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Land Use/Land Cover of Tirupati area for Agriculture Land Classification: A Study

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Abstract: Land use/land cover (LULC) data is fundamental for the choice, arranging and usage of administration methodologies to meet the expanding requests for essential human needs and welfare of the regularly developing populace. This paper shows the status of land use/Land cover in the Tirupati zone of Andhra Pradesh state utilizing an incorporated approach of remote Sensing and Geographic Information System (GIS). The National Land use/Land cover categorization created by National Remote Sensing Center (NRSC) and Indian Space Research Organization (ISRO) partition the land in the study area into five grade classes. This paper gives the practical particulars for the first three data collection, data pre-processing and data analysis alongside a short depiction of the study area in light of the utilization of land.

Index Terms - Land use, Land Cover, Remote sensing, Geographic Information System, Data Pre-processing, Data Analysis, Land Classification.

1. INTRODUCTION

Owing to hasty rise of residents, urbanization, industry, the agricultural land is diminishing day by day. In tiny & bulky area in agriculture the data on Land cover/ use play are participate an important role using GIS& Remote Sensing Technique are carry to acquire decision & forecast in more valuable & practical. In Land cover there be a dissimilar things of the terrain are included like Mountain, Rocks, Water, Crop, Building, Trees, and Soil etc . Human has put many practices in practice to utilize the land to generate provisions, developing area for their need. All country economic enlargement & foodstuff safety is dependent on cultivation. In countless countries Agriculture is primary source to sustain the food requirement for everyone. The aim of every cultivator and agricultural agencies are achieving high production rate with minimum cost. Remote Sensing, GIS and GPS technology furnish the information to cultivator regarding the crop condition, damage, and yield & soil condition [1]. The nation's primary priority is to produce the food in adequate levels. For rising crop water and nutrients are crucial. Climate condition changes are effect on crop growth. So, avoid this problem Remote Sensing & GIS data are used in monitor crops and identified problem& supports in decision about crops & agricultural strategies. In sequence about land use/cover is useful in budding, scheduling & decision in, preparation in agriculture[2]. The dissimilar part are vital in the revision of Land use/ cover for helpful planning like Soil survey, flood area, maps, Arial photography , vegetation survey etc. In urban planning the Remote Sensing & GIS in turn be worn in speedily changes in land use/ cover. Remote sensing is ability of science which gives the information about the globe without touch it.

Earth-orbiting platform, among linkage towards GPS data, GIS data layers, and function, and promising modelling capability. Remote sensing information, with help of the technologies such as GPS and GIS collects the information and using which can be made efficient planning decisions with cost efficient. This has made remote sensing a priceless resource of land cover and land use information. Land use/ land cover are two split terminologies which are frequently used interchangeably [3]. In general, land cover is defined as the observed (bio)-physical cover on the Earth's shell. It includes vegetation as well as man-made quality plus naked rock, naked soil, plus inland water surfaces. While Land use alludes to the shape in which Land have been worn by people and their frequent, more often than not with the emphasize on the practical part of land for monetary activities[4]. Land Use/Land cover data sets are essential contributions for ecological displaying and checking,

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natural resources administration, approach making, carbon cycle analysis, hydrology and worldwide environmental change analysis.

The study area is one of the quickest developing urban areas in Andhra Pradesh and has witness a significant raise in populace, monetary development, industrialization, and transportation exercises in current years which demonstrate a unenthusiastic effect on the surroundings. Urbanization, tourism advancement deeds as it is one of the world legendary pilgrim centre, human population growth, and claim for forest products have been important drivers of land use/land cover change in the learning area.. Quite a few other scenarios like the interest for nearby produced food, global issues such as privileged energy prices and climate change are influencing the urban ecosystem. In the learning area, populace projections propose that the expansion in urban sprawl will likewise increment in rural areas, possibly because of public commuting between exertion in urban areas and field homes. Huge development of developed area, diminish in agricultural area, water extension area and forest areas. It visibly shows the noteworthy effect of population in addition to progress activities on value of life.

Hence, suitable information on LU/LC is required for implementing diverse developments, planning, and land utilize schemes to meet up the mounting demands of vital human desires. Tirupati a divine city of Andhra Pradesh State and its surroundings area was chosen for the study in view of its noteworthy populace development, expansion of production, transport, monetary, tourism and mortal an educational hub [5]. Hence, an shot has be prepared to analyze the urban sprawl, monitoring the dynamics of LU/LC, its change the pathway that blow the urban ecosystems.

2 RESEARCH METHODOLOGY

The research methodology can be alienated into the accompanying real segments: (i) data acquisition and gathering; (ii) data pre-processing; (iii) classification scheme design; (iv) hierarchical classification; (v) spatial reclassification; (vi)accuracy evaluation; and (vii) land-use and land-cover change analysis. This area provides the technical details for the initial three methods, along with a pithy explanation of the study area.

2.1 Study Area

Tirupati (13?34' - 13?45'N, 79?15' - 79?29'E) is the world famous pilgrimage centre of Lord Sri Venkateswara Swamy and is one of the speediest developing cities situated at the lower regions of the Seshachalam hill range in Chittoor region of Andhra Pradesh. The number of inhabitants in the study area developed between 1981, 1991, 2001 and 2011 at a rate of 1.91 percent yearly and it has seen a significant increment in urbanisation, industrialization [6], financial development and transportation activities which shows a negative impact on the surroundings. It covers an area of about 388.48 km2 and consists of Tirupati rural and urban areas. This area has a semi-arid atmosphere. The mid year temperature ranging from 35 to 40 degrees Celsius and the winter temperature changes from 18 and 20 degrees Celsius. The town experience outrageous precipitation in November during the northeast monsoon season with a normal yearly precipitation of 979 and 1088 mm of Tirupati rural and urban areas respectivelyShallow gravelly reddish brown soils are predominant in the revise area over the granites and gneisses of peninsular gneissic complex, quartzites, shales/phyllites as well as limestones of the Cuddapah super gathering. Figure 1 shows the location map of the study area.

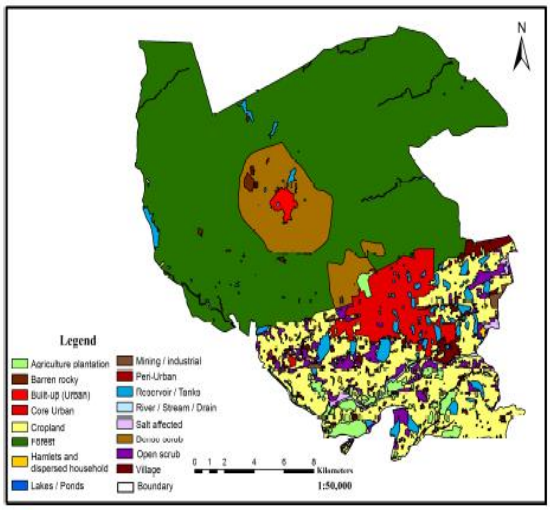

Figure1: Land Use/ Land Cover map of the Tirupati study area.

2.2. Agricultural Plantation

Agricultural Plantation is characterized as an area under agricultural tree crops planted embracing certain agricultural management techniques. Mango and eucalyptus plantation are the dominant plantation type in the study area. Plantation appears in light-red to red in tone on satellite imagery [7]. These are identified by its tone of different sizes with regular and sharp edges which are an indication of a fence around it. In the present study,

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the plantation occupies an area of about 9.48 km2 (2.44%).

2.3. Cropland

The land in which the crop is being cultivated as on the date of the satellite flyover is called cropland. Usually the seasons are Kharif or Rabi or Kharif Rabi. Cropped land appears in thick red to red in colour with shifting shape and volume in contiguous to non-contiguous in the pattern. . In the current study, the cropland is 60.88 km2 (15.67%) and it is showing that crops with huge water need are major crops in the entire crop land.

2.4. Water Bodies

The water bodies include both natural and man-made water features such as pond, lakes, tanks and reservoirs flowing as streams, rivers, and canals etc. This category comprises areas with surface water, either impounded in the form of ponds, lakes and reservoirs or flowing as streams, rivers, and canals etc. Water sources are appears light blue to dark blue in color and flat to dappled in touch on satellite imagery. Usually Water sources appear in dark on satellite imagery due to absorption of incoming IR radiation [8]. Surface water bodies such as tanks/reservoirs and river/stream/drains are recognized in the revision area and they spread to the extent of 11.12 km2 (2.86%) hectares and 2.91 km2 (0.75%) respectively. Papavinasanam, Gogarbham, Akasa Ganga, Kumaradhara, Pasupudhara, Kalyani dam and Sri Sai Ganga canal under the Telugu Ganga project are the major drinking water resources of Tirumala and Tirupati region

2.5. Forest

These are the lands with majority of trees and other undergrowth plants. In the satellite image, such forest is recognized by red to dark red in tone with a coarse texture [9]. This class is distributed in the northern part of the study area. Forest land is the majority land coverage category in the study area and it covers an area of about 227.46 km2 (58.55%).

2.6. Wasteland

Wasteland may be depicted as degraded land underutilized lands majority of which could be brought into gainful use with appropriate soil and water management preparations [26] or the land which is decaying because of absence of suitable water and soil management or by virtue of natural causes [27]. Wastelands protect result from inherent/ forced incapacities, for example by area, environment, chemical and physical properties of the soil or budgetary or management constraints [10]. In the study area, three primary wasteland classifications are predominantly observed. Barren rocky, salt influenced, scrubland are listed under this classification.

Table 1: Land use/ land cover classification levels based on NRSC and IRSO (2011)

Level-1	Level-2	Level-3
Built-up	Built-up (Urban) Built-up (Rural) Mining/industrial area	Built-up/core urban/peri-urban Village/hamlets/dispersed house hold Industrial mine/quarry
Agricultural land	Agricultural plantation Cropland	Agricultural plantation Cropland
Forest land	Forest	Forest
Water bodies	Reservoir/tanks River/stream/drain	Reservoir/tanks River/stream/drain
Wastelands	Barren rocky Salt affected Scrubland	Barren rocky Salt affected Open scrub/dense scrub

3. AGRICULTURAL LAND CLASSIFICATION:

1966 and a national survey was carried out and published on 1 inch to 1 mile maps between 1967 and 1974. The classification methodology was amended in 1988. It gives a broadly predictable and perceived method for assessing the potential productiveness of agricultural land. The classification is based on the inherent soil characteristics, external land features and environmental factors that limit the use of the land for various uses. The grades range from 1 (excellent) to 5 (very poor) also defined as follows (Source: MAFF (1988) Agricultural Land Classification of England and Wales (revised guidelines and criteria for grading the quality of agricultural land)

3.1 Grade 1 – Excellent quality agricultural land Land with no or exceptionally minor restrictions to agricultural use. An extensive variety of agricultural and horticultural crops can be grown and commonly include best natural product, delicate organic product, serving of mixed greens yields and winter harvested vegetables. Yields are high and less variable than on land of lower quality.

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3.2 Grade 2 – very good quality agricultural land
Land with minor confinements which are influence crop yield, cultivations or harvesting. A extensive variety of agricultural and horticultural crops can usually be grown however on some land of this grade there might be decreased adaptability because of challenges with the production of the more demanding crops, for example, winter harvested vegetables and arable root crops[11]. The level of yield is by and large high yet might be lower or more variable than Grade1.

3.3 a) Sub-Grade 3a – good quality agricultural land
Land capable of reliably delivering moderate to high yields of a narrow range of arable crops, particularly cereals, or moderate yields of a wide range of crops including cereals, oilseed rape, potatoes sugar beet and the less demanding horticultural crops

3.3 b) Sub-Grade 3b – moderate quality agricultural land
Land capable of producing moderate yields of a narrow range of crops, primarily cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the yea[12]r.

3.4 Grade 4 – poor quality agricultural land
Land with extreme constraints which fundamentally confine the range of crops and/or level of yields It is mainly suited to grass with incidental arable crops (eg cereals and forage crops) the yields of which are variable. In most atmospheres, yields of grass might be moderate to high however there might be challenges in usage. The grade also includes very droughty arable land.
3.5 Grade 5 – very poor quality agricultural land
Land with very severe limitations which confine use to permanent pasture or rough grazing, except for occasional pioneer search crops.

4. REMOTE SENSING:

Agricultural land classification maps can likewise be delivered by mapping Straightforwardly onto satellite images, either as printed copies or showed on computer screens. The agricultural land class restrictions on hard copies of images can be digitized and gone into the computer for production of maps. Satellite images contain detailed records of ground cover features, land use patterns and quality of agricultural land at the time of exposure. A skilled interpreter familiar with the area that can recognize the nature of physical objects and landform features by conducting systematic examination. There are six attributes recorded for each landform highlight spoke to on a image. These are size, shape, shadow, tone or colour, pattern and texture. These attributes are evaluated using interpretation strategies such as location and association, temporal change and convergence of evidence to determine the agricultural land class boundaries. As for field mapping, it is required to conduct a field reconnaissance survey of the area. This includes ground truthing the satellite image and acquiring the preliminary information as outlined for the field survey technique: soil, geological, slant and climatic information, applicable topographic map sheets and information on the type and productivity of agricultural enterprises..

Table 2. Statistical distributions of land use/land cover categories of the study area.

LU/LC category	Area in (km^2)	%to total geographical area (TGA)
Core urban	11.94	3.07
Peri-urban	12.11	3.12
Village/hamlets/dispersed house hold	7.38	1.90
Industrial mine/quarry	1.28	0.33
Agricultural plantation	9.48	2.44
Cropland	60.88	15.67
Forest	227.46	58.55
Reservoir/tanks	11.12	2.86
River/stream/drain	2.91	0.75
Barren rocky	0.70	0.18
Salt affected	1.18	0.30
Open scrub	11.98	3.08
Dense scrub	30.06	7.74
Total	388.48	100.00

Being a quickly developing area Tirupati was chosen as a study area to quantify the LU/LC pattern for the year of 2012. The National LU/LC classification developed by NRSC and ISRO partitions the land in the study area into 5 sorts of Level I class land type, 11 sorts of Level II class land type and 15 sorts of Level III class land type. The three level hierarchic based designs uncover that the Forest land is the major LU/LC [6] category in the Tirupati area covering 227.46 km2 (58.55%), followed by agricultural land, wastelands, built up land and water bodies respectively, contributing 70.36 km2 (18.11) %, 43.92 km2 (11.31%), 32.71 km2 (8.42%) and 14.03 km2 (3.61%) of the total geographical area. The study concludes that in the Tirupati area forest contributed the highest (58.53%), while the lowest was contributed by

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water bodies (3.61%) and also finds the driving forces that show the considerable impact on the urban ecosystem.

5. DIGITAL IMAGE PROCESSING:

Digital image handling strategies were completed for Indian Remote Sensing satellite (IRS) LISS III and LISS IV sensors and Hyperion. Radiometric correction, Geometric correction plus image geo-referencing, image enhancement and colour composites, were done to change and alter the original raw phantom information to increase the data accessibility [8], and to give the finest possible invention for analysis and understanding for data mining (unsupervised classification, supervised classification), normalize difference vegetation index (NDVI). GIS was also used to erect the soil properties, the land resource catalogue and to toil the spatial model to generate the different maps.

5.1 Software used:

ENVI 5.0 as well as GIS 10.1 package was used for integration between RS and GIS to arrive at the capability and suitability final spatial map verdict. Map construal was done using Geographic information system (GIS).

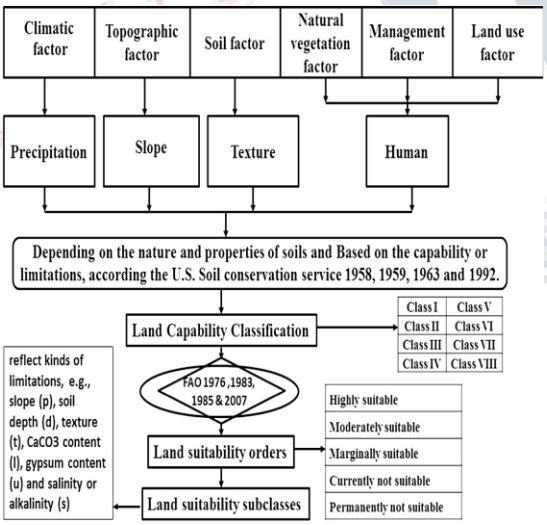

Figure 2: Flowchart for generating land evaluation maps

Land evaluation classification was undertaken according to the FAO (1976, 1983, 1985 and 2007) system to assess the suitability of the studied area soils for agriculture and development [10]. Land capability classification was also undertaken based on the capability or margins according to the U.S. Soil conservation service (1958, 1959, 1963 plus 1992). The methodology flow chart for mutually land potential plus land evaluation classification is exposed in Figure. 2.

6. CONCLUSION:

This manuscript concentrate on different types of land use/ land cover for the study area of tirupati, with different levels based on NRSC and IRSO (2011). The grades range from 1 (excellent) to 5 (very poor) are also described as per the source of Source: MAFF (1988) Agricultural Land Classification of England and Wales. Data analysis and interpretation for information extraction for the study area (unsupervised classification, supervised classification), normalized difference vegetation index (NDVI) are going to carry out in our future research work to digitalize the satellite image extracted from map using remote sensing and GIS.

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