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Original Article

Assessment of Changes in Land Use Pattern During 2009-2019 After Starting a Cement Plant: A Study in Mylavaram Mandal, Kadapa, Andhra Pradesh using Indian Remote Sensing Data

D. Anitha[1], M. Sridhar Reddy[2]

[1,2]*Department of Environmental Science, Yogi Vemana University, Kadapa, Andhra Pradesh, India.*

[2]*Corresponding Author : sridharmullangi@yahoo.com*

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Abstract *- Kadapa district is a mineral-rich area with large deposits of cement-grade limestone. These rich mineral deposits have led this area to be placed along the list of the largest cement producers in Andhra Pradesh. The present study focuses on land use changes in the decade between 2009 and 2019 in the Mylavaram Mandal, where the Dalmia cement plant started in 2009. For this, the study uses the IRS imageries to produce LULC maps, and further, it tries to assess the changes in cropland and mining areas. The study tests the hypothesis that initiating a cement plant has led to the progress of industrial activity in this area. For which the utilization pattern of natural resources and land use will be carried out through LULC maps and how human capital was utilized through interaction and interview processes. It was observed that the thriving cement and slab polishing industries are mainly due to the availability of limestone-rich areas, roads, railway connectivity, and water resources. At the same time, initiating the powerloom sector at the household level is due to government support and conviction among the people to raise economically among both the skilled and semi-skilled people in the area.*

Keywords *- Dalmia cement plant, Industrial activity, Landuse land cover Map, IRS data*.

1. Introduction

Immense technological advancements in Remote sensing have paved the way for obtaining satellite data on Earth's natural resources at varied scales and themes [1]. The presence and availability of mineral resources play an important role in the region's industrial development. This vast geospatial data can be readily used by Geographic Information Systems in order to prepare Land Use Land Cover maps, which help in visual interpretation to make decisions in the utilization of resources [2]. The Kadapa district region comprises mineral resources like barytes, chrysotile asbestos, clays, limestone and Kadapa slabs, mainly associated with Proterozoic sedimentary rocks. For cement production, the availability of limestone is crucial, and the limestone mines that exist in the Vaddirala, Yerraguntla areas of Jammalamadugu and Mylavram mandals comprise good reserves of cement-grade limestone in Kadapa District. This region comprises six large cement plants, resulting in clusters of industrial and commercial activities in certain areas. Napa slabs/ Kadapa slabs are black-coloured limestone and are present in the areas of Niduzivi, Koduru, Valasapalli Sugumanchupalli villages of Yerraguntla, Mylavaram and Jammalamadugu mandals [3]. Hence, the majority of the polishing industries in the Kadapa district are mainly concentrated in Yerraguntla and Mylavaram mandals, which produce polished slabs that are mainly utilized for flooring in houses [4].

Basic information about land use and land cover in a particular area has become a tool for making decisions to achieve a high growth rate with minimum environmental damage by better utilizing the natural resources as well as by not losing the fertile agricultural lands, wetlands, and forest cover. Thus, the land use land cover (LULC) maps comprising land use changes at varied time periods are very useful for proper planning in the utilization of natural resources. The objectives of the study are to know how the open land, agricultural land, limestone mineral-rich land, water resources, and road/railway connectivity have been utilized in a decade (2009 -2019) after starting the cement plant in 2009 in Mylavaram mandal by using GIS technology. To know whether the momentum provided by the Dalmia cement industry has led to further improvement in commercial activity or led to a reduction in agricultural land area.

2. Materials and Methods

2.1. Landuse/Land cover Thematic map Preparation (LULC)

The LULC map represents the distribution of natural resources at different places present at the time of study in an

area. Remote sensing is an ideal technology for producing a LULC map on varied scales. Owing to its possession of varied spectral bands with spatial details and temporal frequency, Indian Remote Sensing (IRS) data is suitable for the assessment of land use changes in the study area. For the present study, satellite imagery (IRS Resourcesat-2) comprising land use classes like vegetation, crop area, reservoir, etc., is considered the base map. The interpretation of the satellite imagery was carried out visually based on the characteristics like tone, size, shape, pattern, texture etc, of an image. These characteristics are crosschecked with the existing topographic map features and as well by undertaking study area visits. IRS imageries with less cloud cover in May 2009 and 2019 were downloaded from the Bhuvan website (http://bhuvan.nrsc.gov.in). The imagery of 23.5m pixel size was accessed from the website in GeoTIFF layout, and the map projection was UTM WGS84. The imagery was topographically corrected using ground control points achieved through the GRASIM GPS instrument, and the imageries were generated using Q GIS software. The multispectral images are attained by stacking the bands that occur in different color combinations of Red, Green and Blue into layers. A subset image was extracted through the multiband image with the help of Q GIS software by using SCP PLUGIN.

3. Results and Discussion

The LULC maps of the Mylavarm mandal 14^0 54' 59" N and 78^0 17' 31" E for the years 2009 and 2019 were prepared and represented in Figure 1 and Figure 2. The land use pattern in 2009 showed agricultural areas, residential areas including villages, townships, Dalmia cement industry, limestone quarrying area, open wasteland, scrub forest, electrical substation, Pennar river, Mylavaram reservoir, water tanks, road and railway network. Mylavaram reservoir was constructed at the junction point of the Chitravathi and Pennar rivers, where 5 and 6 stream orders were also noticed (Figure 3). This water resource mainly supports the much-needed water for industries and agriculture. The contour map revealed that agricultural and residential areas were present in the 100-350m contour interval (Figure 4). A higher proportion of the area is of hilly terrain of 300-450m contour levels comprising mainly huge barren rock exposures with the least vegetation.

Limestone is extensively used as a chief raw material in cement production. Geologically, cement-grade Narji limestone that is exposed in Vaddirala, Nawabpet and Talamanchipalli villages is used for cement production in the Dalmia cement industry, which was established in Chinnakommerla village of Mylavarm mandal in 2009. In addition, black-coloured limestone, famously referred to as Kadapa slabs, mainly used in house flooring, occurs in the Sugumanchupalli areas. These rocks feature perfect cleavage planes of 3-5 cm and a few metres in length, and several stone polishing industries extensively use these quarried rocks in Mylavaram Mandal.

The study intends to test the hypothesis that the cement industry certainly provides an impetus to commercial activity in the surrounding area. A comparison between the LULC maps prepared for 2009 and 2019, especially on the lines of hypothesis, revealed new additions like a railway line and ultra solar park. The railway line between Yerraguntla and Nandyal town was commissioned in 2016, and one of the goals is to increase the industrial activity in this limestone-rich area by increasing the railway goods service to enhance the cement and coal transport (Figure 5). In addition, Kadapa Ultra Mega Solar Park was started in an area of 5,927.76 acres in the Mylavaram mandal, mainly due to the availability of open land in the contour intervals of 100m and 350m.

The slab polishing industry is being encouraged by Micro, Small and Medium Enterprises in this area (kadapa.ap.gov.in). The LULC map has also shown an increase in the stone Quarry area and as well the water bodies that are formed in the deep quarry pits. It suggests that the hypothesis can be accepted as the initiation of the Dalmia cement industry has led to further industrial activity in the mineral-rich area. While less than 5% change was recorded in agricultural areas and open scrub forests (Table 1). It suggests that the conversion of forestry land to non-forestry purposes was not noticed. But a greater than 10% increase in area was noticed in the categories of quarrying area and residential area.

In addition, the substantial increase in agricultural land was not noticed in the decade. It is noteworthy to be noticed that Non-agrarian employment in the form of the powerloom industry being run by both weavers and non-weavers, was also successful in this area. This kind of decentralized powerloom sector has become important not only in producing fabric but also in employment generation, women empowerment and economic growth [5]. The studies on the powerloom sector indicate that due to certain favourable factors like being small units, less expensive, and having no applicable labour laws, they flourished in small villages being run by small entrepreneurs [6]. In this study area, especially in a village named Dommara Nandyala, these powerloom units are being successfully run by women entrepreneurs, even from the non-weaving community, with active support from the government. The occupation has generated a parallel economy in addition to the main occupation of agriculture in the form of buying fabric dyes from the market, producing fabrics like sarees and dhotis, and exporting them to other cities. The interaction with the powerloom owners revealed that the proactive role of the then Joint Collector in providing financial support in the form of loans, technical training to the non-weaver people and the availability of water power has paved the way for the success of the household power loom units in the village. Similarly, the interaction with slab polishing owners reveals that the presence of workable raw materials is the main reason for establishing the industry. They have given more importance to the infrastructure in the form of the road network, power and semi-skilled labour as factors that helped

them to flourish in this industry, as also noted in a similar study carried out in a mineral-rich area, namely Tadipatri [7].

4. Conclusion

The flourishing cement industry, slab polishing industry, and functional ultra solar park are mainly due to the locational advantages such as limestone-rich area, the presence of open land, road, railway connectivity, water resources, and both skilled and semi-skilled people. It was observed that the availability of water and transport networks has increased commercial activity even with the preservation of agricultural land. However, the improved transport sector in the form of trucks and lorries based on the demand for cement and slabs should be sustained properly, as it was observed that these vehicles are diverted to sand mining, which is detrimental to the environment.

Table1. Details of the geographical area of various land use patterns of Mylavaram Mandal

S.No	Land use Land Cover/ LULC-Class	Area in Km^2	Area in Percentage
1	Scrub Forest Land	118.33	23.43
2	Cropland	243.08	48.14
4	Built upland (Towns and Villages)	15.76	3.12
5	Stone Quarrying Area	4.4	0.87
6	Mylavaram Reservoir and Water Bodies	8.1	1.6
7	Open Barren land	113.4	22.46
8	Stony Mine wasteland	1.8	0.36

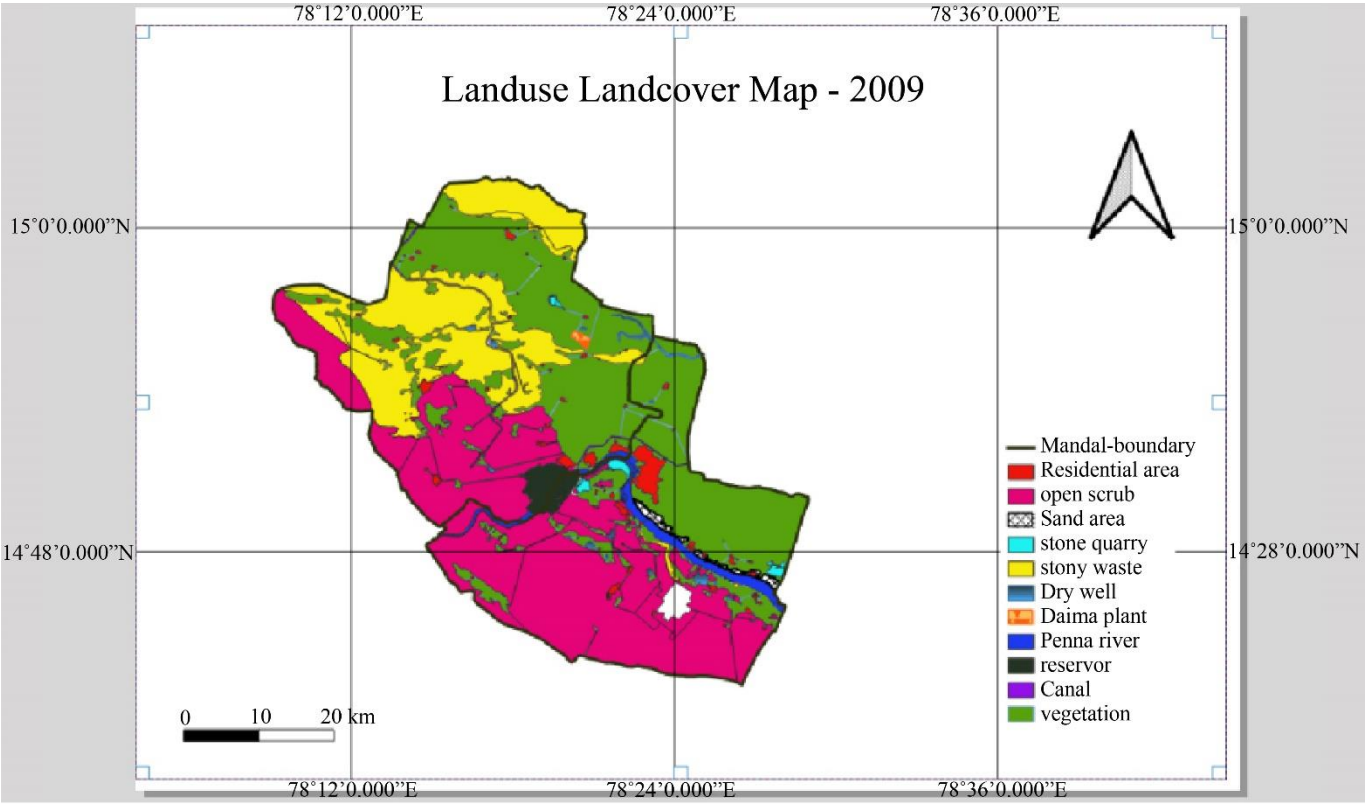

Fig. 1 Details of the Land Use and Land Cover Maps of the Mylavaram Mandal in 2009

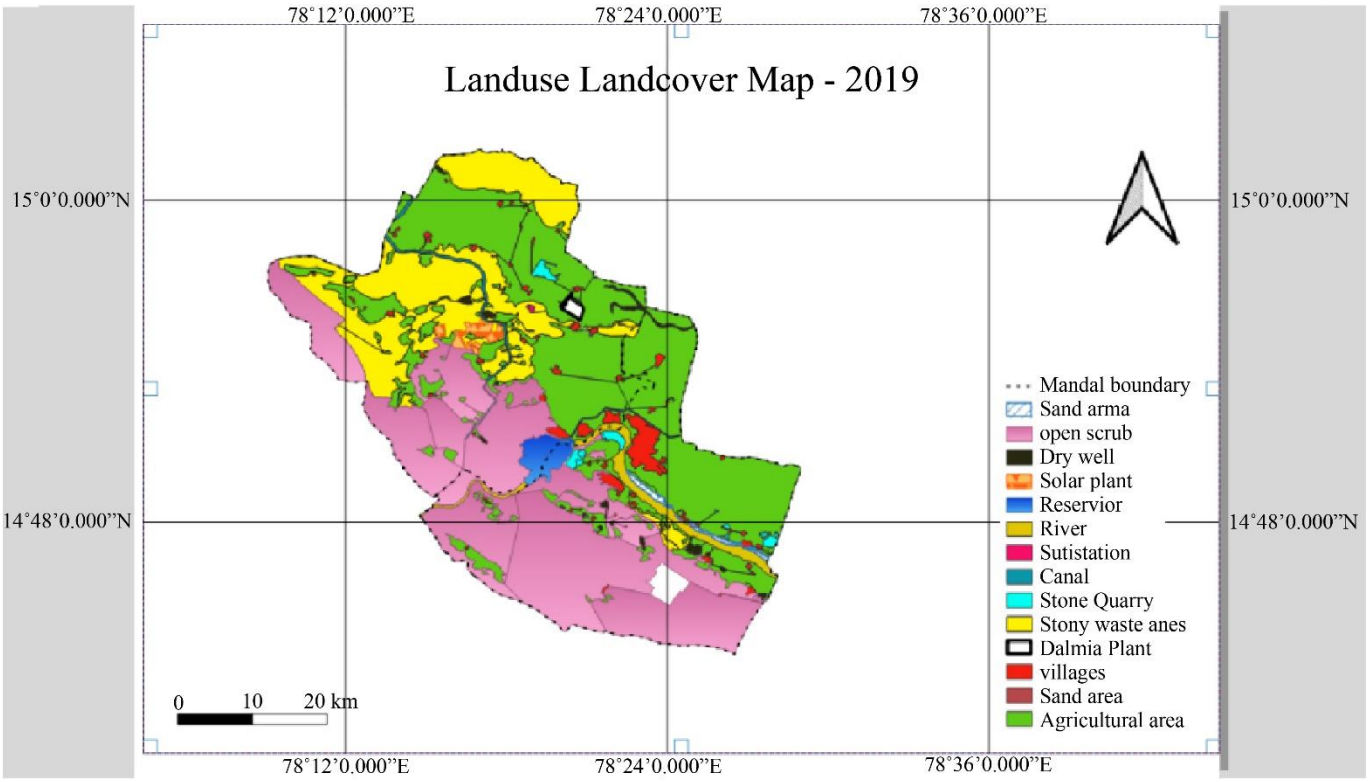

Fig. 2 Details of the Land Use and Land Cover Maps of the Mylavaram Mandal in 2019

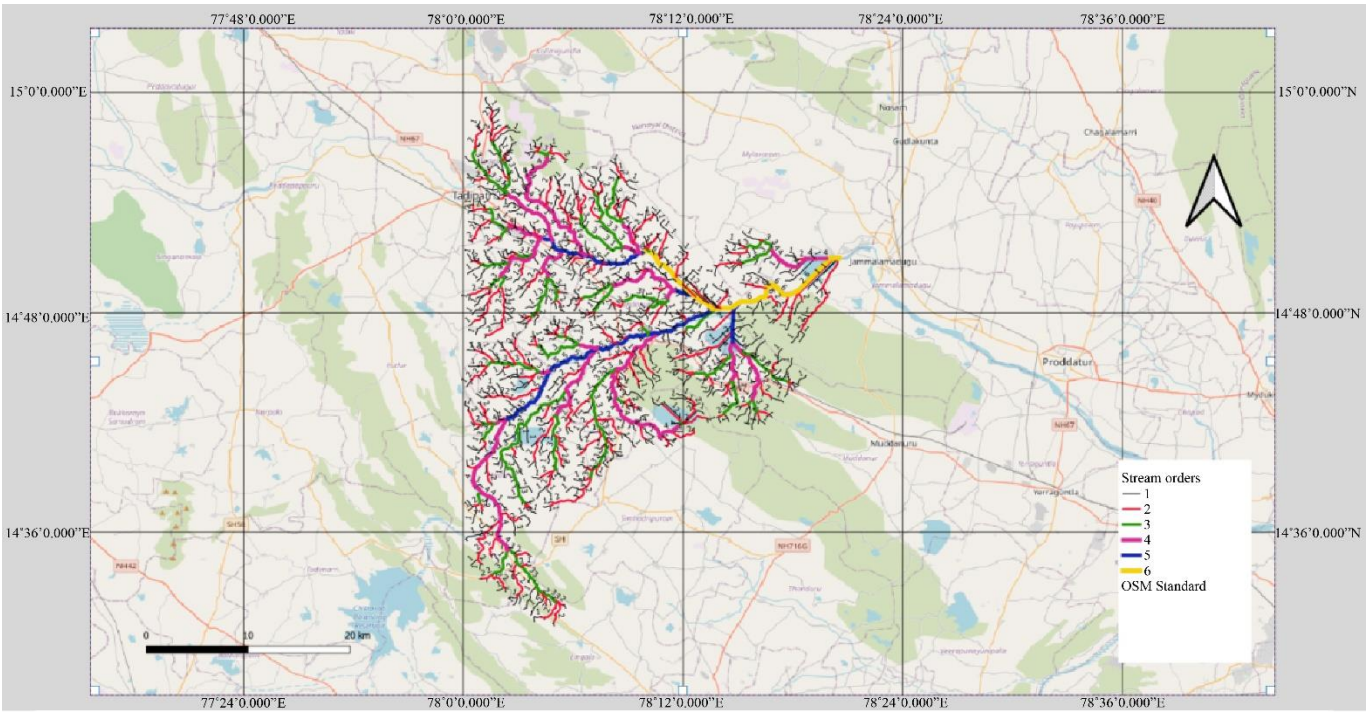

Fig. 3 Details of the stream orders of the Pennar River in and around the Mylavaram reservoir

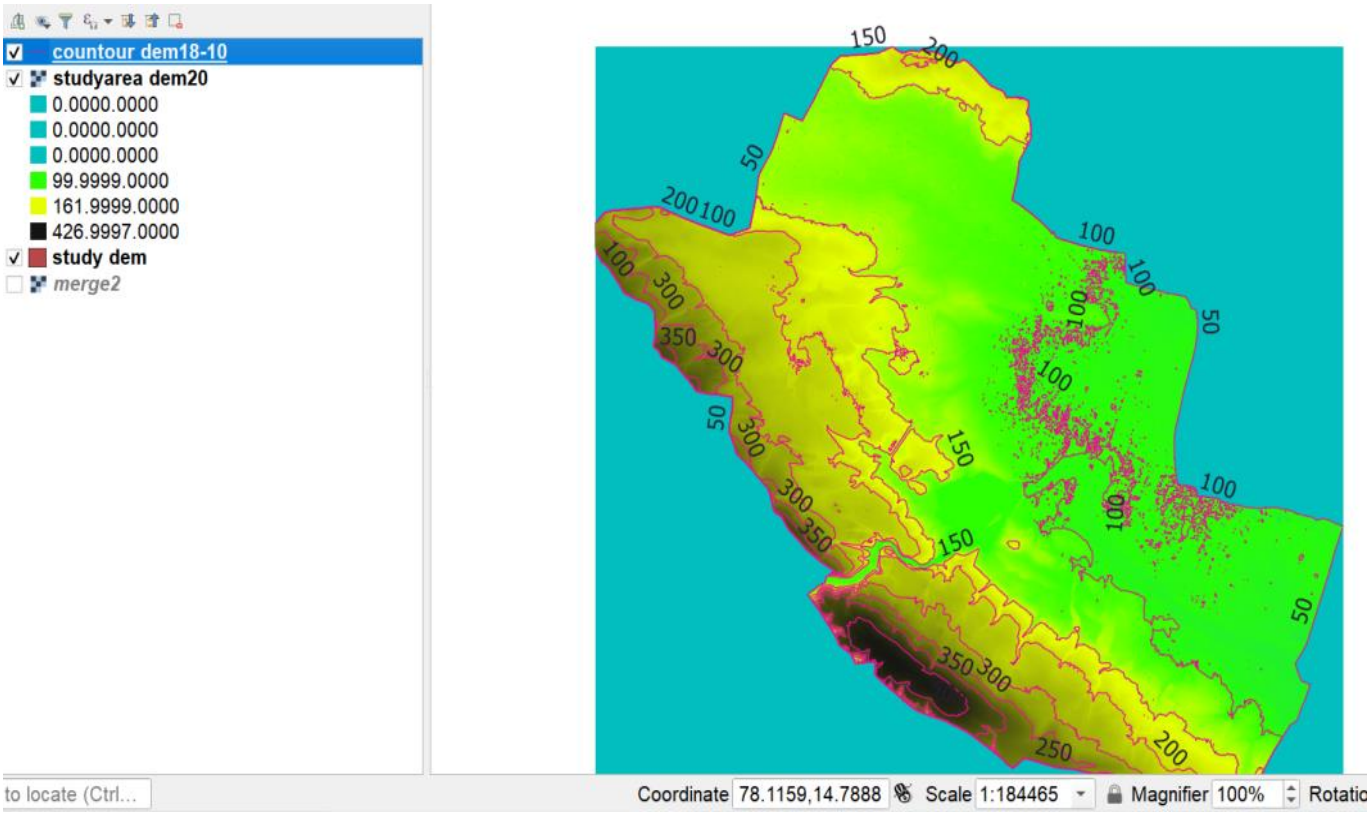

Fig. 4 Details of the Contour lines ranging between 50-350m of the Mylavaram Mandal

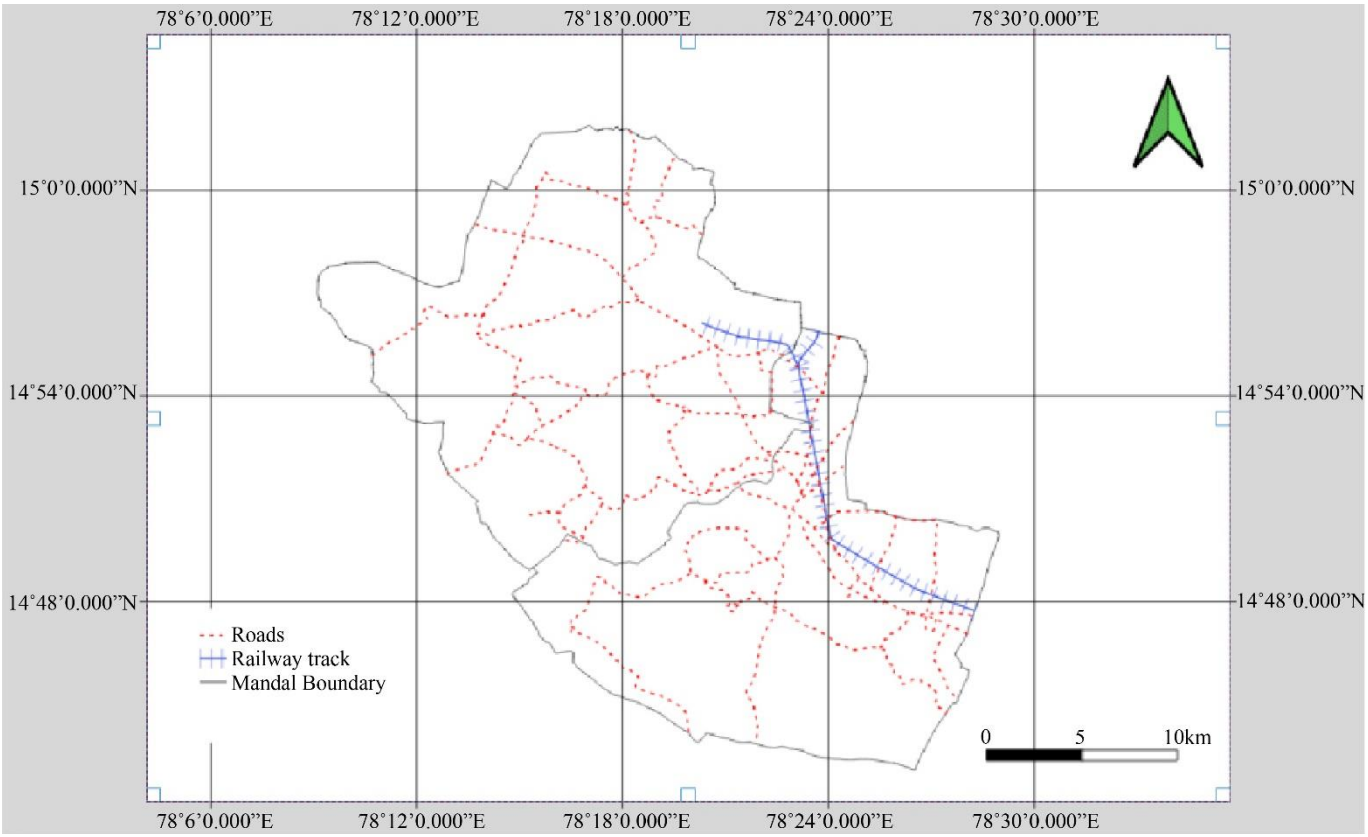

Fig. 5 Details of the LULC Map showing the Road and Railway networks in the Mylavaram Mandal

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