

# Landuse / Landcover Change Detection Analysis of Area Surrounding NTPC Power Plant using Remote Sensing and GIS

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**Abstract:** Harmony or balance between people and the environment is the basics requirement of a healthy life. Industrial and human activities have affected the natural ecosystem, leading to changes in land cover in land use, which is a major concern for ecologists and society. The change of land cover structure in land use is the result of natural and socio-economic factors and human use in time and space. Change analysis plays an important role in natural resource management and environmental change assessment. With the help of remote sensing and geographic information systems, in parts of Sonnebhadra and Singrauli regions, land use and land cover changes have been investigated for 10 years. The impact of NTPC Thermal Power Plant in Shaktinagar and Vindhyanagar of Sonebhadra and Singrauli district of Uttar Pradesh and Madhya Pradesh state and its surrounding can be well monitored through Geo-spatial Technology. Satellite images of different resolutions are the main source for creating various thematic layers by analyzing digital images and GIS applications. The growth of human settlements, the changes in vegetation cover and surface water, and the growth of mining activities are some of the key factors that can be used to appropriately control environmental impacts. The main purpose of this study is to create several thematic levels for environmental analysis and land use/land cover changes within a 5km radius of the NTPC thermal power station. The study is conducted for the two period of time frame i.e. for the year 2010 and 2020. It is observed that the Dense forest cover is reduced from 3457.95ha (2010) to 2266.54ha (2020) that resulted in the low precipitation in the singrauli region and continuous increase in the temperature. Mining area is estimated at 3514.28ha in 2010 which is increased to 6602.67ha in 2020 which causes negative impact on the ecological balance of the region. Deforestation is a continuous phenomenon as Tree clad area reduced to only 467.63ha (2020) as compared to 907.06ha in (2010). Therefore it is observed that quick and effective measures must be taken to combat the growing environmental degradation and reduce the environmental impact on its surroundings areas through ameiolarative measures like plantation ,treatment of abandoned mining areas, sewerage treatment, ash water recycling ,land reclamation, etc.

**Key Words:** Remote sensing (RS), Geo-spatial, Climate change, NTPC

## 1. INTRODUCTION

National Thermal Power Plant is located in Singrauli and Shaktinagar region. This is coal based power plant, which captured total area of 1234ha (2010) and 1433ha (2020). The geometric coordinate of power plant is **82°39'23.923"E, 24°05'55.498"N** and **82°42'44.763"E, 24°06'30.277"N**. For studying the relationship between land surface temperature and LU/LC is essential to understand the changing environmental dynamics. There were factors that directly or indirectly affected the earth's surface temperature. Land cover change is a complex process with multiple driving forces, depending on the terrain. Land cover changes also have spatial and temporal dynamics . Land cover change the main heat flow existing in and between the earth's surface and vegetation and affects the interaction between the earth's surface and the atmosphere. Human activities affect the natural balance of the ecosystem in unusual ways, surface temperature rise and more forms of irregular precipitation and polar region glaciers and polar ice cap melting. Influenced by changes in landuse/landcover. Previously, the meteorological temperature of the meteorological station was obtained by the conventional method, which was not continuous and required extrapolation. But today, remote sensing can be used to continuously measure the changes of LULC in space and time. Remote sensing is a relatively economical and fast method to obtain the latest information about large geographic areas, which can provide information about unavailable remote areas.

This research focuses on the change detection of LULC from 2010 & 2020, which is defined by temporal and spatial changes. There are a total of research areas, covering an area 5km<sup>2</sup> around the National Thermal Power Plant. Study area includes 11 LAPs: Agriculture, Forests, Plantation, Waterbody, Ash dyke, Mines Area, Industrial area, Buildings, Stony/rocky area, Road, Railways. Research result explains how the surface temperature of soil increases with the pre-development, construction and operation of Thermal Power Plant shaktinagar and singrauli. Therefore, remote sensing is an important index to study the temporal change of urban ecosystem and its relationship with vegetation. Area was once densely forested, rich in biodiversity, and owner-owned coal reserves. How sonbhadra and singrauli was developed by the private sector to install large power plants, which in turn led to major changes in the LULC research area. The purpose of this research is to study the impact of thermal power plant on Landcover/landuse. The area was temporarily expanded in due to large number of development activities.

This research focuses on the long – term evolution of Landuse Landcover caused by the development of mining and related industries, as well as urbanization and its impact on various ecosystem through Remote Sensing and GIS.

## 2. STUDY AREA

The study area lies in some part of Sonbhadra district of Uttar Pradesh and Singrauli district of Madhya Pradesh. It ranges from latitude 24°6'53.957" and 24°7'26.764" N and longitude 82°34'43.656" and 82°44'18.445" E. The area for the study is National Thermal Power Plant of Singrauli District of (M.P) and Sonbhadra District of (U.P) State in India. On 24 May 2008, Madhya Pradesh government proclaimed Singrauli as its 50th region by isolating from Sidhi with 3 tehsils, Singrauli, Chitrangi and Deosar. On 1 April 2012 two new Tehsils were added, Mada and Sarai. Population of the study area is 2.2 lakhs from (2011 census survey). Dense and Undeveloped forests cover the entire area and wild animals inhabit the area. Today, it is coming for thasone of the energy hubs of India and would soon be the India's new energy capital. All thermal power plants at Singrauli together have an installed capacity of around 10% of India's total installed capacity. The locals also call it as 'Urjanchal' i.e. the land of energy.

The climate of the study area is characterized as tropical monsoonal and the temperature reaches up to 48°C during June, the atmosphere remains humid in rainy season while in January the temperature goes down. Kalyan, Mayar, Matwani and Baliyanala are the four main seasonal rivers transverse through the Singrauli area. North flowing streams join the Bijul tributary of Son River and south-flowing streams mostly join the Kachan and Mayar tributary of Rihand reservoir.

NTPC is a 3600Mw coal based power station located in eastern part of the state Madhya Pradesh along with the adjoining southern part of Sonbhadra district of Uttar Pradesh. The baseline Landcover and Land surface temperature relationship was studied around 5km<sup>2</sup> area of NTPC singrauli and shaktinagar, through buffering

method. Total area of study is 182.56km<sup>2</sup>.

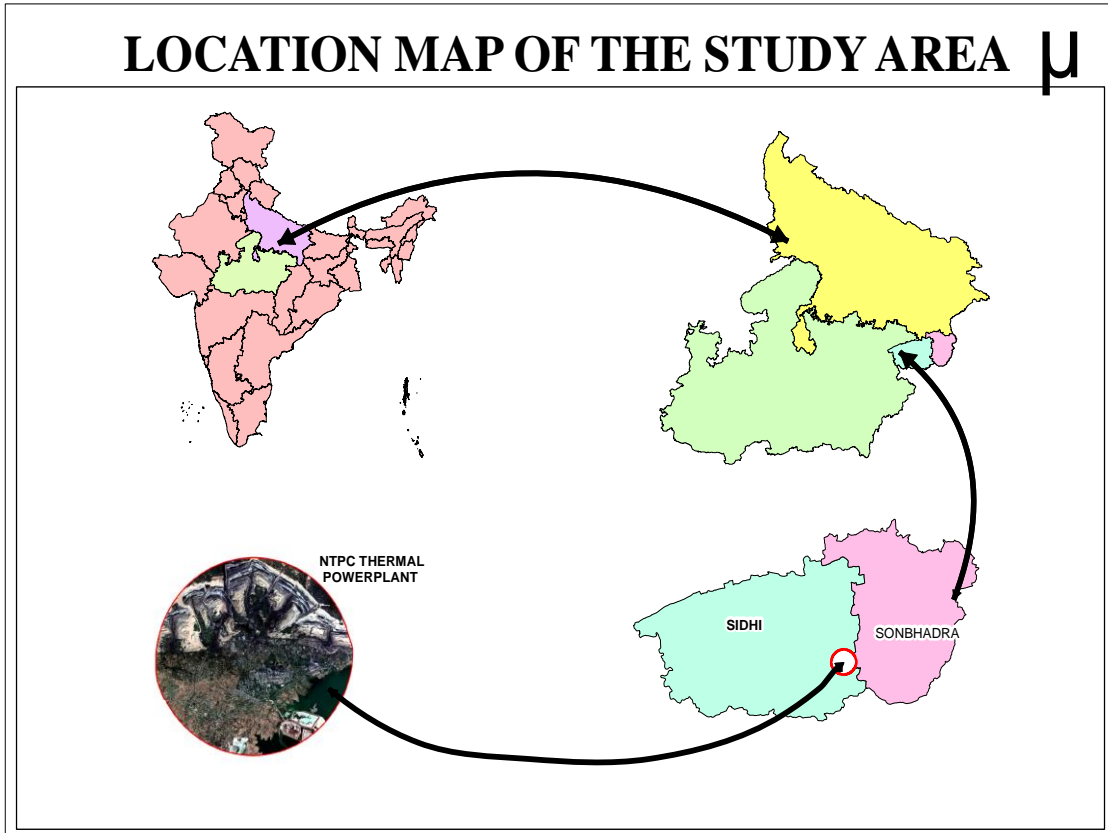


Fig. -1: Study Area

### 3. Materials and Data Used

The Landcover data in the study area is mainly based on satellite image of different period 2010 and 2020 . Landcover study was done using IRS LISS III (2010) and Google Earth (2020). Satellite images were geometrically rectified by using Survey of India toposheet. These data provide reliable and up-to-date information about spatial and temporal changes of Landuse /landcover, which may lead to land cover trends. Methods of deriving landuse/landcover change result of Study area is through Digitization of the Muti-temporal Google Earth and LISS III images. Various combinations of bands have been applied to image to better explain features and collect the signature. Ten classes were made based on interpretation and Digitization of satellite data . A field Survey had been undertaken to check the accuracy of landcover digitization and interpretation

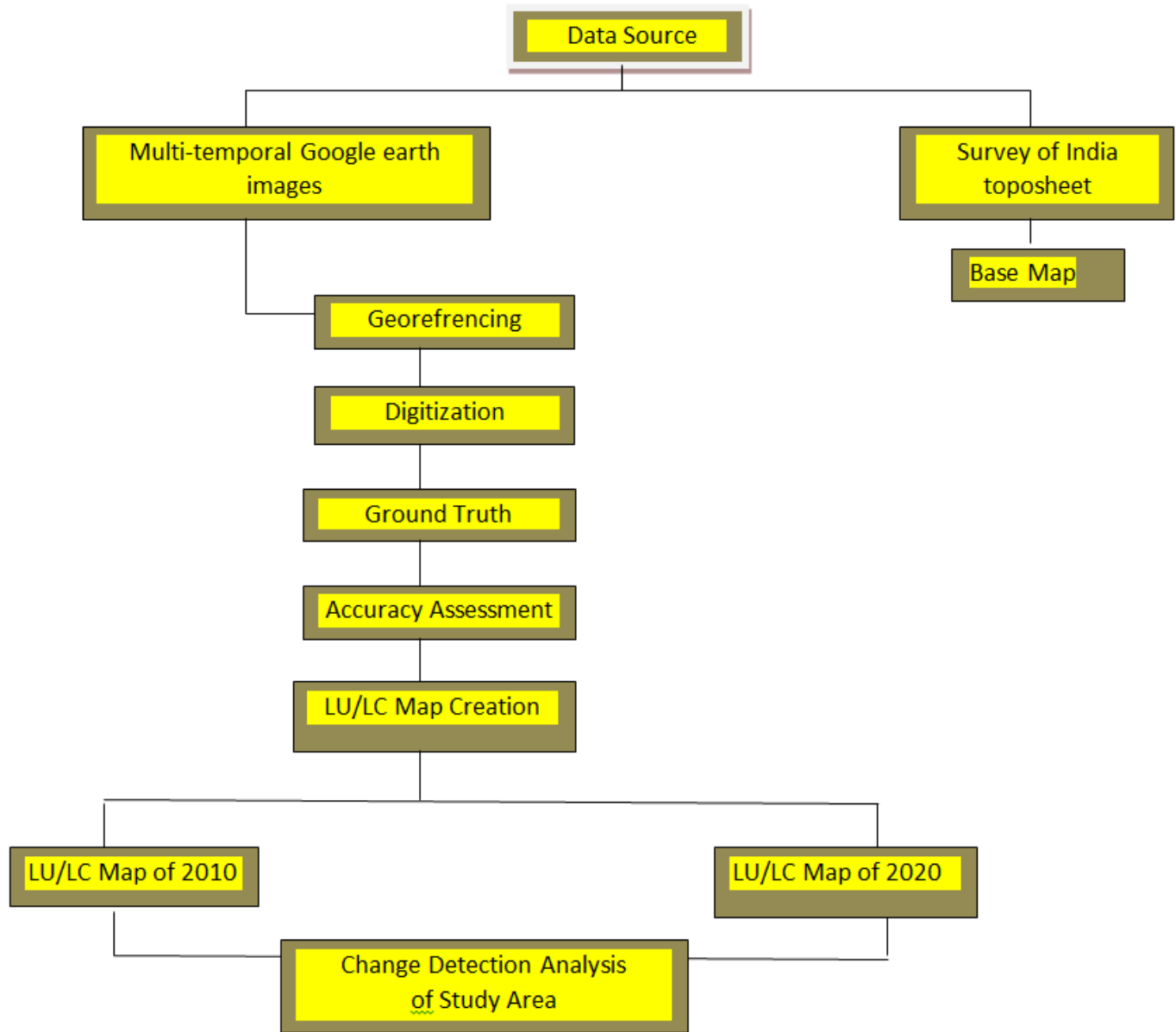
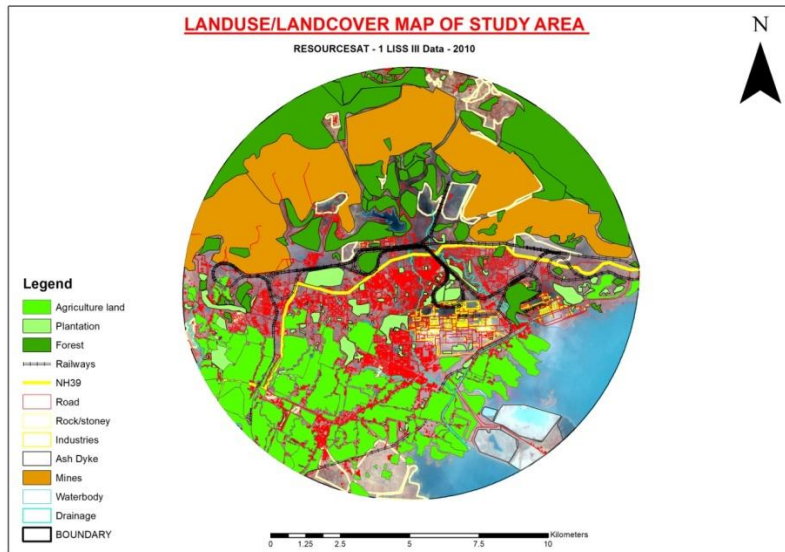


Fig. -2 Flow Chart of Methodology

#### 4. Results and Discussion

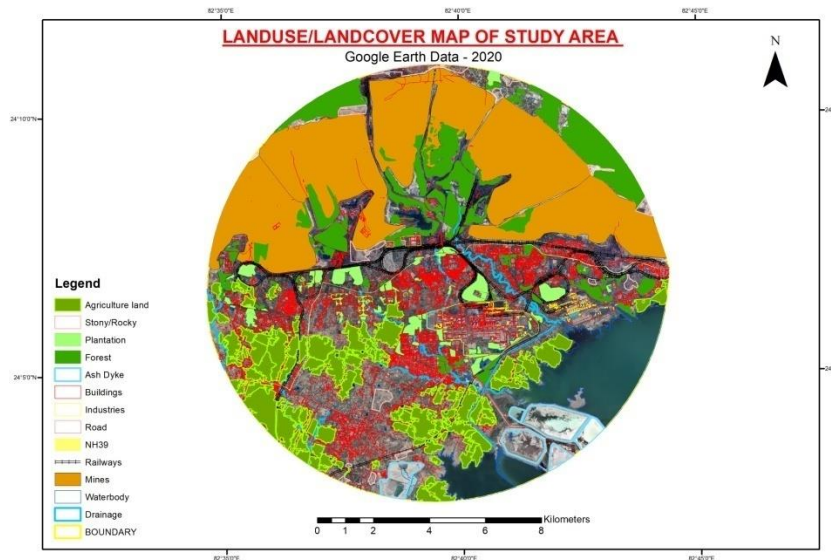
##### Landuse /Landcover status

In 2010, Forest and Plantation was 3457.71ha (18.9%) and 907.03ha (4.9%), respectively of the total studied area while Agriculture Land , road, rocky/stony area, industries, Ash dyke, Mines, Waterbody, and Built-up were 3953.34ha, 490.57ha, 1174.54ha, 1233.83ha, 723.6ha, 3934.28ha, 1938.96ha and 442.39 respectively of total study area



**Fig.-3: LULC Map of 2010**

In 2020 status of Forests , Plantation, Agriculture land, Mines, Ash dykes, Stony/Rocky , Road, Built-up, Waterbody and Industries are 1979.44ha, 496.63ha, 2256.54ha,6602.67ha, 1149.34ha, 628.81ha, 909.79ha, 855.28ha, 1881.45ha and 1496.46ha respectively of total study area.



**Fig. - 4: LULC Map of 2020**

<b>Land Transformation Statistics of Study Area between 2010-2020</b>						
S.NO	Class Name	2010 area in Ha	2020 area in Ha	Change in area in Ha	% change in trend	
1	Built-up Area	442.39	855.28	-412.89	-7.73	
2	Road	490.57	909.79	-419.22	-7.85	
3	Water body	1938.96	1881.45	57.96	1.08	
4	Industrial area	1233.83	1496.46	-262.63	-4.92	
5	Mines area	3934.28	6602.67	-2668.39	-49.99	
6	Ash dyke	723.46	1149.34	-425.37	-7.96	
7	Plantation	907.03	496.63	410.4	7.68	
8	Forest	3457.71	1979.44	1478.27	27.69	
9	Rocky / Stony waste area	1174.54	628.81	545.18	10.21	
10	Agriculture	3953.34	2256.54	1696.8	31.78	
	<b>TOTAL</b>	<b>18256.11</b>	<b>18256.41</b>	<b>5337.6</b>	<b>100</b>	

**Table -1:** Land Transformation Statistics Table

The area under different Landuse/Landcover categories and their comparative status are shown in fig. The Google earth data analysis informed that Forest cover, Plantation, Agriculture Land and Waterbody steadily decreases during the study period and Mines Area, Ash dyke, Road, Built-up, and industrial area expanded during the period (2010-2020).

The substantial increase in built-up area was due to destruction of forest land and agriculture land. The increase in built-up area, industries, mines area, Ash Dyke was the reason for reduction of waterbodies.

### 5. Conclusion

Present investigation recognized huge changes in land use and land cover from 2010 to 2020. The land region under Forests, Agriculture land, Plantation, Stony/rocky area and waterbody decreased while Mines area, Industries, Road, Built-up and Ash Dyke area expanded. The increment in mines area by 49.99% was because of continuous mining activity. There was a significant expansion in Ash Dyke by 7.96% was because of sudden expansion in industries and mining areas. The Agriculture land diminished due to the growing populace subsequently developed region has upgraded. There were increase in Built-up area. The increment in developed region has prompted the obliteration of backwoods land, transformation of rural land and furthermore has set off decrease of water bodies (landfill on water bodies and change to developed regions). Subsequently, the current investigation delineated that Google earth data and Digital IRS-1 LISS-III are significant innovations to recognize the land use and land cover change location examination of NTPC area.

Regarding the life support system and the forest area needs to be improved, vegetation for biological organisms, Industry and mine managers and local residents must pay attention to protecting the forest and reduce air and water pollution in the coal capital of India.



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