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International
Journal
Of Modern Engineering Research (IJMER)

Land Use/Land Cover Mapping Of Allahabad City by Using Remote Sensing & GIS

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Abstract: *The present study was carried out to produce and evaluate the land use/land cover maps by on screen visual interpretation. The studies of land cover of Allahabad city (study area) consist of 87517.47 ha out of which 5500.35 ha is build up land (Urban / Rural) Area. In this respect, the Build up land (Urban / Rural) area scorers 6.28% of the total area. It has also been found that about 17155.001ha (19.60 %) of area is covered by current fallow land. The double/triple crop land of 30178.44ha (34.84%). The area covered by gullied / ravines is 1539.20 ha (1.75 %) and that of the kharif crop land is 2828.00 ha (3.23 %). The area covered by other wasteland is 2551.05ha (2.91%). Table 4.1 shows the area distribution of the various land use and land cover of Allahabad city.*

Keywords: *Land use, Land caver, Remote Sensing, Geographic Information System.*

I. INTRODUCTION

1. General Background

Landuse and landcover exerts considerable influence on the various hydrologic phenomenons such as interception, infiltration, evaporation and surface flow. Various aspects of hydrological problems (**Vemu Sreenivasulu et al. 2010**). Land use and land cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to be able to simulate changes (**Tiwari Kuldeep, et al. 2011**). Land-use and land-cover change has become a central component in current strategies in managing natural resources and monitoring environmental changes. Urban expansion has increased the exploitation of natural resources and has changed land use and land cover patterns. Rapid urbanization, therefore, brings opportunities for new urban developments, however, it also has brought serious losses of arable land, forest land and water bodies. Land cover change is a major concern of global environment change (**Bhagawat Rimal, 2011**). Changes in Land use Land cover is a dynamic process taking place on the surface and it become a central component in current strategies in managing natural resources and monitoring environmental changes (**Phukan P. et al. 2013**). Change detection is the measure of the distinct data framework and thematic change information that can guide to more tangible insights into underlying process involving land cover and land use changes than the information obtained from continuous change (**Ashutosh Singh, et al. 2013**). In the last three decades, the technologies and methods of remote sensing have evolved dramatically to include a suite of sensors operating at a wide range of imaging scales with potential interest and importance to planners and land managers. Coupled with the ready availability of historical remote sensing data, the reduction in data cost and increased resolution from satellite platforms, remote sensing technology appears poised to make an even greater impact on planning agencies and land management initiatives involved in monitoring land-cover and land-use change at a variety of spatial scales. Current remote sensing technology offers collection and analysis of data from ground-based, atmospheric, and Earth-orbiting platforms, with linkages to GPS data, GIS data layers and functions, and emerging modeling capabilities (**Franklin, 2001**). This has made remote sensing a valuable source of land-cover and land-use information. As the demand for increased amounts and quality of information rises, and technology continues to improve, remote sensing will become increasingly critical in the future. Therefore, the focus of this chapter is on the issues and challenges associated with monitoring land-cover and land-use change. Urban growth leads to the change of land use and land cover many areas around the world; especially in developing countries.Spatial distribution of land use land cover and its changes is desirable for any planning management and monitoring programmers at local and national levels. Land use and land cover change has become a central component in current strategies for managing natural resource and monitoring environmental change. The rapid development of the concept studies of vegetation mapping has lead to increase studies of land use and land cover change worldwide. Remote sensing information, in concert with available enabling technologies such as GPS and GIS, can form the information base upon which sound planning decisions can be made, while remaining cost-effective (**Franklin et al., 2000**). Clearly, however, the fast-paced developmental nature of remote sensing technology often overlooks the needs of end-users as it 'continues to outpace the accumulation of experience and understanding' (**Franklin, 2001**). In the near future, the field of remote sensing will change dramatically with the projected increase in number of satellites of all types (Glackin, 1998). This will further compound the problems described above. In order to help create a better understanding of the rapid advancements in remote sensing technology that has occurred over the last three decades, we review the current state of remote sensing technology (i.e. sensors, data, analysis methods and applications) for monitoring land cover and land use. Specifically, we provide a brief history of the advances in remote sensing technology, and a review of the major technical considerations of land-cover and land-use monitoring using remote Sensing data.

II. Materials and Method

2.1 Study Area Characteristics

Geographical Location: Allahabad is located at 25^0 27' N, 81^0 50' E; 25.45^0 N, 81.84^0 E in the southern part of the Uttar Pradesh at an elevation of 98 meters (322 f).The Indian longitude that is associated with Jabalpur also passes through Allahabad, which is 343 km (213 mi) north to Jabalpur on the same longitude. To its southwest, east and south west is the Bundelkhand region, to its north and north east is the Awadh region and to its west is lower Doab of which it is a part. It is the last point of the Yamuna River and is the last frontier of the Indian west.

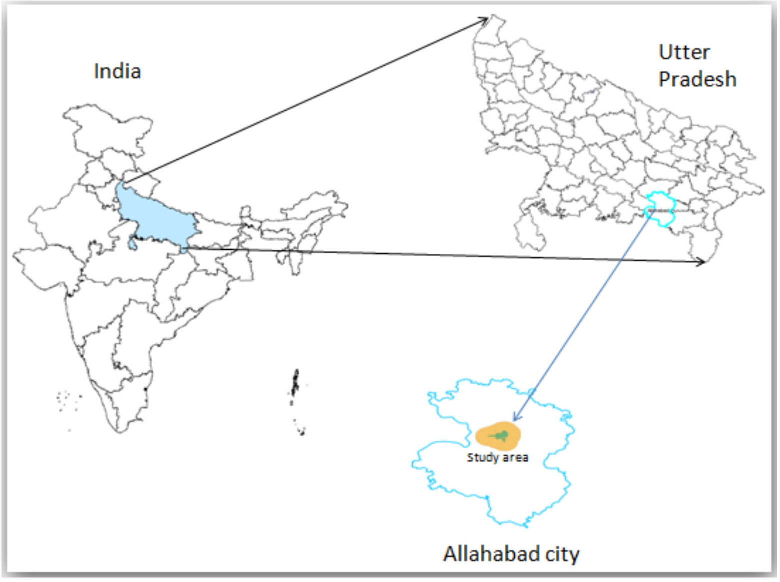

Fig: 1 Location map of the study area

2.2 Data Used

2.2.1 Remote Sensing Data

Landsat ETM^+ sensor data were used for this study. Since the study area was covered in many paths of Landsat satellite data acquisition (each path is covered separately in a different day as per orbital calendar), cloud free data was acquired in different time windows depending upon the overpass of satellite. Each scene was ortho corrected; geo-referenced and suitable Image enhancements are applied to facilitate the delineation and and interpretation of different thematic information. interpretation of different thematic information. Characteristics of Land sat data is shown in Table 1.

Table.1 satellite remote sensing data specification

Remote sensing Data	Land sat Satellite Data
Sensor	Enhanced Thematic Mapper Plus (ETM^{+})
Temporal Resolution	16 Days
Spatial Resolution	30 m X 30 m
Spectral Range	0.45 - 12.5 µm
Image Size	183 km X 170 km
Sensor type	Opto-mechanical
No. of Bands	8
Swath	183 km
Path	142, 143, 144
Row	42, 43, 44

2.2.2 Ground Truth Data Collection

Ground truthing refers to the acquisition of knowledge about the study areas from fieldwork, analysis of the data set and personal knowledge. Ground truth data are considered to be the most accurate (true). Data was collected at the same time as the remotely sensed data, so that the data correspond as much as possible to ground realities. Reconnaissance survey was made in the study area to recognize and relate land cover types to their tonal variation on the satellite images. Field work was carried out in the study area during January 2011 to December 2011. Ground truth data were collected by using hand-held 12- channel GPS and surveying the site. Various observations were noted on different land cover and its physiognomy and strata. Intensive ground truth was collected to develop interpretation criteria for stratification into different land cover classes, waterlogged area and salt affected area was located on the false color composite (FCC). Information was acquired from the local departmental officials, and the local people through interaction/formal interviews, regarding previous/past status of salt affected/waterlogged, forest and its distribution, land use/cover dynamics.

2.3 Software used

ERDAS imagine 9.2 Software was used in various steps of satellite image processing.
Arc GIS 9.3 Software was used in GIS database for analysis, database creation and map composition.

2.4 Methodology

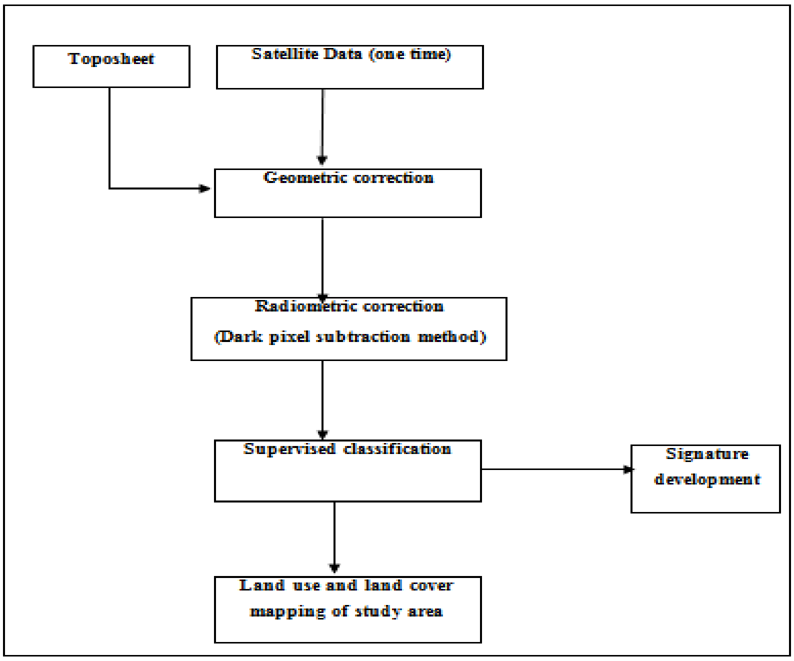

Figure 2: Methodology of research

III. Result and Discussion

4.1 Land use/Land cover mapping

Landsat data with limited field checks was used to derive the Land use/Land cover. The data from landsat is first of all geo-referenced for the enhancement of better visual display. Then the image is visually interpreted in Arc GIS 9.3 for identification of objects and classification, visually from the hard copy photographic prints using digital image the classification of various features is done on the basis of fundamental image characteristics depend on spectral spatial temporal and radiometric resolutions of sensor like tone, texture, association shape, size, pattern, shadow, location. Topology is prepared and cleaning is done. Finally the attributes are given to define the classes and thus LULC map is prepared.

3.2 Land use Land cover mapping

The satellite data was transformed into thematic land use land cover map using on screen visual interpretation. The satellite data of 2011 was classified into various classes. The land Use land Cover map of the study area is shown in figure 4. Statistics of study area has been calculated and shown in table 2.

3.3 Land use land covers statistics

The modern techniques of satellite image processing have been applied to extract the different information about land use land cover of Allahabad city. The land use /land cover categories such as Buitt up land (Urban / Rural), Current follow, Double / Triple crop land, Gullied / Ravince, Kharif crop land, Other wasteland, Plaution / Orchands Rabi crop land, Scru bland Water bodies and Zaid cropland.

Allahabad city (study area) consist of 87517.47 ha out of which 5500.35 ha is build up land (Urban / Rural) Area. In this respect, the Build up land (Urban / Rural) area scorers 6.28% of the total area. It has also been found that about 17155.001ha (19.60 %) of area is covered by current fallow land. The double/triple crop land of 30178.44ha (34.84%). The area covered by gullied / ravines is 1539.20 ha (1.75 %) and that of the kharif crop land is 2828.00 ha (3.23 %). The area covered by other wasteland is 2551.05ha (2.91%). Table 2 shows the area distribution of the various land use and land cover of Allahabad city.

Different interpretation key like X, Y coordinate, shape, size, tone, site the texture, association, were used to identify land use / land cover map.

Table 2. Area Statistics of Land use / Land Cover Map

Class	**Area(ha)**	**Area (%)**
Build up land (Urban / Rural)	5500.35	6.28
Current fellow land	17155.00	19.60
Double / Triple crop land	30178.44	43.84
Gullied / Ravines	1539.20	1.75
Kharif crop land	2828.00	3.23
Plantation / Orchards	152.39	0.17
Rabi crop land	11270.98	12.87
Scrubland	4310.24	4.92
Water bodies	8468.65	9.67
Zaid cropland	3563.17	4.07
Other wasteland	2551.05	2.91
Total	**87517.47**	**100**

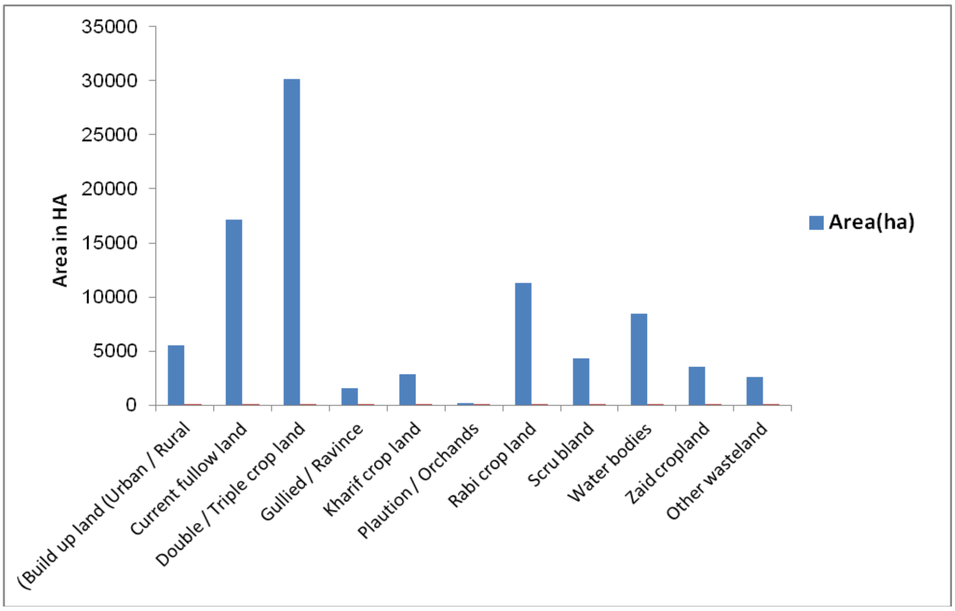

Fig. 3. Area Statistics of Land use / Land Cover

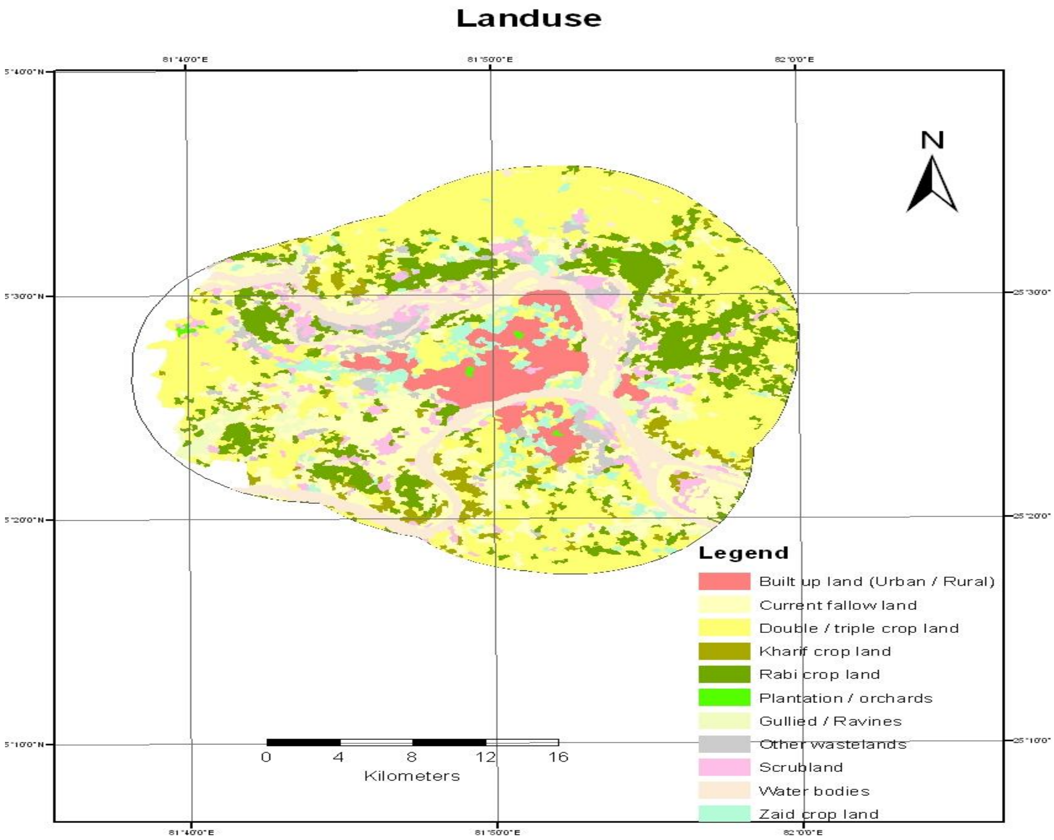

Fig: 4 land use and land cover map of Study area

Humans can define Land use as the use of land, usually with emphasis on the functional role of land in economic activities. Land use forms an abstraction, not always directly observable even by the closest inspection. We cannot see the actual use of a parcel of land but only the physical artifacts of that use.

In contrast, land cover, in its narrowest sense, often designates only the vegetation, either natural or man-made, on the earth's surface. In a much broader sense, land cover designates the visible evidence of land use to include both vegetative and non-vegetative features. In this meaning, dense forest, plowed land, urban structures, and paved parking lots all constitute land cover. Whereas land use is abstract, land cover is concrete and therefore is subject to direct observation.

IV. Conclusion

For this study remotely sensed data have been used for Land use/ Land cover mapping. The following conclusion has been drawn from the result of study:

1. Study area consist of 87517.47 ha out of which 5500.35 ha is build up land (Urban / Rural) Area. In this respect, the Build up land (Urban / Rural) area scorers 6.28% of the total area. It has also been found that about 17155.001ha (19.60 %) of area is covered by current fallow land. The double/triple crop land of 30178.44ha (34.84%). The area covered by gullied / ravines is 1539.20 ha (1.75 %) and that of the kharif crop land is 2828.00 ha (3.23 %). The area covered by other wasteland is 2551.05ha (2.91%).
2. Geo spatial techniques of Remote Sensing and GIS are useful in classifying the Land use/Land cover of any specific area.
3. Remotely sensed data have been found to be effective, less time consuming, and accurate tool for Land use / Land cover mapping.
4. Remotely sensed data of satellite image recognizes Land use/ Land cover spatially that open way for management using other data towards sustainable agricultural development.

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