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Temperature Rise and Effect on Ecosystem Using Remote Sensing Techniques: A Case Study of Raniganj in Barddhaman District, India

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Abstract:

Some of the most serious environmental damage is taking place in the third world, especially destruction of forests and the loss of species. The resulting famines, floods, erosion and droughts are taking a rapidly increasing number of lives each year. As the trees are lost rain runs of more rapidly, eroding soils and causing more serious flooding, and more serious droughts later on. When there is less wood people burn more dung, which should be going back to the soil. There are now millions of "environmental refugees: people fleeing because their environments have become unable to support them. The changes in the environmental quality parameters due to mining activities may have substantial impact on the regional ecosystem. The biodiversity of the nearby areas need to be kept into consideration on a long term basis for better monitoring of environmental impacts and cost effective characterization of the changes in the land utilization and land cover changes maps, over time. Presently, it has become mandatory to study and analyse the impacts of mining on its surroundings with the use of remote sensing technology to generate valuable land cover maps of valuable assets for complete environmental assessment over mining affected area. In this paper the same has been demonstrated for the small mining operations in the district of Barddhaman with respect to the forest and greenery changes in and around the mining areas.

Keywords: Mining, Remote Sensing, Environmental Impacts. Environment Awareness

1.0 Introduction:

Some of the most serious environmental damage is taking place in the third world. Increasingly serious environmental problems are due to population increase but remote sensing has proven to be reliable tools for studying earth surface and atmosphere in much application. In case of high temperature object conditions, but remote sensing can give a good synoptic view of the area under consideration. In the entire electromagnetic spectrum, 3-60 mm is considered as thermal infrared, whereas 3-5 and 8-12 mm is actually used in thermal remote sensing. Thermal infrared sensing exploits the fact that everything about absolute zero (273^0C) emits radiation in the thermal infrared range of the electromagnetic spectrum. Thermal infrared radiation of an object is controlled mainly by the characteristics of the surface, the emissivity, geometry of the object and its temperature. Borehole temperature was the main tool to detect subsurface in the mining area. The main advantage of this method was that temperature measurements can be done very close to fires but it was nearly impossible to gather enough data over a large area. In early 60's when airborne and later satellite borne data started to became available, the detection and monitoring of temperature in the mining area. There is much reference on the part of economists and governments to the concept of environmentally sustainable development. However this is in general only an attempt to take some steps to reduce the environmental impact of economic activities, but there is never any question of reducing the volume of production and sales, or of eliminating grossly unnecessary or wasteful or luxurious production or of eliminating grossly unnecessary or wasteful or luxurious production. Ecologically sustainable development is only about looking for ways of continuing to produce, but in ways that will have reduce environmental impact.

1.1. Research Area:

Raniganj coalfield covering an area of about 1652 sq. km. and bounded by latitude 23°30'& 23° 40'N, longitude 87°00'& 87°10'E is located in the eastern part of India. It is covered under Survey of India toposheet (73M/2)) on RF 1:250,000. This coalfield holds a premier position in India for having the largest share of reserve of superior grade non-coking coal in your country.

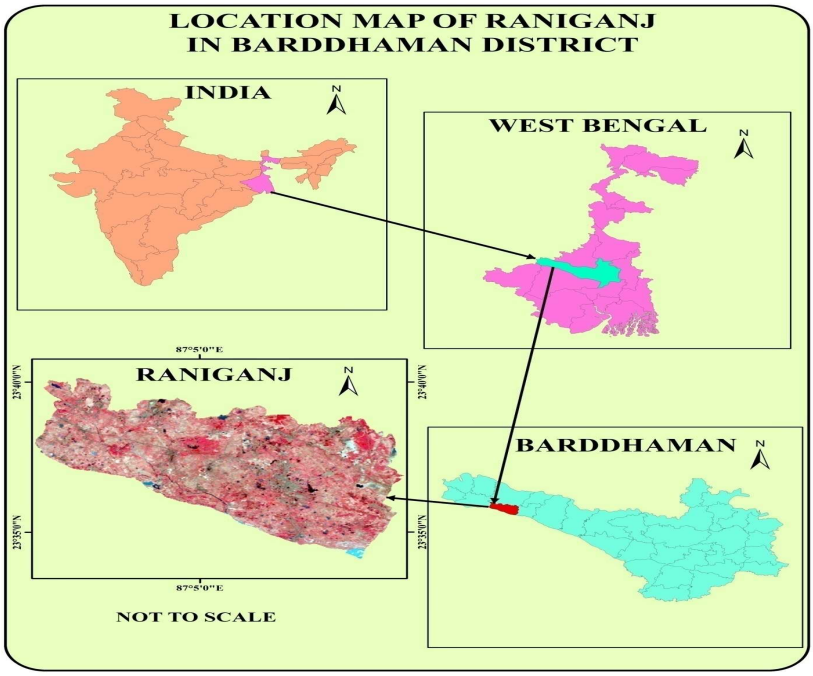


Fig.1: Location Maps

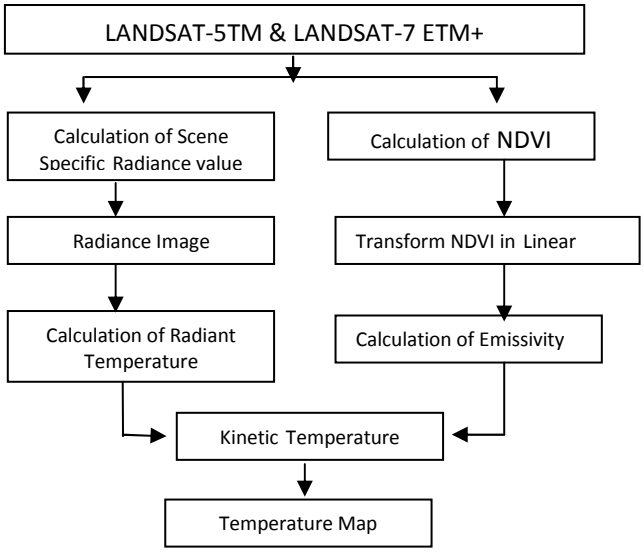
2. Data Used:

LISS-III 2010 pertaining to the study area was used and Cadastral data from survey building, Kolkata, and also Toposheet from survey of India.

2. 1.Objectives of the Study Area:

The research work focuses on change detection of vegetation, temperature rise and changing of ecosystem of the mining area. The study is showing 10 years differences in temperature and vegetation which demonstrate in the NDVI map and present condition of land use/land cover.

2.2. Methodology:



2.3 Vegetation of the Area:

The study area is mainly colliery, but the area is totally bereft of forest cover. The vegetation consists mainly of the like Mongo, Banyan, Neem, Jackfruit, Pipul and Palmyra. Small shrubs and bushes grow in the fallow land. Afforestation endeavors are not noticeable though it is desirable throughout the area in general and around the open cast in particular mining area. The native vegetation in and around the mining or non-min sing area is typically mixed dry deciduous forest with *Shorea robusta, Terminalia Tomentosa, Butea monosperma, Dalberagia sisso, Madhuca indica, Terminalia arjuna* and *Azardirchata indica*. During the rainly seasons, herbaceous Vegetation rapidly cover the adjacent area of mine spoils and biomass peaks occur in late September or October (Kumar,et al., 2011).

2.4 Surface Temperature Monitoring in Raniganj area:

Surface temperature has an important criterion which depends on geology (rock, soil, etc.), vegetation cover, local climate and also land use of the area. In my study area the atmospherically corrected red and infrared bands were later used for NDVI calculation to extract surface emissivity. Thermal infrared band of Landsat TM & ETM+ imagery was used to extract brightness temperature by using the method described below (Gangopadhyay, et al., 2005).

2.5 Calculation of Land Surface Temperature for Landsat TM, Band-6 and Landsat ETM+, Band-7 Data:

The atmospherically corrected red and infrared bands were later use for NDVI calculation to extract surface emissivity. Thermal infrared band or TM6/ETM+7 Landsat were used to extract brightness temperature by using the method described below (Gangopadhyay, et al., 2005). The digital values of thermal band were converted to spectral radiance using the following equation.

$$L\lambda = L\min(\lambda) + \frac{L\max\lambda - L\min\lambda}{Q\,cal\,max} Q\,cal$$

Where, L λ is spectral radiance: L min (λ) TM- 1990 (0.12378), 2006(1.238). ETM+ - (0.000) is the minimum detect spectral radiance. L max (λ) TM – 1990 (15.2431), 2006 (15.303). ETM+ - (17.040) is the maximum detect spectral radiance. Q cal is the grey level for analyzed pixel. Q cal max is the maximum grey level. Once the spectral radiance (L λ) for TM band 6/TEM+ band 7 is computed, it is possible to calculate radiant temperature directly by the following equation: (Roy, et al., NRSC)

$$TR = \frac{k2}{\ln k1 L\lambda + 1}$$

Where, TR is the temperature: L λ the spectral radiance. K1 is the calibration constant (TM-607.76w. ETM + - 666.09.w). K2 is the calibration constant (TM-1260.56K. ETM + -1282.71K). To enhance the vegetation characteristics over an area under consideration, one of the most common vegetation indices is NDVI, which can be calculated as:

$$NDVI = \frac{Band\,4 - Band\,3}{Band\,4 + Band\,3}$$

Where band 4 is the spectral reflectance measured in NIR BAND (4). Band 3 is the spectral reflectance measured in red band (3).

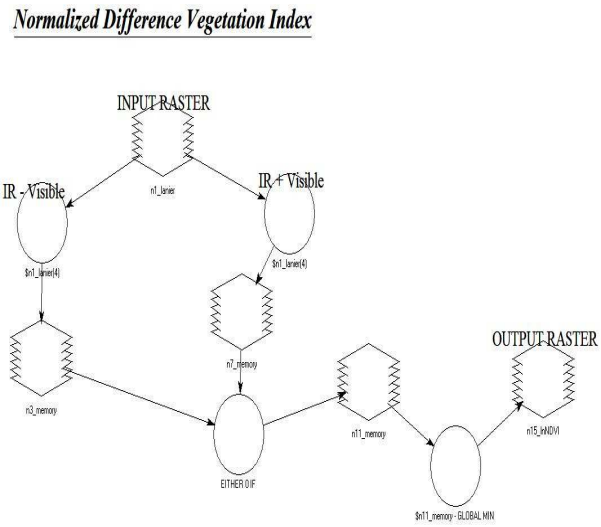


Fig. 2: Model showing for Land surface Temperate

NDVI = (NIR — RED) / (NIR + RED) In ETM+ image of study area. Apply NDVI modeler to detect the greenness of the area. It is clearly shown the high range in vegetation area of the research area and also is one domestic area where vegetation is found.

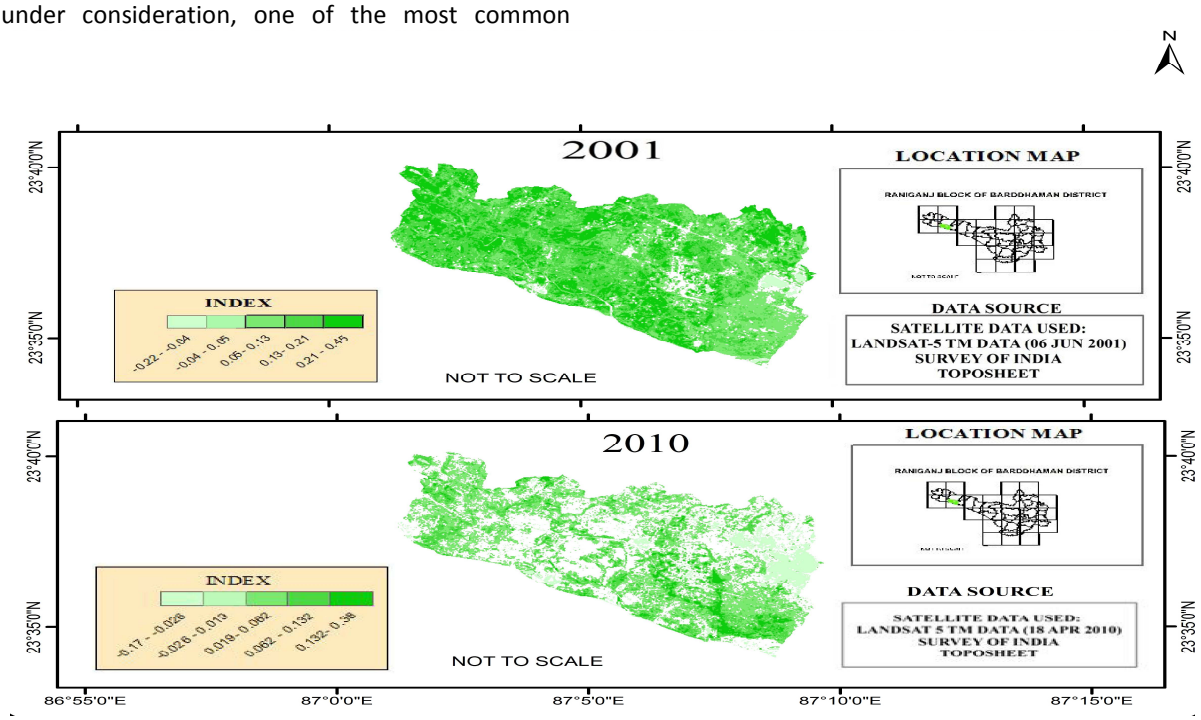


Fig. 3: Normalize Differences Vegetation Index Map of Raniganj in Barddhaman District

Ten years condition of vegetation by using NDVI modular (Fig. 2) in the study area of Raniganj in Barddhaman district. Data collected form the years of 2001, 2010. Landsat-5TM data 06 Jun, and last show 18th April, above showing map in 2001, the study area was covered by vegetation, in that time the mining zone did not spread and even urbanization growing stage was slow, but vegetation condition have quite different in respect to 2010 imagery that time outside people were coming in the area due to mining purpose which was declared as a mining zone area, resulting vegetation have to change by indoctrination

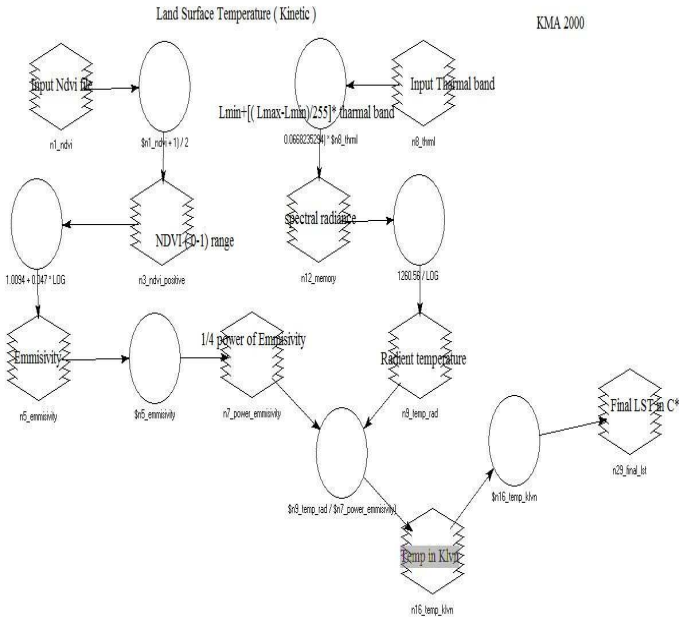


Fig. 4: Modal showing for Land surface Temperate

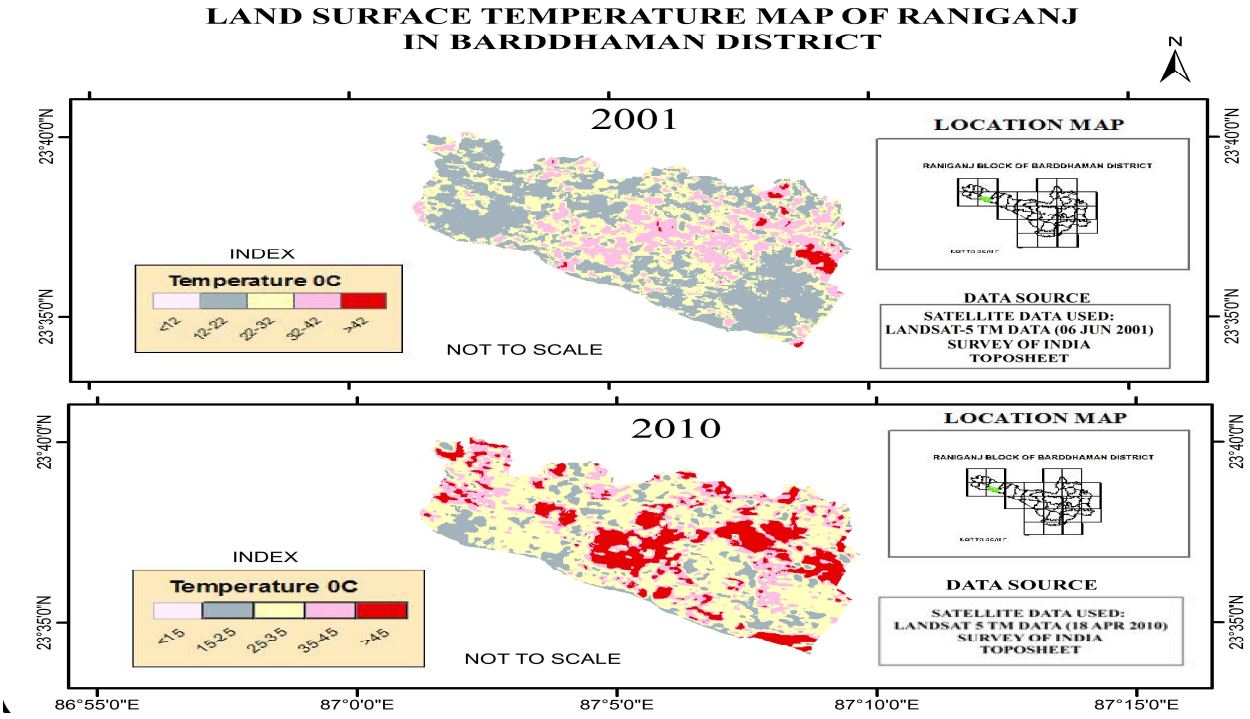


Fig. 5: Temperature changes of the study area

If we see the imagery condition 2001 that due to high vegetation condition, the temperature was low, in that time only mining areas have quite high temperature though surrounding area's temperature was normal but 2010 imagery condition was totally changed, due to poor vegetation, resulting high temperature rise in that area, above the analysis indicates different temperatures of the study area in different year.

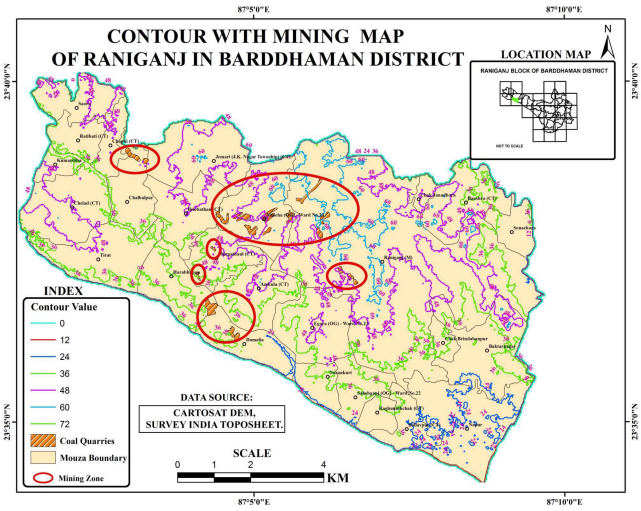


Fig. 6: Map showing mining area demarcation of the study area

Above the layout map showing open cast mining area, are indicated in buffer zone which represent the contour value. Here using Cartosat (Digital Elevation Model) and survey India Toposheet 73M/2.

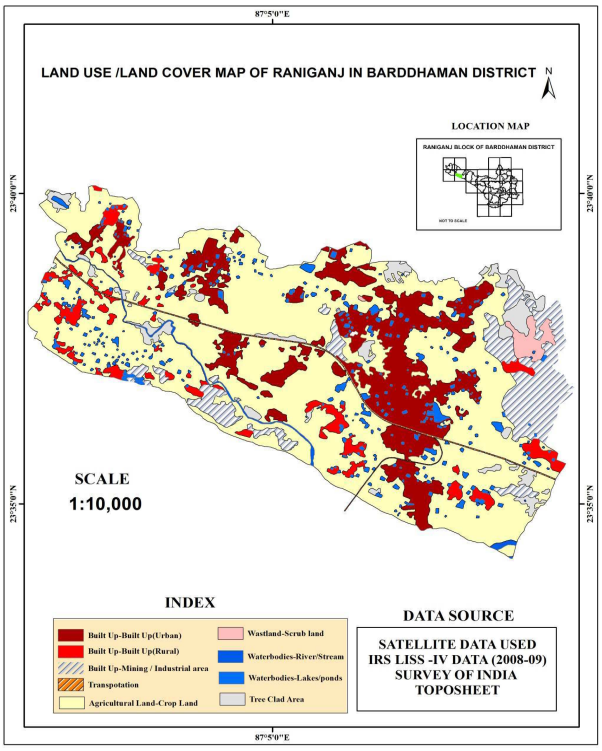


Fig. 7: land used/ land cover map of the study area

3.0 Impacts on Land Use:

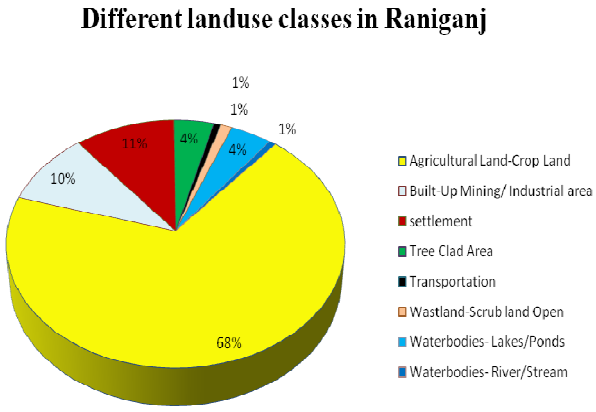


Fig. 8: Pie graph showing area of land used /land cover classes

The figure used above is a replica Raniganj in Barddhaman district which represents a land use/ land cover mapping. There are eight classes in figure, namely Agricultural Land-Crop Land, Built-Up Mining/ Industrial area, Settlement, Tree Clad Area, Transportation, Westland-Scrub land Open, Water bodies- Lakes/Ponds, and Water bodies-River/Stream. In that region agricultural land crop area holds maximum 50.33 % which other like Built-Up Mining/ Industrial area 7.14 %, Settlement 7.8 %, Tree Clad Area 3.13 %, Transportation 0.53 %, Westland-Scrub land Open 0.9 % , but making water bodies 3.23 % and River/stream minimum area covered 0.53 % recorded. A pie chart is to drawn to represent the classification in a diagram (Fig. 7).

The study area, Raniganj dominated by mining activity and the output result of the current research work describes the impact of mining actives on land use/land cover pattern. The economic condition of the people of Raniganj is very poor. The soil fertility of the area is not so good, so, basically the first choice of economically backward people is to go for mining work. Remote sensing data offers comprehensive and accurate information for mapping and monitoring of land use/cover over a period of time. By analyzing the different year data, impact of mining on land use and vegetation cover can be determined.

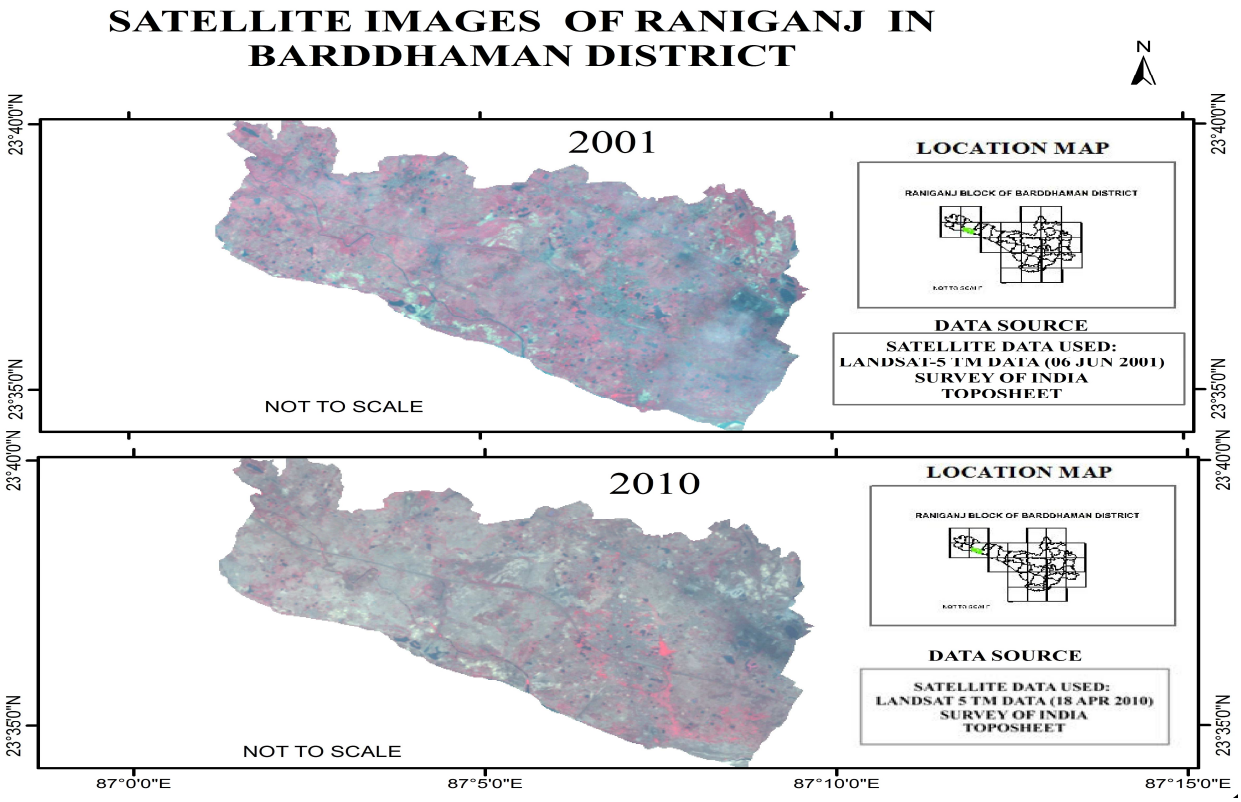


Fig. 9: Map showing for imagery condition

In the 2001 image showing a large portion occupied by red tone which indicate vegetation cover but in 2010, significantly vegetation cover decreased in study area. The two different year satellite data demonstrate the current condition. Above the imagery show that in 2001 imagery has red is indicate vegetation cover in the area bur if we see the 2010 Imagery, there are so many changes, few portion cover in vegetation. Map show the real condition of study area.

Fig. 8: Field photo of the study area (A to D)

Above the field photo show that vegetation condition is rapidly change in between field photo AB & CD due to mining area

4.0 Environment Management Plan:

4.1 Measures for Controlling Air Pollution:

Regular water spraying on haul roads. The volume of dust rising from waste dump areas & ore, roads, etc. by action of wind shall be checked by planting grasses and broad leaf trees. Ensuring transporting vehicles not to cross stipulated speed. Exhaust fumes in the internal combustion engines used in excavators, dumpers, dozers and other machinery shall be minimized by ensuring vigorous maintenance and stringent overhaul schedules.

4.2 Measures for Controlling Water Pollution:

Proper drainage system shall be done within the study site. There will be no effluent discharge from the project site, so the chance of water pollution is negligible. Appropriate measures shall be taken to ensure that the surface water quality in the project area is within permissible limits. Before water is supplied for consumption particularly for drinking purpose it has to be ensured that the water is free from any pathogens.

4.3 Occupational Safety and Health:

To avoid any adverse effect on the health of workers due to dust, noise and vibration etc. extensive measures has to be adapted related to safety aspect. Regular maintenance and testing of all equipments & machineries as per manufacturer's guidelines. Periodical medical examination of all workers by medical specialists shall be conducted.

4.4 Socio Economic Measures:

The work, does not involve any displacement of human habitation, hence no habilitation package is needed for displacement. The activity envisages the deployment of local laborers. So, it is likely that the general economic condition of the local people will improve. The peripheral development package will also improve their health and sanitation. Health and education facilities created in the project shall be extended to villagers also. Roads development in the project shall be utilized by the villagers. Providing employment to local people will be the major factors for upliftment of the society (Mondal et al., 2012).

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5.0 Conclusion:

In above mentioned analysis, it's clear that if vegetation gets destroyed due to mining purpose, pollution will be spreading in surrounding areas also, if it is going to continue, ultimately the land will be polluted and temperature rise will be high. The government, mining agency and also local people should take action, plan for protecting the area by plantation and then society will be benefitted from increasing temperature. Unfortunately most concern about the environment at present is only devoted to saving areas or species threatened by growth and affluence society, or to working for less polluting ways or for recycling schemes or more energy efficient transport, etc., without any thought of changing form a society that is obsessed with growth and affluence. Such light green efforts are important and admirable but many people concerned about the environment fail to see that there is no chance of solving the environment problem unless we change to a radical conserver society involving very different lifestyles, patterns of settlement, levels of consumption and economic arrangements.

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