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EVALUATION OF LAND USE AND LAND COVER CHANGE USING REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS: A CASE STUDY IN VIKARABAD DISTRICT, TELANGANA, INDIA

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ABSTRACT:

The study and evaluation of natural resources in any part of the world has recently become increasingly reliant on remote sensing as a direct adjunct to professional fields. It's a common misconception that the three types of anthropogenic land change—land use and land cover—are all the same. Land use is typically influenced by human, socioeconomic, and political factors, while land cover is simply the biophysical surface of the earth. Using a Geographic Information System (GIS) in conjunction with Remote Sensing (RS) is a powerful method for studying shifts in land use and land cover. Land use and land cover property changes in geo-registered multi-temporal remote sensing data can be determined through a process called digital change detection. Recent government policies have sought to strike a balance between the need to encourage rural development and ecological stability, so this study used LISS-4 and cartosat-1 imageries to examine waterbodies, wastelands, Agriculture, Forest lands, and built-up areas in the Vikarabad district. Maximum Likelihood was used to categorise the images in ERDAS 2014, and ArcGIS was used to create the maps. Built-up areas (29.97 sq. km), forests (80.85 sq. km), bodies of water (14.10 sq. km), agricultural land (781.94 sq. km), and wastelands (144.66 sq. km) were the types of land use/land cover found to have undergone the most significant changes during the study period. Conclusions from this study confirm the feasibility of remote sensing and GIS modelling for land use/land cover detection utilising multi-temporal images.

Keywords: Remote sensing, GIS, change detection, LU/LC, classification

INTRODUCTION

Vegetation, bare soil, water, and manmade structures all fall under the umbrella term "land cover," which describes the physical and biological cover over the earth's surface. To alter the physical and biological characteristics of land through human intervention is considered land use [1]. Alterations in land use and land cover are major causes for alarm when thinking about the state of the planet's environment [2].

There are many aspects of both the human and natural environments that are affected by and connected through land cover. It is widely accepted that changes in land cover have far-reaching consequences for fundamental processes like biogeochemical cycling and, by extension, global warming; soil erosion and, by extension, sustainable land use; and biodiversity over the next century or so [3, 4]. In recent years, alterations to land use and land cover (LU/LC) have come to be seen as a key driver of a variety of negative environmental outcomes around the world [4-6].

Urban and regional planning, natural resource conservation and management, and many other socio-economic and environmental applications rely heavily on up-to-date information about land use and land cover. Alterations to LU/LC are a major cause for alarm in the context of the changing global environment [7].

There are a number of factors that are propelling LU/LC forward today [8]. These include the rapid development and expansion of urban centres, rising population, limited land availability, increased production demands, and evolving technological capabilities. LU/LCs adapts to the social, economic, political, cultural, demographic, and environmental conditions and forces associated with dense human populations (Ref. Masek et al., 2000; Sisay et al., 2017). Researchers and policymakers around the world have made LU/LC a top priority [9,10].Davis defines urbanisation as "the transition from a dispersed pattern of human settlements to one characterised by concentration in urban centres" [11]. It appears from history that urbanisation is a process that occurs everywhere. The expanding size and population of cities constantly necessitates more money, better housing, and more efficient government. Even though most people now live in cities, only 28% of the global population did so in 1950. Over half the global population now resides in cities [12]. More than half of the world's population is projected to reside in urban areas by 2008, with that number passing 60 percent by 2030 [13].

Extensive use of remote sensing and geographic information system technique has resulted in reliable and up-to-date data describing the extent of LU/LC over time. It investigates novel techniques for identifying, describing, and tracking forest transformation [14,15]. Deforestation in the Wiretap watershed has been evaluated using change detection analysis based on geographic information system (GIS) and remotely sensed data [16, 17]. The watershed, which is a major tributary of the Lake Tana basin, has recently been covered by urban expansion.

The causes, mechanisms, and outcomes of land use and land cover change have been examined from a variety of vantage points. Urban expansion, especially the development of suburban and exurban areas on formerly agricultural land, has long been seen as an indicator of economic health in each region. It has many advantages, but these are increasingly weighed against its costs and negative effects on the environment, such as pollution, deforestation, and the spread of disease. Geographical information systems (GIS) and remote sensing, two modern technologies, offer a low-cost and precise alternative for studying landscape change [18].

Understanding landscape dynamics requires the ability to detect, identify, map, and monitor changes in land use and land cover patterns over time, and digital change detection techniques based on multi-temporal and multi-spectral remotely sensed data have shown great promise in this regard. Because of recent advancements in satellite image quality and availability, image analysis can now be carried out on a much grander scale than ever before [19].

MATERIALS AND METHODS

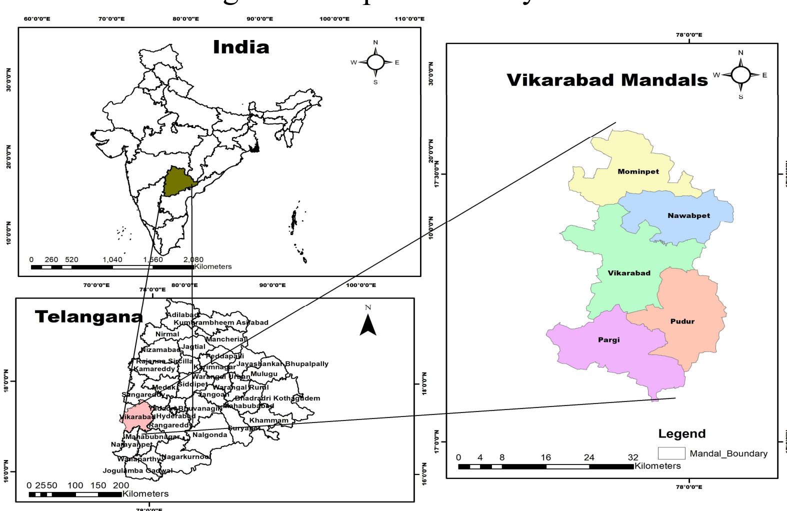
STUDY AREA:

The district of Vikarabad was officially founded on October 11th, 2016. The area is quite sizable, measuring in at a whopping 1,386.00 square kilometres in total (1,307.34 sq. mi). Telangana's

Sangareddy and Rangareddy districts, as well as Karnataka's Mahaboobnagar district, border these areas. According to the 2011 Indian Census, the district is home to 927,140 people. Ananthagiri Hills, a major tourist attraction in Telangana, are located in the Vikarabad district, which is justifiably proud of this fact. Nature lovers flock to the Anantagiri Hills, from which the River Musi flows on its way to the city of Hyderabad. The ancient Anantha Padmanabha Swamy Temple in the Ananthagiri hills is a popular destination for tourists. Sri Anantha Padmanabha Swamy, an incarnation of Vishnu, is the primary deity of Ananthagiri. Along with the Pambanda Ramlingeshwara Temple, other important religious sites in the area include the Bhavigi Bhadreshwara Temple, the Bugga Rameshwaram Temple, the Bhukailas Temple, the Ekambareshawar Temple, the Jhuntupally Rama Temple, and the Kodangal Venkateshwara Swamy Temple.

In addition to their significance as irrigation projects, the Kotipally, Jhuntupally, Laknapur, and Sarpan Pally paddy fields are popular tourist destinations. Tandur, a significant town in the district, serves as its economic hub. Tandur is the primary source for both the blue and yellow limestone used around the globe. In the study area our research is focused on parigi, puddur, vikarabad ,nawabpet,mominpet mandals of vikarabad district, telangana state.

Figure 1: Map of the study area



This inquiry made use of Survey of India toposheets and an official map of the area. Satellite imagery, such as Landsat TM and ETM Plus, can be acquired for the study area via USGS Earth Explorer. Most people who want to keep an eye on Earth's resources use images from the USGS earth explorer satellite. Subsequently, the image must be cropped so that it contains only the study area. Images will be processed in ERDAS Imagine, and the data will be interpreted so that land use and land cover maps can be generated. The next step is for a human to manually categorise the images. After the maps have been generated, they are analysed to spot any changes in urban sprawl or expansion [21].

DATA COLLECTION

From the USGS Earth Explorer website, we pulled some cloud-free Landsat satellite imagery. Image Pre-processing. Before anything is used, it is transformed into UTM coordinates. Since each downloaded image has its own distinct banding pattern, stacking is required to produce a final composite. Each image is processed with histogram equalisation and other picture enhancement techniques to make them all look better. Using Survey of India Toposheets at a scale of 1:50000 and the study area was outlined. A portion of the Landsat image is then overlaid with the resulting base layer. Images created using a false colour composite (FCC) algorithm and data from the Landsat 5 TM satellite in 1989 [22].

CLASSIFICATION OF IMAGES

After the initial processing is complete, the images undergo a number of classification procedures, both unsupervised and supervised. It is possible to perform unsupervised classification in ERDAS Imagine by utilising the ISODATA clustering algorithm according to the number of classes required and the number of pixels available in digital form. For maximum likelihood image classification, the user provides training sites (signature examples) based on his knowledge of the topic. User-supplied training data instructs the programme on the best pixels to select for a given land cover [23]. In order to better understand the spatial distribution of different numbers across an image's pixels, we compared and studied an unsupervised categorised version. At its conclusion, the process will have provided you with a comprehensive picture of the land use and cover in the area under study. The study area included urban, agricultural, water, bare, and vegetated regions, making a total of five different land cover types [24].

LAND USE AND LAND COVER (LU/LC)

There is little space for debate about the extent to which human activity over the past half-century has changed the land cover in and around Vikarabad district, Telangana, India. Islands are regarded as one of the world's most precious commodities. To be successful in farming, raising livestock, or growing trees, productive land is essential. Including soil, water, and plant life, the land can provide all of life's necessities [25]. The use of satellite images has become critical in assessing the long-term consequences of human activities on Earth's natural resource base. When rapid and, at times, unreported and unrecorded shifts in land use occur, observations of Earth from space provide objective knowledge of human activities and utilisation of the landscape. You can learn everything you need to know about the land use and land cover of the study area from the labelled images [26].

RESULTS AND DISCUSSION

All available satellite photos for the research area were processed, and differences in land use and land cover across time were analyzed to identify common themes and variables. Land in the study area was divided into five categories (Figure 6): agricultural, forested, urbanized, unused, and aquatic. The image presented the current state of the four land cover categories under investigation.

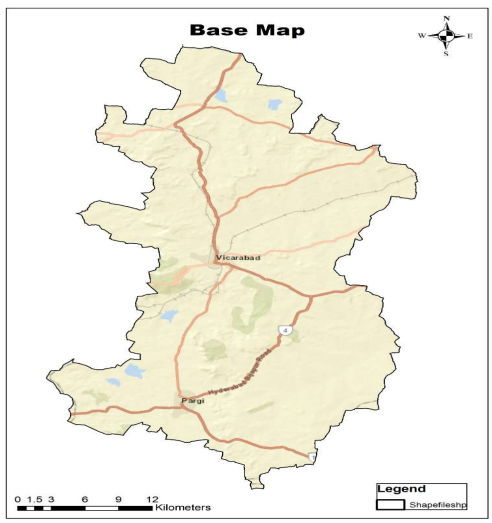
The study period's distribution of land cover types is graphically shown in Figure 6. Both the local and regional administrative boundaries and main thoroughfares were depicted on the maps.

Table 1: Summary Statistics of land use / land cover of the study area.

FID	Shape	Description	Shape Length	Shape Area
0	Polygon ZM	Agricultural Land	0.001726	781.942936
1	Polygon ZM	Built UP	0.009767	29.975576
2	Polygon ZM	Forest	0.009892	80.858123
3	Polygon ZM	Water Bodies	0.300196	14.104411
4	Polygon ZM	Wastelands	0.046377	144.668067
		Total Area (Sq.Km)		1051.549113

BASE MAP

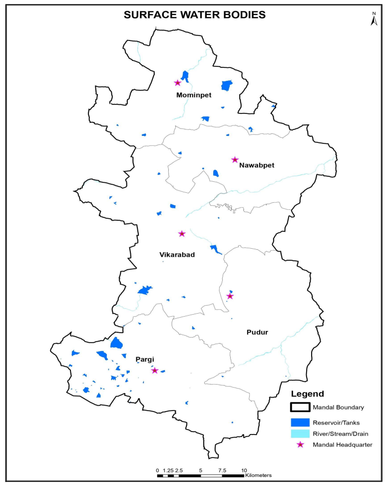
Figure 2: Base map of study area



A plan for organising and imaging primary sources and the conclusions drawn from them. Locations of lease or concession boundaries, wells, seismic survey points, and other cultural data like buildings and roads are typically shown on top of a map's base using a geographical reference like latitude and longitude or the Universal Transverse Mercator (UTM) grid information. As a starting point, geologists use topographic maps to draw detailed maps of the surface geology. Shot point maps are frequently used by geophysicists to illustrate interpretations of seismic data, as they show the directions of seismic lines and the precise locations at which seismic data was gathered. A plane table and alidade allow geologists to make a rough map on the spot.

SURFACE WATER MAP:

Figure 3: Surface area map of study area



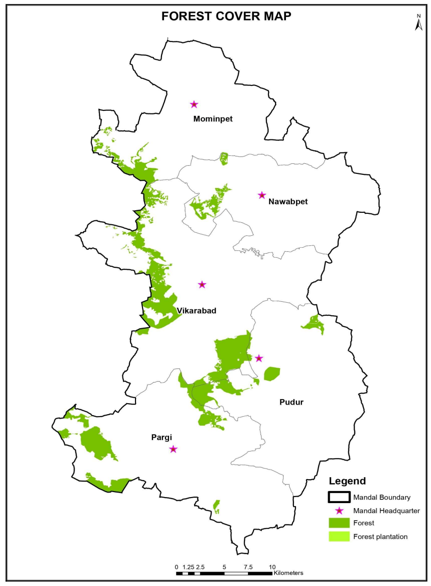
Toposheets are the backbone of watershed mapping. For an additional cost, you can supplement your mapping efforts with watershed satellite imagery to use with these maps. With these images, geologists and planners can get a clearer picture of the local geology and topography, as well as structural features like fracture and fault zones, regional folding in rocks, soil moisture variation, and land use and cropping patterns, which are all important when assessing and planning watersheds.

Images like these are useful for mapping surface water drainage systems, but they don't depict groundwater levels. But general geological mapping of the watershed can be done with the help of toposheets and satellite images, which can lead to a systematic mapping of the water resources in the watershed and an accurate knowledge of the groundwater resources. A map of the study area's surface shows that the shape is 0.30 km along its longest side and 14.10 km2 in area.

FOREST COVER MAP:

The hybrid classification approach used in forest cover mapping makes use of the algorithms' potential by clustering pixels that share similar characteristics and then assigning each cluster unique information class, in this case a unique forest cover density class. Evidence for this comes from the interpreter's prior experience, information from corroborating sources, and results from ground-truthing. Periodic ground data collected by field parties and other ground truth information is used to generate training data and assess the accuracy of the interpreted image data. Maps of forest coverage in the current study area have a shape that is 0.009 square kilometres in length and 80.85 square kilometres in area (Figure 4).

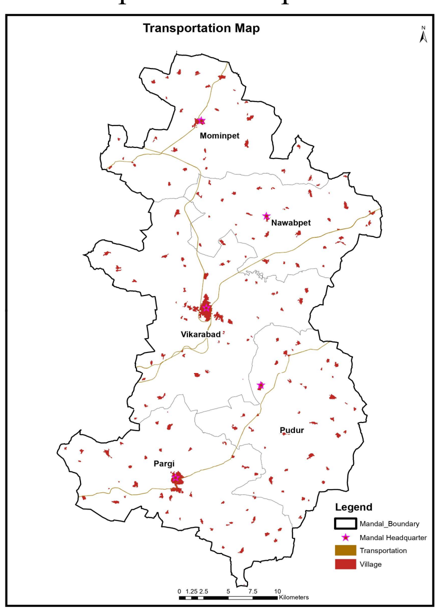
Figure 4: Forest map of the study area



TRANSPORTATION MAP

The routes and stops of a public transportation system are depicted on a transportation map, which is a topological map in the form of a schematic diagram. Coloured lines represent individual services, and numbered icons represent particular halts or stations.

Figure 5: Transportation map of the study area

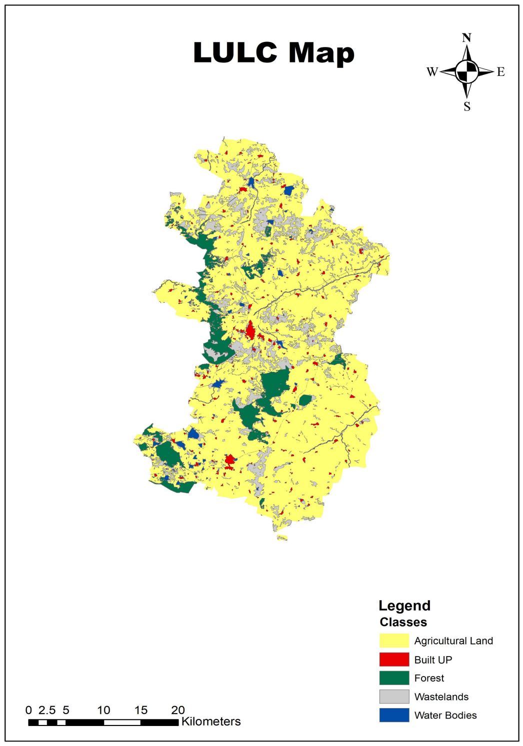


LAND USE/LAND COVER IMAGES

Figure 6 shows the pre-processed and supervised classification-obtained images of the land use and land cover. The land use pattern of the research area can be deduced from these pictures. Cities are depicted in red, farms in yellow, bodies of water in blue, pastures in grey, and forests of shrubs and trees in green leaves.

Overall, 1051.54 square kilometres of this study area were included from the various land use land cover classes. The total acreage used for urban development was about 29.97 square kilometres, while agriculture and forests used a combined 782 square kilometres and 80.85 square kilometres. There were a total of 14.10 square kilometres of water bodies and 144.66 square kilometres of wastelands.

Figure 6: Land use land cover map of the study area



Base areas, agricultural lands, forests, built areas, waste lands, and water bodies were the five categories used in this research. A total of 1051.54 square kilometres were covered, and the study area divided them into five distinct regions. At the same time, the forested area was 80.85 square kilometres, agricultural lands were 782 square kilometres, and wastelands were 144 square kilometres. While the built-up area covered 29.97 square kilometres, water bodies occupied only 14.10 square kilometres.

CONCLUSIONS

The analysis of LU/LC data derived from LISS-4 and cartosat-1 images has provided a reliable picture of the study area as it existed. It clearly delineated the Built-up area, where most people live and work, the agricultural production area, the wastelands, the forest area, and the water bodies area. Current research will aid in forecasting how changes in land use may affect farming in the future. The significance of digital detection in understanding the local ecosystem is emphasised in this paper.

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