

PROJECT

Entitled

“Preliminary studies on Impact of coal dust on soil, crop and tree species due to Open Wagon Coal Transportation”



By

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GENERAL INFORMATION ON THE PROPOSED PROJECT

Sl No	Heading	Details
1	Name of the Institute / University/ Organization submitting the Project Proposal	BTC College of Agriculture and Research Station, Indira Gandhi Krishi Vishwa Vidyalaya, Bilaspur- 495001, Chhattisgarh
2	State	Chhattisgarh
3	Status of the Organization	State Agricultural University
4	Name and designation of the Executive Authority of the Institute/University forwarding the application:	Director Research Services, Indira Gandhi Krishi Vishwa Vidyalaya, Krishak Nagar, PO-Labhandih, Raipur (C.G.)
5	Project Title:	Preliminary studies on Impact of coal dust on soil, crop and tree species due to Open Wagon Coal Transportation
6	Specific Area	Study on coal dust effect on agriculture and forest trees during transportation
7	Duration:	01 Year (<i>Research work is under progress</i>)
8	Total Cost (Rs.):	9,35,000/-
9	Is the project Single Institutional or Multiple-Institutional (S/M):	Single
10	If the project is multi-institutional/ Network mode, please furnish the following	NA
11	Scientists Involved:-	A) Dr. Jagat Ram Patel, Principal Scientist / Professor (Agronomy) B) Dr. A. K. Awasthi, Professor (Entomology) C) Sh. A. Williams, Scientist (Forestry) D) Dr. Geet Sharma, Scientist (Agronomy) E) Sh. P. K. Keshry Scientist (Soil Science) F) Dr. (Smt.)Y. Sao, Assistant Professor (Soil Science) G) Dr. N. K. Chaure, Principal Scientist (Agriculture Statistics)
12	Scope of coal dust on agricultural environment	As given below

IMPACT OF COAL DUST ON SOIL, CROP AND TREE SPECIES DUE TO OPEN WAGON COAL TRANSPORTATION

INTRODUCTION

Man needs energy in various forms and for various purposes. Prior to the discovery of the use of coal, wood provided a major source of energy as fuel. Substitution of coal in place of wood burning has perhaps protected at least the remaining forest cover on the earth's surface. As a matter of fact coal is fossilized solar energy, stored in fossil plants which grew extensively in the geological past.

Energy in the form of electricity is a basic requirement for all modern developmental activities and can be generated by a variety of methods, materials and mechanisms. There continues to be a controversy about the long-term impact of generation of large amount of energy by various methods. However, the vagaries of the monsoon and the uncertainty of hydel power, the meager oil reserve, and the problems associated with safety and disposal of nuclear waste and high technology needed for tapping non-conventional energy resources; single out coal as the primary and principle source of electricity in India.

Coal will continue to be used as the main source of generating electricity at least in the next decade also in the developed and developing countries. In Nations with planned economies 70 to 90% of the coal produced is utilized in power generation. The variation on a global basis would be nearly 70% in USA to 50% in Western Europe to 15% in Japan. From 350 million metric tonnes of coal burned in 1972 in 50 thermal power plants a rapid increase to 446 million in 1976 and 840 million in 1985 and 741 TPS shows remarkable increase in coal utilization in developed countries (Unni, 1995).

In India Coal production increased from 34.9 million tonnes in 1950 to 369.41 million tonnes in 2009-10. Super thermal power stations recently set up have increased the power production in a thermal power station from 2000 to 3000 MW. With a meager consumption of 5.1 million tonnes per annum during the first plan period the consumption in 2011-12 increased to 680 million tonnes (Anon., 2011a).

The coal fired thermal power stations are widely distributed all over India. According to Central Electricity Authority of India, there were 83 coal fired thermal

power plants in India. From 1,362 MW in 1947 and 1,700 MW in 1950 the capacity of Thermal power production enhanced to 42,585 in 1985, 63,636 in 1990 and is expected to grow between 1, 85,000 MW to 2, 07,000 MW by the end of 2013 in India (Anon., 2011b & Anon., 2011c).

Energy is the brighter side of coal combustion, pollution of environment is the darker aspect of this process. The environmental impacts of coal transportation include air pollution, water pollution, solid wastes, noise levels, safety and traffic hazards. Direct environmental impacts can occur at the mine, where the coal is being transferred, transported or loaded. Indirect environmental impacts from coal transportation largely result from the combustion of fuel for the transportation itself. The utilization of coal in large scale and production of ash waste from the combustion of coal and their subsequent disposal into holding ponds have created potential environmental risks in the receiving system. The composition of coal and method of combustion determine the chemical composition of the waste products. The environmental effects are due to the elements that make up the coal and the oxidants which are burned and discharged into the basin.

Major gaseous emissions from a thermal power station consist of SO₂ and nitrogen oxides. The conditions of coal combustion and fuel characteristics determine the CO₂ and SO₂ emission. The sulphur contents of the coal forms an important factor which determine SO₂ emissions- the main pollutant around thermal power stations. According to 1980 estimates, 13 millions tonnes of fly ash, 4, 80,000 tonnes of SO₂, 2, 80,000 tonnes of NO_x, 16,000 tonnes to CO and 5,000 tonnes of hydrocarbons are released in the atmosphere each year by our thermal power stations (Sharma, 1986). During the past five years, we have added quite a few thermal power stations/super thermal power stations and many more are likely to be commissioned during the coming years, thus further aggravating the already serious environmental pollution problem in certain pockets of the country.

SIPAT Super Thermal Power Station or Rajiv Gandhi Super Thermal Power Station is located at Sipat in Bilaspur district in State of Chhattisgarh. The power plant is one of the coal based power plants of NTPC. The coal for the power plant is sourced from Dipika Mines of South Eastern Coalfields Limited.

The project has an installed capacity of 2980 MW consisting of two stages, stage one which got commissioned late was of 3 units of 660 MW each involving super-critical boilers technology and stage two consisted of 2 units of 500 MW.

Coal is the dirtiest of all fuels. From mining to coal cleaning, from transportation to electricity generation to disposal, coal releases numerous toxic pollutants into the air, water and land. These disrupt ecosystems and endanger human health. Some cause cancer, others damage the nervous and immune systems, and some impede reproduction and development (Keating, 2001).

Coal is considered as the most polluting source of energy which creates environmental problems at various stages of its procurement from mining, transportation, stock piling, coal preparation and utilization stages of operations. Coal produces a variety of pollutants during electricity generation and releases numerous toxic pollutants into the air, water and land. The environmental impacts of coal mining are complex and depend on the mining method and its location with respect to the place of utilization.

Trucks, rail, ports and barges which are used to transport coal, may all affect air and water quality, in addition to the environmental health impacts from blowing coal dust and air pollution coming from the vehicles themselves. The environmental impact of coal transportation is moderate and associated with energy consumption used for loading/unloading equipment, water usage for dust suppression and spillages occurring from rail cars, trestle conveyors and wharf transfer points. Noise from jack hammering and dust from unloading coal wagons can also cause environmental problems.

Coal dust generally comprises a small component of total dust present in air near coal railways and coal terminals. Nevertheless, coal dust emission can affect amenity, and predominantly comprises coarse dust particles (dustfall) of particle size generally between 50 and 200 microns in diameter. As coal dust is black in colour, it is generally highly visible. It is these dark visible dust particles that can cause nuisance due to soiling of property, surfaces and washing. The fine particle (PM_{10}) composition of coal dust is generally quite low.

Environmental scientists are deeply concerned about the global misuses and abuse of nature in the name of development and progress, resulting not only in the air, water and soil pollution but also threatening the biological rhythm everywhere. On account of

the unabated process of wide-spread universal degradation of environment and the imminent threat that looms large on the entire ecology, the Council of Environmental Quality has sounded a warning for developing countries stating that if the present trend continues, the world by the end of the 20th century, will be more crowded, more polluted, ecologically less stable and more vulnerable to destruction than the world we live in now.

Environmental values are generally not perceived at all or are often under priced in the comparison to marketable goods. However, with rapid industrialization and consequent deleterious impact on environment, values of environmental protection offered by trees/forests are becoming clear. It is realized that importance of trees with regard to carbon dioxide is not its short time circulation through leaves, litter and soil humus, but it is the locking up of carbon in wood over long duration (Poore,1976).

A study was conducted to characterize the growth of vascular plants and species composition of vascular plants, lichens and mosses growing on and off the coal dust plume. While few differences in the frequency and percent cover of vascular plants, or in biomass of perennials, were found on the coal dust plume, the biomass of annuals was significantly higher. Growth characteristics of three vascular plant species were not significantly different on and off the plume. Plant growth seems to occur earlier on the plume, possible due to the significantly higher soil temperature. In addition to increased soil temperature, decreased pH, and increased moisture-holding properties on the plume, some heavy metal concentrations were also higher. These edaphic features may be responsible for the lower frequencies and diversity of lichen species on the plume. Moss diversity, frequency and percent cover are similar on and off the plume with the exception of *Ceratodon purpureus* . The increased percent cover of *C purpureus* on the plume may be attributed to an adaptive tolerance for certain heavy metals found in the coal dust that provides a competitive advantage. Lichens play a vital role in natural desert ecosystems by increasing soil surface stability against wind erosion, adding nitrogen to the soil, and improving water retention, thus potentially enhancing the growth of vascular plants. Although there were small differences found among vascular plant communities on and off the plume, over the long term a decrease in abundance of lichens may have a negative effect on vascular plant species Spencer (2001).

Agricultural crops can be injured when exposed to high concentrations of various air pollutants. Air pollution injury to plants can be evident in several ways. Injury to foliage may be visible in a short time and appear as necrotic lesions (dead tissue), or it can develop slowly as a yellowing or chlorosis of the leaf. There may be a reduction in growth of various portions of a plant. Plants may be killed outright, but they usually do not succumb until they have suffered recurrent injury. Injury ranges from visible markings on the foliage, to reduced growth and yield, to premature death of the plant. The development and severity of the injury depends not only on the concentration of the particular pollutant, but also on a number of other factors. These include the length of exposure to the pollutant, the plant species and its stage of development as well as the environmental factors conducive to a build-up of the pollutant and to the preconditioning of the plant, which make it either susceptible or resistant to injury. Most common among the local pollutants are sulfur dioxide, fluorides, ammonia and particulate matter, while widespread pollutants consist primarily of oxidants (Ozone, Sulfur Dioxide, Fluoride, Ammonia, Particulate Matter). Particulate matter such as cement dust, magnesium-lime dust and carbon soot deposited on vegetation can inhibit the normal respiration and photosynthesis mechanisms within the leaf. Cement dust may cause chlorosis and death of leaf tissue by the combination of a thick crust and alkaline toxicity produced in wet weather. The dust coating also may affect the normal action of pesticides and other agricultural chemicals applied as sprays to foliage. In addition, accumulation of alkaline dusts in the soil can increase soil pH to levels adverse to crop growth (Heather Griffiths, 2003).

Trees play an important role in the maintenance and amelioration of environment. They not only improve the atmosphere through absorption of carbon dioxide and other obnoxious gases and release oxygen, but also help in trapping dust particles and effluents in water discharges. Evapo-transpirational processes also moderate temperature to some extent. While doing so, trees also provide many tangible and other intangible benefits.

During the past many decades, there has been a growing awareness about the serious hazards of atmospheric pollution to which we are constantly exposed. However, we have just begun to become conscious to this problem. Unlike industrialized nations, in India, air pollution problems are still localized in certain pockets, but exert a potential threat to plant and animal lives. India has vast reserves of coal and therefore, thermal

power plants, which produce energy by burning coal, supply bulk of the power generated in this country. Consequently, thermal power stations spread all over the country are a major source of atmospheric pollution. Environmental pollution will continue to be a problem due to increased demands resulting from urbanization and industrialization leading to release and accumulation of pollutants in air, water and soil. Effect of coal dust on crop, soil and tree species due to open wagon coal transportation varies but these have so far not been evaluated in quantitative terms. There is a great need for an in-depth study in this direction.

Such an approach will ensure development with the least ecological disturbance and without destruction by providing much needed data base for integrating tree planting with the planning of major industrial complexes.

OBJECTIVES OF THE PRESENT RESEARCH WORK

Agriculture crop and trees are known to reduce various types of pollution viz., air, water and soil pollution. However, impact of coal dust on soil, crop and tree species due to open wagon coal transportation has not been worked out. The present study aims at screening of agricultural crop and tree species according to their regeneration capacities under various pollutants grown in SIPAT industrial area, which is polluted due to transportation of coal by railway wagon from Dipika mines of South Eastern Coalfields to NTPC, Sipat, Bilaspur (C.G.).

In view of the increasing dependence on coal fired power plants as energy source during coming decades, and the environmental problems related to this developmental activity, the present work will be planned in Sipat industrial area situated in Bilaspur district of Chhattisgarh, India, with following specific objectives:

1. Enumeration of crop and cropping pattern, soil properties, forest vegetation and tree species present in the study area.
2. Evaluation of the quantity of coal deposition in soil and plants due to transportation of coal on quarterly basis after monsoon rain.
3. Determination of the effects of pollutants on different tree species preset at study area.
4. Physico-chemical analysis of soil and major plants grown/available in the study area.

5. To create awareness among the farming community about the effect of coal dust in agriculture and forest trees species by the brochure/ pamphlet/ Kisan Goshthi/Farmer's Scientist interaction and or Kisan Mela.

SCOPE OF THE WORK

The human awareness of environment pollution is not new and the subject has been of much importance and interest and engaging the attention of man since ages. Even in ancient days it was his understanding of environment that ensured the survival of human species. Although there has never been a time when man has not modified his environment, the changes that are occurring today are major and very rapid as compared to the past. They are capable of upsetting the mechanism of natural regulation and balance which could endanger our very existence. Moreover, many changes taking place in the physical environments are constantly lowering the already declining quality of life. It is perhaps these threats to our life and survival and not merely the scientific urge that explain the increasing number of studies in the field of environment. The effects of pollution to our biosphere are numerous and are increasing tremendously due to man's urge to ensure and achieve good quality of life. Unless otherwise checked they could make the whole planet uninhabitable. Extensive research work therefore, has to be given top priority and importance and to be carried out on an on going basis and as a continuous process keeping abreast with the day to day development and changes taking place on earth for the timely and proper remedial measures. The urban-industrial and technological advances and developments are necessary evils and pollution creates, and they will also continue to grow in a large proportion hence research has to be matched with the challenges of the future in mind.

It is observed that little work had been done so far on the "Effect of coal dust on crop, soil and tree species due to open wagon coal transportation". Very little work also had been done on the quantity of pollutants being absorbed by the agriculture crop, soil and its removal by the plants in its part. The present work at Sipat, Bilaspur (C.G.) is important both from the academic as well as practical point of view in relation to the progressive march of country through industrialization. The work would have a far reaching effect on future management of Thermal power areas in relation to the integrated package development for expending sinks of the pollutants emitted by the

industry. Such type of studies had provided a base line for selection of species and their suitable combinations to minimize hazards and restrict ill effects of environmental pollution without affecting the pace of industrial development.

PROPOSED METHODOLOGY OR PLAN OF WORK (For one year)

Effect study of transportation of coal on crop, soil and tree species, it is proposed to proceed as follows:

Phase I:

Study will be conducted at nearby railway track for coal deposition due to coal transportation on crop, soil, tree species, forest vegetation, etc. be covered specially during winter and summer seasons under study. Both side of rail line, about 01 km distance will be covered as treatment area and beyond this; area will be treated as control zone. There will be 03 stations at crop area, forest area and fallow land on transportation line. Similarly, both side of line, 03 sub stations will be marked in each station at 0(near rail line), 500 and 1000 m distance. A suitable questioner will also be developed to know effect of coal transportation on agriculture of the selected study area. Soil and plants sampling and analysis will be undertaken for its physicochemical properties.

Phase II:

Interpretation of analyzed data and preparation of final report.

FACILITIES AVAILABLE (Equipments and apparatus)

1. Well equipped Computer facility is available for data analysis and report compilation
2. Well equipped laboratory is available for *Lab* test
3. Office facilities are available at BTCCARS, Bilaspur
4. Well equipped office facilities for proper handling of the account are available.
5. Audit staff of State Government is available for audit work.

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