantify spatial and temporal changes in the study area NDVI methodology was applied for classifying the satellite data of Thematic mapper (TM) and Enhanced Thematic Mapper (ETM+). TM and ETM+ satellite image datasets are downloaded from Global Land cover Facility (GLCF) web site (www.glcf.umd.edu). Band wise data sets are downloaded from the web site and using layer stack option in image interpreter tool box of ERDAS software prepared the false color composite (FCC) images. The details of data sets were used for the study area as shown in the table 1.

Table.1 Satellite images used for the study area.

Sno	Actuation Date	Path / row	Dataset	Resolution (Meters)	Season
1	21-11-1989	144/047	TM	30	Rabi
2	29-10-2001	144/047	ETM+	30	Rabi
3	27-10-2009	144/047	TM	30	Rabi

Vegetation indices are applied to satellite data sets to measure and quantify the vegetation vigor. VI is formed from combination of several spectral values that are added, divided, or multiplied in a manner design to yield to a single value that indicates the amount or vigor of vegetations with in a pixel (James Campbell). Generally, vegetation index values range between -1 to +1. The negative values indicate water bodies and the higher positive value indicates dense vegetation. Out of the various vegetation indices available, NDVI is very widely used as it minimizes the effect of change in illumination condition and surface topography (Holben, 1986). Stratification of the Normalized Difference Vegetation Index (NDVI) response to broad scene components was shown in Table .2.

Table. 2 Albedo Values for Different Cover Types

Sl. No	Cover Type	Planetary Albedo CH1	CH2	NDVI
1	Dense green leaf vegetation	0.050	0.150	0.500
2	Medium green leaf vegetation	0.080	0.110	0.140
3	Light green leaf vegetation	0.100	0.120	0.090
4	Bare soil	0.269	0.283	0.025
5	Clouds	0.227	0.228	0.002
6	Snow and Ice	0.375	0.342	-0.046
7	Water	0.022	0.013	-0.257

NDVI (Normalized Differenced Vegetation Index) is defined as

NIR-IR

NIR+IR

IV. RESULTS AND DISCUSSIONS

The Land use categories such as agricultural land, bare soil, fallow land, forest have been classified and mapped by using LANDSAT TM and ETM+ data sets with NDVI method. The descriptive of Minimum and Maximum values of NDVI for LU/LC are shown in the Table. 3. The NDVI real values, by definition, would be between -1 and +1, where higher positive values are indicates increase green vegetation and negative values indicate non-vegetated surface features such as water, barren land, ice, snow, or clouds. Negative values range is showed for water bodies and barren land in all years of NDVI outputs. Fallow land minimum value is found in year 1989 NDVI image is 0.13 and maximum value found in 0.23 in year 2009 NDVI image. Agricultural land minimum value is found in the year is 2001 NDVI is 0.17 and maximum value 0.46 found in the year 2009 NDVI image. For forest the minimum value 0.291 is found in the year 2001NDVI image and maximum value is found the in the year is 2009 NDVI image.

From table .4, it is understood that water bodies and agricultural land were increased trend, barren land, fallow land and forest has decreased trend from year 1989, 2001 and 2009 in the study area. Water bodies have increased from 0.84% to 0.96%. North eastern part of the study area, 5 to 25% of forest lands changed into agricultural land. From temporal data sets (1989 to 2009 year) it was observed that in the study region forest lands were decreased from 46.67% to 36.59%. The decrease in 10% indicates that, 265.26 sq.kms of forest is changed to deforestation; it would be possible to indicate on impacts of the hydrology of the study area. In this context, soil and water conservation structures to be construct minimum mini or micro level of watersheds. Apart from that barren lands and fallow lands decreased as follow from 11.67% to 2.76% and 14.50% to 5.83%. Table .5 is showed change trend in the study area. Prepared LU/LC map using NDVI method represented in the fig. 2.

Table .3 Descriptive statistics of NDVI values for lu/lc classes

Sno	LULC classes	NDVI-1989		NDVI-2001		NDVI-2009	
		Min	Max	Min	Max	Min	Max
1	Water bodies	-0.99	-0.11	-0.65	-0.29	-0.99	-0.007
2	Barren land	0.01	0.13	0.29	-0.05	-0.008	0.15
3	Fallow	0.13	0.18	0.004	0.17	0.16	0.23
4	Agricultural land	0.19	0.3	0.17	0.29	0.24	0.46
5	Forest	0.31	0.65	0.291	0.53	0.47	0.8

Table .4 Generated LU/LC categories using NDVI

Sno	Land use Class	Years 1989	2001	2009	1989	2001	2009
		Values In Sq.kms			Area in %	Area in %	Area in %
1	Water Bodies	22.32	25.54	23.22	0.84	0.96	0.87
2	Barren Land	310	334.2	73.25	11.67	12.58	2.76
3	Fallow land	385.1	34.65	154.8	14.50	1.30	5.83
4	Agland	699.1	1196	1433	26.32	45.04	53.95
5	Forest	1240	1066	972	46.67	40.11	36.59
	Total	2656	2656	2656	100	100	100

Table .5 LU/LC change trend from 1989 to 2009

Sno	Land use Class	Change in Area		% Change in Area	
		1989-2001	2001-2009	1996-2001	2001-2009
1	Water Bodies	3.22	-2.32	14.43	-9.08
2	Barren Land	24.2	-260.95	7.81	-78.08
3	Fallow land	-350.45	120.15	-91.00	346.75
4	Agland	496.9	237	71.08	19.82
5	Forest	-174	-94	-14.03	-8.82

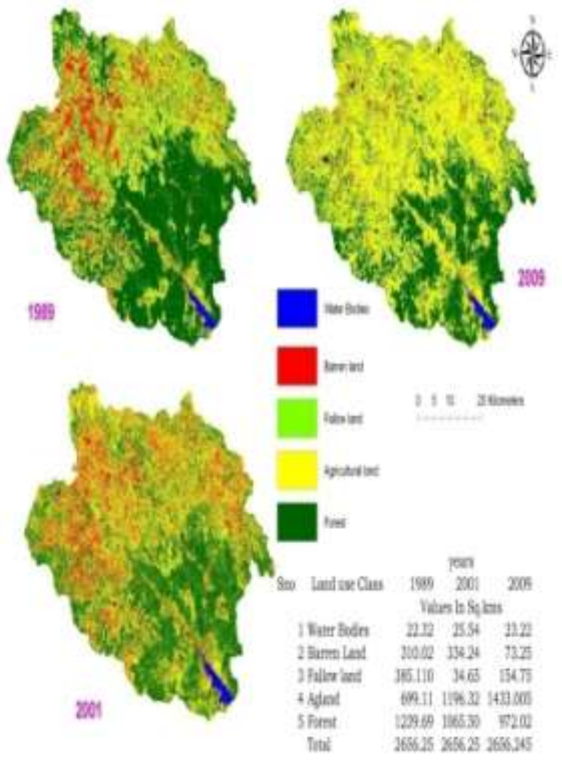

Figure 2 Prepared Land use/land cover map using NDVI method.

V. LULC CHANGE DETECTION

To identify the spatially and temporal changes in the study area change detection analysis were performed using years of 1989, 2001 and 2009 NDVI outputs. To get the changes in output of 1989 to2001, in the change detection analysis tool box before image taken as 1989NDVI and after image taken as 2001NDVI. Similarly to get the changes in 2001 to 2009, before image considered as 2001NDVI and after image considered as 2009 NDVI. The output map of change detection is showed in the fig .3. The changes of the study area represents in two colors. Red colour showed in decreased one form of land area to another form of land practices and Green colour showed in increased one form of land area to another form of land practices area in the study area.

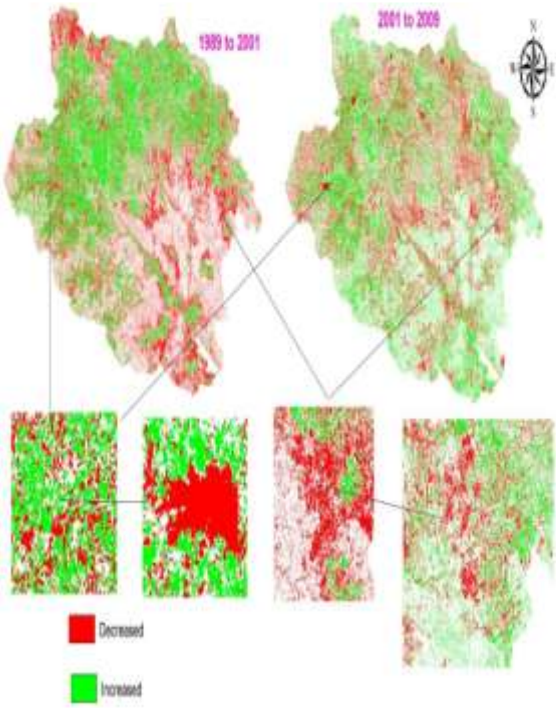

Figure .3 Change detection map of the study area.

VI. CONCLUSIONS

The present study demonstrated that TM and ETM+ temporal data sets are very effectively measure and mapping the changes in land use/land cover of study region using NDVI method. NDVI results showed satisfactorily with filed observation. The NDVI results, changes in LU/LC mostly forest land 265.65sq kms (26500ha) has been converted in to agricultural lands. These changes in spatially and temporarily identification is very difficult without NDVI outputs and change detection analysis. From this study it can concludes that change detection analysis and NDVI outputs gives an immense result of changes in patterns from land cover to land use practices. These studies are also helpful to researchers and planner, reasons behind the changes in land cover to land uses, assess hydrological parameters impacts on study area previously and present, assess climate changes impacts in the feature of the study are while using any hydrological model. The results from remote sensing data sets, classification using NDVI method has showed satisfactorily. The advantage of NDVI images are if a researcher has extensive knowledge on the image spatial and temporal pattern and its association can avoid the field visits of the study area.

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