Urban Sprawl Mapping through Geo-Informatics and Impact on Land use and Landcover of Kakinada Municipal Corporation in Andhra Pradesh, India.

B Sandeep Kumar, R Sivakumar

Abstract: *Urban infrastructure and urban sprawl required the idea of preparing a proper management plan to avoid the unwanted environmental and economic impacts that come with it. The main objective of the research is to map the urban sprawl using Geospatial technology and t its impact on land use and land cover. The increase in the rate of population over the last two decades is equally responsible for the urban expansion and subsequent infrastructure development. The results of the integrated geospatial study shows that the urban expansion of Kakinada Municipal Corporation was largely caused by the increase in built-up area from 29.67% in 1995, 44.86% in 2011 to 51.34% in 2017 to 62.84% in 2019 out of Kakinada's township area of 189552.6 ha mainly due to natural increase of the population and rural ward migration. Vegetation area was 50.68% in 1995 and has declined to 37.82% in 2011. However, the percentage of vegetation experienced a hike and covered 40.23% in 2017 and then went downhill with a land cover percentage of 34.04% of the total township by the year 2019. Over the last two decades the water-body and the dry land were largely converted into built-up areas. The decline of 49151 ha of water-body due mainly because of the urban expansion and the dry-land lost nearly 27200.79 ha of its land cover to the built-up areas. Therefore, controlling and monitoring of urban expansion using GIS and remote sensing technologies are vital solutions to assess the impact of urban expansion of land use and land cover.*

Keywords: Change detection, Land-use/Land-cover, Geospatial analysis, Urban Sprawl.

I. INTRODUCTION

Land-use and land-cover change (LULCC) is a general term for the human modification of Earth's terrestrial surface. The Earth's terrestrial surface modification is monitored on the basis of the LULC (land use and land cover) change. There is a tremendous increase urban population and conversion rural to semi urban and semi urban to urban. Due to this expansion or sprawl of urban leads to the changes in the existing land pattern. This also further reducing the natural resources, changes of many vegetation land and settlement. The urban settlements are growing vertical as well as horizontal. It is very important to understand to rate of change, pattern of change, identification of past land use patter and trend of the change. There is an urgent need to identify and analyze the land use pattern intensified in the past few decades due to the drastic change in land use and landcover for urban expansion. Hence the aim of this present work was to study and checking urban sprawl redundantly utilizing multidate high, moderate & low-resolution images so that eventually, a procedure is developed where obligation of any harms that occur after some period can be improved on the present field staff in that period. The objectives are in this work is

1. To classify the land use and landcover of Kakinada Municipal corporation of Andhra Pradesh,
2. To map the main LULC classes change trajectories
3. During the study period, in Al Ain city, using remote sensing and GIS techniques.

II. METHODOLOGY

A. Study Area

The investigation region is situated in East Godavari district of Andhra Pradesh. The zone shrouded from this examination is around 189 km² lying in the middle of 16°52'30''N - 17°6'0''N latitude and 82°4'30''E - 82°24'0''E longitude (Fig.1) The jurisdiction of the corporation is spread over an area of 30.51 km^2 and the population as per the 2011 Census of India was 312,538. It started to expand from 1920, when it was only 20.31 km^2 (7.84 sq. mi) and the population was just over 50,000. The urban agglomeration area of Kakinada is spread over an area of 57.36 km^2 (reference)
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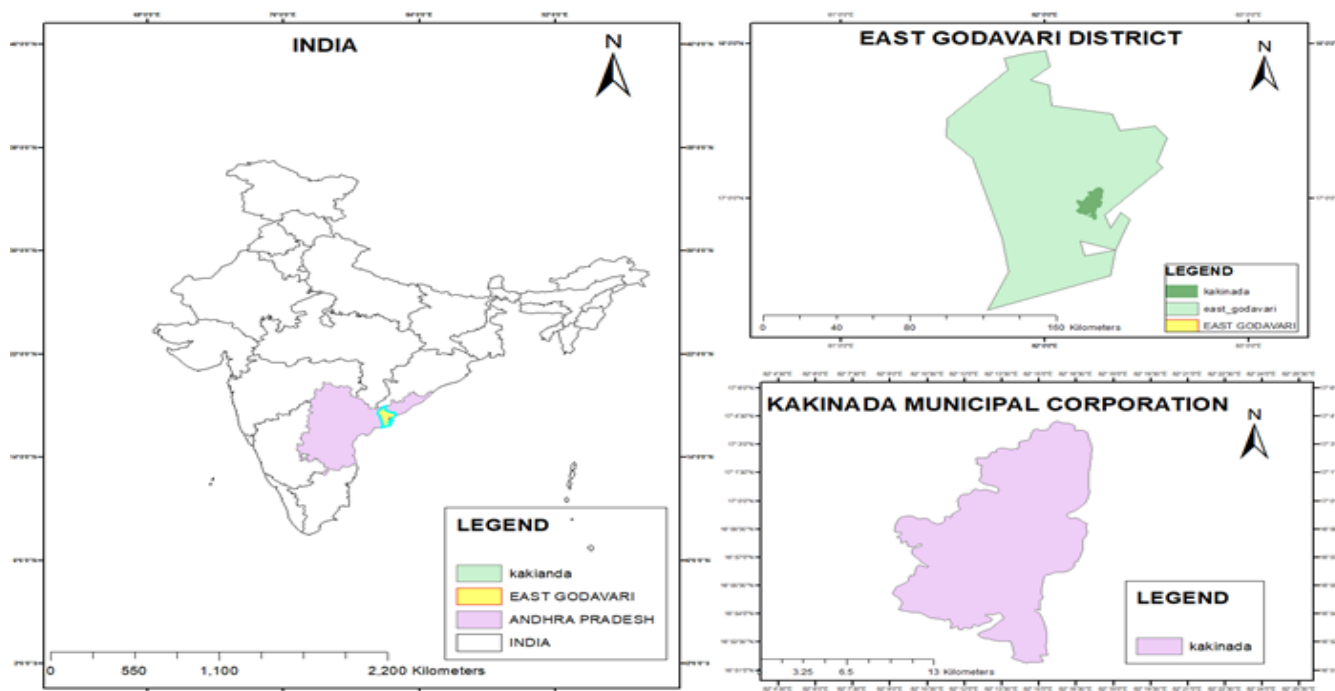*& Sciences Publication*

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Fig 1: Study Area

B. Climate

The Kakinada lies over sea flat on 7m. The summers Possess a understanding of precipitation, as the winters possess nothing. Depending on Geiger and Koppen, this setting is assigned. The temperatures in Kakinada is 27.8 °C 82.1 °F. Approximately 11 09 M-M 43.7 inches of all precipitation drops annually.

C. Transportation Network

The road network map is prepared 1:50,000 scale toposheets from Survey of India (SOI) and updated using satellite imagery Transportation network of the study area contains mainly Railway with 43.16km and Major Roads covered with 48.04km and National Highway with 47.22km. The legend indicates with colors are red was National Highway and blue was Major Roads and black was railway lane

D. method

The methodology involves the analysis of multidate satellite images through Digital image processing and Visual interpretation to prepare various thematic maps like Land use and Land cover, Transportation network etc.,
A set of Landsat satellite images spanning the years 1995, 2011, 2017 and 2019 was downloaded for Multiyear comparison of land used land cover. This is used as a primary data source for the extraction of the main land-use and land-cover classes. All images are reduced to a common Universal Transverse Mercator (UTM) coordinate system, zone 44 and the WGS84 datum.

E. Classification

Supervised classification is used in this paper which led to the following four classed representing most land cover types of the study area:

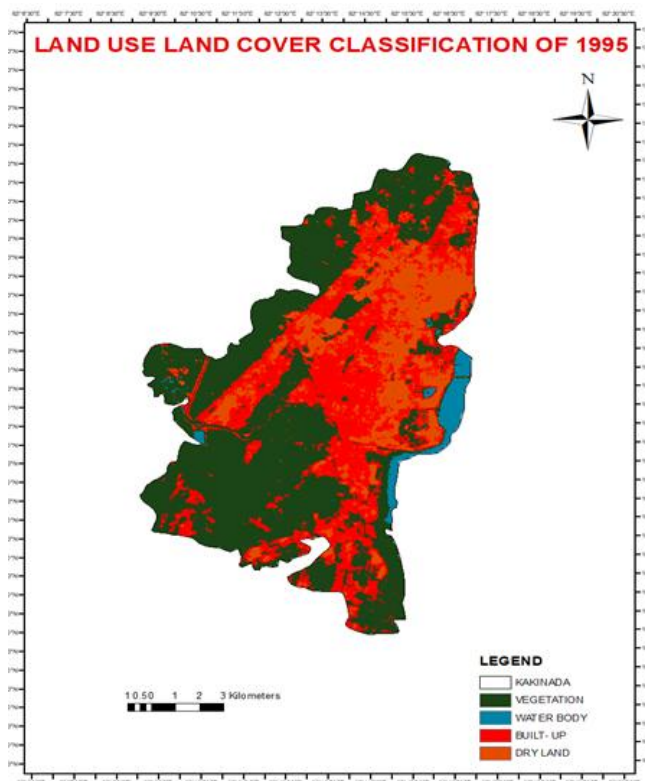- Built-up areas
- Vegetation
- Dryland
- Waterbodies.

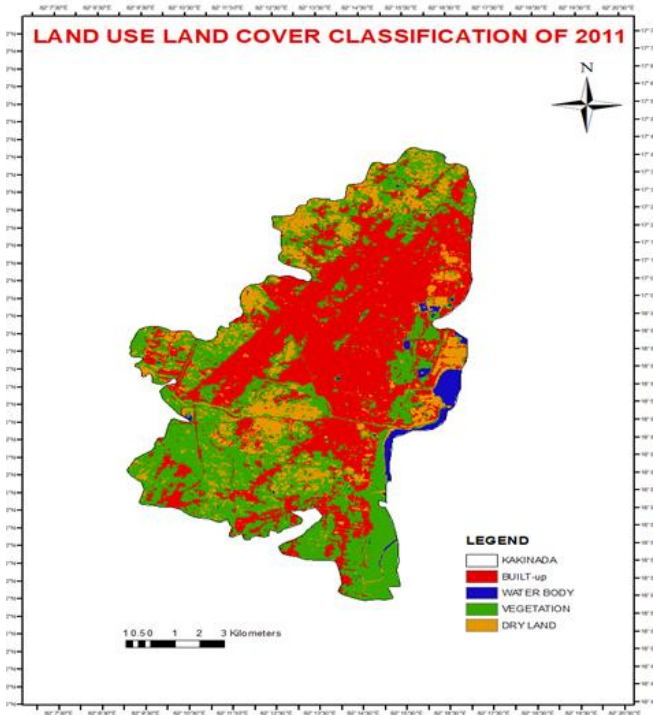**Fig 2: Land-use and land cover of year 1995**

Fig 3: Land-use and land cover of year 2011

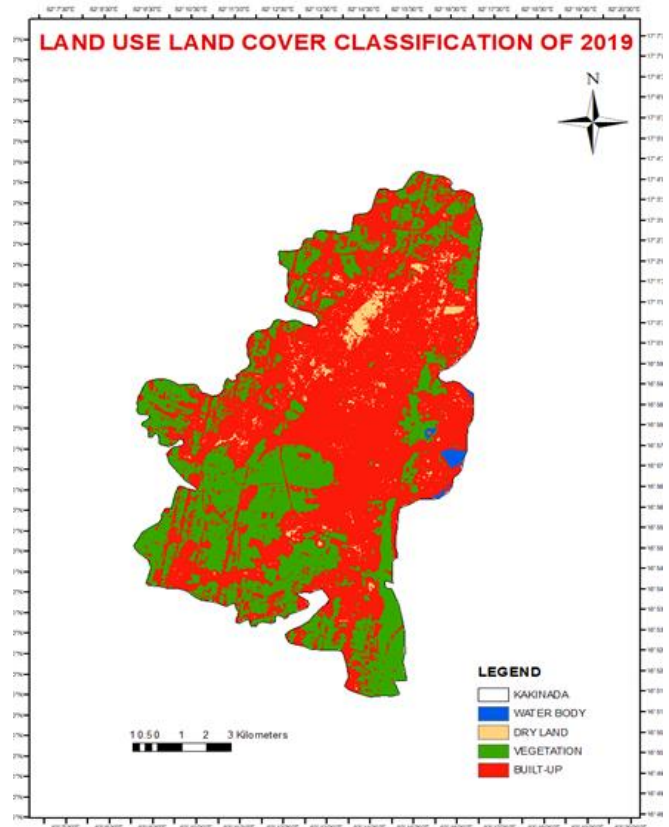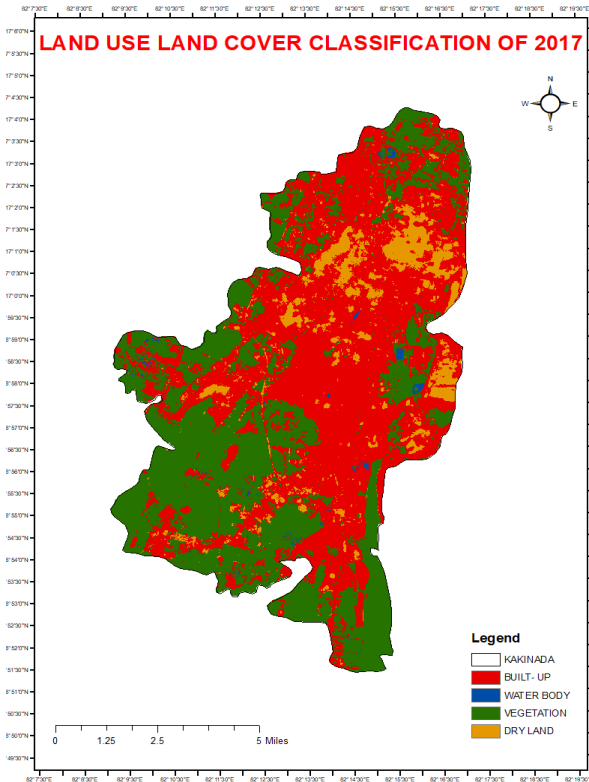**Fig 4: Land-use and land cover of year 2017**

Fig 5: Land-use and land cover of year 2019

III.   RESULTS AND DISCUSSION

A.   Distribution Of Area
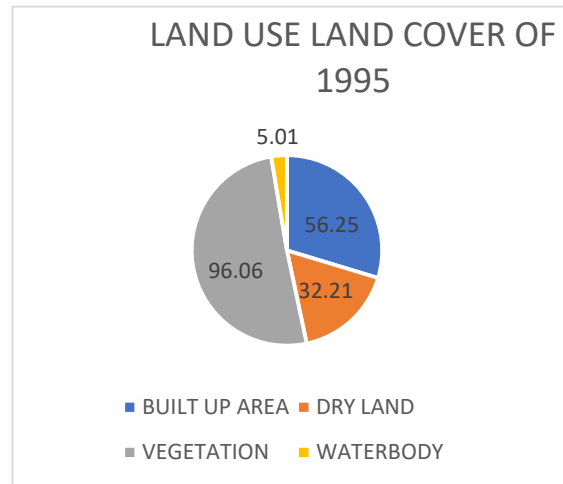

Fig 6: Distribution of area in 1995

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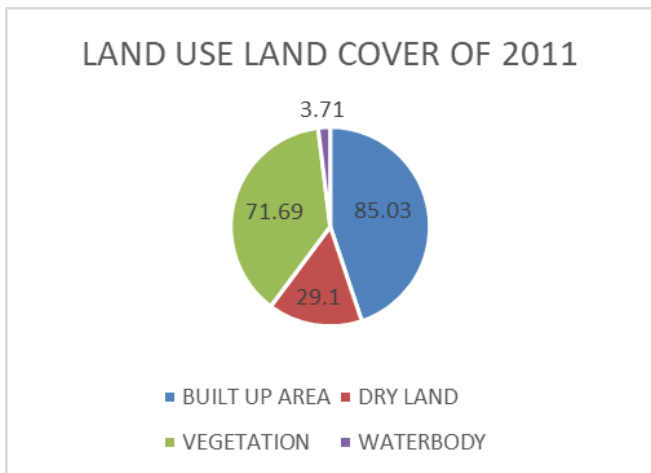*& Sciences Publication*

Fig 7 : Distribution of area in 2011
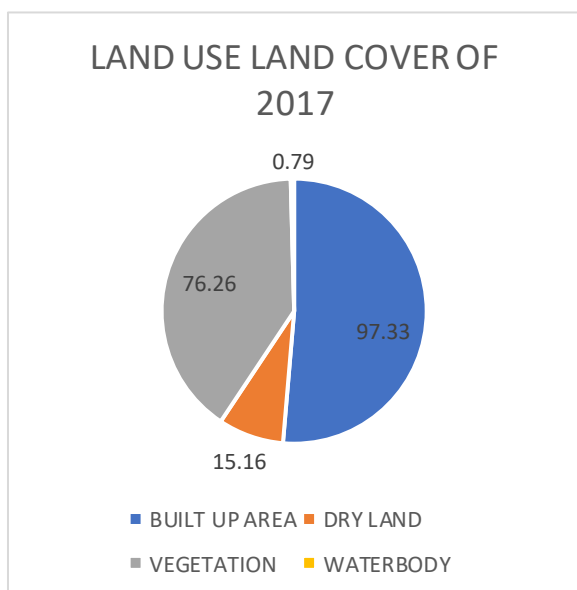

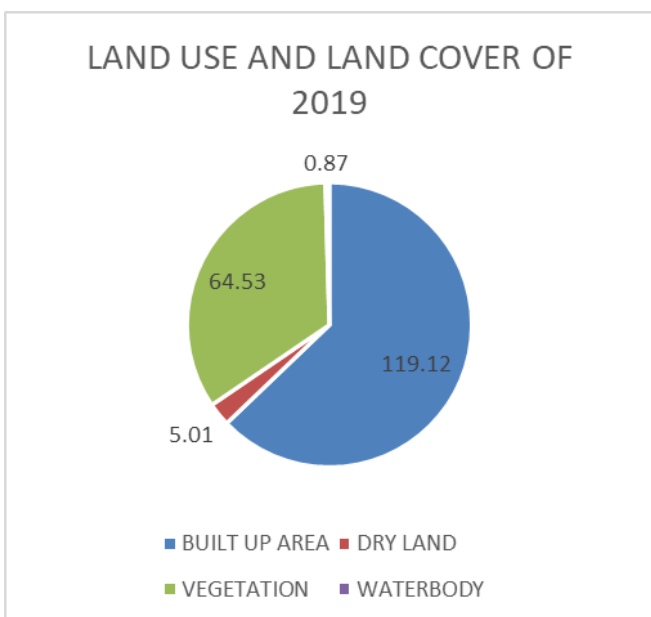**Fig 8: Distribution of area in 2017**

Fig 9: Distribution of area in 2019

B.   Land use and Land cover Classification

Land use and land cover data are significant in understanding the surface coverage on the either by natural or manmade. The land spread identifies with the highlights of the earth surface and land use identifies with the human exercises related with a particular zone of land. Change in land spread is customarily estimated utilizing GIS procedures joined with significant ground truthing and measurable examination. There are different remote detecting change discovery techniques that can be utilized to measure changes in land spread. Usually, this includes taking away the phantom reflectance esteems saw in the various groups of pictures caught at various dates that contain coordinating otherworldly and spatial goals. Change in land use, anyway is substantially harder to measure.
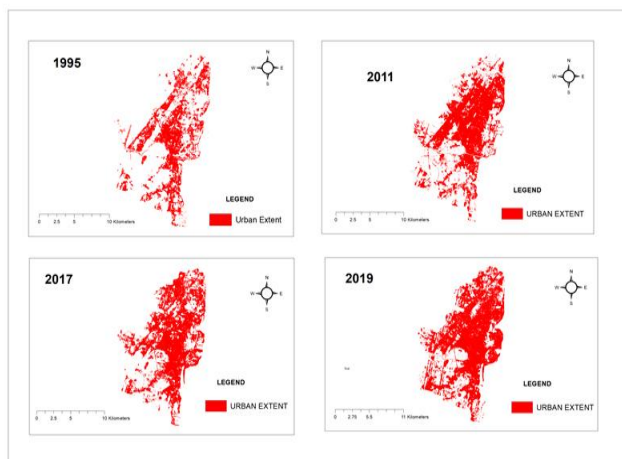

Fig 10: Urban Sprawl for 1995, 2011,2017 and 2019

C.   Urban Sprawl mapping

Urban areas were extracted from land use and landcover classes of Kakinada municipal corporation using remote sensing and GIS methods (Fig. 1.6) for the period from 1995 to 2019. Urban settlement areas were   identified and demarcated the zones of urban based on image processing and interpretation and field knowledge (Table 1.1).

Table 1.1 Urban Expansion for the period between 1995 - 2019

Area in sq.km	1995	2011	2017	2019
Urban area	56.25	85.03	97.33	119.12

D.   Change Detection and analysis

After the classification of various land use and land cover types using the satellite images and image processing techniques, a comparative analysis was carried out. The compare son was done individually on the basis of the prepared classified land-use and land-cover maps of 1995, 2011, 2017 and 2019. the output of the comparison helps to identify the change in the exiting land use and landcover classes and gives detailed information about the nature of change that occurred during the period between 1995 and 2019.

Further the classified image analysis was used to prepare the change detection or the conversion of the existing LULC to Urban. Hence to get this, Geospatial overlay analysis and spatial metrics are used to identify the changes in the existing urban database. The integrated database on the above all periods were analyses to make the trend of urban expansion. The following Table 1.2 is showing the changes in Built up area, Vegetation, Water body and Dry land for various years mainly 1995, 2011, 2017 and 2019.

The results of the integrated geospatial study show that the urban expansion of Kakinada Municipal Corporation was largely caused by the increase in built-up area from 29.67% in 1995, 44.86% in 2011 increasing to 51.34% in 2017. Further it is expanded to 62.84% in 2019 out of Kakinada's township area of 189552.6 ha mainly due to natural increase of the population and rural ward migration (Table 1.3).

Table 1.2 Changes in land use and Land cover and urban expansion (in Sq.km)

TYPE	1995	2011	2017	2019
Built-up area	56.25	85.03	97.33	119.12
Vegetation	96.06	71.69	76.26	64.53
Waterbody	5.01	3.71	0.79	0.87
Dry land	32.21	29.10	15.16	5.01

Vegetation area was 50.68% in 1995 and has declined to 37.82% in 2011. However, the percentage of vegetation experienced a hike and covered 40.23% in 2017 and then went downhill with a land cover percentage of 34.04% of the total township by the year 2019. Over the last two decades the water-body and the dry land were largely converted into built-up areas. The decline of 49151 ha of water-body due mainly because of the urban expansion and the dry-land lost nearly 27200.79 ha of its land cover to the built-up areas.

Table 1.3 Changes in land use & Land cover and urban expansion (in %)

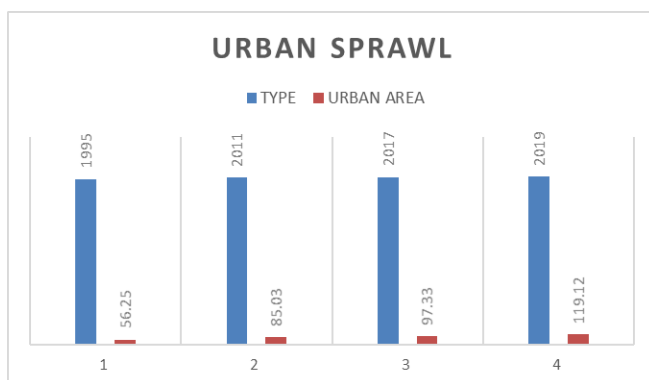| TYPE	1995	2011	2017	2019
Built-up area	29.67	44.86	51.34	62.84
Vegetation	50.68	37.82	40.23	34.04
Waterbody	2.64	1.95	0.41	0.45
Dry land	16.99	15.35	7.99	2.64

Fig 11: Urban sprawl for the periods between 1995- 2019

IV. CONCLUSIONS

The urbanization and Industrialization are showing a very fast-growing trend for the past few decades. There is an enormous increase of urban population and conversion rural to semi urban and further semi urban to urban. Due to this urban sprawl will lead to the changes in the existing land use and landcover pattern. The natural resources are further declining and also conversion of many agricultural lands to urban settlement. Thus, an exploration study was done on the land use and landcover mapping for in Kakinada Municipal Corporation in East Godavari locale of Andhra Pradesh. The period of observation was planned for about 22 years according to the availability of cloud free satellite data and other relevant data base. There is a huge change in the existing land use and landcover is observed for the time frame between the period 1995 to 2017, The urban settlement territory is expanding constantly according to grouped transient images.

The results of the integrated geospatial study show that the urban expansion of Kakinada Municipal Corporation was largely caused by the increase in built-up area from 29.67% in 1995, 44.86% in 2011 increasing to 51.34% in 2017.

Further it is expanded to 62.84% in 2019 out of Kakinada's township area of 189552.6 ha mainly due to natural increase of the population and rural ward migration. Vegetation area was 50.68% in 1995 and has declined to 37.82% in 2011

The percentage of vegetation experienced a hike and covered 40.23% in 2017 and then went downhill with a land cover percentage of 34.04% of the total township by the year 2019. Over the last two decades the water-body and the dry land were largely converted into built-up areas.

The decline of 49151 ha of water-body due mainly because of the urban expansion and the dry-land lost nearly 27200.79 ha of its land cover to the built-up areas.

The percentage of vegetation experienced a hike and covered 40.23% in 2017 and then went downhill with a land cover percentage of 34.04% of the total township by the year 2019. Over the last two decades the water-body and the dry land were largely converted into built-up areas. The decline of 49151 ha of water-body due mainly because of the urban expansion and the dry-land lost nearly 27200.79 ha of its land cover to the built-up areas. Hence it requires to have proper planning to safeguard the existing agriculture field and other natural resources. Further, the alarming rate of urban expansion has to be carefully monitored frequently and stop the conversion of fertile lands to urban or semi urban.

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