DECADAL CHANGE IN LAND USE PATTERNS IN PORUMAMILLA MANDAL IN ANDHRA PRADESH USING OPEN SOURCE SATELLITE DATA

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Abstract

Using multi-temporal satellite imagery, digital change detection algorithms can be used to better understand landscape dynamics. An analysis of land use/cover changes in the Kadapa District of Andhra Pradesh, India's Andhra Pradesh state is presented here. In order to determine the changes in the study region from 2008 to 20018, the earth explorer site obtained Landsat satellite images from two separate time periods, i.e. Landsat Thematic Mapper (TM). ERDAS2014 Software employs supervised classification approaches based on maximum likelihood. In order to categorise the photographs of the research region, they were divided into five categories: forest, agriculture, wastelands, built-up areas, and waterways. According to the findings, the amount of waste land and built-up land has increased by 3.48 percent (12.82 Sq km) and 4.03 percent (14.86 Sq km) during the past decade, while agriculture, forest, and waterbodies have dropped by 6.81 percent, 3.72 percent, and 1.9 percent, respectively.

Key Words: Landuse/Landcover, Remote Sensing, Change detection techniques, Landsat 8 Imagine, GIS.

Introduction

It's common to use the terms "land use" and "land cover" interchangeably (J.Srawat et al., 2015). The distribution of plant, water, soil, and other soil physical features, even those produced only by human activity, are all considered to be part of landcover. There are many different types of settlement, but they all have one thing in common: they all have one thing in common: they all use land. There are several elements that influence land use/landcover, including natural, socio-economic, and human influences. An increase in urbanisation requirements and a rise in the number of residents in gifts is the result of land use/landcover changes. Land degradation isn't always a result of human-caused alteration of the landscape. However, many models alter land use owing to a variety of socioeconomic factors, resulting in alterations in land cover that have an impact on biodiversity, water consumption, and radiation emissions, among other things (Riebsame et 1994) Land use/land cover changes can help us better understand how the landscape evolves over time, which is essential for long-term management. Natural and human-induced changes in land use/landcover are prevalent and accelerate the process, resulting in changes that may damage natural ecosystems (Ruiz-Luna et al, 2003, Turner and Ruscher 2004). For proper land management and decision-making, both human activity and natural occurrences are required. According to Yuan et al. (2005; Brondzio et al., 1994), the present area of sensor technology comprises air and satellite systems that repeatedly collect physical data at a high rate, allowing us to analyse data created by multiple spatial models and optimise the entire planning process. Using remote implementation of susceptible data, it is possible to more quickly, cheaply, and accurately study landcover changes. R.M. Rajasekhar and colleagues (2017); G. Sreenivasulu and coworkers (2014). Large-scale land use/landcover change monitoring necessitates the use of remote sensing and geographic information systems (GIS), both of which provide flexible environments for collecting, storing and analysing geographic data in order to detect changes. Selcuk Reis (2008) argues that GIS and remote sensing provide powerful tools for this task. Over the past three decades, the Landsat-TM image contains significant and undisturbed land records (USGS, 2014). All the Landsat archives are freely available to the scientific community, which provides a wealth of information to identify and monitor changes in both manmade and natural environments. For example, according to (Chander and El Bastawesy 2014) Features of land use/landcover are the outcome of natural and social-economic processes, as well as human activity. Because of the immense agricultural and statistical demands, Earth is becoming increasingly scarce. Land use/landcover information and opportunities for optimal use is vital in the selection, planning, implementation, and evaluation of land use plans that satisfy the growing demands for fundamental human requirements. Because of the ever-increasing demands of a growing population, it is also possible to track how land usage changes over time. The authors of the papers cited above (Sreenivasulu.G et al., 2014; M. Rajasekhar et al., 2018) As part of the contemporary approach to resource management and environmental change research, the LULC shift has become an essential component. In order to accurately assess the distribution and health of forest, grassland, and agricultural resources, it is necessary to expand the notion of vegetation mapping.

Forest regions and heavy areas are often used to fulfil the growing demand for agricultural land, although this practise can be limited through land intensification (raising Rabi, Kharif and Zaid harvests) in order to meet the growing demand for agricultural land. As a result of land transformation, remote sensing data can be used to analyse land cover changes in a shorter period of time (Yuvan et al., 2005b). They can be interchanged, since the landuse/landcover relationship is based on landcover and related data and the latter is based on landuse and related data. Native land usage and land cover changes occur gradually and in a way that often goes unnoticed. Their combined effect is one of the most significant features of global climate change. These thematic guides introduce the reader to significant land use and land cover research subjects, such as deforestation, desertification, biodiversity loss, landcover and water cycle, and urbanisation. They also direct the reader through these topics. An image collection research was used to create a total of three thematic maps, including maps of location, drainage, and land use, as well as maps of terrestrial coverage.

Models for a wide range of land uses and landcovers, including agricultural land, forest massifs, aquatic bodies, and cultivated land that is not used for agriculture (Sreenivasulu, 2013). The forest is a major natural resource in this educational area. Human activities has caused a decrease in forest cover. The amount of land that may be used for farming is likewise decreasing. In addition, the amount of land that is under the developed area is growing. Burn and farmland have been devastated recently because of the role of building contractors and real estate agents. With regard to land management, this is a dangerous condition. Land-based transformation must be explored in order to comprehend the current condition and plan for the future generations.

Objectives

1. Basemap preparation
2. Land use/cover change detection using open source Satellite data

Study Area

The proposed study area covers the Porumamilla Mandal, Kadapa District, Andhra Pradesh, India. The study area is located in the Survey of India Toposheet Nos: 57 J/14, and 57 J/13 on 1:50,000 scale and lies between North longitudes $78^0$55' 0’’ to $79^0$10' 30" and East latitudes 14^0 50' 0" to 15^0 10' 0" (Fig.1). The study area comprises a total geographical area of 368.65 sq. km A popular investigation soil survey of Kadapa district exhibits the occurrence of exclusive soil sequence and their associations in the study area.

Geology

The research area contains a diverse range of rock types. Sedimentary low grade metamorphic rock formations dominate the landscape. Between the Bairenkonda quartzites, the Cumbum shale deposit can be found. It is made up of Najri Limestone, Koyalakuntla Limestone and Quartz. The Nallamali formation is home to these sorts of rocks. These rocks have been heavily worn and have been partially covered by recent fills and alluvial deposits at several locations. The Teluguganga Reservoir serves as a major source of water for the people who live on both sides of the river and even for humans themselves, providing irrigation, drinking water, and other necessities. There has been a significant improvement in the quality and quantity of groundwater replenishing water throughout large swaths of the country. Sinking deep bore wells indiscriminately and low recharge from infrequent rainfall and the absence of any surface water sources cause the groundwater table to plummet dramatically.

Weather and Climate

The climate here is tropical. The study area receives maximum precipitation in North-East (NE) monsoon season. The climate here is classified as Aw by the Köppen-Geiger system. The average temperature in Porumamilla is 28.7 °C. In a year, the average rainfall is 745 mm. May is the warmest month of the year. The temperature in May averages 33.8 °C. The lowest average temperatures in the year occur in December, when it is around 23.8 °C.

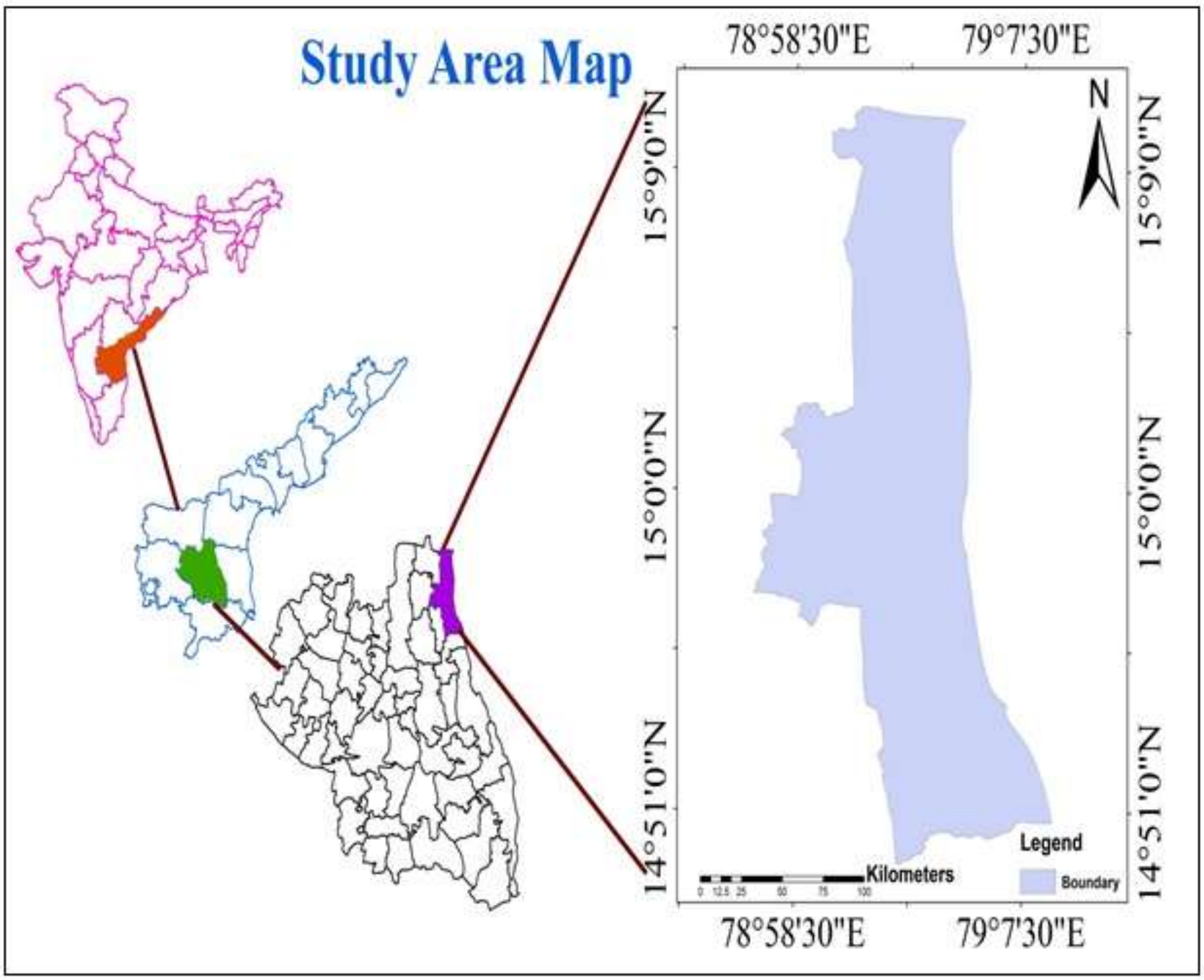

Fig 1 Location map of the study area.

Material and methods:

Classification of land use and cover was performed using Landsat Thematic Mapper images from 2007-2008 and 2017-2018, both at a resolution of 30 metres. To gather satellite data for the study area, researchers turned to the National Remote Sensing Center (NRSC) and the USGS Earth Explorer website (http://earthexplorer.gov/). Satellite image processing software ERDAS Imagine version 2014 was used to generate a composite of these datasets (FCC). The FCC for the area under consideration is generated using the layer stack settings in the picture rendering toolkit. Satellite images are pre-configured in the isolation study area of the two images, which indicates the geographic area of the research region map as AOI (area of interest).

Land use/cover detection and analysis

ERDAS Imagine programme used supervised classification with the maximum likelihood algorithm method to classify a specific area's land use/land cover.. These probabilities are consistent across all classes and the normal distribution of input bands, according to the theory underlying the experiment. Even though it needs an extensive calculation based on the normal distribution of data for each input bar, this approach usually takes longer than is required to get the required number of distinct results. Using the signs classification, the study area has been divided into five landuse/landcover types: Forests, agricultural land, wastelands, built-up terrain, and waterbodies are only a few examples.

Land use/cover change detection and analysis

A post-classification detection method was used for land use/cover change detection. There is an advantage to using "from, to" information in a pixel-by-pixel comparison to provide change information that is easier to grasp. Cross-tabulation was used to compare image pairings from 2007-08 and 2017-18 in order to determine qualitative and quantitative changes in the data. ERDAS Imagine software was used to create a change matrix (Weng, 2001). The changes in Landuse/Landcover overall, as well as the gains and losses in each category from 2007-08 to 2017-18, were then quantified on an areal scale.

Analysis of Landuse / Landcover by using Remote Sensing data

The use of remote sensing techniques is critical to the identification of change in specific places and at certain times. The selection of a suitable approach for detecting changes is vital for research purposes in selecting remote sensed data and study areas, in order to discover qualitative changes in regions. Landsat Thematic Mapper was utilised to map the study area's Landuse/Landcover categories at a resolution of 30 metres in 2007-08 and 2017-18. Using satellite data, the map was visually interpreted, and it was approved after a comprehensive field review. Agricultural land, built-up land, waste land, vegetation/scrub, and water bodies are some of the numerous land use and land cover classes interpreted in the research area.

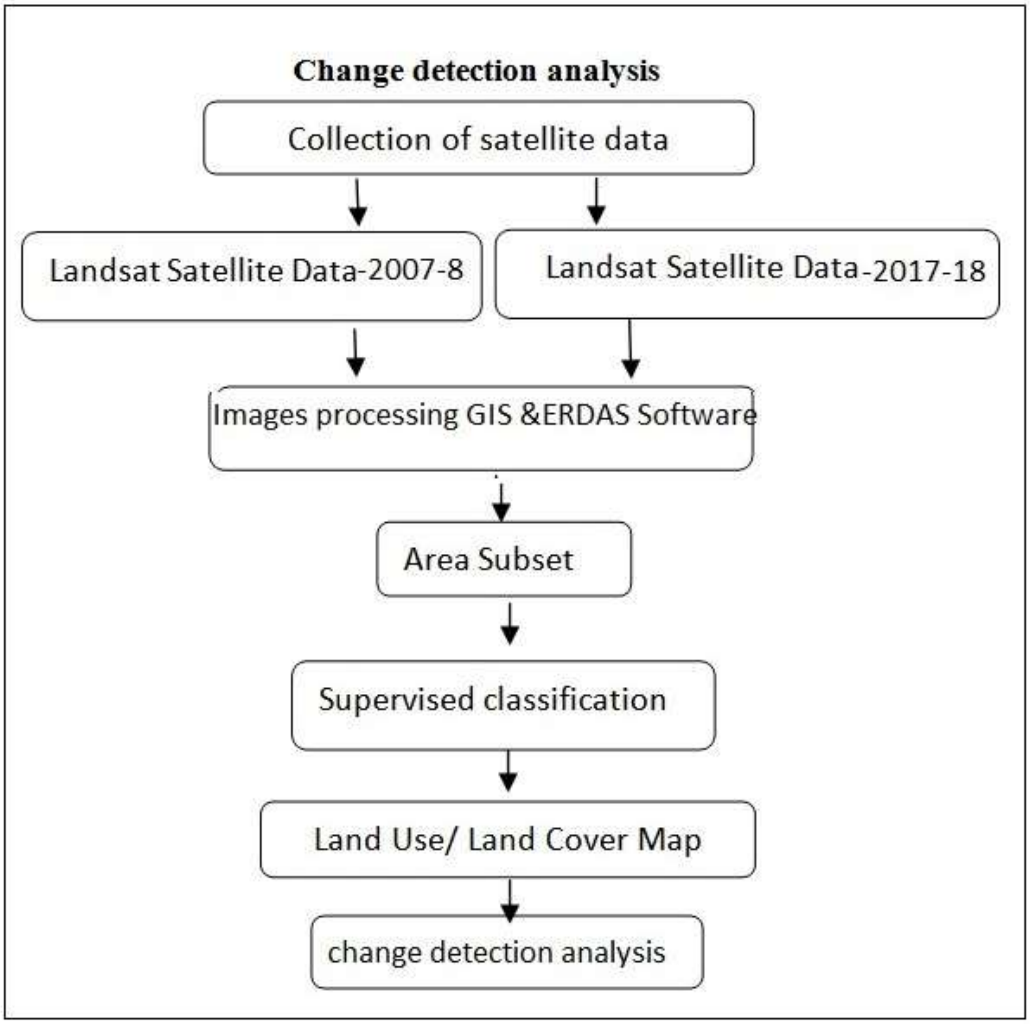

Figure: 2 Flow chart showing the broad methodology adopted in the study

Results & Discussion

The use of remote sensing techniques is critical to the identification of change in specific places and at certain times. The selection of a suitable approach for detecting changes is vital for research purposes in selecting remote sensed data and study areas, in order to discover qualitative changes in regions. In order to classify the research area's Landuse/Landcover categories, Landsat Thematic Mapper at a resolution of 30m was employed from 2008 to 2018. Using satellite data, the map was visually interpreted, and it was approved after a comprehensive field review. Agricultural land, built-up land, waste land, vegetation/scrub, and water bodies are some of the numerous land use and land cover classes interpreted in the research area. Figures 3 and 4 show a diagrammatic representation of the research area's change detection, and tables 1 contains the collected data. In Figs. 2 and 3, land-use/landcover status and change are shown in distinct land-use categories. Fig 4 depicts the percentage change in land use/landcover between 2008 and 2018.

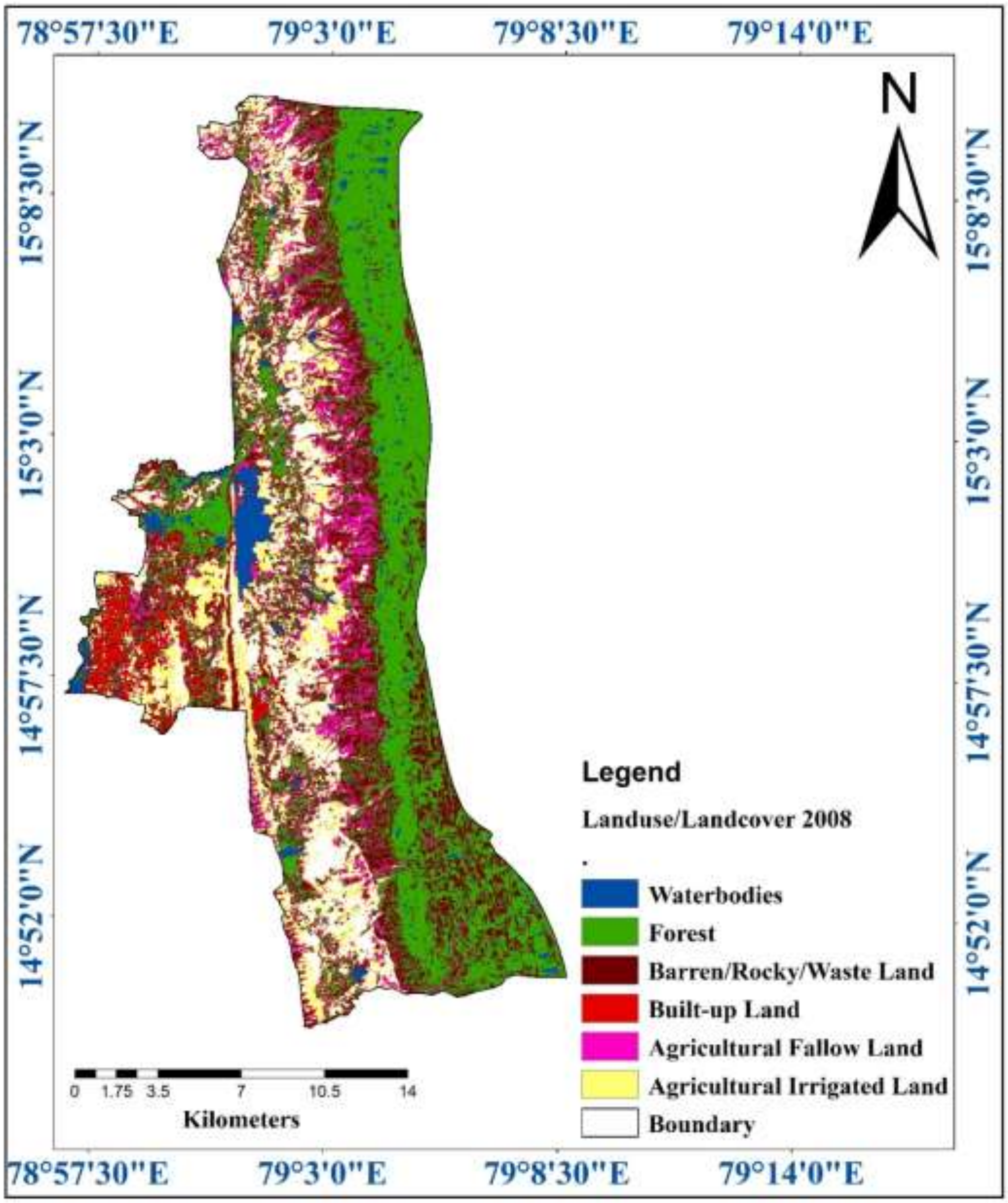

Figure 3. Landuse/Landcover status of the Study Area in 2008 (based on Landsat Thematic Mapper Satellite Imagery).

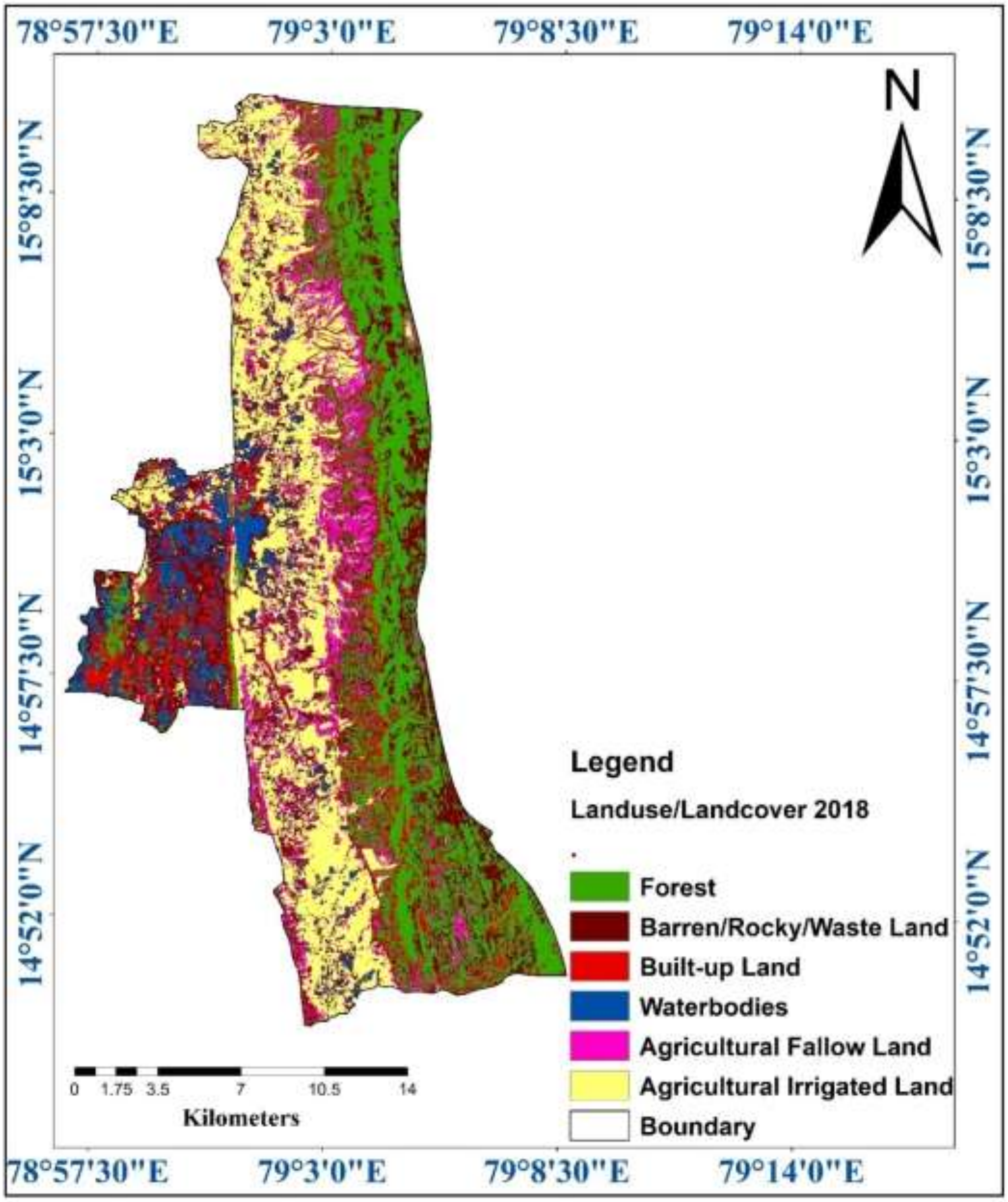

Figure 4. Landuse/Landcover status of the Study Area in 2018 (based on Landsat Thematic Mapper Satellite Imagery).

Field Photo.1: Barren/Wastelands

Field Photo.2: Agricultural Land

Field photo.3: Waterbodies

Field Photo.4: Agricultural Fallow Land

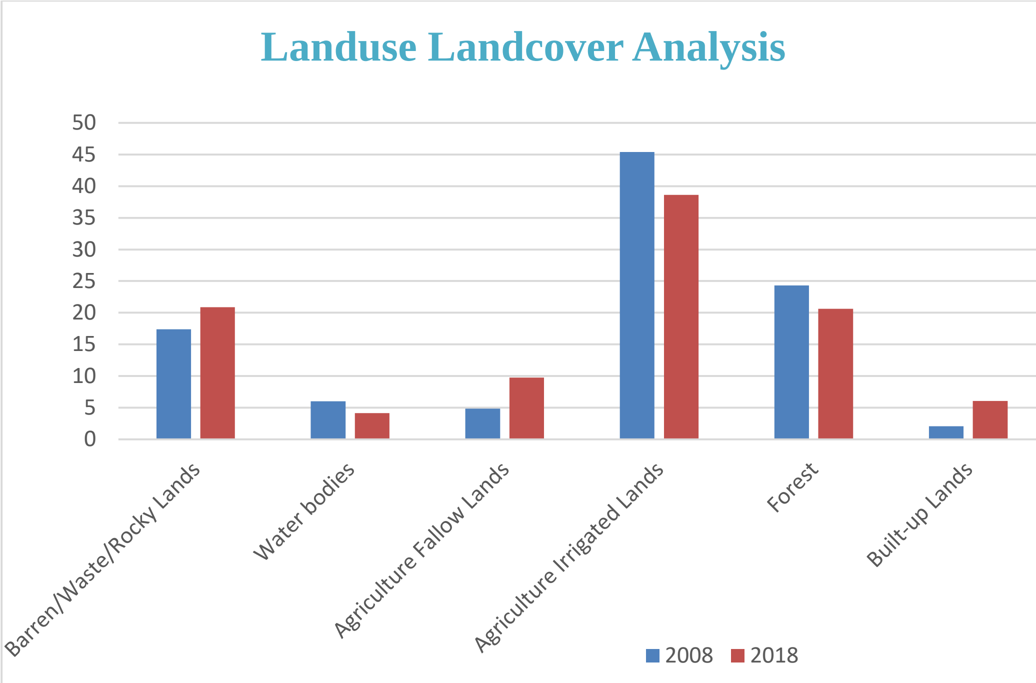

Figure 4 Graphical representation of landuse/landcover changes in percent during 2008–2018

Agriculture Land

This category includes cropland, orchards, and plantations. As a whole, the research area's agricultural land declined from 167.40 square kilometres to 142.30 square kilometres (45.41 percent to 38.60 percent). Agriculture fields under crop are known as crop lands. Crop areas in the research area feature both wet and dry cropping. Food crops such as rice, sugarcane, groundnuts, turmeric, and vegetables are grown under wet conditions..

Forest

Scrub of trees covers a wide area in the forest. To distinguish them, forests have a reddish-to-dark green hue and come in a variety of sizes. They have a smooth surface and an uneven form. Northwestern and northernmost portions of the research region are home to dense forests. In a decade, the overall vegetative area shrank from 89.64 square kilometres to 75.94 square kilometres (24.32 percent to 20.6 percent). The study region consists primarily of thick and scrubby forests. Small trees and shrubs make up the bulk of this group. Satellite pictures show this vegetation/scrub with a green hue and smooth texture. Degradation, erosion, or prickly shrubs all contributed to the formation of these areas. The link between yellow colour, upland affiliation, and irregular shape determines these places. North and east of the research area there is a lot of scrub land.

Built up Land

The overall area of built-up land has increased from 7.52 sq. km to 22.38 sq. km, mainly due to an increase in the amount of land covered by structures (2.04 percent to 6.07 percent). Cities, towns, and villages, as well as commercial and industrial complexes and institutions, all fall under this heading. Eedalaplli, Markapuram, Chintarapalle, Kalavakatta, Ramireddykunta, Vasudevapuram, Akkalreddypalle, Venkatapuram, and Nagalakuntla are only a few of the important cities and villages in the study region. Roads are the primary mode of mobility in the research area. It is possible to go from Porumamilla to Nellore and Vijayawada by highway.

Waterbodies

Natural and man-made ponds, such as rivers, lakes, canals, reservoirs, and reservoirs, are examples of water bodies. On the satellite view, the water's function appears black. It is dark blue in colour in the deep oceans and bodies of water. The square/rectangular shape and blue colour tone of tanks distinguish them from vineyards. The canal may be seen through the foliage. The majority of the tanks are concentrated in the middle of the area, with a few scattered in the east, where there are a few more dry tanks. Water bodies in the region shrank from 22.19 square kilometres to 15.19 square kilometres (from 6.02 percent to 4.12 percent).

Landuse/Landcover Categories	2008		2018	
	Sq.km	%	Sq.km	%
Barren/Waste/Rocky Lands	64.04	17.37	76.86	20.85
Water bodies	22.19	6.02	15.19	4.12
Agriculture Fallow Lands	17.85	4.84	35.98	9.76
Agriculture Irrigated Lands	167.40	45.41	142.30	38.6
Forest	89.64	24.32	75.94	20.6
Built-up Lands	7.52	2.04	22.38	6.07

Table 1 Area and % change in land use/cover categories in the study area during 2008 to 2018 .

Wastelands

Bare land or waste land is a term used to describe area that has no vegetation. This group includes salt-affected land, scrubland, sandy areas, sheet rocks, and stony regions. They are generated by factors like soil qualities, temperature and precipitation as well as the general environment. There has been an increase in the study area of barren/waste land from 64.04 square kilometres (17.37 percent) to 76.86 square kilometres (20.85 percent).

Conclusions

A better understanding of the studied area leads to the conclusion that several temporal satellite photos are critical in evaluating spatial and seasonal features that are otherwise impossible to record using traditional methods According to the findings of the research, agricultural land occupies the majority of the studied area. Since 2008, deforestation has caused a 3.48 percent (12.82 sq.km) rise in the amount of land that is unusable. Due to the conversion in vegetation, bare land and built-up land, agricultural land declined by 6.81 percent (25.1 sq.km) in the studied region. In the research region, the third major category of land was reduced by 1.9 percent (7 sq.km). Built-up land expanded by 4.03 percent (14.86 sq.km) from 2008 to 2018, as a result of conversion into urban and industrial zones. These findings show remote sensing and geographic information systems (GIS) are crucial tools for analysing and quantifying spatiotemporal phenomena that can't be done using conventional mapping techniques. These technologies allow for faster, cheaper, and more accurate change detection.

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