

Received on 28 January 2015; received in revised form, 05 April 2015; accepted, 27 April 2015; published 30 May 2015

OPERATIONAL POWER PLANTS BASED IMPACTS ON PLANT BIODIVERSITY TO MEASURE ATMOSPHERE DEGRADATION IN SINGRAULI DISTRICT, MADHYA PRADESH, INDIA

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ABSTRACT: Number of thermal power plants in Singrauli MP (India) has changes air composition, water quality, and environmental conditions that consequently affected biodiversity, wildlife, and migration of livings in the region. Operational thermal power plants produce an enormous quantity of pollutants mostly fly ash as a by-product of combustion of coal or any pulverized fuel at a higher temperature. Industrial effluents contain several heavy metals distrusted the metabolic process of the living organism due to easily dispersion and mobilization in the environment. The eatables and applicable potential plants and vegetables altered by these heavy metals and concern derivatives which directly and indirectly posing severe risks to human health which, extremely toxic even in low concentration, and will accumulate in organisms and ecosystems. The National Action Plan on Climate Change must tackle properly the subject of power generation, renewable energy, and energy competence sources. Increasing public attentiveness is one of the most important ways to conserve biodiversity. This can be accomplished through educational programs, incentive programs, and volunteer monitoring programs. Various organizations NGO's and conferences that research biodiversity and associated conservation strategies help to identify areas of future research analyze the current trends of conservation and management associated with the biodiversity.

Keywords: Power Plant, Air Quality, Fly Ash, Biodiversity (Plants and Vegetables), Conservation, Singrauli

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INTRODUCTION: Energy generating power plants are necessary for the increasing demand of power in term of electricity, but operations of these potential power plants have changed the environment as targeting source quality like air and water mostly.

The electricity sector in India had an installed capacity of 232.164 GW as on 2013, and non-renewable power plants constitute 87.55% of the installed capacity, and renewable power plants constitute the remaining 12.45% of total installed capacity^{1,2}.

After coal, renewable hydropower accounts for renewable energy for 15% and natural gas also³. Total per capita consumption of power in India is 778 kWh⁴. As per estimates of International Energy Agency, it is assumed that India will add between 600 GW to 1200 GW of additional new power generation capacity before 2050 for their

	<p>QUICK RESPONSE CODE</p>
	<p>DOI: 10.13040/IJPSR.0975-8232.IJLSR.1(5).199-06</p>
<p>The article can be accessed online on www.ijlsr.com</p>	
<p>DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJLSR.1(5).199-06</p>	

fulfillment of power need due to developing era of an Indian city.

On the average accounting bases, The Indian coal has a disgusting Calorific value, which is about 4400 Kcal/kg, whereas the quality elsewhere in the world is much better to notify ^{5, 6}. In the industrial scenario, Singrauli is a prime district of the Indian state of Madhya Pradesh emerging as India's energy capital covered coal mine, electricity generation power plants, and dense forests. Eastern part of Madhya Pradesh and adjoining southern areas of Sonbhadra district of Utter Pradesh state are collectively known as Singrauli region. Populations around 185,580 were calculated as per the current census 2011 with 85/km² (220/sqm) density. Energy generating industries like Singrauli Super Power Plant (SSPP), Vindhyanchal Super

Thermal Power Plant (VSTPP), Northern Coal Limited (NCL), Kanoria Chemicals are most marked industries regularly increases the quantity and types of pollutions via disposing of organic, inorganic, degradative and non-degradative waste materials in local environment which directly and indirectly affect the human health. Modern civilization and prolonged discharge of these industrial effluents, industrial sewage, and solid waste dump cause the air and groundwater pollution to created no's of health troubles ⁷. Both water and air is the most imperative component of eco-system, any imbalance, physical or chemical alterations beyond permissible limit would be harmful to eco-organization ⁸. The mining and power plants operation created air pollution in terms of ash and dust.

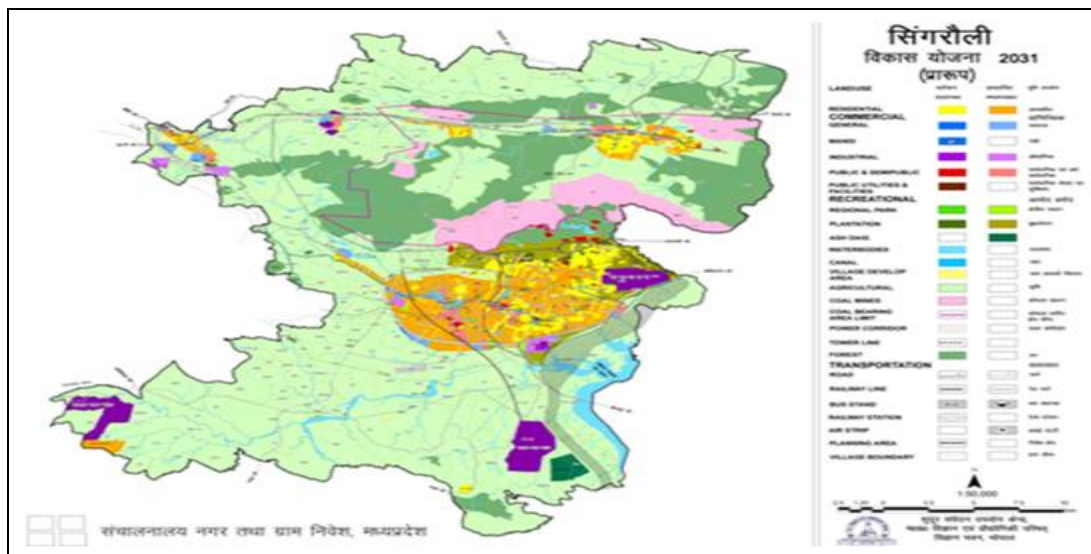


FIG. 1: SPATIAL LOCATIONS SINGRAULI CITY THERMAL POWER PLANTS IN MP (INDIA)

Pollutant containing more and more fly ash as a solid waste produced in large quantities during the burning of coal contains toxic elements such as Barium, Copper, Molybdenum, Zinc, Beryllium, Cadmium, Selenium, Lead, Mercury, etc. Besides these, several other metals are also present in traces amount ⁹. Predominantly heavy metals interact with soil, undergoes several changes in their forms.

Part of these released elements gets dissolved frequently in water and water resources which further become available for plants and vegetables to created health risk or toxicity (Neurotoxicity, hepatotoxicity, nephrotoxicity) produced *via* absorption and accumulation process of toxicants ¹⁰.

They all have in common is that only their absence can eliminate the respective health risk. Therefore it is essential to recognize the problems and take appropriate early measures. Dietary sources account for most of the human exposure to heavy metals except for areas in the vicinity of toxicant emitting industries. Metals took up via roots and pass easily to edible leaves of fruits and seeds. It will also accumulate in animal milk and fatty tissues ^{11, 12}.

High ash content in India's coal affects the thermal power plant's potential emissions. Therefore, India's Ministry of Environment & Forests has mandated the use of beneficiated coals whose ash content has been reduced to 34% (or lower) in

power plants in urban, ecologically sensitive and other critically polluted areas, and ecologically sensitive areas. The suggestion guideline of the Ministry of Environment and Forests help to project investigators furthermore to put off ecological pollution in India from thermal power plants as this sector has many environmental issues^{13, 14}.

The installed capacity of Thermal Power in India, like 2012, was 140206.18 MW which is 66.99¹⁵ of total installed capacity. Madhya Pradesh (India) has a number of thermal power plants. Lack of clean and reliable energy sources such as electricity is, in the division, causing concerning 80 crore population in India to continue using traditional biomass energy sources¹⁶. India's coal-fired, oil-fired, and natural gas-fired thermal power plants are inefficient and offer significant potential for greenhouse gas (CO₂) emission decline through better technology¹⁷.

In the present study, the toxicant especially heavy metals which discharge in routine basis by the established operational power plant were observed and documented priestly, the present piece of investigation focus their impacts on plant biodiversity to measuring of environment degradation.

Environment Revolutionizes Impacts: Plants and animals are susceptible to fluctuations in temperature and climate. In the past, the climate has varied considerably inside short time scales. Evidence from fossils and paleobiological studies have indicated that these periods of rapid climate change have been associated with crowd extinction events. Operation of power plants have revolutionized climatic situations and speeding up the rate of universal warming¹⁸. This is a direct result of the increase in production of greenhouse gases, such as carbon dioxide, methane, and oxides of nitrogen due to the burning of fossil fuels.

Moreover, unfinished combustion from vehicles and release of anthropogenic chemicals called chlorofluorocarbons (CFCs) into the atmosphere has degraded the stratospheric ozone layer around the Earth, which shields the planet from harmful ultraviolet radiation¹⁹. Increasing water temperatures will radically alter the ecology of

freshwater ecosystems and wetlands, leading to increased phytoplankton, changes in the distribution of invertebrate and fish species and the loss of coldwater species (like lake trout) altogether. Studies on the effects of global warming point to two major facts: the speed of change is much more accelerated than in the past, which may pose a serious threat to slow-growing communities which cannot respond quickly, and which may shrink the range of plants that need cooler environments. Secondly, global warming may increase the frequency of climatic disturbances such as fires, disease, insects, storms, etc.²⁰

Although some metals were present at relatively low concentrations, some such as lead and cadmium are highly toxic even at very low doses, to humans as well as many animals and plants, and are usually found in the environment at only very low levels. Many metals discharged in wastewaters tend to bind to sediment particles and accumulate in bottom sediments of receiving waterways. Ongoing discharges of wastewaters containing high concentrations of metals, even if those levels are below regulatory discharge limits, can lead nonetheless to increasing levels of metals in sediments in receiving water bodies, which can, in turn, result in long-term impacts in sensitive aquatic species and, potentially, predators further up the food web²¹.

The water-based ecological system altered by these power plant toxicants, they regulate the metabolism of the plant with certain changes in the environment. Regular entertainments of this toxicant with plant affected to the life span and survivability of plant. Metals found at high concentrations in plant sample included beryllium, cadmium, chromium, lead, manganese and zinc. Levels of all these heavy metals steps by step degraded plants and associated other biotic components, which further responsible for the loss of biodiversity²². No.s of plants and animal species affected by operational power plant based discharged contaminants.

Furthermore, the levels of beryllium and manganese exceeded the highest allowable levels under the effluent standard by many times and 2-3 times respectively, while the concentration of some other metals exceeded but the highest allowable

level for this metal and that of chromium was just below the allowable level. Food and water are the main sources of our essential metals; these are also the media through which we are exposed to various toxic metals²³. Heavy metals are easily accumulated in the edible parts of vegetables, as compared to grain or fruit crops²⁴. Vegetables take up heavy metals and accumulate them in their edible and inedible parts in quantities high enough to cause clinical problems both to animals and human beings consuming these metal-rich plants^{25, 26}.

Contaminated sediments threshold levels and local background levels for metals Standards defining thresholds for acceptable levels of metals in sediments have not been justify in singrauli city. As a result, previous studies that investigated sedimentary metal concentrations have made exercise of various standards from other countries intended for comparison, including threshold levels for seriously contaminated sediments in the city.

The levels of toxicants were shown adverse biological effects in aquatic organisms. Some published data indicate general local background levels of metals in sediments, both for deep sediments in the local available water reservoir. The Singrauli district and other covering location already showed some toxicity in groundwater²⁷.

Risks for Biodiversity: Biodiversity is the sum of all the different species of animals, plants, fungi, and microbial organisms living on Earth and the variety of habitats in which they live. Each species is adapted to its unique niche in the environment, from the peaks of mountains to the depths of deep-sea hydrothermal vents, and from polar ice caps to tropical rain forests.

Humans have long depended on biodiversity resources for food, medicines, and materials as well as for recreational and commercial purposes such as fishing and tourism²⁸. Aquatic organisms also rely upon the great diversity of aquatic habitats and resources for food, materials, and breeding grounds. There was a significant increase in the concentration of the metal in the plants' tissue (roots and leaves), which was sufficiently correlated with the metals in recorded in the plants irrigated with the stronger of the watering solutions²⁹.

A changing global climate threatens species and ecosystems. The distribution of species (biogeography) is largely determined by climate, as is the distribution of ecosystems and plant vegetation zones, change may simply shift these distributions but, for a number of reasons, plants and animals may not be able to adjust. The pace of climate change almost certainly will be more rapid than most plants are able to migrate the presence of roads, cities, and other barriers associated with human presence may provide no opportunity for distributional shifts. Parks and nature reserves are fixed locations³⁰.

In the same plants the larger heavy metals concentrations were also recorded. This toxicity was significantly correlated with the watering pattern and not the substrate. Factors including overexploitation of species, the introduction of exotic species, pollution from urban, industrial, and agricultural areas, as well as habitat loss and alteration through damming and water diversion all contribute to the declining levels of aquatic biodiversity in both freshwater and marine environments. As a result, valuable aquatic resources are becoming increasingly susceptible to both natural and artificial environmental changes. Thus, conservation strategies to protect and conserve aquatic life are necessary to maintain the balance of nature and support the availability of resources for future generations. Air and water pollution, sedimentation and erosion, and climate change also pose threats to aquatic biodiversity³¹.

Thermal power plants' spatial locations at different locations in Madhya Pradesh (India) have affected biodiversity and migration path of birds in the State of MP. Figure exhibits locations for major thermal power plants and important forms of pollutants includes: (i) poisonous pollutants: agrochemicals, metals, acids and phenol reason mortality, if present in a elevated concentration and affect [32, 33]; (ii) suspended solids: it affects the respiratory processes and secretion of protective mucus making the fish susceptible to infection of various pathogens; (iii) sewage and organic pollutants: they cause deoxygenation due to eutrophication causing mortality in fishes; (iv) thermal pollution: it cause an increase in ambient temperature and reduce dissolved oxygen concentration leading to the death of some sensitive species. These factors affect the

aquatic biodiversity directly or indirectly. Excessive mortality of organisms due to any of these factors may lead to two types of effects: (a) extinction of the species/populations (b) reduction of population size.

Biodiversity Conservation based Safety Approach and Efforts:

Strategies for Biodiversity management are too essential, which is possible through the creation of certain enterprises by the involvement of governmental, commercial, NGOs, local populations, and the general public. Additional effective legislation, including biodiversity aspects into all relevant laws, the designation of legislation hold of biodiversity conservation must be measurement used for sustainability. The best scientific approach for decision-making procedure, looking for biodiversity indicators, cadastre of biodiversity, development of monitoring, etc are addition support scheme for biodiversity conservation strategies. Ecosystem models have relevance in a variety of regulations. Natural resource, eco-toxicology and environmental health, agriculture, biodiversity and wildlife conservation, and management are affordable.

The climate change affects biological processes like metabolism; nutrient requirements quickly react to them. Because individual plants and therefore species can only function on the bases of their physiology and complete their life living cycles under specific environmental conditions changes to the climate are likely to have significant impacts on plants from the level of the individual right through to the level of the ecosystem. Increases in temperature raise the rate of many physiological processes such as photosynthesis in plants^{34,35}, to an upper limit. Extreme temperatures can be harmful when beyond the physiological limits of a plant

Aquatic biodiversity includes a variety of life and ecosystems of freshwater. In general, aquatic conservation strategies should support sustainable development by protecting biological resources in ways that will preserve habitats and ecosystems. For biodiversity conservation to be effective, management measures must be broad-based. This can be achieved through many mechanisms. In recent times, the factors like over-exploitation, pollution, habitat alteration and destruction are

overwhelmingly causing impacts and threats to aquatic biodiversity. Heavy metals are very harmful because of their non-biodegradable nature, long biological half-lives and their potential to accumulate in different body parts. Most of the heavy metals are extremely toxic because of their solubility in water.

Even low concentrations of heavy metals have damaging effects on man and animals because there is no good mechanism for their elimination from the body. Nowadays, heavy metals are ubiquitous because of their excessive use in industrial applications. Wastewater contains substantial amounts of toxic heavy metals, which create problems^{36,37}. Excessive accumulation of heavy metals in agricultural soils through wastewater irrigation, may not only result in soil contamination but also affect food quality and safety³⁸. Central Pollution Control Board is executing a nation-wide program of ambient air quality monitoring known as National Air Quality Monitoring Programme activities and there is continuous monitoring of Sulphur Dioxide, Nitrogen Dioxide, respirable suspended particulate matter and suspended particulate matter etc. in many areas in the country to determine status and trends of ambient air quality, ascertain whether the prescribed ambient air quality standards are violated, identify non-attainment cities, to obtain the knowledge and understanding necessary for developing preventive and corrective measures; to understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of pollutants generated for pollution control strategies.

Many specialized programs have been instituted to protect biodiversity. For example, the USDA Forest Service initiated Bring Back the Natives, a cooperative state-federal program. The goal of this program is to restore the health of riverine systems and associated species. Areas targeted for this program include lands managed by the U.S. Forest Service and the Bureau of Land Management.

Various organizations and conferences that research biodiversity and associated conservation strategies help to identify areas of future research

analyzed current trends in aquatic biodiversity, even conduct specialized studies. Biodiversity management strategies through the creation of partnership by involving governmental, commercial organizations, navy and military, NGOs, local populations, and the general public are important.

More effective legislation, including biodiversity aspects into all relevant laws, the designation of legislation support of biodiversity conservation must be part of sustainability. The scientific approach for the formalization of decision-making procedure, looking for biodiversity indicators, cadastre of biodiversity, development of monitoring, etc are an additional support system for biodiversity conservation strategies. Ecosystem models have applications in a wide variety of disciplines, such as natural resource management, eco-toxicology, and environmental health, agriculture, biodiversity, and wildlife conservation.

The climate change affects biological processes such as metabolism, nutrient requirements, and

biochemical activities quickly react to them. The behavioral response like migration and geographic distribution of birds are changed. Reproductive physiology and breeding behavior of animals are directly affected by photoperiods, temperature, and precipitation^{39, 40}. Changes in atmospheric carbon dioxide and methane can affect plant species and indirectly animal species. The entire food web is affected and becomes imbalanced. There is a need to explore uses of bio-energy & bio-fuels and imposition of ban on coal-based industries with immediate effect⁴¹.

Use of clean energies like solar and wind power for running industries and household lights must be encouraged through subsidies by Government. The capture of atmospheric carbon dioxide from the air through speedy forest development programs. Both ex-situ and in-situ conservation strategies for biodiversity must be incorporated in planning by the government. Regulatory measures must be taken on wastewater discharge in the water body to conserve biological diversity.

TABLE 1: POWER PLANTS WITH THEIR INSTALLED CAPACITIES (MW) IN M.P AND ADJOIN AREA OF UP (INDIA)

S. no.	Power Station Location	Industry type	District, state	Installed Capacity (MW)	Operator
1	Vindhyachal Thermal Power	Thermal Power (electricity)	Singrauli District M.P,	1260 MW (6×210 MW) under Stage-I, 1000 MW (2×500 MW) of Stage-II and	NTPC
2	VindhyaChal Pooling sub-station	Power transmission	Singrauli District M.P	from Sasan UMPP No 765 KV S/C Sasan Satna Transmission lines and Vindhyachal Stage-IV (400 KV D/C (Quad) Vindhyachal - Vindhyachal Pooling line, 2 No 765 KV S/C from Vindhyachal Pooling to Satna Sub-Station, a 765/400 KV Pooling Sub-Station near Vindhyachal Stage-IV (1000 MW), Rihand Stage-III (1000 MW) as well as Aryan Coal Beneficiation Pvt Ltd 1200MW Generation Projects	Powergrid
3	Singrauli Super Thermal Power Station (SSTPS)	Thermal Power (electricity)	Sonebhadra, U.P, India	5 x 200 MW + 2 x 500 MW=2000 MW	NTPC
4	Sasan Ultra Mega Power Project	Thermal Power Plant (electricity)	Singrauli District M.P, India	3,960 MW	Reliance Power
5	Rihand Thermal Power Station(RTPS)	Thermal Power (electricity)	Sonebhadra, U.P., India	1000 MW (2x500 MW each) in Stage-I and 1000 MW (2x500 MW each) in Stage-II Total= 2000MW and 1000MW of stage-III have been commissioned recently.	NTPC
6	Northern Coalfields Limited	Coal mining	Singrauli District M.P, India	coal supplies 13295 MW of electricity from pithead power plants of NTPC, UPRVUNL, and Renupower M/s. Hindalco Industries	Coal India Limited

7	Muher and Muher Amlori extension	Coal mining	Singrauli District M.P, India	coal reserves of these mines are around 720 MT with a production level of 25 mtpa	Reliance Power
8	Mahan Super Thermal Power Project	Thermal Power plant (electricity)	Singrauli District M.P, India	2x 600 MW = 1200MW	Essar Group
9	Mahan coal Limited	Coal mining	Singrauli District M.P, India	-	Essar and Hindalco
10	Mahan Captive Thermal Power Plant	Thermal Power plant(electricity)	Singrauli District M.P, India	900-MW 150x6	Hindalco Industries
11	Mahan Aluminium Limited	Aluminium smelter plant	Singrauli District M.P, India	359-ktpa aluminum smelter	Hindalco Industries
12	M.P. Jaypee Minerals	Coal mining	Singrauli District M.P, India	2 million tonnes	M.P. Govt. and Jaypee Group
13	Jaypee Nigrie Super Thermal Power Project	Thermal Power plant (electricity)	Singrauli District M.P, India	2 x 660 MW= 1320 MW	Jaypee Group
14	DB Power M.P. Limited	Thermal Power plant (electricity)	Singrauli District M.P, India	1320 MW	Dainik Bhaskar
15	Chitrangi Power Project	Thermal Power Plant (electricity)	Singrauli District t M.P, India	3,960 MW	Reliance Power
16	Amelia coal block	Coal mining	Singrauli District M.P, India	----	Sainik mines and M.P. State Mining Corporation Ltd.

CONCLUSION: The results of our investigation substantiate the conclusions. Heavy metals and fly ash from thermal power effluents absorbed in the surface of plants and vegetables leaves which creates toxicities with alteration on plants structures, photosynthesis, pigment production, growth, and development, *etc.* several environmental problems in terms of land degradation, ground, surface water contamination were also associated as results of toxicity these metals which responsible for the routine pollutant for local environment and alter the survivability of plants; therefore the plants and there variable species moves to loss as frequent basis or diversity.

Screen out and monitored plants species having a variable concentration of heavy metals which unsafely affects to human health. The present situation could, however, change in future depending on the dietary pattern of community and volume of contaminants added to the ecosystem. Although there is a general tolerable level of metals at the moment and daily intake of it is less than the concentration. Elemental residues have raised serious setbacks and risks, which will also persevere in future. There is an effort to decline to

a minimum or eliminate dispersion of contaminants into the food string and therefore also into the livings.

ACKNOWLEDGEMENT: Nil

CONFLICT OF INTEREST: Nil

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How to cite this article:

Pandey R, Singh PK, Pandey SK, Singh B and Patel BL: Operational Power Plants Based Impacts on Plant Biodiversity to Measure Atmosphere Degradation in Singrauli District, Madhya Pradesh, India. *Int J Life Sci & Rev* 2015; 1(5): 199-06. doi: 10.13040/IJPSR.0975-8232.IJLSR.1(5).199-06.