SPATIAL AND TEMPORAL VARIATIONS OF LAND USELAND COVERIN KADIRI WATERSHED USING RS & GIS TECHNIQUES.

ABSTRACT:

The change detection and land use and land cover (LULC) maps are more important powerful forces behind numerous ecological systems and fallow land. It is widely known that land use/land cover (LULC) changes significantly alter watershed hydrology and sediment yields. The impact, especially on erosion and sedimentation, is likely to be exacerbated in regions dominated by high rainfall patterns such as monsoons. RS & GIS technologies are very useful to determine the LULC changes.Present research area Kadiri Watershed of Anantapur district of Andhra Pradesh, India, drains an area about 240 km^2 including 15 villages. The average annual rainfall in this area varies between 600mm to 700mm in which 60%, 35% and 5% of total rainfall occurs in S-W, N-E and in Summer seasons respectively.The current research focuses on demarcating the spatiotemporal LULC changes. These effects directly affect the ecosystem, land resources, cropping pattern and agriculture. LULC assessment and surveillance are essential for long-term planning and sustainable use of natural resources. The LULC maps were prepared for the study area using Landsat-5, Senthinel 2 images pertaining to pre-monsoon and post-monsoon seasons of 2013, 2017 and 2021. During these years in pre-monsoon seasonobserved variations of extents in agriculture, plantations, scrubs, water bodies, open lands as well as built up were from 22 to 35 and 43%, 2 to 3 and 5%, 22 to 28%, 1 to 4%, 52 to 29 and 15% as well as 1 to 5% respectively. Similarly, in post-monsoon season variationsobserved as 29 to 40 and 47%, 3 to 7%, 33 to 30%, 2 to 4%, 32 to 20 and 7% as well as 1 to 5% respectively.Kadiri watershed, an agriculturally dominant area, has seen an increase in cultivated land due to the conversion of fallow land and open scrub into cropland as a result of good rainfall received during the south-west monsoon during in assessment years and implementation of watershed development activities.These findings highlight the potential impacts of LULC changes in a monsoon-dominated watershed and may contribute to the development of successful LULC-based watershed management strategies for prevention of flooding and sediment loss.

(*Keywords: Land Use Land Cover, RS & GIS,Pre-Monsoon, Post-monsoon etc*.)

1.INTRODUCTION

Land use land cover change is one of the stressors that significantly affect hydrological balance and then aggravate water quantity issues (Fu *et al.,* 2009). Hydrological processes such as infiltration, groundwater recharge, base flow and surface runoff are influenced by land use changes in a catchment.

LULC modification such as changes in vegetation cover alter surface roughness and leaf area index (LAI) that can lead to disturbance in surface energy balance and evapotranspiration (ET) (Pielke and Avissar, 1990). The changes in energy balance and ET may significantly affect the timing and magnitude of evaporative losses to the atmosphere and the amount of water yield that governs soil moisture content, runoff and base flow patterns of regional hydrologic responses. Hence these disturbance in hydrological balance lead to increase in runoff rate, volume and more intense and frequent floods (Brath*et al.,* 2006).

Land use/land cover (LULC) pattern of a region is an outcome of both natural and socio-economic factors and their utilization by man in time and space. Land is becoming a scarce resource

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due to immense anthropogenic pressures, e.g., agricultural expansion, forest logging, commercial plantation, mining, industry, urbanization, road hydropower, etc. All of these are responsible for damaging the land cover. It has already been widely accepted that the LULC play a very important role at local to global scales on ecosystem functioning, ecosystem services, and biophysical and human variables such as climate and government policies (Meyer WB *et al*., 1984). Hence, land-cover classification and change detection analysis have become one of the most important and typical applications of remote sensing data.

Satellite based data as a basis for generating valuable information for LULC is by now widely recognized, although initial efforts was made since mid seventies for application of different interpretation techniques in LULC mapping. Rapid replacements of land cover by various land use categories are observed globally (Geist, 2001). LULC changes on the surface of the earth are generally divided into land use and land cover which are two concepts and are often used interchangeably. The importance of investigating LULC and their impacts as a baseline requirement for planning and sustainable management of natural resources (Lambin et al., 2000; Petit et al.,2001). These researchers have argued that land use has significant impacts on the functioning of socio-economic and environmental systems with important tradeoffs for sustainability, food security, biodiversity and socio-economic vulnerability of people and ecosystems.

Over the past years, data from earth remote sensing satellites have become vital in mapping the earth's features and infrastructures, managing natural resources and studying environmental change. Collection of remotely sensed data facilitates the synoptic analysis of earth system function, pattern, and change at local, regional and global scales over time. As such, utilization of multispectral-multitemporal remotely sensed data has been widely used to generate thematic LULC inventories for a range of applications including urban planning, agricultural extension and forest ecosystem classification. Since 1972, the Landsat satellites have provided repetitive, synoptic, global coverage of high-resolution multispectral imagery. The most popular instrument in the early days of Landsat was the Multi-Spectral Scanner (MSS) and later the Thematic Mapper (TM) and the latest satellite in the series is Enhanced Thematic Mapper (ETM+). With repetitive satellite coverage, the rapid evolution of computer technology, and the integration of satellite and spatial data with geographic information systems (GIS), and development of environmental monitoring applications, change-detection analysis over time have become ubiquitous (Jensen JR.1995). Remote sensing technology also provides a cost-effective way of assessing the land change studies at different scales with better accuracy (Kachhwaha TS. 1985 14).

Several procedures have been developed and applied for monitoring the changes in LULC by making the use of remotely sensed data, for instance, image diferencing, pixel- and object-based classifcation in land cover change mapping King DJ (2011), cross-correlation analysis (Jones DA, et al,. 2009), comparison of spectral indices and principal component analysis (Yanan L, *et al*,. 2011), post-classifcation comparison (Hassan Z, *et al.,* 2016) and image fusion-based land cover change detection (Wang D, et al.,). Change detection analysis is widely used for demarcation of LULC changes based on multi-temporal remotely sensed data.

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2. MATERIALS AND METHODS

2.1 STUDY AREA

Present study area of Kadiri watershed is located in between 78˚ 9' 32" N, and 14˚ 6' 49" E, having an extent of 239 km^2 which includes 15 villages. The extent of villages varies from 1.22 km^2 to 86.96 km^2. The average elevation of study area was 620m above the Mean Sea Level (MSL) with highest value of 830m and lowest valve of 409m. The average annual rainfall in this area varies between 600mm to 700mm in which 60%, 35% and 5% of total rainfall occurs in S-W, N-E and in Summer seasons respectively. Major crops grown in this area were Bengal gram, ground nut, maize, mango and paddy. Watershed program was initiated from the year 2012-13 and completed in 2019-2020 during in this period different soil conservation measures as well as structures were carried out, these tends to observable changes land use land cover. The location map of study area shown in Fig.1

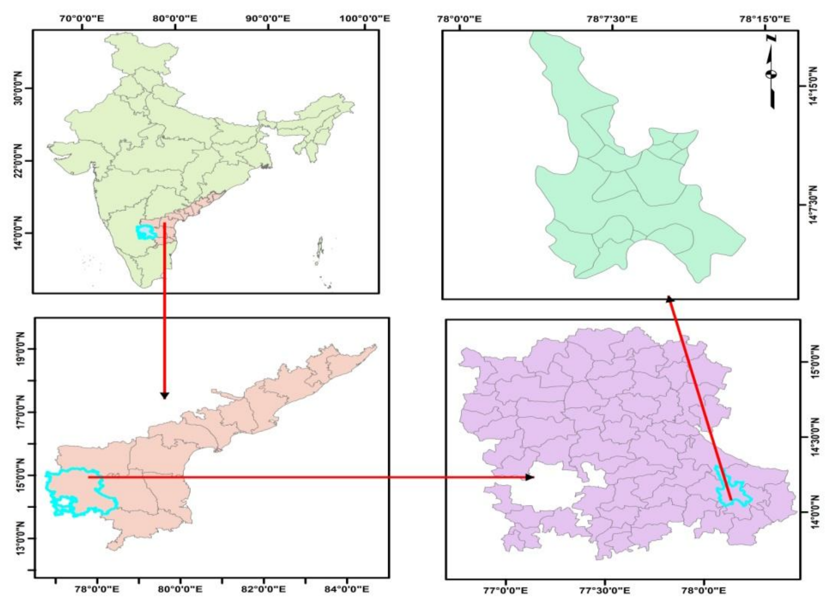


FIG. 1 Location map of Kadiri watershed of Anantapur District.

Methodology:

The LULC maps were prepared for the study area using Landsat-5, Senthinel 2 images pertaining to pre-monsoon and post-monsoon of 13th April and 7th November of 2013, 24th April and 21st October of 2017 as well as 12th February and 25th September and respectively. For the classification of land cover and creation of training sets, data from photos and toposheets were used. Ground truth survey was carried out by walking around the field boundaries for two times (pre-monsoon and post-monsoon) during 2013, 2117 & 2021 using GPS. Unsupervised classification was used for the present study area.

Unsupervised Classification is the process of Classifying or Separating the Satellite Reflectance Numbers OR Digital Numbers into Meaningful Information into Several numbers of Classes Such as Agriculture- Different Crops, Forestry, Urban Settlements, Water Bodies., etc with the Inbuilt Classifiers in the Software using Mathematical Algorithms Such as K Means or ISODATA without any TRAINING DATA or GROUND FIELD POINTS. Fig.2 provides the flow chart of crop mapping and acreage estimation using RS and GIS technique.

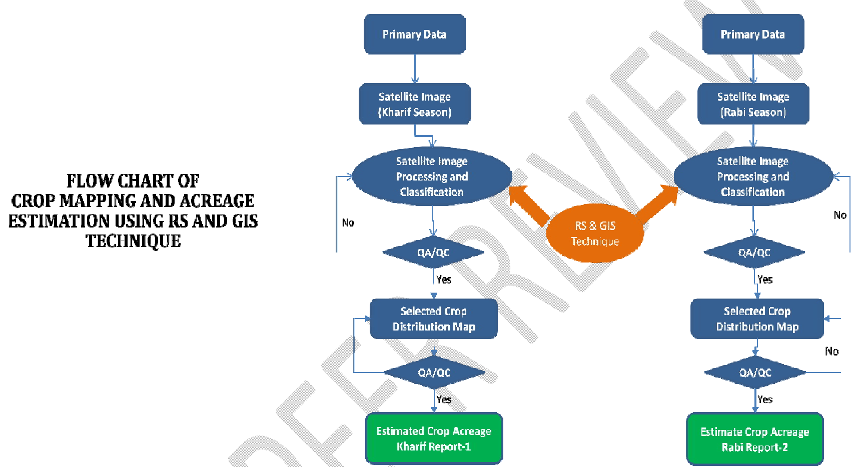


Fig. 2 Flow chart for preparation of LULC.

3.Results and discussions:

The land use land cover maps were prepared for the present watershed as described above for both Pre-Monsoon and Post Monsoon LULC estimation was done from three years i.e. 2013, 2017 and 2021 (pre-implementation of watershed programe, during the programe and post-implementation) respectively.

Theinvestigatedareahasobservable changes during this period. LULC maps of watershed are represented in Figs. 3.(a), (b), 4 (a), (b) and 5 (a), (b). The year wise detail of different LULC's were represented in the Table 1.

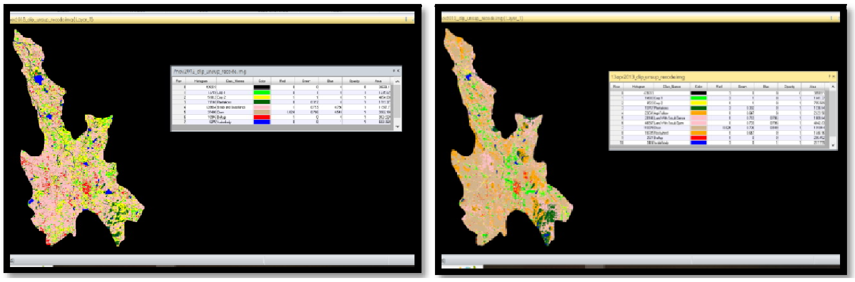


Fig. 3.(a), (b) Pre-monsoon and Post-monsoon LULC images of 2013

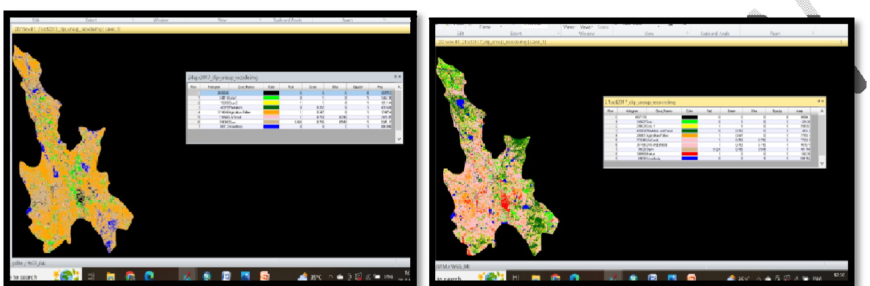


Fig. 4.(a), (b) Pre-monsoon and Post-monsoon LULC images of 2017

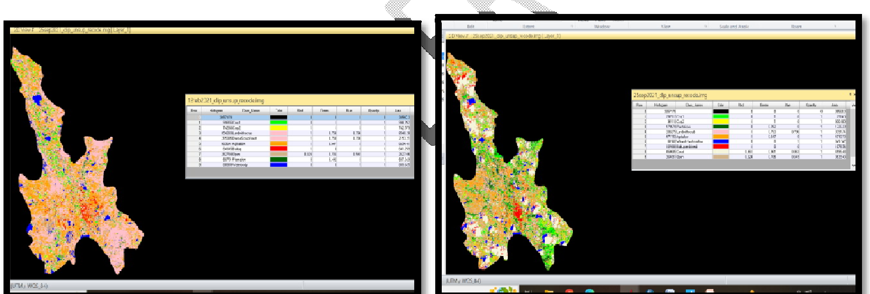


Fig. 5 (a), (b) Pre-monsoon and Post-monsoon LULC images of 2021

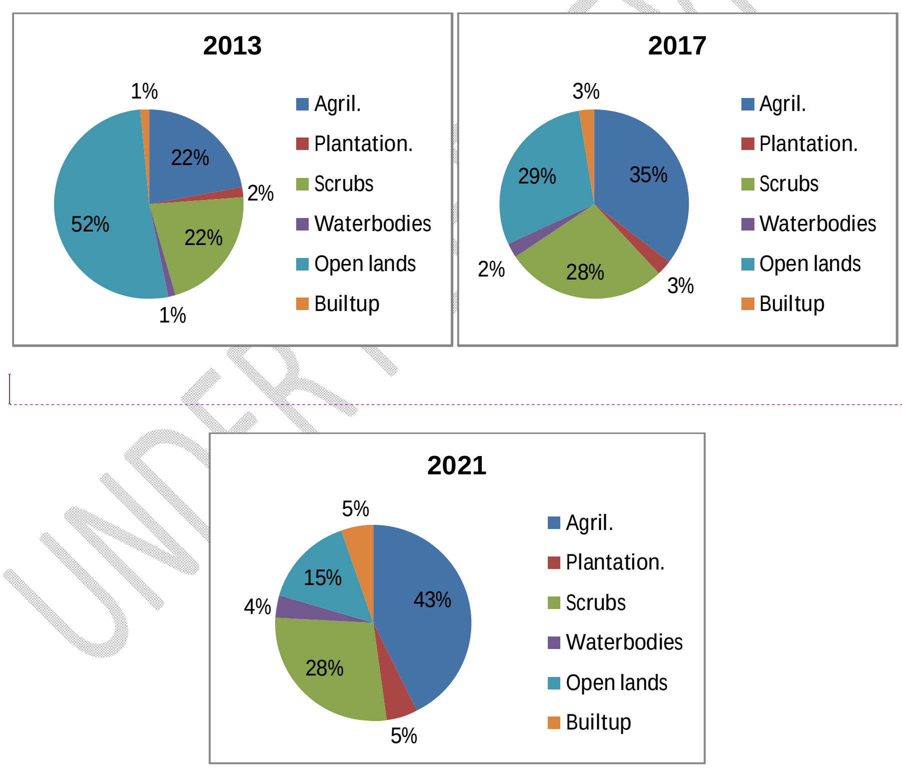
TABLE 1.LULC Comparison (ha)

LULC	**Pre-Monsoon**			**Post-Monsoon**		
	2013	**2017**	**2021**	**2013**	**2017**	**2021**
Agril.	5280	8435	10175	6900	9680	11145
Plantation.	410	608	1237	619	750	1545
Scrubs	5166	6552	6700	7864	7365	7150
Waterbodies	285	587	890	564	688	1025
Open lands	12355	6977	3627	7550	4760	1745
Builtup	340	625	1250	340	630	1270

Total	**23836**	**23784**	**23879**	**23837**	**23873**	**23880**

From the above table it is clearly identified that the LULC extent in the present area was considerably changed during the years 2017 and 2021 respectively. In pre-monsoon season percent change in Agriculture, plantation, Scrubs and Water bodies, Open lands and Builtup were shown in Fig's. 6 (a - c). During these years variations of extent in agriculture, plantations, scrubs, water bodies, open lands as well as built up were from 22 to 35 and 43%, 22 to 28%, 2 to 3 and 5%, 1 to 4%, 52 to 29 and 15% as well as 1 to 5% respectively.

Similarly, in post-monsoon season percent change in Agriculture, plantation, Scrubs and Water bodies, Open lands and Builtup were shown in Fig's. 7 (a - c). During these years variations of extent in agriculture, plantations, scrubs, water bodies, open lands as well as built up were from 29 to 40 and 47%, 3 to 7%, 33 to 30%, 2 to 4%, 32 to 20 and 7% as well as 1 to 5% respectively.



Fig's. 6 (a - c) Changes in LULC during pre-monsoon in study area.

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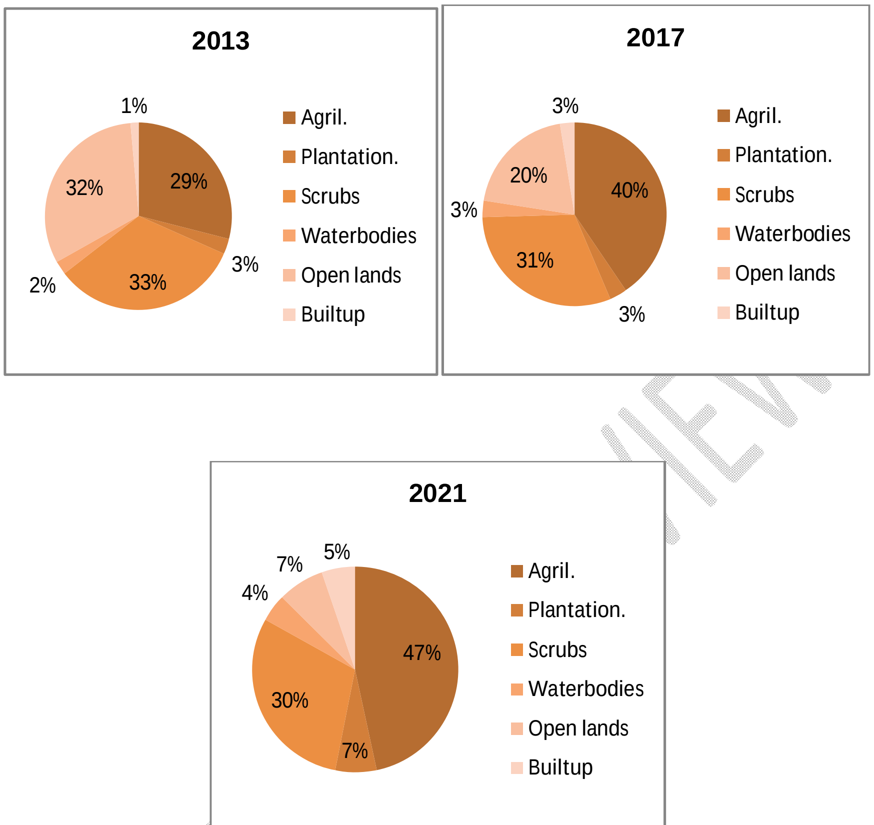

Fig's. 7 (a - c) Changes in LULC during post-monsoon in investigated area

Conclusions:

The LULC maps were prepared for the study area using Landsat-5, Senthinel 2 images pertaining to pre-monsoon and post-monsoon seasons of 2013, 2017 and 2021. Concluded that in pre-monsoon season observed variations of extents in agriculture, plantations, scrubs, water bodies, open lands as well as built up were from 22 to 35 and 43%, 2 to 3 and 5%, 22 to 28%, 1 to 4%, 52 to 29 and 15% as well as 1 to 5% respectively. Similarly, in post-monsoon season variations observed as 29 to 40 and 47%, 3 to 7%, 33 to 30%, 2 to 4%, 32 to 20 and 7% as well as 1 to 5% respectively. Kadiri watershed, an agriculturally dominant area, has seen an increase in cultivated land due to the conversion of fallow land and open scrub into cropland as a result of good rainfall received during the south-west monsoon during in assessment years and implementation of watershed development activities.These findings highlight the potential impacts of LULC changes in a monsoon-dominated watershed and may contribute to the development of successful LULC-based watershed management strategies for prevention of flooding and sediment loss.The methodology adopted herein demonstrates the ability of remote sensing and GIS in the change detection analysis of land use/land cover of a given area. The results of the study could be used for decision-makers in the administration and planning sectors for effective and sustainable management.

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