Effect of Different Mining Dust on the Vegetation of District Balaghat, M.P - A Critical Review

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Abstract: ***Industrialization had increased requirement of more energy with mining for more minerals resultant pollution. Soil pollution due to different mining dust has become problem in district Balaghat, M.P beside that dust deposition on the surface of vegetation affects photosynthesis and growth of common plants nearby the mining areas. This review articles describes briefly the various mining sites in Balaghat district of Madhya Pradesh, India and dust chemical characteristics which had many effects on vegetation and soil. The physical and chemical characteristics of a range of mining dust types are explained and its effects on photosynthesis, respiration and transpiration. Plants growing on this atmosphere show a reduction in growth performance and yield. Visible injury symptoms and decreased in productivity on vegetation is well noticed. Most of the plant community structure is altered. However, there have been very few detailed studies on natural and semi-natural systems and some dust types are also much understudied. Recommendations for future research are made in order to overcome this knowledge gap.***

Keywords: Dust, Growth performance of Vegetation, Mining in district Balaghat, M.P, Soil pollution.

1. Introduction

This paper briefly explains the effects of mining dust pollution on plant communities. Dusts consist of solid matter in a minute and fine state of subdivision so that the particles are small enough to be raised and carried by wind. They may originate from many sources. A large number of mines and mining industrial process can produce particulate emission (Fennelly, 1975). The main processes that regularly cause problems, however, are those concerned with mineral extraction. This range from the quarrying itself to the various processing operations e.g. copper, manganese, limestone, marble and aluminum ore processing with cement manufacturing. Mining dust suppression in this operation is more difficult and dust levels can be very high. Mineral extraction is increasing in many countries in order to meet increased construction demand (Harris, 1975, Stanton 1989). Industrialization, urbanization, economic growth and associated increase in metal and minerals demands have resulted in a profound deterioration of air quality in developing countries like India.

Although minerals and heavy metals are naturally present in the soil, geologic and anthropogenic activities increase the concentration of these elements to amounts that are harmful to plants. Some of these activities include mining smelting of metals, processing of minerals also. Growth reduction as a result of changes in physiological and biochemical processes in plants growing on mining polluted soils has been recorded (Chatterjee & Chatterjee, 2000).

This paper shows a comprehensive review of literatures available on the effect of mining dust on plants with their communities and soil. Initially the characteristics of various dust types are described, highlighting those factors that are important in determining the likely impact its deposition may have. The effect of mining dust is considered according to vegetation type followed by a discussion of the effects of mining dust on plant species, crop species and on a range of natural and semi-natural vegetation types.

Further, the objective o this study is to know the influence of mining activity on the concentration of dust in air, soil and vegetation surrounding mining sites at Balaghat district, Madhya Pradesh, India.

2. Detail of sites

2.1 About different mining sites in district Balaghat, M.P.

In Madhya Pradesh, Balaghat district has a huge mineral deposits and also prosperous with forest. Balaghat is located in the southern part of Jabalpur division. It occupies the south eastern portion of the satpura range and the upper vally of the Wainganga River. The district extends from 21º19' to 22º24; north latitude and 79º31' to 81º3' east longitude. The total area of the district is 9,245km^2 (Figure.2.1 and 2.2).

About 80% of the manganese production in India comes from Balaghat district by MOIL, and copper deposit at Malanjkhand, Balaghat is regarded 70% as the largest in the country. In fact it is largest open-cast mining in Asia. Bauxite, Kainite, Marble, Dolomite, Clay and Limestone are the other main minerals of the Balaghat district (Table.2.1).

The lust green forest of Balaghat district and Kannah National park is also important as mining of different minerals present in and around.

Table 2.1: Mineral Resources of District Balaghat, M.P, India

S. N.	Minerals	Village	Tehsil	Uses
01.	Copper ore (Chalcopyrite, Pyrite, Cuprite)	Malanjkhand	Baihar	Used in wire, plates etc.,
02.	Manganese ore (Pyrolusite, Bryonite, Magnite)	Ukwa, Tirodi, Hirapur, Bharweli, Manegaon, Miragpur	Baihar Katangi Balaghat	Used in steel and alloys.
03.	Cement Raw	Duglai, Hatri, Kandai, Deodongla, Jangla, Piprahi	Baihar	Used for Cement
04.	Marble Dolomite	Bhagatpur latri, Sitapchoro, Dulhapur	Balaghat Baihar Katangi	Used in Tiles
05.	Bauxite (Alumina)	Mardi Dadar,Toursi Dadar, Garhi Dadar	Baihar	used in Refractory
06.	Limestone	Tirodi	Katangi	Used in Cement.

Figure 2.1: Location Map of district Balaghat,M.P, India

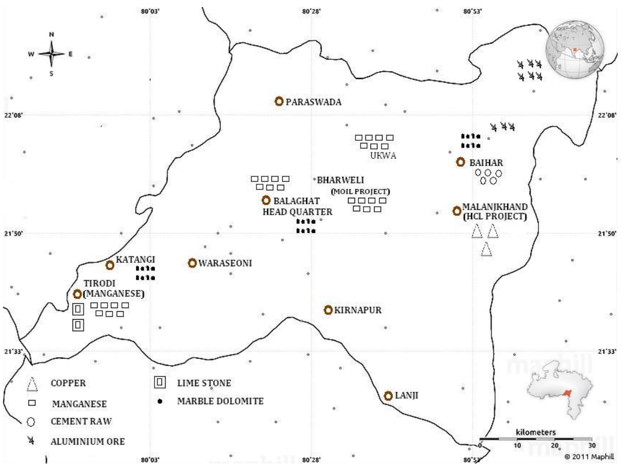

Figure 2.2: Geographical location of different mining site in district Balaghat, M.P, India

3. Source of Contamination

There are different sources of dust in the environment such as (1) Natural source (2) Agriculture source (3) Industrial Source (4) Atmospheric source (5) Mining Source etc. Dust can be emitted into the environment by both natural and anthropogenic activities. The major causes of emission are the anthropogenic sources specifically mining operations (Nriagu 1989). In some cases, even long after the mining activities have ceased the emitted metals continue to persist in the environment. Peplow (1999) reported that hard rock mine operate from 5-15 years until the minerals are depleted, but metal contamination that occurs as a consequence of hard rock mining persist for hundred of year after the cessation of mining operations. Heavy metal and minerals are emitted both in elemental and in compound (organic and inorganic) forms. Anthropogenic sources of emission are the various industrial point sources including former and present mining site.

4. Effect of Mining Dust on Plants

Plants are often sensitive both to deficiency and to the excess availability of some heavy metal ion as essential micronutrient, while the same at higher concentrations and ions are strongly poisonous to the metabolic activities. Research shown significant adverse effects of toxic mining dust on plants (Reeves and Baker 2000, Fernandes and Henriques 1991) and agricultural soil has become a critical environmental concern due to their potential adverse ecological effects. Further, such toxic elements are considered as soil pollutants and their acute and chronic toxic effect on plants grown in such soils.

4.1 Effect of Copper Dust on Plants

Copper (Cu) is considered as a micronutrient for plants (Thomas et al., 1998) and plays important role in CO_2 assimilation and ATP synthesis. Cu is also an essential component of various proteins like plastocyanin of photo-synthetic system and cytochrome oxidase of respiratory electron transport chain (Demirevska-kepova et al., 2004). But enhanced industrial and mining activities have contributed to the increasing occurrence of Cu in ecosystems. Cu is also added to soils from different human activities including mining and smelting of Cu-containing ores. Mining activities generate a large amount of waste rocks and tailings, which get deposited at the surface. Excess of Cu in soil plays a cytotoxic role, induces stress and ROS (Stadtman and Oliver 1991). Oxidative stress causes disturbance of metabolic pathways and damage to macromolecules (Hegedus et al., 2001). Copper dust had adverse effect on photosynthesis pigmentations of vegetation around the mining site (Pichhode & Nikhil, 2015 **a**) with soil and vegetation cumulatively on certain vegetation of district Balaghat, M.P (Pichhode & Nikhil, 2015 **b**). Excess application of pesticides had resultant in the rise of Cu in soil (Nikki, 2000).

4.2 Effect of Manganese Dust on Plants

Accumulation of excessive manganese (Mn) in leaves causes a reduction of photosynthetic rate (Kitao et al., 1997). Mn is readily transported from the root to shoot through phloem to other organs after reaching the leaves (Loneragan 1988). Necrotic brown spotting on leaves, petioles and stems is a common symptom of Mn toxicity (Wu 1994). This spotting starts on the lower leaves and progresses with time toward the upper leaves (Horiguchi 1988). With time, the speckles can increase in both number and size resulting in necrotic lesions, leaf browning and death (Elamin and Wilcox 1986). General leaf bronzing and shortening of internodes has been documented in *Cucumis sativus* (cucumber) (Crawford et al., 1989, a and b). Anathor common symptom is known as "crinkle-leaf", and it occurs in the youngest leaf, stem and petiole tissue. It is also associated with chlorosis and browning of the tissue (Wu 1994; Bachman and Miller 1995). Roots exhibiting Mn toxicity are commonly brown in colour (Le Bot et al., 1990; Foy et al., 1995) and sometimes crack (Foy et al., 1995). Chlorosis in younger leaves by Mn toxicity is thought to be caused through Mn-induced Fe deficiency (Horst 1988). Excess Mn is reported to inhibit synthesis of chlorophyll by blocking a Fe-concerning process (Clarimont et al., 1986). Manganese toxicity in some species starts with chlorosis of older leaves moving toward the younger leaves with time (Bachman and Miller 1995). This symptom starts at the leaf margins progressing to the interveinal areas and if the toxicity is acute, the symptom progresses to marginal and interveinal necrosis of leaves (Bachman and Miller 1995).

4.3 Effect of Iron on Plants

Iron as an essential element for all plants has many important biological roles in the processes as diverse as photosynthesis, chloroplast development and chlorophyll biosynthesis. Iron is a major constituents of the cell redox system such as heme proteins including cytochromes, catalase, peroxidase and leghemoglobin and iron sulfur proteins including ferredoxin, acontiase and superoxide disumutase (SOD) (Marschner 1995).

4.4 Effect of Cement Dust on Plants

The cement industries also plays a vital role in the imbalances of the environment and produces air pollution hazards (Stern 1976). These dust particulates are causing large scale deforestation destruction of biota (Panda, et.al., 1996) and other natural resources. Among these deposition of cement kiln dust in large quantities around cement factories causes changes in soil's physical and chemical properties (Asubiojo, et.al., 1991; Saralabai 1993). The effect of such deposition affects the growth and biochemical characteristics of field crops has also been widely studied (Prasad and Inamadar 1990; Prasad et al., 1991). According to Farmer (1990) cement industrial region are confronted with the problems of alkalization due to high deposition of alkaline cement dust and their ash in the pollution complex. In addition, the growth of quarrying and open-cast mining suggests the deposition on vegetation may be increasing.

4.5 Effect of Bauxite Dust on Plants

Bauxite mining is one such major open cast mining activity which has significant negative impact on the local environment. The major threats of this activity are dust pollution, vegetation loss, forest fragmentation and biodiversity loss, negative impact on water resources, generation of wastelands and social impact. The study revealed that the legal and illegal mining activity has initiated serious environmental degradation in the region. Though mining initially provided job opportunities for limited inhabitants and generated revenue to Government, it would last only for a short period. However, the damage caused to the local ecology as a result of the changed land use is permanent (Rohan and Samant, 2012).

4.6 Effect of Marble Dust on Plants

The paper describes the effect of marble dust on plants. Trees species growing were selected and various morphological characteristics were studied such as leaf area dry weight ratio (LADWR), Dust retaining capacity (DRC) and Chlorophyll content. In the study the effects of marble dust on selected tree species was observed. LADWR was recorded maximunm 217.90 cm2 g-1 dry wt. in Polyalthia longifolia and minimum 98.74 cm2 g-1 dry wt. in Ficus religiosa in Nindar whereas The DRC was observed maximum 178.51 mg cm-2 in Azadirachta indica as well as minimum recorded 66.41 mg cm-2 in Thevetie pervvianain. However the Total Chlorophyll Content was also determined and it was found maximum in Bougainvillea i.e. 2.949 mg g-1(fresh wt.) whereas minimum 0.784 mg g-1 (fresh wt.) in Ficus religiosa (Saini, et.al., 2011).

5. Conclusion and Future Aspects

The physiological response of plants reveals many different direct routes of action through which dust can affect plants. Mining dust may also exacerbate secondary stresses, such as drought, insects and pathogens, or allow penetration of toxic metals or phytotoxic gaseous pollutants. Effect of mining dust on natural communities may alter the competitive balance between species in a community. These changes in the vegetation may also affect animal communities, from vertebrate's grazers to soil invertebrates. This may, for example, alter cycles of decomposition. Response of individual species may be positive or negative depending on the particular situation, and only detailed studies may reveal the main reason behind any observed changes. There have, unfortunately, been only a limited number of studies at the community level.

In is evident from this review of the literature that there are many gaps in our knowledge of the effects of mining dust. Until research into these areas in undertaken, the ability of those with responsibility for plant and crop protection, or preventing the deterioration of natural and semi-natural habitats, to address developments that may threaten sites will be inadequate. It is important therefore, that current trends in dust emissions are identified as well as the vegetation types that are likely to be affected by such emission.

Thus, it is evident from the several research reports that judicious use and presence of mining dust have toxic effect on plants, animals and other living organisms and affects the same after certain limits. Therefore, it is well needed to intensify the research program for better understanding of effect of mining dust on plants and allied areas to maintain the ecological harmony.

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Jyotish Katare, M.Sc., Department of Biotechnology, Sardar Patel College of Technology, Balaghat affiliated to Rani Durgavati Vishwavidyalaya, Jabalpur, M.P. done his project work at EMG, CSIR-CIMFR, Dhanbad, Jharkhand, India in the year 2013 and publishing his experimental finding which is very significant and important work. This review paper will helps in understanding the effects of copper and other mining present at district Balaghat, M.P through dust showing effects on plants and soil. He further grown plants on the copper overburden dump top material as growing media with or without soil and Cowdung manure in different combination shown significant cumulative effects on the plant growth which has already been published.

Mohnish Pichhode, M.Sc. in Biotechnology, Department of Biotechnology, Sardar Patel College of Technology, Balaghat affiliated to Rani Durgavati Vishwavidyalaya, Jabalpur, M.P done his project work at EMG, CSIR-CIMFR, Dhanbad, Jharkhand, India in the year 2013 and published very significant and important review paper as well as an experimental work in the second paper which had indeed helped in understanding the effects of copper mining in nearby vegetation and soil within the district Balaghat, M.P.

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