Land Use Land Cover (LULC) classification with wasteland demarcation using Remote sensing and GIS Techniques

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Abstract
Land use and land cover changes are derived by natural process and anthropogenic interference in the ecosystem. Appropriate management of natural resources requires quick and up-to-date information for effective decision making. This study aims to generate land use land cover information using Remote sensing and Geographical Information System (GIS) technology to support the land use planning and strategy formulation of the newly emerging problem of the study area. Vizianagaram Mandal of the Vizianagaram district (Andhra Pradesh, India) covering 83°18’0”E to 83°29’0”E longitude and 18°2’0”N to 18°10’0”N latitude of total area 12437 hectares had been taken as a study area. The software Arc GIS and ERDAS used in this study for obtaining better outcomes. Two satellite imageries of Landsat TM, MSS 2000, and Landsat MSS 2010 were downloaded from USGS, and supervised classification carried out for the detection of Land use Land cover (LULC) classification. The ten-land use/land cover classes have been identified from the classification processes. The study focused to identify the wasteland demarcation and analyze the land cover changes between the years 2000 and 2010.

Keywords: Land use Land cover, Remote sensing, Arc GIS, ERDAS, supervised classification, USGS.

1. Introduction
LULC is a very complicated process, affected by natural and human dimensions [2] Due to population growth and their activities, most of the land is converted into urbanization, industrialization and some are turned up as wasteland that causes an impact on the environment. Land use practices generally develop over a long period under different environmental, political, demographic, and socio-economic conditions [10]. Technically, land use and land cover change (LULCC) mean quantitative changes (increase or decrease) in a particular Land Use Land Cover over some time [5]. Moreover, the mix of land use/cover in a place affects its sensitivity to climate change: e.g., dryland farming areas may be more sensitive than irrigated areas [7]. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels [3]. For this reason, there is a need to understand the pattern and trends of LULC changes on the local, regional and global scales [6]. The questions like what changes occur where and when they occur, the rates at which they occur will give a better understanding of LULC change [1]. The timely, accurate and up-to-date information on land use/land cover can be obtained from various satellite data on a cost-effective basis at the shortest possible time [4] The minute changes on the earth’s surface can be estimated fairly accurately [5] with advances in remote sensing science that made
it possible to obtain valuable spatiotemporal information on LULC [6]. Landsat Multispectral Scanner (MSS), Thematic Mapper (TM) data have been broadly employed in studies towards the determination of land cover since 1972[8]. By comparing two sets of images taken of the same area at different times the LULC change analysis can be carried out easily [9] For that, software like Arc GIS, ERDAS, and other software tools can be helpful for the display of spatial data and non-spatial attribute data to perform analysis and retrieval of the data.

2. Study Area
Vizianagaram District is situated within the geographical coordinates of 17-15’ and 19-15’ of the northern latitude and 83-00’ and 83-45’ of the eastern longitude. The district is bounded on the east by Srikakulam district on the west and south by Visakhapatnam district, on the south-east by the Bay of Bengal and North West by Odisha State. Vizianagaram Mandal located at 18.12°N, 83.42°E has been taken as a study area. This study area has a geographical area of 12437 hectares and has 23 revenue villages and 21 panchayats.

![Location of the study area](image.png)

3. Data source
The primary data collected from different sources include satellite imagery, statistical handbooks of Vizianagaram 2000 & 2010, information from local experts and surrounding community members. The secondary data such as a topographic map and some instruments like digital camera, compass and tape used to collect the field data. The software Arc GIS 9.0 and ERDAS 9.2 had been played a vital role in the demarcation of wastelands. Before the fieldwork, the necessary satellite imagery such as Landsat TM, MSS 2000 and TM 2010 was downloaded from USGS (United States Geological Survey). The following table depicts the source of satellite images that were used in this study.

| Sl. No. | Sensor | Path /Row | Spatial Resolution |
|--------|--------|-----------|--------------------|
| 1      | Landsat TM and MSS 2000 | 141/047   | 15 meters          |
| 2      | Landsat TM 2010          | 141/047   | 13 meters          |

![Table 1. The data source of Satellite Images](image.png)
4. Methodology

The following steps had been followed in the methodology

1. INPUTS
   - Toposheets
   - Satellite Imageries (8-band Landsat-7) 2000 & 2010

2. PROCESS
   - Geo-Rectification of Topo sheets
     - Un-Supervised Classification
     - Field visit (for Ground Truth)
     - Supervised Classification
     - Authentication with Statistical Handbook of the District
     - Finalizing the Classes
     - Delineation of Wastelands from both 2000 & 2010
     - Classifying the Wastelands

3. OUTPUT
   - Land use Land cover classes
   - Waste Land demarcation
   - Change Analysis

Initially, unsupervised classification was carried out to get some valuable information about the different land cover classes. After that, a field survey had been carried out and this data used in supervised classification for a better understanding of land covers. A total of 10 land use land cover classes were finalized and change analysis carried out between the years 2000 and 2010.

5. Results and Discussion

The results obtained from the land use land cover classification which is shown below (Figure 2 to 8). From the independent image classification results of the two-satellite imagery (Landsat TM, MSS2000 & TM 2010), ten different land use and land cover (LULC) classes had been identified. The classification results are shown in Table 2. In the 2000 image classification results, the built-up land covered 4.66% of the total study area. The cultivated land is 59.48% and the uncultivated land 16.46% covered in the total area. Forest area covered by 3.34% and scrubs occupied by 0.8%.

![Figure 2. Landsat imagery of Vizianagaram Mandal (2000)](image1)

![Figure 3. Landsat imagery of Vizianagaram Mandal (2010)](image2)
The image classification of 2010 showed that the cultivable land covered 29.46% in the total study area. The built-up land and the forest area covered 5.26% and 3.36% and the occupancy of scrubs and water bodies had been almost the same. At the same time, the wasteland is nearly the same in the years 2000 and 2010. It has been identified that, in change analysis, 0.94% (nearly 1%) of land was converted into wastelands. In change analysis, it was observed that built-up land and uncultivated land increased by 13% and 85% respectively.

**Figure 4.** LULC map of Vizianagaram Mandal (2000)  
**Figure 5.** LULC map of Vizianagaram Mandal (2010)

**Figure 6.** Change analysis of water body

Majorly the authors identified that the cultivated land is decreased by 30% in through 2010 classification. Due to inadequate rainfall on time, most of the farmers left their cultivation and some were migrated to other cities. If it continues most of the land will turn up into wasteland in the future.
Figure 7. Wasteland demarcation using Google earth

Figure 8. Field photos (sample) of wastelands in the study area

Table 2 Land use classification of the study area in 2000 and 2010

| Sl. No. | Land use category         | In 2000   | % of Total Area | In 2010   | % of Total Area |
|---------|---------------------------|-----------|-----------------|-----------|-----------------|
|        |                           | Area (Hectare) |                | Area (Hectare) |                |
| 1       | Built-up Lands            | 580.22    | 4.66            | 654.28    | 5.26            |
| 2       | Cultivated Lands scrub    | 7,397.55  | 59.48           | 3,664.44  | 29.46           |
| 3       | Fallow Lands              | 501.48    | 4.03            | 2,626.90  | 21.12           |
| 4       | Forests                   | 416.00    | 3.34            | 418.00    | 3.36            |
| 5       | Plantation                | 1,200.55  | 9.60            | 1,225.00  | 9.84            |
| 6       | Scrubs                    | 100.55    | 0.80            | 140.74    | 1.13            |
| 7       | Un-Cultivated Land        | 2,047.54  | 16.46           | 3,781.68  | 30.40           |
| 8       | Vegetation                | 642.00    | 5.16            | 652.25    | 5.24            |
| 9       | Wasteland                 | 264.02    | 2.12            | 267.09    | 2.14            |
| 10      | Water bodies              | 153.22    | 1.23            | 167.99    | 1.35            |
6. Conclusions
The following conclusions are made in this study.
1) When compared to statistical reports of Vizianagaram Mandal of 2000 and 2010 the LULC classification had been done 80% with the help of Remote sensing and Arc GIS techniques in the present study.
2) The results obtained 98% in the demarcation of forest area and 85% in the wastelands had been successfully identified in this study.

6.1 Scope for further study
Using the latest surveying equipment and skilled teamwork, the Land use Land cover classification results will be achieved by 100%. Hence a detailed study with sophisticated equipment is suggested along with RS and GIS techniques.

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