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A Comprehensive Study on Peri-Urban Regions of Visakhapatnam Smart City

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Abstract: ***The study aims to develop map layers at local and regional scales for an area where the rapid urbanization leads to degradation of it's surrounding land resources. Since the urbanization activity leading to chaotic growth in sub-urban or peri-urban regions, the present study made an attempt to demonstrate the use of remote sensing techniques in evaluation of land-scape analysis by applying modern classification techniques and characterize the landscape patterns and their inter relationship with spatial objects.Using the small scale information does not support broad generalization of spatial parameters. This increasing demand for high resolution data for regional and local scale planning's due to its potential in capturing minute details of spatial objects. Remote sensing technology is considered the most effective as it provides timely and authentic information about the spatial distribution of landscape pattern, while Geographical Information System(GIS) provides a flexible digital environment for collecting, storing, visualizing and analyzing the spatial data. The broad objective of the study of peri-urban areas of Visakhapatnam steel city provides a complete profile of current existing position on land resources. This study evaluates and visualizes the current state of land coverage and land usage pattern in the selected study area. The classification of various existing parameters of the study area developed on 1:50,000 scale and a minimum delineation unit of sentinel 10 m resolution satellite image employed for better visualization.***

Keywords: Remote Sensing, Visakhapatnam, Sentinel data,

I. INTRODUCTION

Land use and land cover information are important for several planning and management activities concerned with the surface of the earth (1). Land cover refers to the observed biotic and abiotic assemblage of the earth's surface and immediate subsurface (2).Land use is defined as the way or manner in which the land is used or occupied by humans. Land cover is the observed physical cover, whereas land use is based on function or the socioeconomic purpose for which the land is being used. Land-cover change can be characterized as land-cover conversion and modification. Land-cover conversion is a change from one land-cover category to another, and modification is a change in condition within a land-cover category (3). Especially in the scenario of rapid changes in use of land resource and the available land size is a scarce resource due to increasing agricultural and demographic pressure which necessitate the improved and updated LULC datasets for effective planning, production and management, thus facilitating both farmers and policy makers (4) Hence, information on land use/ land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. The deficiency in spatial information is overcome by the introduction of satellite data with different resolutions for different planning's and purposes. Use of satellite remote sensing data is in practice since the 1970s in monitoring LULC changes at coarser spatial scales (5). Remote Sensing and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The land is essential to human growth and sustainability development (6). The subject matter of land use and land changes has attracted many researchers around the world (7). Therefore, the observations of changes in land use land-cover (LULC) are vital for many management and planning strategies (8). The concept of land use refers to economic and human activity related to specific parts of any geographic area, while land cover refers to the type of phenomena represented on the surface of the earth(9). This aimed to improve understanding of the dynamics of LULC changes; including the relationship with global environmental change (10).Land use applications involve both baseline mapping and subsequent monitoring. Since, the timely information is required to know the current quantity of land which is in use and to identify the land changes from year to year (11).

Remote sensing, in conjunction with GIS, makes it possible to derive land utilization pattern, bio physical existence of multiple variables such as vegetation, soils, biomass etc., and it gives a broad scope of further planning and decision-making to meet welfare of the ever-growing increasing population challenges. In 20th century, Spatial technology considered as a crucial tool decision makers since the technology playing a vital role in land resource management and environmental impacts induced by human as well as natural factors.

Identifying and Mapping land changes with respect to anthropogenic activities and gradual changes of land resources spatially and temporally become an important research topic in Remote sensing studies. The regional, social, and economic activities are always reshaping the land resources in the course of time and it has a direct impact on rural,urban or peri-urban land resources. The current study identify the dynamic shaping of the land resources and complex nature of the land scape features in the selected study area broaden the knowledge in understanding of human-environment interactions in the study area.

A. Objective of Study

1) Identification and Mapping of various land use/land cover classes.
2) Quantify the land-cover /land-use areas.
3) Extract the satellite information and provide comprehensive details of the study area.
4) Provide the dynamic information on LULC and highlight some critical environment areas.
5) To support the relative environment research in the study area

B. Study Area

The present study is focused on demarcating boundaries of different land use / land cover units using remote sensing and GIS techniques .The study area located in Andhra Pradesh, Visakhapatnam district suburban region, located in the north eastern part of the city along bay of Bengal coast. The geographical coordinates of the study area extend from 17°54′–17°64′N and longitudes 83°16′–82°21′E, covering the total area approximately 86 SqKms. Visakhapatnam is witnessing rapid rate of urbanization as it announced as a smart city and recent consequence of establishment of an administrative capital of the state. It is one of the fastest growing cities and has a beautiful long sea coast with natural harbor facility. The study area is prevailing the semi-humid to semi-arid climatic conditions with the annual average rain fall 1008mm (mostly southwest monsoon rains from June to September) and the area experiences with an average temperature of 17^{o}C in winter and 38^{o}C in summer. Population is concentrated in eastern part of the city,

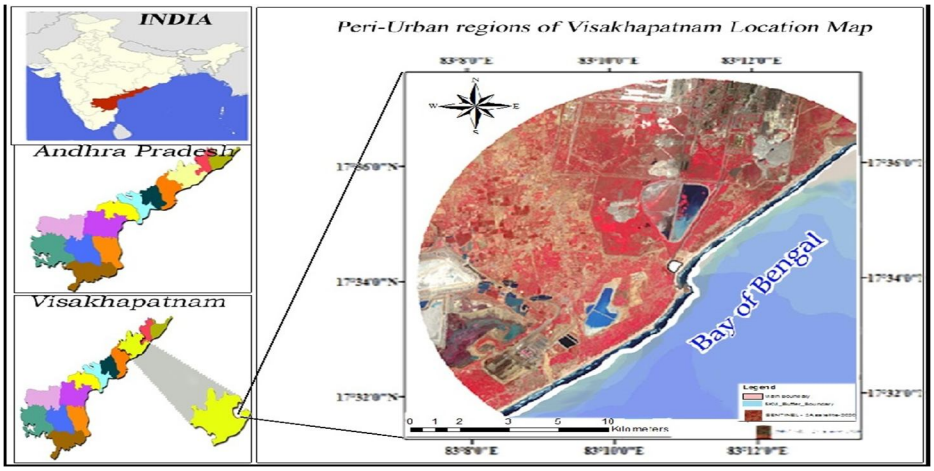

Fig:1 Study Area

The study area is characterized by undulating topography, with coastal ridges on northern, southern and western sides and the Bay of Bengal on eastern side.Khondalite groups (khondalites and leptynites) of the Precambrian Eastern Ghats are the geological formations, khondalites being most dominant rocks (Fig. 2). The soils of the Recent Formations are red in colour, known as red sediments, which are the products of khondalites (12). They occur over the country rocks (13). The depth of the red soil cover is up to 9 m from the ground surface(14). In some locations, laterite occurs as capping on the khondalites and sand dunes occur along the beach (14). The topographical structure of this area is gently sloped south east ward with the altitude range of 1.5–89 m due to presence of the Western Ghats in the northern side (15). The study area is underlain by the Khondalitic suite of rocks (garnet ferrous-sillimanite-gneiss and quartzo-feldspathic-garnet-gneiss) belonging to the Precambrian Eastern Ghats (15). The charnockites (hypersthenes pyroxene granulite), quartzites and pegmatites intrude the rocks(16). The geomorphic features strongly influencing the spatial distribution of LULC feature along the coastal area. Major industries located along the north east coastal part of the district. Demographically, the study area covers both urban and rural settlements with different communities and religion people, farmers and fisher man community dominated among the habitants. This study area is certainly a spot of tourist interest.

C. Materials And Methods

This study aim is to explore the spatial relationship between different environmental parameters like plantations, vegetation, occupied built areas and industries in the peri-urban regions of Visakhapatnam. Sentinel 2A satellite image, MSI sensor,76 orbit,10 m resolution data of 2019-2020, Survey of India toposheet for the study area and the digital elevation data with a resolution of 30 m acquired from http://glcf.umiacs.umd.edu/data/srtm/. Open source GIS tools like QGIS, ILWIS and commercial GIS tools ERDAS 9.1 employed in preparation of thematic maps. The thematic layers such as drainage pattern, geomorphology, land use/land cover, soils and slope maps have been generated individually and integrated all the thematic layers for the final output.The drainage map generated from the toposheet and soil maps generated with reference of Andhra Pradesh State Agricultural Department (2016-2017-Soil health maps).

II. METHODOLOGY

The present study is carried out for assessment of Land-use Land-Cover features in the North east rural areas of Visakhapatnam coastal region. The satellite image was geometrically corrected using UTM-WGS84 projection and applied coordinates with the help of Survey of India (SOI) published topographical maps (scale 1:50,000). Different combination of bands in satellite image is effectively suitable for extraction of various LU/LC features. False Colour Composite map of selected study area was generated with the combination of available bands (3, 2, I) which produce features like settlements, water bodies, salt marsh, forest, vegetation and cultivate lands distinctly. Displayed image with the different classes was spectrally enhanced by equalization method and histograms. Land use land cover maps of study-area was then prepared by on-screen visual interpretation method using ERDAS IMAGINE 9.1.The classification of the image was performed applying superwised and unsupervised classification techniques. In this sort of classification, spectral classes are grouped into a particular class, the algorithms called clustering algorithms, which identify the obscure pixels in a picture and grouped them into a number of classes based on clusters present in the image fig-no.3. The use of descriptive statistics of an image via parametric clustering enables the capturing of vital information on given dataset (17). The clustering method uses minimum spectral distance to form clusters to represent the classes, The assigned algorithm repeats the procedure until the maximum number of iterations and but taken 13 major and minor classes recorded for the assessment. Average values of elevation extracted for individual LULC classes to examine the spatial variability of these parameters in the target study area. Classification to be the process of recognition of the pattern associated with each pixel position in an image in terms of the characteristics of the objects (18). For reaching effective results, Ground Checking Field visits were made to selected known features in the study region to check for relevance between the classified features and their real location on the ground using portable Global Positioning System (GPS) units. 60 GPS points have been collected for this study. The GPS points were recorded in a way that covers each Land-use Land-cover classes in almost equal proportion and from all parts of the selected study area. All the obtained results have been cross verified based on field investigation. Land-use and land-cover features clearly demarcated, assessed and tabulated their areal extent values and expected statistics in tab no-The land Use land Cover map of the study area is shown in fig- 4.

A. Accuracy Assessment

The post classification accuracy assessment is an important part of the LULC classification and mapping which is used to analyze the precision of the classified maps (20). The classification accuracy estimate the quality of maps produces and helps to evaluate the applicability of a map for a specific use for an accurate interpretability and identification, the minimum accuracy of a classier map should not be less than eighty percent (21).

In this study, Kappa co-efficient technique is used to evaluate the accuracy of LULC maps of Visakhapatnam peri-urban regions .The outcome of precision assessment show an overall accuracy level of 82.00 percent and the Kappa statistics was 0.81723 respectively.

III. RESULTS AND DISCUSSION

Land-use, Land-cover mapping serves as a basic inventory of natural resources for all levels of government, environmental agencies and private industry throughout the world [21]. The land-use/land-cover information helps in formulation of policies and programs for regional development. Therefore, an attempt has been made here to adopt a sustainable LULC classification system using remote sensing and GIS techniques. For success of any planning activity, detailed and accurate information regarding the land-cover and the associated land-use is of paramount importance. The main aim of developing this classification for the study area is to produce a maximum level of accuracy tried in the interpretation of the data.

S.No	Land-Use/Land-Cover Type	Area In Km^2	Percentage(%)
1	Agricultural Land-Crop Land-Kharif Crop	3.38	7.44
2	Agricultural Land-Fallow	4.78	10.51
3	Agricultural Land-Plantation	11.69	25.71
4	Built Up (Rural)	0.51	1.12
5	Built Up-Industrial	13.47	29.63
6	Built Up-Industrial area-Waste	7.62	16.76
7	Vegetated / Open Area	1.87	4.11
8	Wastelands-Gullied	0.32	0.70
9	Wastelands-Scrub land-Dense scrub	0.23	6.80
10	Wastelands-Scrub land-Open scrub	0.72	1.58
11	Waterbodies-Reservoir/Tanks	0.54	1.19
12	Waterbodies-River/Stream	0.06	0.13
13	Wetlands-Coastal	0.27	0.59
	Total	45.46	100.00

Table:1 Percentage of Land Use Land cover Features of Study Area

The Present study area being enveloped by major industries, hence it is witnessing rapid developments and urban growth towards the interior of the selected study area. The rapid Changes taking place in the area selected for the study demanding an urgent need for real time monitoring on protection of environment and natural resources in the locality. The comprehensive study made on 45.46 Km^2 was selected to delineate the present state of spatial pattern of land-use/land cover features. The various objects have been depicted using the visual interpretation of the satellite imagery and the LULC classes are effectively delineated from the digital remote sensing data. The study revealed that The identification of settlements in satellite imagery was based on tone and colour. They have tone of grayish & light bluish colour. It occupies 0.51 Km^2 (1.12%) of the total study area.The large settlements of the study area like Peddapalem, Islampeta, Marubhayi, Devada, Appikonda, Gorusuvani palem, KN palem, Siddeswaram and Palavalasa have been identified with the help of satellite imagery. This unit also includes roads & other infrastructure related to human beings.

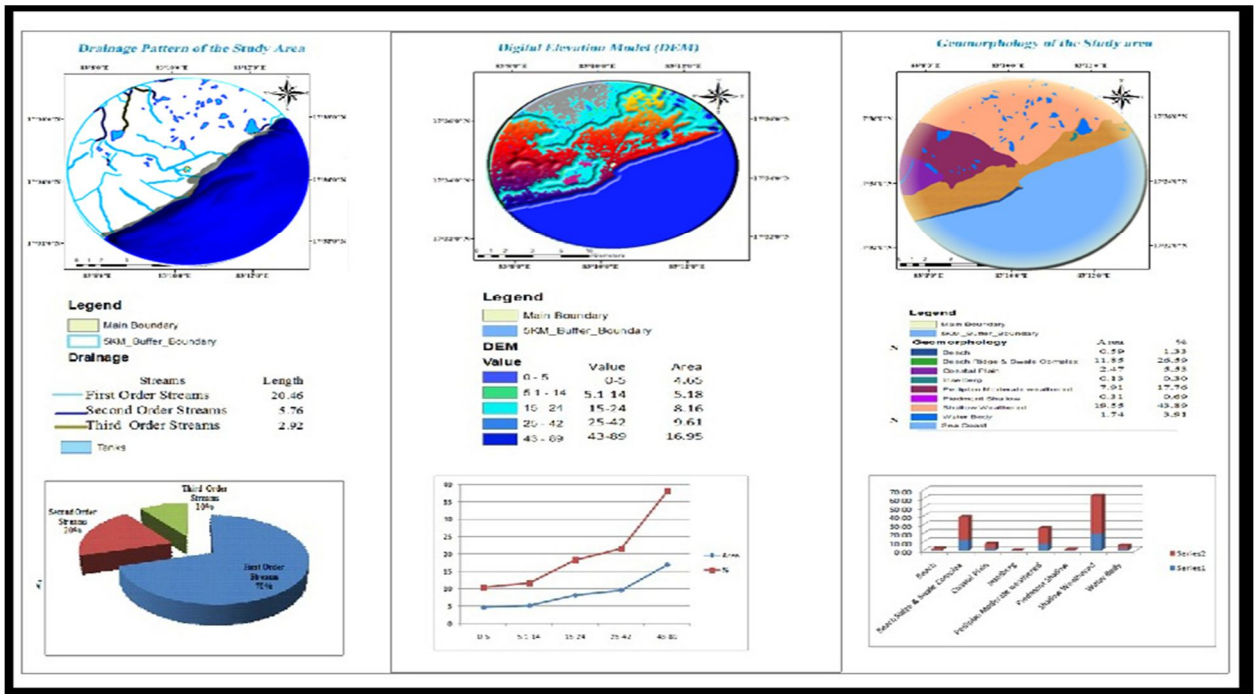

Fig:1 Drainage, DEM and Geomorphological Features of Study Area

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The drainage in the study area is resembles dendritic type and sub-dendritic. The drainage density varies from less than 1 km to 3 km.There are three kinds of stream orders observed in the study area, the first order streams cover around 20.46 Sq km, second order streams cover around 5.76 Sq km and the third order stream cover around 2.92 Km^2 (Fig.1). Due to the slope towards south-east,all the drain flowing towards bay of Bengal. The study area is characterized by few prominent hill ridges running parallel to each other. The western part of study area constitutes a small narrow valley and a small stream descends gradually to the east. The eastern part consists of rather rugged hilly with steep slope, that the eastern part of the study area has gentle slope as compared with the western part. The study area is covered by the predominant soils like red loams, sandy loams, sandy soils and the narrow valleys and low lying areas covered with red loamy soils. Patches of Sandy soils observed all most entire study area. The Study area is covered by Charnockite soil, Brown gravelly clay soil 27.99%, Red coastal clay soil 14.84 and sandy soils covers approximately 57.17 % (Table 1).

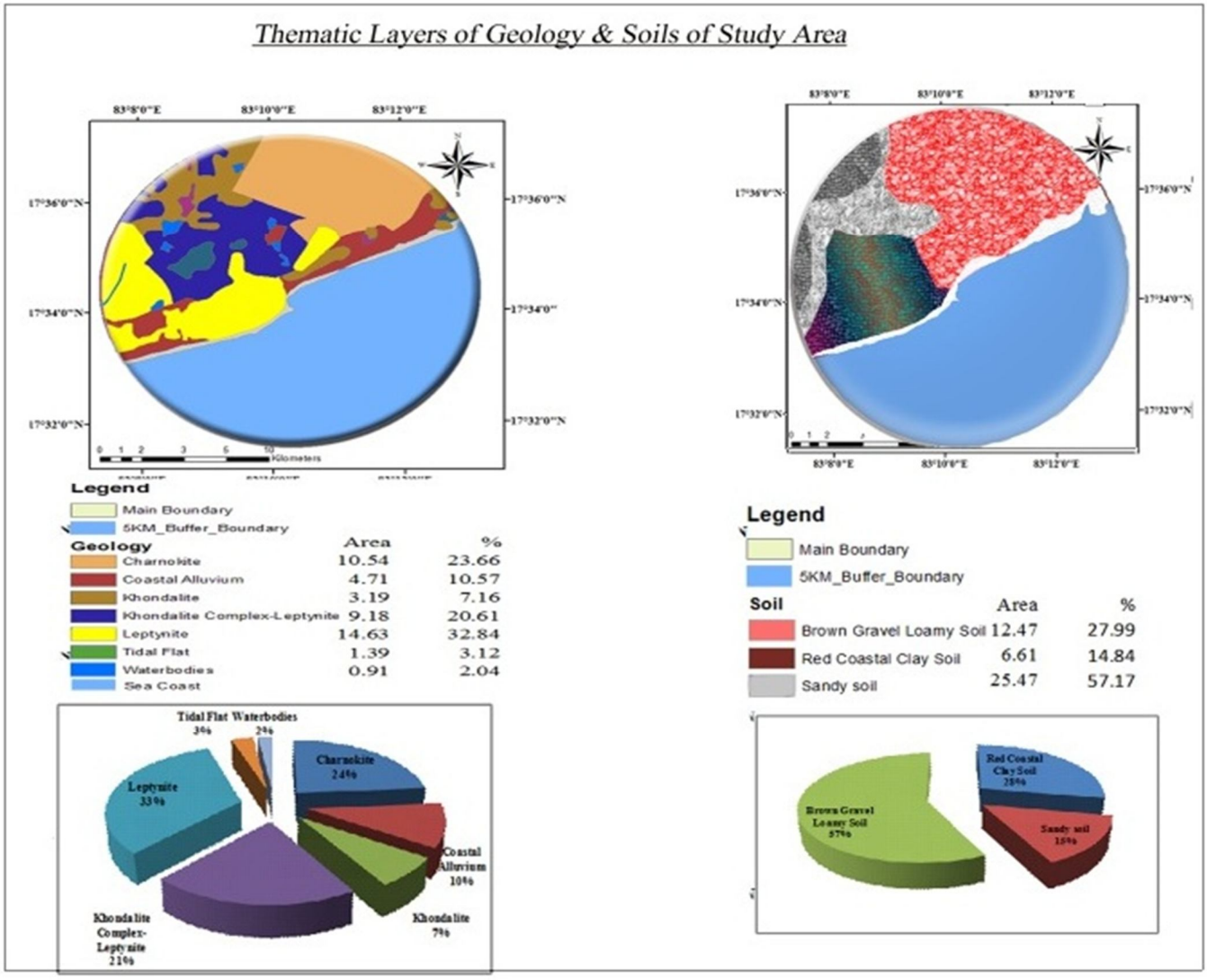

Fig:2 Thematic layers of Geology & Soils

Covers around 16.76 percentage of total surface area and occupies around 7.62 Km^2 with trees, shrubs and herbs. The agricultural lands for the production of food, fiber, and other commercial and horticultural crops shared nearly 7.44 percentage of total study area. Major horticultural crops like Cashew mango identified Near villages Appikonda, Devada and parts of Islam peta east and west. Crop areas appear in bright red to red in color with different shapes and sizes in a contiguous to non-contiguous pattern. Patches of Kharif crop observed near chinna palem and Naduvuru rural parts.

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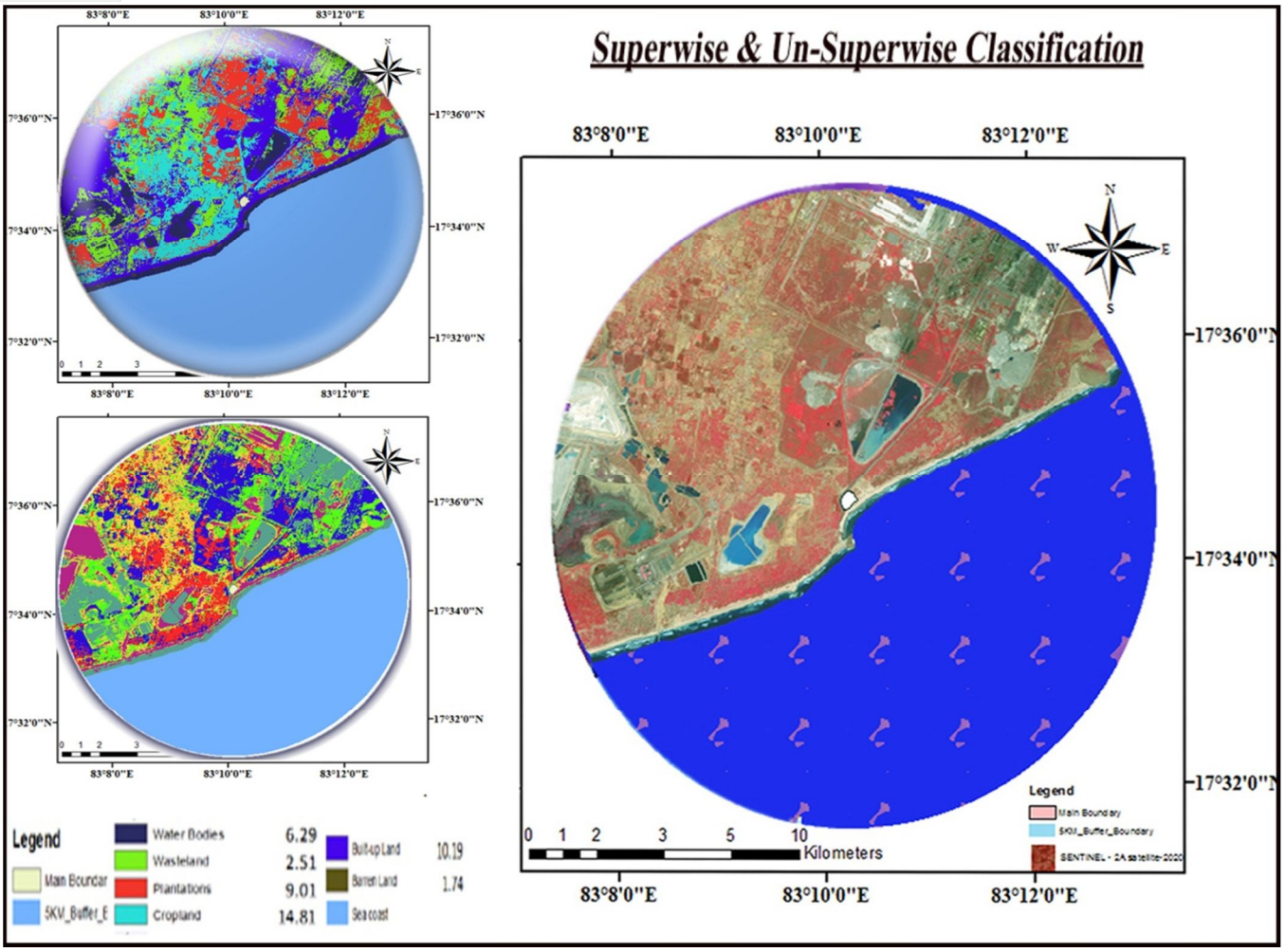

Fig: 3 Superwise & Un-Superwise Classification

Agriculture is the world's major user of land, water and biological resources. It is the major source of livelihood of more than 70% of the people of any country [20]. The agriculture plantation comes under the areas of land use systems and practices wherein cultivation of herbs, shrubs, and vegetable crops are deliberately integrated with agricultural crops mostly in irrigated conditions for ecological and economic reasons. The agricultural land plantations occupied near around 25.71 percentage of total land area which accounts 11.69 Km^2.Fallow Lands which are taken up for cultivation, but are temporarily allowed to rest, un-cropped for one or more season recorded nearly 10.51 percentage with 3.38 Km^2. area. Wastelands are described as degraded lands which can be brought under vegetative cover with reasonable effort and which is currently under utilized and land which is deteriorating for lack of appropriate water and soil management on account of natural causes. The wasteland identified in the villages of Marubhayi. Peddapalem, Devada and Islam Peta, Palavalasa and Gorusuvani palem. Gullies develop from rills which are tiny water channels with a few centimeters deep, a narrow, steep sided channel formed in loose earth by running water formed as a resultant impact of heavy rainfall and wearing action of runoff generated from Islampeta to Appikonda beach area covers around 4.11 percentage of land area occupied which accounts approximately 1.87 Km^2.. We also identified some scrub lands which are generally prone to deterioration due to erosion. These areas possess shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and lands subjected to excessive aridity with scrubs dominating the landscape. There is approximately 6.80 percentage of total study area occupied with dense scrub land area and 1.58 percentage of open scrub lands also identified in the study area which accounts for approximately 1 Km^2..Sandy coastal areas which has stabilized accumulation of sand, in coastal, revering or inland areas, that can be either deserts or coastal, Increasing population and industrialization along the coastal areas are adding pressure on the coastal ecosystems [20].

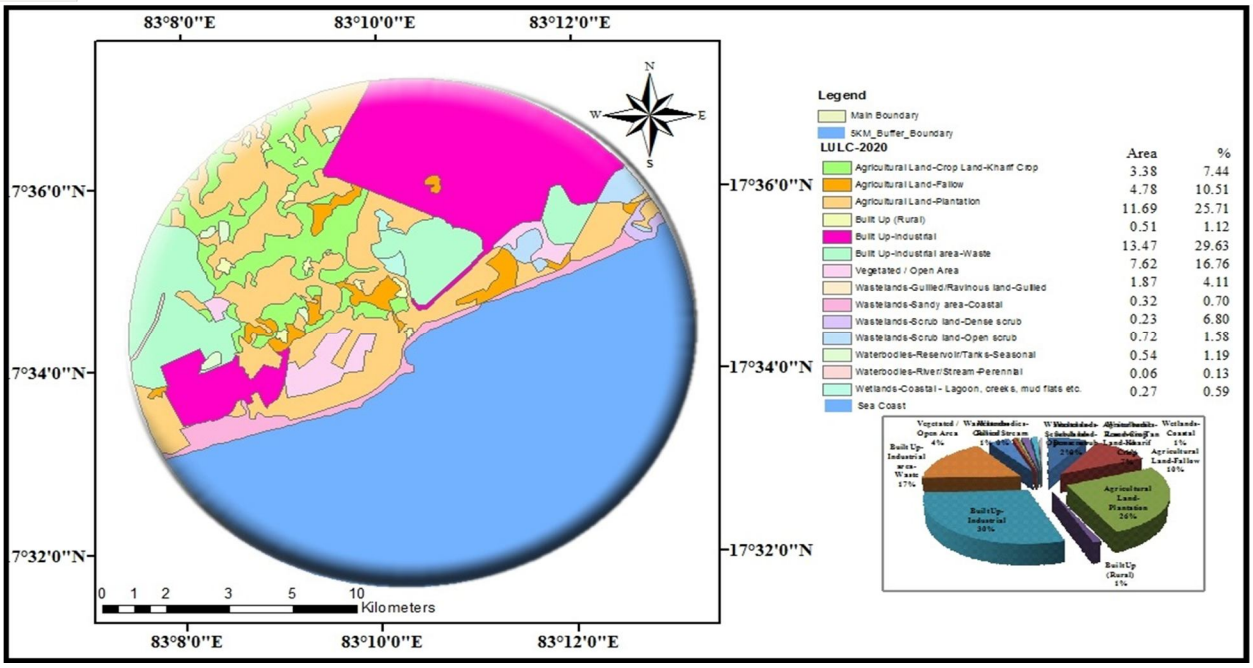

Fig : 4: Land Use Land cover Features of study area

They appear as white to light yellow/ bluish depending on moisture content in the soil.The sandy area identified at Appikonda village and Devada villages assessed 0.70 percentage area of total surface land. All submerged or water-saturated lands, natural or man-made, inland or coastal, permanent or temporary, static or dynamic which necessarily have a land-water interface are defined as wetlands. Hence, the portions of water body (partial or full) having emergent vegetation or observable submerged vegetation is placed in the Wetlands category. The sandy area identified at the Appikonda and devada villages estimated 0.59 percentage of total surface area..Non-wooded areas tidally, seasonally or permanently waterlogged with brackish or saline water identified with 0.13 percentage of study area.Water Bodies are seen clearly in the satellite image in blue to dark blue or cyan color depending on the depth of water. Water bodies recorded with an areal extent of 1.19% (0.54 Km^2) of total surface area.Small man made tanks are observed at Islampeta area and near Palavalasa, impounded water ways constructed on land surface for storage of rain water which occupies around 1.19 area of total surface land .The study area also shares 29.63(13.47 Km^2) percentage of land for industries and their activities which is used for temporary storage of ash, contaminated soil, rubble, cooling of hot water or tailing ponds associated with the industry. The areas where industrial waste is permanently kept and lands which have been deteriorated due to a large scale industrial effluent discharge and accumulated waste debris after extraction of required minerals are observed near Devada and Pittavani palem villages.

IV. CONCLUSIONS

The present comprehensive study focused on generates high accuracy and good precision of different land use/land cover maps on a regional basis. In fact, satellite data are very helpful for the detection of land use/land cover spatial objects .The socio-economic development of any country, state or region is based on natural resources available in that particular location. Since the population growth is increasing rampantly, the available resources are over stretched often leading to resource depletion. To wisely manage these limited resources, remote sensing and GIS techniques can be applied effectively and measure to generate data for management of resources in a sustainable manner. The Spatial technology is widely using in almost all the applications which we are using in our daily routine life. Spatial technology is an efficient tool to create database for natural resources assessment and management in either large or small scale. The main objective of mapping of land use land cover is to assess potential and limitation of resource availability in the region.

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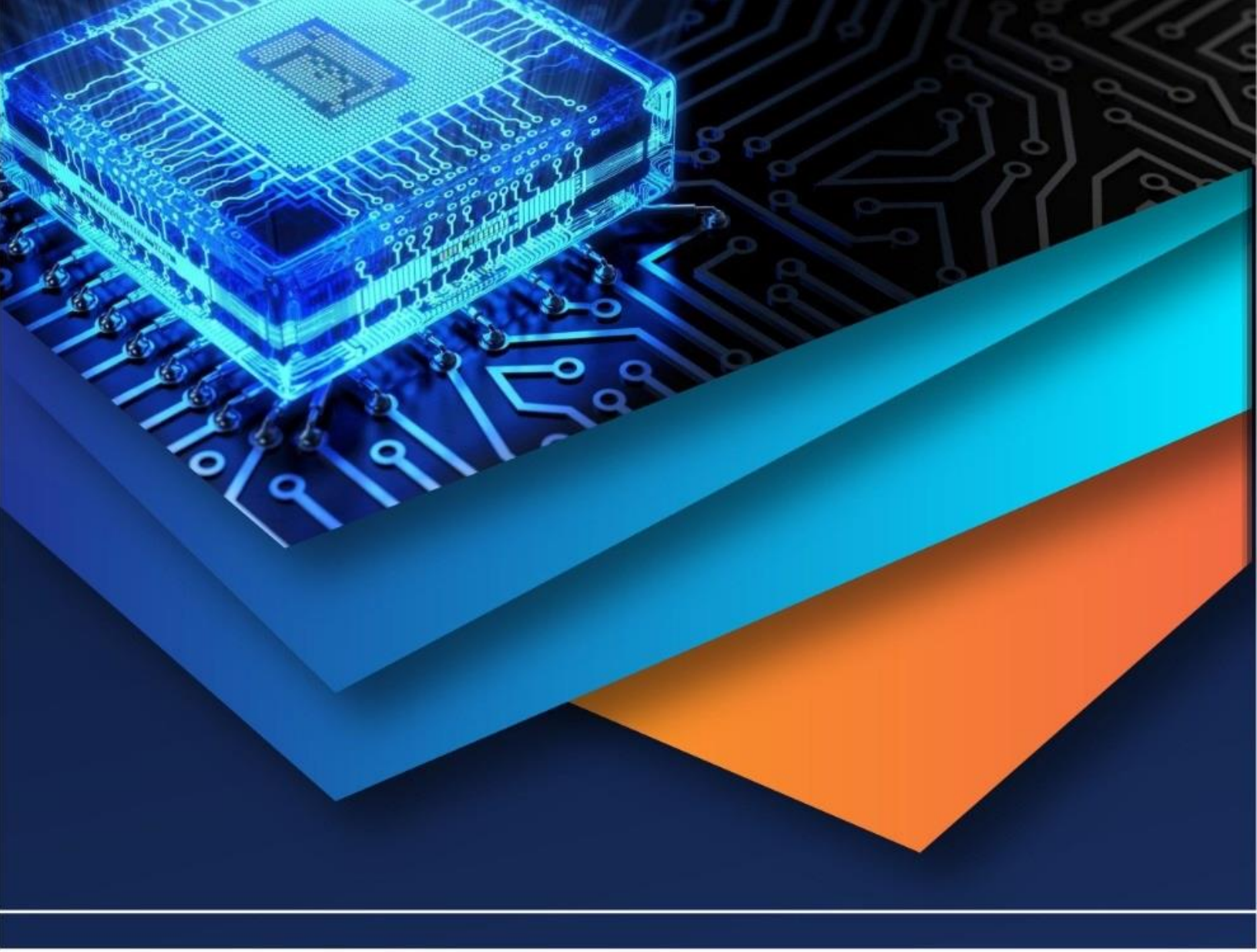
REFERENCES

[1] Lillesand, T. M., Kiefer, R. W., and Chipman, J. W., 2008, Remote sensing and image interpretation, New York: John Wiley & Sons, Inc.
[2] Meyer, W.B. and Turner, B.L. 1994. Changes in Land Use and Land Cover: A Global Perspective: Papers Arising from the 1991 OIES Global Change Institute. Cambridge; New York: Cambridge University Press.
[3] Wardlow B D, Egbert S L, Kastens J H, 2007. Analysis of time-series MODIS 250 m vegetation index data for crop classification in the U.S. Central Great Plains. Drought Mitigation Center Faculty Publications. Paper 2. http://digitalcommons.unl.edu/droughtfacpub/2.
[4] Liping, C.; Yujun, S.; Saeed, S.: Monitoring and predicting land use and land cover changes using remote sensing and GIS techniques—a case study of a hilly area, Jiangle, China. PLoS ONE **13**(7), e0200493 (2018)
[5] Shao Y, Fan X, Liu H et al., 2001. Rice monitoring and production estimation using multitemporal RADARSAT. Remote Sensing of Environment, 76(3): 310–325. doi: 10.1016/S0034-4257(00)00212-1.
[6] Khan, M.S.; Suhail, M.; Alharbi, T.: Evaluation of urban growth and land use transformation in Riyadh using Landsat satellite data. Arab. J. Geosci. **11**(18), 540 (2018)
[7] F.C. Dai, C.F. Lee & X.H. Zhang, GIS-based geo-environmental evaluation for urban land-use planning: A case study, Engineering Geology, 61(4), 2001, 257-271.
[8] Kushwaha SPS, Suchismita Mukhopadhyay, Hari Prasad V & Suresh Kumar, Sustainable development planning in Pathri Rao sub-watershed using geospatial techniques. Current Science, 98, 2010, 1486.
[9] Chandrashekhar MB, Sarnam Singh & Roy PS, Geospatial modeling techniques for rapid assessment of phytodiversity at landscape level in western Himalayas, Himachal Pradesh. Current Science, 84, 2003, 669
[10] Singh, A.: Review article digital change detection techniques using remotely-sensed data. Int. J. Remote Sens. **10**(6), 989–1003
[11] Turner,B.L.; Hydén, G.;Kates,R.W.: PopulationGrowth and Agricultural Change in Africa. University Press of Florida (1993)
[12] Rao, N.D.; et al.: Healthy, affordable and climate-friendly diets in India. Glob. Environ. Change **49**, 154–165 (2018)
[13] Rao, A. T. (1978). Red sediments from Visakhapatnam area,Andhra Pradesh. Journal of the Geological Society of India, 19, 79–82.
[14] Rao,A.T.(1978).Red sediments from Visakhapatnam area, Andhra Pradesh. Journal of the Geological Society of India, 19, 79 –82. Rao, A. T., & Vijayakumar, V. (1992). Chemical petrology of charnockites from the Eastern Ghats granulite province India. In A. Bartokyriakidis (Ed.), High grade metamorphics (504). Athens, Greece: Theophrastus Publishing of Proprietary Co., S.A. (Ltd).
[15] Raju, K. C..B, Rao, G. V. K. and Kumar, B. J. (1985). Analytical aspects of remote sensing techniques for groundwater prospecting in hardrocks. Proc. The Sixth Asian Conf. On Remote Sensing, 1985, pp. 127-132.
[16] Raghavaswamy, V (1981). Landforms, land systems and geographical synthesis of Visakhapatnam tract in the East Coast plain of India. Unpubl. Ph.D. thesis submitted to the Andhra University, Visakhapatnam.India201 p.
[17] Ram, B. and A.S. Kolarkar, 1993. Remote sensing application in monitoring land use changes in mid Rajasthan. International Journal of Remote Sensing, 14(17):3191-3200
[18] Mather, A.S. (1999) Land Use and Cover Change. Land Use Policy, 16, 143.[18].Manandhar, R., Odeh, I. O.
[19] A., & Acnev, T.(2009).Improving the accuracy of land use and land cover classification of Landsat data using post-classification enhancement. Remote Sensing, 1, 330–344.
[20] Anderson, J. R., Hardy, E. E., Roach, J. T., & Witmer, R. E. (1976). A land use and land cover classification system for use with remote sensor data. Geological Survey Professional Paper 964.
[21] Avalgund, RK, V. Jayaraman and P.S. Roy, 2007. Remote sensing application: An Overview. Current Science, 93(12): 1747-1766.



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