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Case Study

Satellite image analysis using remote sensing and GIS: a case study of Jagtial District, Telangana State, India

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Abstract

A detailed land use / land cover mapping has been carried out in the Jagtial district of Telangana State, India, by applying visual and digital interpretation IRS-R2-LISS-IV satellite imagery. The diverse Land use category as forest, agriculture, liquidation, water bodies, drainage, transportation and land cover pattern is divided into built upland, cultivated land, forest land and uncultivated land (Barren land).These features follow a general trend of having a set of natural resources in the study region.

Keywords: Land use/land cover, IRSR2-LISS-IV satellite image, agriculture plantation, topography, soil map, transportation.

Introduction

Land use is product of fundamental interaction between a society's cultural background, province and its physical needs on the one helping hand and the natural potentiality of earth on the other[1]. The intended employment of land use management strategically placed on the land by human being agents or land managers to exploit effort and to reflect human activities natural action such as industrial zones, residential zones, agricultural fields, grazing, logging and mining among many others[2]. On the other hand the land cover is defined by the attributes property of the earth's land surface control airfoil captured in the distribution of vegetation, water, desert and ice and the immediate subsurface, including biota, soil, topography, surface and ground water and it additionally included those structures engendered by human activities such as mine exposures and settlements[3-5]. Remote Sensing (RS), integrated with Geographic Information System (GIS), provides an effective tool for analysis of mapping the data and interpreting the relationships among the data and making inferences.

Study area: Jagtial district is located in the southern part of the Godavari river basin, River Godavari occupies largest surface expanse in the peninsular India, The rest of the study area located in between Pedda vagu I and II and south Kakatiya canal. The study domain lies in and around newly formed Jagtial District, in the Telangana state is located between latitudes 18° 30' N to 19° 5' N and the longitudes 78°30'E to 79° 35'E. The district binding an area of 1419.34 sq km. The rock formations[6] in the district comprise granites, gneisses, sandstone, limestone, shale, quartzite's etc. The occurrence and movement of the groundwater is a consequence of a finite combination of topographical, climatological, hydrological, geological and structural features. The location map of the study area is shown in Figure-1.

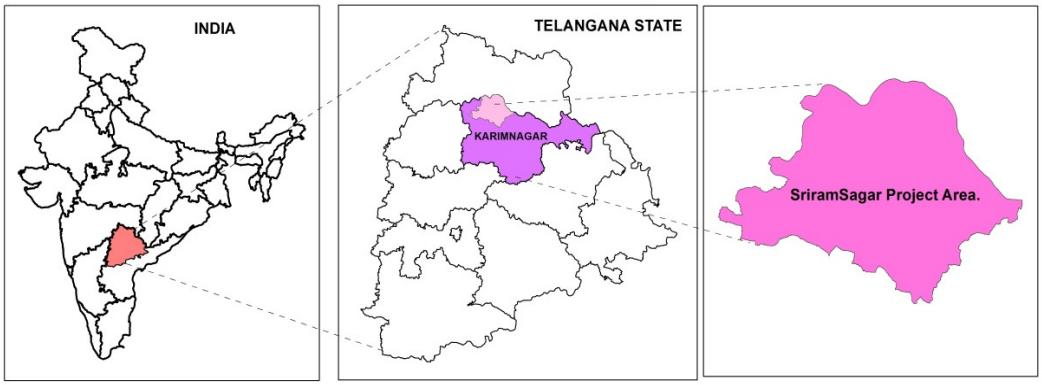


Figure-1: Key map of the study area, Telangana State, India.

Results and discussion

The data have been collected from NRSC Hyderabad and freely available on the net source. The topographic map (1:50,000) from Survey of India are the primary winding (Toposheets No. 56J/13, 56N/1, 56I/16, 56M/4) and multi spectral IRS-R2-LISS-IV Satellite Images of 2012-14, resolution 23m number of bands are 8, path No.100 and row is 59 of Jagtial district. The precision geo-coded data, IRS-R2-LISS-IV multi spectral scanning radiometer with eight bands and being capable of providing high resolutions were prepared using several band combinations and as many band rationing/indexing techniques mentioned by several authors[7-11] techniques of image information of the earth's surface.

ERDAS imagine is used for classification and mapping the resources for image processing operations[12-16]. To improve the quality of mapping techniques for stratification, directional filtering and refinements are applied wherever necessary. A total of three thematic maps such as land use and land cover, soil and transportation maps were prepared based on image interpretation studies with limited checks. The satellite data is acquired over the area on 19-03-2013 and the standard data product corresponds to a panorama with path/row numbers 100/59. Subsequently the image was geo-referenced and analyzed using appropriate software modules of ERDAS 9.1 and Arc GIS 9.2. Geometrical ratification for satellite data is used for ground control points (GCPs) extracted from the base map. The ground control points including roads, drainage lines and other manmade features displayed to process, enhance and analyze the output raster as well as vector data for various applications. IRS-R2-LISS-IV image of Jagityal district is shown in Figure-2.

The land use/land cover pattern of a region is an outcome of natural and socio–economic factors and their utilization by man in time and space[16]. The Land use and land cover pattern and its spatial distribution are the major fundamentals of a successful strategies required for the appropriate development and organization of any domain. The land use map prepared through remote sensing and their spatial distribution is shown in Figure-3, Table-1. The various land use patterns are depicted in the report area using the visual interpretation of the satellite imagery of IRS Resourcesat-2 LISS-IV, Spatial Resolution 5.8m.

The land use / Land cover is categorized to ten conventional divisions in the present study i.e. Agricultural land, barren land, built-up area, canal distributions, core urban, cropland, forest, afforestation, habitates, lakes/ponds, rural, mining/industrial, reservoir/tanks, rivers, salt affected zones scrub land dense, scrub land open and roads. These maps are the true representation of earth's phenomena such as spatial distribution of natural resources existing at the time of survey. Visual interpretation is carried out based on the visual keys such as color, tone, texture, pattern, size and shape is based on the ground truth. Land use and land cover map of Jagtial district shown in Figure-3. The classification of land use/land cover is discussed in detail in the following paras.

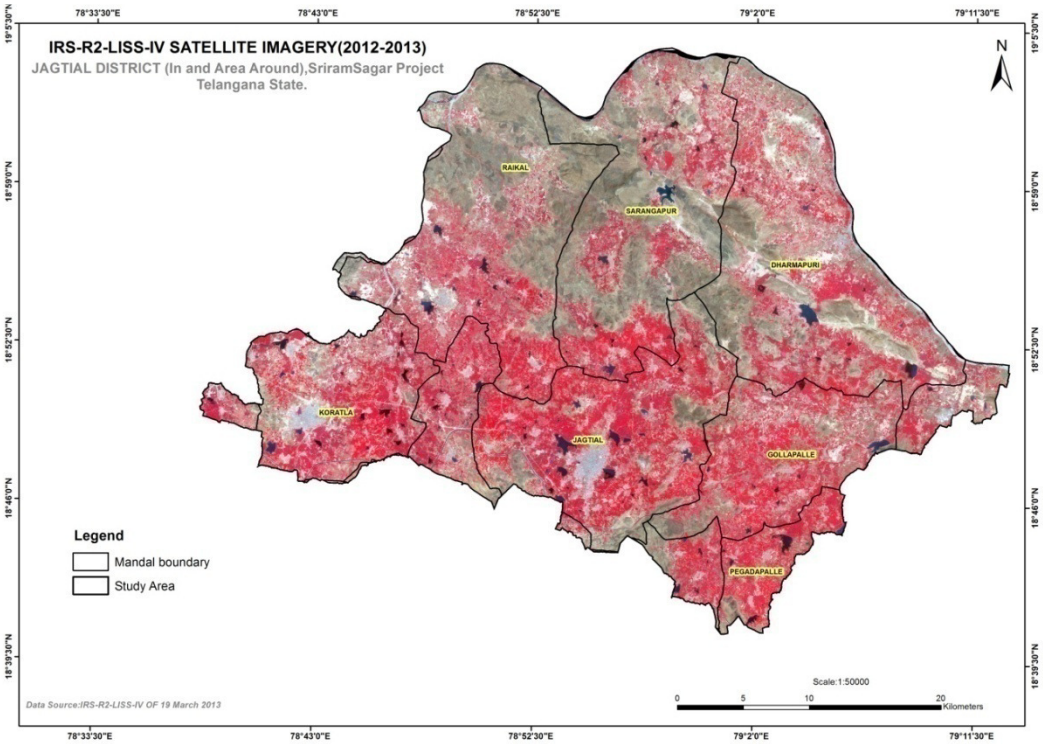
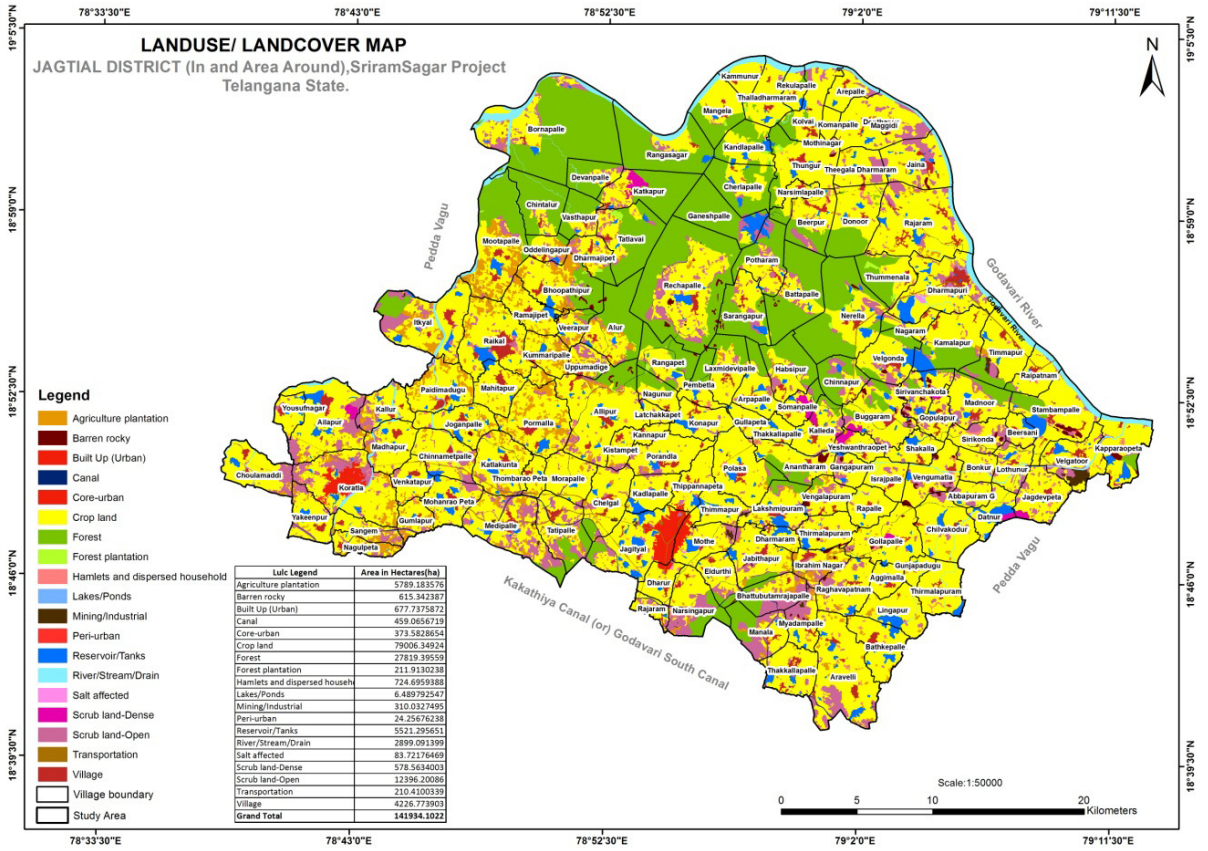


Figure-2: IRS-R2-LISS-IV Satellite image of the Jagtial study area, T.S.



Lulc Legend	Area in Hectares(ha)
Agriculture plantation	5789.183576
Barren rocky	615.342387
Built Up (Urban)	677.7375872
Canal	459.0656719
Core-urban	373.5828654
Crop land	79006.34924
Forest	27819.39559
Forest plantation	211.9130238
Hamlets and dispersed househ	724.6959388
Lakes/Ponds	6.489792547
Mining/Industrial	310.0327495
Peri-urban	24.25676238
Reservoir/Tanks	5521.295651
River/Stream/Drain	2899.091399
Salt affected	83.72176469
Scrub land-Dense	578.5634003
Scrub land-Open	12396.20086
Transportation	210.4100339
Village	4226.773903
Grand Total	**141934.1022**

Figure-3: Landuse/land cover map of the Jagtial district. T.S.

Agriculture Plantation: The agriculture plantation includes head crops grown in the field during kharif and Rabi seasons. 22% of the amount geographical domain of the district covers the wet crops (Kharif) are raised during June to October. Kharif crops include paddy, red gram, green gram and other pulses etc. The harvest which are grown during November to March/April are considered as Rabi crops are normally grown under irrigated circumstance. Rabi crops include mainly paddy, cotton plant, sugarcane, etc. While paddy is exclusively cultivated under tanks, maize, turmeric, groundnut and chilies are the major irrigated dry crops catered by wells. The other crops like Jowar, ground nut, green gram, sesame are grown mainly under rainwater conditions. With the availability of the irrigation water from Pochampad project in the command area. These crops clearly see on the satellite image (FCC) in red color.

The areas where harvest are grown two times in a year called double crops i.e. Khariff and Rabi. The study area covered 57.90Sq.km and it consists of 4.07% of the area having double crop i.e., Kharif and Rabi crops. It means the percentage of area under double crops indicates the economic successfulness of the field area. The cropped area appears in a yellow tone with varying configuration and size in a contiguous to non-contiguous pattern and are widely distributed in different terrains.

A cursory look at the map indicates that areas around Metpally, Korutla, Maidipally, Pegadapally, Ramadugu, Kodimial, Husnabad, Sultanabad etc., are under double crops. Besides, wherever there is water body or tank which provides water for irrigation is also under double crops.

There are two main types of soils, namely sandy loam and clayey loam in the test area (Figure-4). Both of them are suitable for irrigation.

Moderately deep calcareous black soils span over 70 to 80 percent of the total area exhibits blue tone on the image. They range in colour from brown to green (shallow gravelly red soils) with low clay content (deep black clayey soils) and occur at depths ranging from 0.30 to 0.50m. They mostly occur near hill flanks and elevated or sloping places. Sandy loams rest on disintegrated rock (morrum).

The permeability of these formations is moderately high. at the other type of Soil, clayey loam, mostly occurs at the boundaries of the test area. The surface soil is lighter in colour, but with increase in depth the clay content increases and becomes black. The thickness of this type of soil varies from 30 to 70cm.

It was found that there is direct control of soil in the report area comprises of different types of ground i.e visible light territory and heavy soils.

Table-1: Land use/Land cover Change Analysis in the Jagtial district.

Class Name	Area (Ha)	Area (Sq. Km)
Agriculture plantation	5789.1835	57.90
Barren rocky	615.343	6.15
Built tup (Urban)	677.737	6.77
Canal	459.065	4.59
Core Urban	373.583	3.73
Crop Land	79006.35	790.06
Forest	27819.39	278.2
Forest plantation	211.913	2.11
Hamlets and dispersed household	724.695	7.25
Lakes/Ponds	6.4898	0.065
Mining/Industrial	310.033	3.10
Peri-urban	24.256	0.24
Reservoir/Tanks	5521.29	55.21
River/stream/Drain	2899.09	28.99
Salt effected	83.72	0.84
Scrubland-Dense	578.56	5.78
Scrub land Open	12396.21	123.96
Transportation	210.41	2.10
Village	4226.774	42.26
Total	141934.11	1419.30

Barren rocky: Open space or barren lands 6.15Sq.km have little or no vegetation and limited to support vegetative communities due to human natural process, expanse such as agricultural, extractive and industrial land uses may be classed as barren land, therefore these areas must be explored very closely through the use of supplemental such as aerial photographs and topographical sheets included in this category are the sub categories of Beaches, exposed rock and distributed land, play grounds. They are appeared in maroon fine colour textured.

As analysis of the nature and rate of land use alteration and its associated impact on ground water quality is essential for a roper agreement of the present environmental problems.

Built-up Area: This class consists of areas of Urban, Core urban and Peri Urban, intensive use much of the land which occupied by man-made structures[16]. It is an area of man dwelling house developed due to non agricultural use and that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. This clause consists of Urban and (6.77Sq.km), core-urban (3.73Sq.km) and Peri urban (0.24Sq.km). Hence the area covered by 0.74% of total area. These appeared in Dark Red tone having very coarse structure.

Forest: Forest area comprises predominantly trees and other vegetation eccentric, capable of producing timber and other forest produces. These world generally occupy the topographically high regions. This land use/land cover covered 278.2sqkm in the study area (Figure-3). The forest plantations are covered 2.11Sqkm and they comprise of thick and dense canopy of tall trees, which can be evergreen, semi evergreen or deciduous (moist/dry/thorn). The forest area spreading over south of Godavari river and its produce teak, beedi leaves, honey, tamarind, etc.

Water Resources: The cogitation examined the natural drainage pattern and surface water bodies in conjunction with the landforms in the study area. The water bodies consist of rivers/streams (28.99 Sqkm), lakes/ponds (0.065 sqKm) etc. and reservoir tanks 55.21 Sqkm. The major rivers in the study area are Godavari and Manner. When the drainage is compared with landform dispersion, reveals that most of the tanks were constructed with the help of linear ridges and river gaps. The tanks are provided irrigation facilities for growing paddy, sugarcane etc. The combining of rivers and surface water bodies provide irrigation which can influence land use in that particular area. The surface water bodies comprises in the form of ponds, lakes and reservoirs or flowing as streams, rivers, canals etc. The water bodies are seen clearly in the satellite image in blue to dark blue or cyan color depending on the depth of the water bodies. The water bodies are spatially dispersed 250sqkm, which is 2% of the total district area.

Scrub land dense and scrub land open (Waste land): Scrub land dense and scrub land open area constitutes as a waste land. Major categories of waste lands are prominently observed and are in the form of dense scrub, open (123.96Sqkm) and Scrub / Ravines occupied by 84sqkm respectively (Figure-3). The total wasteland in the district covered by barren, rocky or stony wasteland spreads over an area of 6.15sqkm of the total area of the district.

The waste land as degraded, which can be brought under vegetative cover and which is currently under-utilized due to lack of appropriate water and soil management or on account of natural causes. Wastelands can effect from inherent/imposed constraints such as, by location, environment, chemical and physical properties of the soil or financial or management constraints. 24% of the waste lands are identified in the Karimnagar district.

An assortment of land use/land cover form like excavation /industrial and salt effect areas occupied by 3.10Sqkm and 0.83Sqkm respectively. The village's constitutes by 42.26 sqkm of the total district area were identified.

Transportation: The transportation map (Figure-5) coverage the entire Jagtial district, it is part of a Karminnagar district (old) , the route are bounded on the north and the south by the river Godavari and the Kakatiya canal respectively, and by Peddavagu I and II on the east and west, occupied by state and national roads and Communications covered by 2.10Sq.km show in Figure-3.

Topography: The topography of the Study area can be treated as undulating with gradual relief towards the north east i.e. towards the river Godavari river (the lowest elevation is below 190m and the highest elevation, over 490 with respect to mean sea level). Figure-6, The maximum elevation occur along the NW-SE direction of illumination being from the Northwest to Southeast facing slopes are light in tone where as the north are dark in tone. The decrease in observed density drainage in these blocks is on account of this increase in elevation. As the topography of rock type and climatic regime govern the drainage pattern, the latter can be used to identify the rock type and structure. The drainage in the northwestern part of the area is sub-dendritic and sparse. It can be seen that this type of drainage is characteristic of granite terrain.

Conclusion

The present study has classified as major land use/land cover types. The Indian Remote Sensing Satellite (IRS-R2-LISS-IV) data, image processing and Geographical Information System techniques were used to identify the land use categories such as Agriculture plantation, Barren rocky, Built-up area (urban), Core urban, Crop-land, Forest, Forest Plantation, villages, Lakes/ponds, Reservoirs/Tanks, Scrub land dense, scrub land open. Satellite images in combination with predated topographic sheet of Survey of India were used for analyzing land use and land cover change detection. With the help of Geographic Information System the various land use and land cover zones are mapped, which in helpful for macro and micro level planning. Topographic map is used for better demarcation of different geomorphic units.

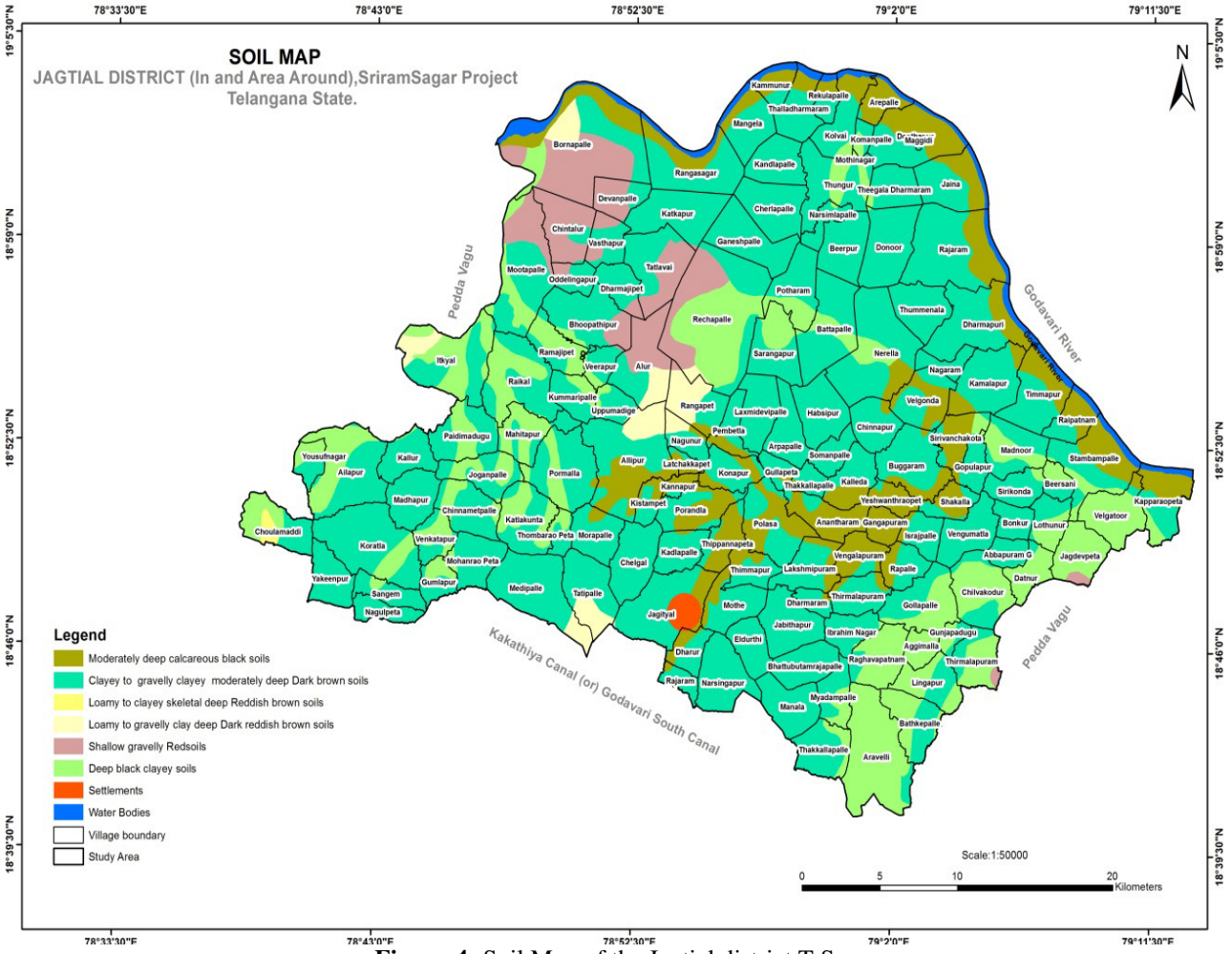


Figure-4: Soil Map of the Jagtial district T.S.

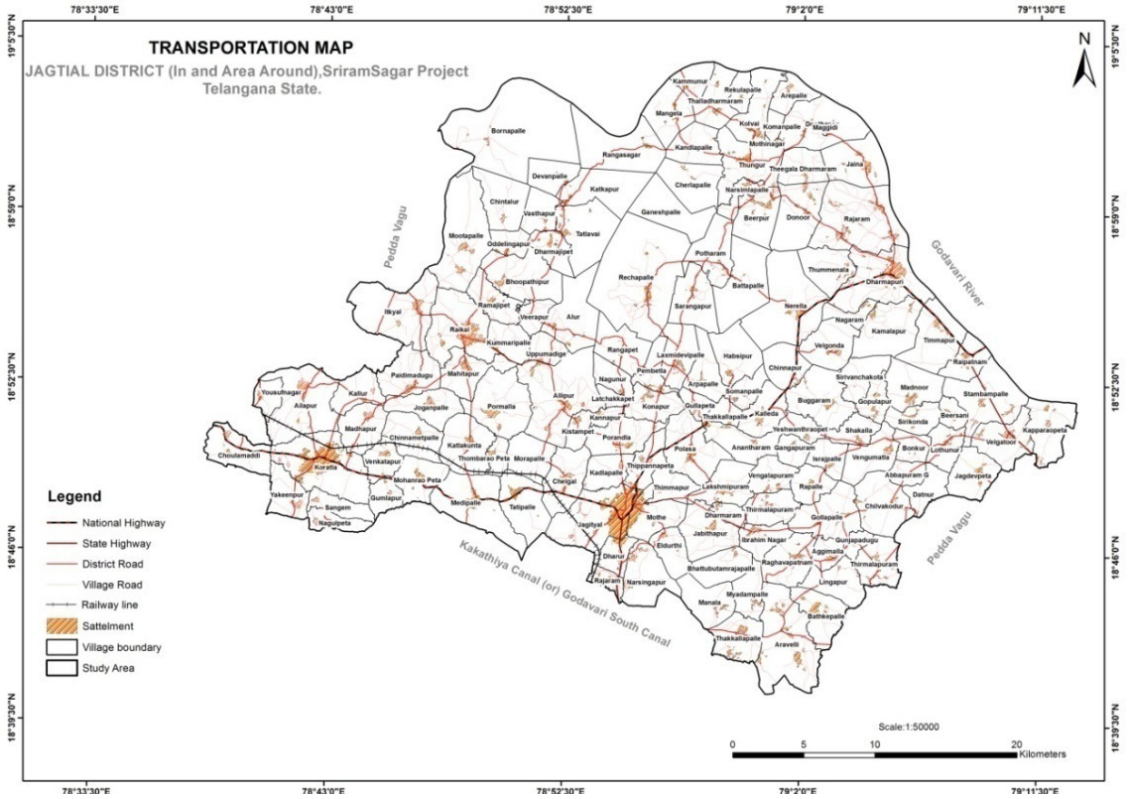


Figure-5: Transportation map of Jagtial District T.S.

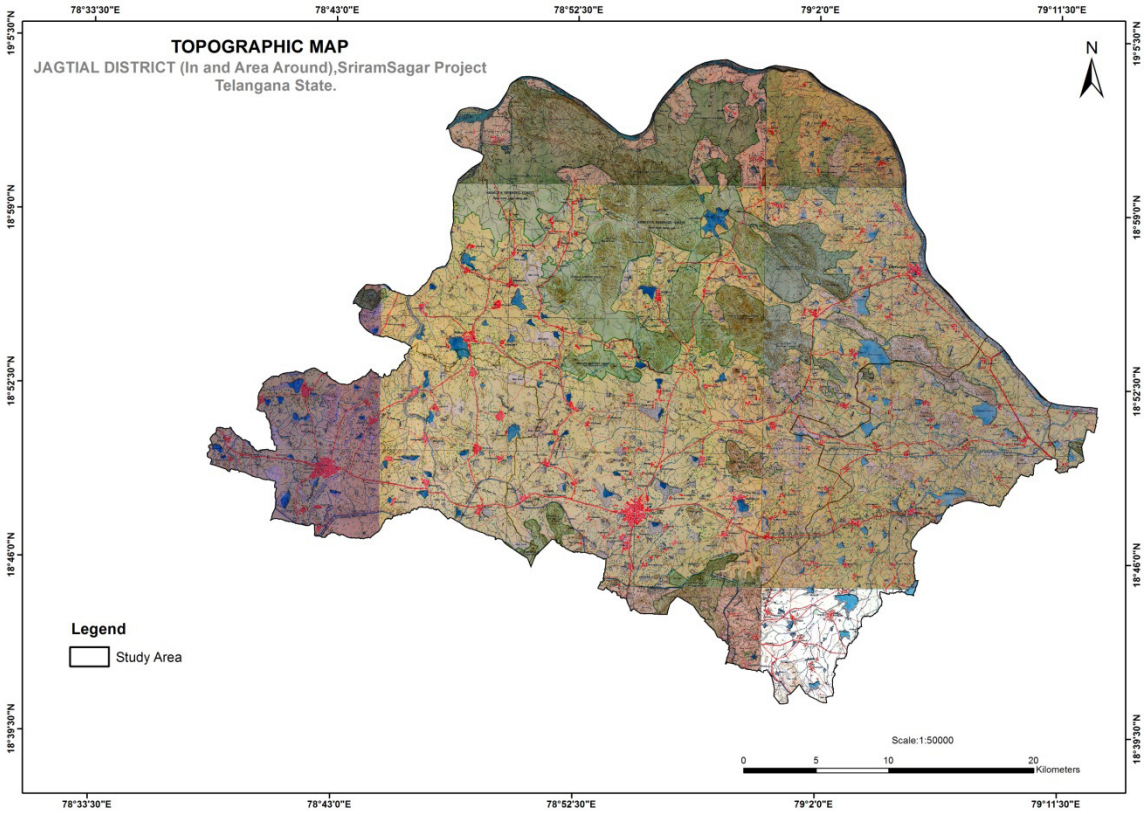


Figure-6: Topographic map of Jagtial district T.S.

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