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COMPARATIVE STUDY OF VEGETATION STATUS AROUND THERMAL POWER PLANTS USING GIS TECHNOLOGY

DESHPANDE, S. V.[1*], THAKARE, S.[2], KHAPEKAR, R. R.[3] AND DALAL, L. P.[4]

[1*] (CORRESPONDING AUTHOR), 4 – J B SCIENCE COLLEGE, WARDHA
[2] DEPARTMENT OF GEOLOGY, SGBAU, AMRAVATI
[3] D.R.B. SINDHU MAHAVIDYALAYA, NAGPUR

ABSTRACT:

Many new thermal power stations (TPS) are being constructed in the country to meet the increasing demand of energy for various purposes of human beings. The effect of such TPS is generation of waste which includes diverse range of chemicals and flu gas. Another threat to environment by power stations is fly ash which contains hazardous elements which enters in the food chain of organisms and responsible for adverse effect of bioaccumulation. In today's world with increasing global change in the climate, vegetation plays a main role in reducing pollution and high temperature. Thus, the study of vegetation in relation to abatement of air pollution becomes extremely important. Remote Sensing and GIS are the appropriate tools for the study of vegetation for Land use/Land cover study. Thus in the present investigation an attempt has been made to study the actual status of vegetation around the power station near Nagpur with the help of GIS technology.

Keywords: Thermal Power Station (TPS), Air Pollution, Vegetation, GIS Technology.

INTRODUCTION:

Environment is the amalgamation of certain conditions and circumstances which surrounds an individual organism, group of organisms or communities. It also understands the cultural and social conditions that affect the individual organisms or communities. Terrestrial, Aerial and aquatic components with their flora and fauna, constitute environment for man who depends on environment and simultaneously becomes an environmental factor for other members in the ecosystem. All the components of environment have reciprocal relationship amongst themselves, which alters the natural balance in the ecosystem.

The term "Vegetation" is the most abundant biotic element of the biosphere and refers to the plant life of a region. It is the ground cover provided by plants, and serves numerous significant functions in the biosphere. The most important function of vegetation firstly is to generate oxygen in the atmosphere, enabling the aerobic metabolism systems to evolve and persist. It also regulates the flow of numerous biogeochemical cycles, like water, carbon, and nitrogen; it contributes greatly to the local and global energy balances which are related to global patterns of vegetation and climate. (https://www.sciencedaily.com). In today's world with increasing global change in the climate, vegetation plays a main role in reducing pollution and high temperature (Escobedo et al., 2011) Thus, the study of vegetation in relation to abatement of air pollution becomes extremely important. Remote Sensing and GIS are the appropriate tools for the study of vegetation, which was introduced in 1982 for Land use/Land cover study. Now a days it becomes common in most of the ecological investigations, providing realistic, cost-effective means of acquiring data over large areas (Nagendra 2001, Kerr and Ostrovsky 2003).

In India, coal based power station contributes highest air pollution compare to other fuel substitutes. The coal available in India is of poor quality, with very high ash content and low calorific value (Ahmad, et. al., 2012). Combustion of coal at thermal power plants leads to emission of Carbon dioxide (CO2), Sulphur oxides (SOx) and nitrogen oxides (NOx) as main pollutants (Tripathi, etal., 2015).Air pollution can be mitigated through best operations SOPs, raw material, and its auxiallary mitigation measures like development of green belt across its periphery. Biological indicators like plants (green belt) are considered as best bio indicators (LeBlanc and Rao, 1975). They give a gigantic leaf area for gathering of air toxins to lessen the contamination level noticeable all around condition with different degrees for various species (Liu and Ding, 2008). Trees removes air contamination principally by take-up by means of leaf stomata, however some gasses are expelled by the plant surface. Trees additionally evacuate contamination by catching airborne particles

(Nowak, 2002). It is found that the adverse effect of urbanization and industrialization leads to the depletion of vegetation cover in developing countries. Thus in the present investigation an attempt has been made to study the actual status of vegetation around the power station near Nagpur in a span of ten years i.e. in between 2005 to 2015 with the help of GIS technology.

METHOD AND MATERIAL:

Description of Study Area and site selection criteria

Across Maharashtra vidharbha is the epic-centre of thermal power stations mainly across Nagpur, where one of such location is Koradi & Khaperkheda are in vicinity to each other creating larger impact zone with common buffer zone for generating air emission. Both these TPS are nearest & oldest coal based power station impacting its surrounding with numerous issues concern to human settlement and flora and fauna.

These towns are located on the Koradi - Saoner road about 3 km from the Koradi Thermal Power Station (KTPS) and about 3.5 km from the Koradi Devi Temple, which is a famous pilgrimage centre. Khaperkheda Thermal Power Station (KHTPS) is also situated in close vicinity of KTPS around 3 KM. The commercial gaseous emissions from KTPS and KHTPS are the prominent sources of air pollution, apart from the existing towns and villages in the study area, which also impact Nagpur urban area sometimes.

Classification of Land use and Land Cover

The National Remote Sensing Agency (NRSA), now NRSC, Government of India, conducted a land use survey using Remote Sensing Techniques in the year 1988-89 at the behest of the Planning Commission for classifying land by visual interpretation techniques and digital techniques. NRSC's output resulted in a two-level system of classification, comprising six first level of classification of land use / land cover categories. Some of these categories required further classification, leading to a second level of classification that resulted in further sub-categories.

This system of classification has been the basis for Land Use / Land Cover studies. Whilst these categories are generally found relevant with respect to describing Land Use and Land Cover classes in the Indian context, sometimes modifications are required, and made, to include additional subcategories which are more relevant in describing the Land Use and Land Cover for a particular study. Such sub-categories are defined, in any case.

Land use /land cover analysis using remote sensing data

An increasingly common application of remotely sensed data is for Land use / land cover analysis and change detection. Land use / land cover analysis is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest. Land use / land cover analysis is useful in such diverse applications as land use change analysis, monitoring shifting cultivation, assessment of deforestation, study of changes in vegetation phenology, seasonal changes in pasture production, damage assessment, crop stress detection, disaster monitoring, day/night analysis of thermal characteristics as well as other environmental changes.

Study Methodology

The study area covers around 5 km radius from the power plants based on co-ordinates on satellite imagery and determined the study area for the proposed project.

The resulting satellite data of study area analyzed using ERDAS Imagine (9.1) image processing software through supervised classification. The satellite image is also interpreted through onscreen visual interpretation using basic elements of interpretation resulting in the combined land use / land cover map for the study site. To accomplish the objective the following steps were undertaken:

- Study and collection of relevant documents and maps and datasets.
- Supervised classification using Erdas Imagine
- Interpretation of satellite data
- Checking of interpreted Google Earth imagery
- Field survey / ground truthing
- Generation of final land use / land cover map

Data Collection

- Resourcesat – 2 LISS IV satellite image of study area procure from NRSC, Hyderabad
- Topographical maps as base map

Interpretation of Satellite Data

The satellite imagery was interpreted considering the basic elements of interpretation such as size, shape, texture, pattern, location, association, shadow, aspect and resolution along with ground

truth and ancillary information collected during the preliminary reconnaissance survey the interpretation was accomplished.

Ground Truth Studies

The aim of ground truth studies is to confirm whether the interpreted land use / cover are correct thus improving the quality of the output. Probability corrections in land use / land cover are made through google earth.

Satellite Specifications

The land use and land cover analysis of study area were carried out for Koradi and Khaperkheda Thermal Power plant, located in Nagpur District, Maharashtra **(Fig 1)**. 5 Km radius study area from thermal plant is selected for land use / land cover study (**Fig 2**). The satellite imagery of **Resourcesat – 2, LISS-IV** sensor selected for these study.

RESULTS AND DISCUSSION

The land use / land cover classification of study area has been analyzed to examine the change vegetation pattern during a decade i.e. years 2005, 2010 and 2015. The LISS III Image of study area (False colour composite) for three different years (2005, 2010 and 2015) covering 05 km radial distance around the thermal power plants are shown in **Fig 3 to 8**.

Digital analysis techniques has been use to obtain Land use / land cover distribution in the study area for a span of ten years. The colour-coded output of supervised classification with color assigned to various land use / land cover classes are shown in **Table no. 1.** Eight different classes are extracted and different colour code were assigned to various land use / land cover classes for supervised classification. Green colour shows vegetation and land with shrubs, red colour stands for the built-up land, yellow colour shows the crop land, blue colour shows the water bodies, fallow land, waste land and river bed represents Aqua colour Maroon colour and white colour respectively.

The classified areas for all types of vegetation (Vegetation + Land with shrub) shows gradual decrease in the area from 16.87 % during the year 2005 to 15.67 % during year 2015. The area of built up land has increased considerably from 10.69 % in 2005 to 29.05 % in 2015 with an overall increase of 2404.61 ha in a span of ten years. Crop land and fallow land have decreased clearly by 13.648 % and 2.665 % respectively with an overall decrease of 2136.4 ha, which is mainly converted into built up area between these years (figure 9).

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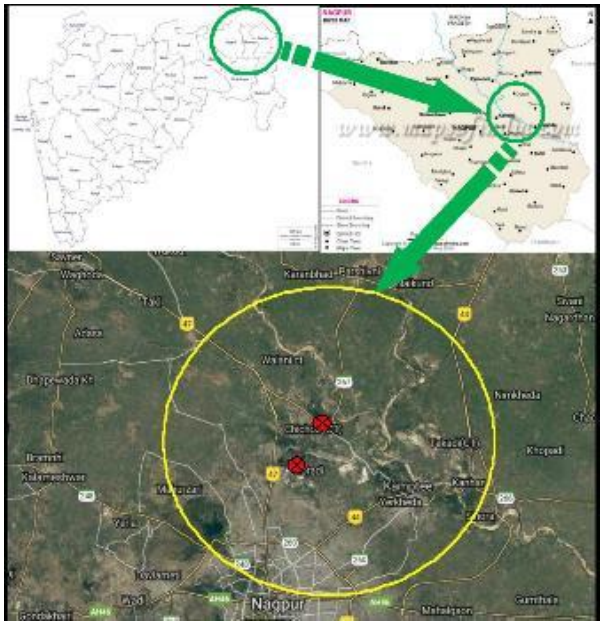
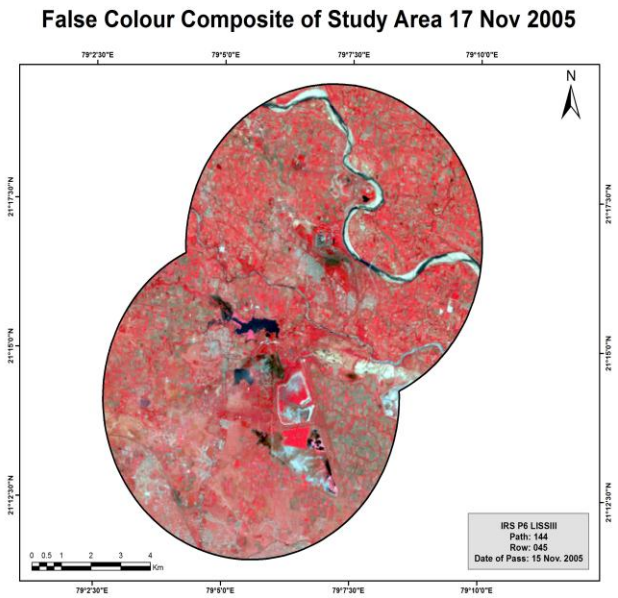


Fig .1



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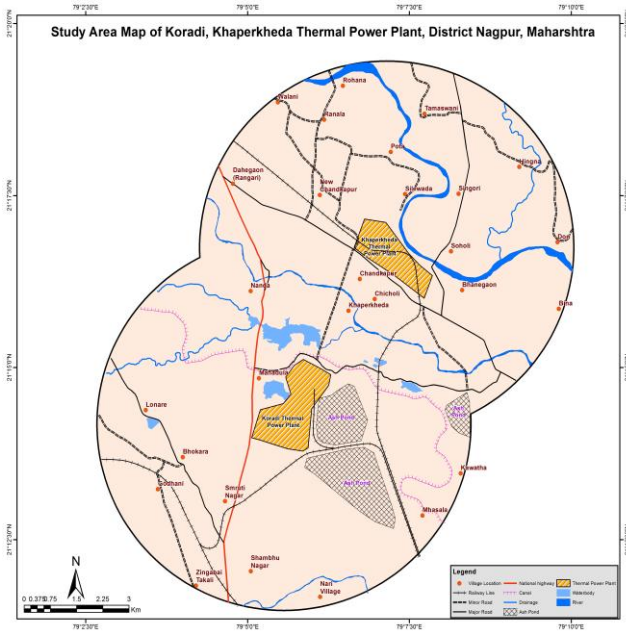


Fig 2

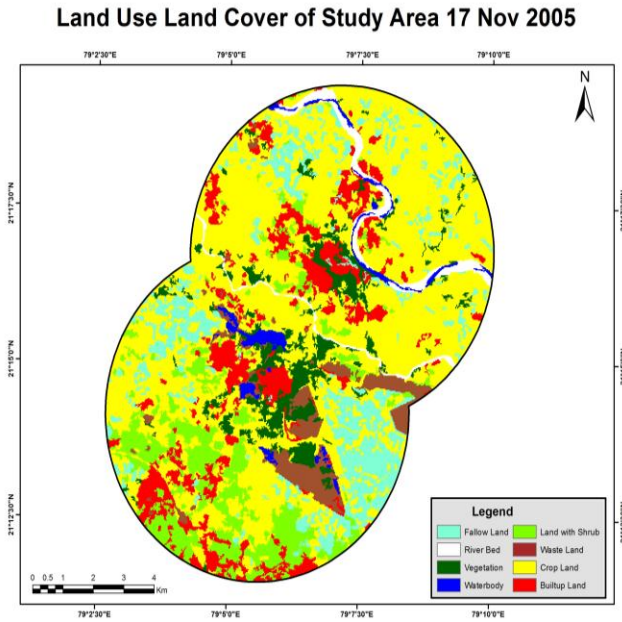
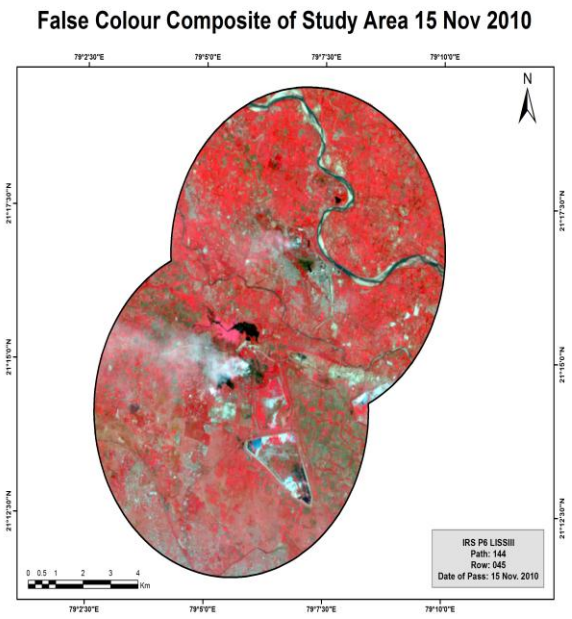


Fig. 4



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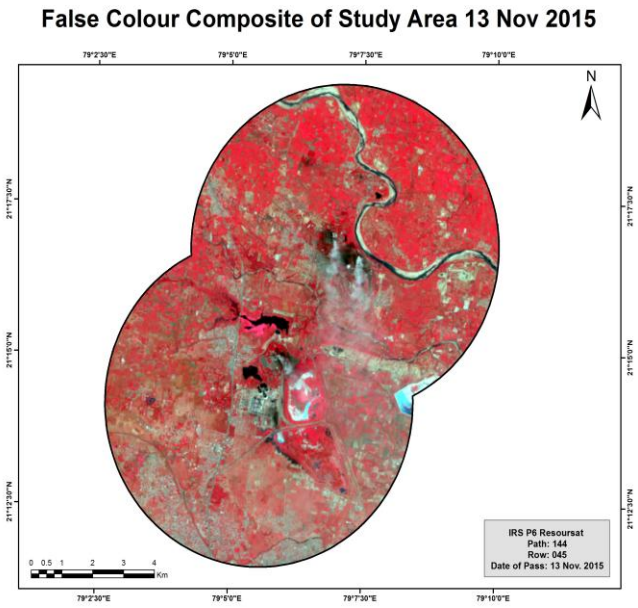

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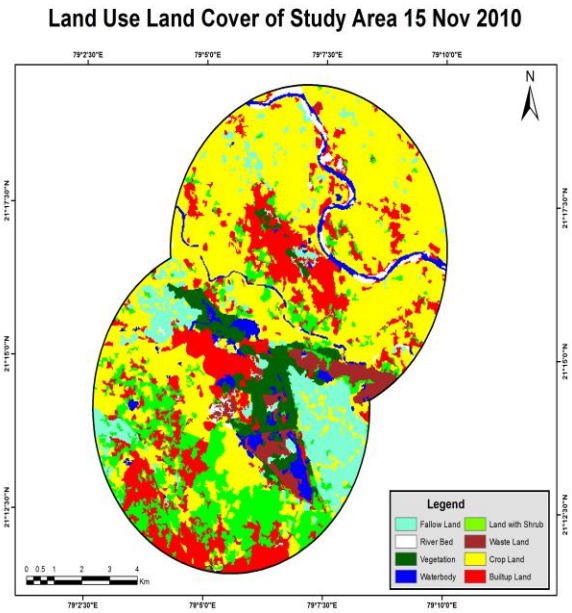

Fig.6

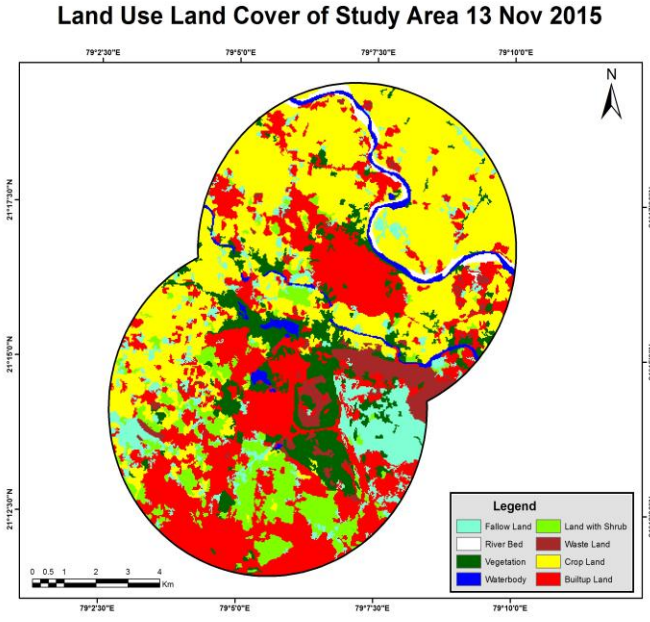

Fig.8