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Climate change impacts, mitigation and adaptation on herbaceous plants due to open cast coal mining in Jharia Coalfields

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Abstract
Generally, any external force, substance, or condition that affects plants in any way, leads to the impact of the environment. Coal mining practices in India have a long history. On a commercial scale mainly British companies started it in India. From its very first day exploitation of coal reserve started and it resulted in the environmental degradation through various ways. It is a topic of research importance because now a day the environmental problem is a burning global issue. Now a day if one observes any coal-mining project in India the truth aforesaid will automatically reveal. There is the destruction of vegetation, soil resource, water resource; underground resource and great intensity of various pollutions have been observed. In short an in human treatment is meted out to the environment by modern civilization. The Jharia coalfields of BCCL are not an exception in this regard. Opencast mining is the predominant mode of coal mining, but it is less environmentally friendly. Impact of coal mining on herbaceous plants is created by human being for the privilege of standards of living. In the Indian coal industry the dependence on opencast mining has been increased rapidly during the last two decades due to the modernization of mining operation. The large opencast mines have the advantage of low gestation period and higher recovery of coal and are more amenable to heavy mechanization and modern technologies than underground mines, thus ensuring speed and economy in implementation. The loss of the layer of top soil due to opencast mining leads to the low frequency of plants. Surface necessitates full uncovering of the mineral deposit and overlying vegetation and soil are completely destroyed. Open cast mining of coal deposits involves removal of overlying soil rock debris. This debris is heaped in the form of dumps and is called over burden. Lack of vegetation cover on such dumps often leads to the acute problem of soil erosion and environmental pollution. It results in the impact on herbaceous dicots plants and physiographic features of the concerned region. Eminent Research scholars have done many research works in India regarding coalfield. Though coal is an essential resource but protection of the environment is not less important. Therefore, environmental impacts of coal mining projects with its possible preventive measures are compulsory. So the environmental impacts of coal mining projects are immense which will also help understand the development of Jharia coalmines.

Keywords: Coal mining, Overburden, Herbaceous plants, Environment, and Species

Introduction
Traditionally, coal production in Jharia coalfield was mostly from underground mines though the scenario has been changed significantly in favour of opencast mining after nationalization. The land loss and land degradation due to underground mining are of lower magnitude compared to opencast mining. But due to sustained underground mining activities carried over so long large area of the coal-bearing area has been degraded and lost due to subsidence. An estimate indicates that about 4600 hectares of land has undergone subsidence up to the year 2000 and the overage surface lowering is about 0.6 m. It may be anticipated that another 1000 hectare of land would be affected by subsidence up to the year 2015 (Goswami, 2013). The above estimate, however, does not take into consideration where subsidence may be triggered anytime due to the inadequacy of supporting coal pillars left underground.

In open cast mines, heavy blasting is usually done for coal and overburden. Operations in many open cast mines are taking place adjacent to the residential area, washery, or other permanent surface structures. Thankfully, blasting techniques are now so much developed that severity of vibrations can be reduced to safe limits. Such controlled and relatively safer, blasting is a common feature of a large number of open cast mines in the country.

Adopting such a controlled blasting technique, it has been made possible now to do the blasting operations at a distance of 90 m from the residential areas and 40-50 m from a washery successfully and safely.

Extinction of biodiversity is a global issue generated by a human being for providing strength

and security to his living standard. The mining activity in the concerned zones provides raw materials in the form of crusher, gravels and stones etc for construction of roads and other infrastructure. The number of species endangered by human activities and the number of natural and semi-natural habitats being destroyed. Surface necessitates full uncovering of the mineral deposit and overlying vegetation and soil are completely destroyed. Open cast mining of coal deposits involves removal of overlying soil rock debris. This debris is heaped in the form of dumps and is called over burden. Lack of vegetation cover on such dumps often leads to acute problem of soil erosion and environmental pollution. It results in loss of biodiversity and physiographic features of the concerned region. Therefore, development of vegetation on the dumps is essential for the conservation of biodiversity and stable environment in the coalfields area (Singh *et al.,* 2002).

Dhanbad district of Jharkhand has about 12.7% forest area and the rest in open land that abounds in herbaceous dicots plants. In Jharia coal fields also rural people depend primarily on the basis of utility but due to open cast mining in recent past have led to the almost complete destruction of herbaceous dicots flora of the concerned locality. The issue of land loss and land degradation shall have to be considered along with the declining of frequency, density and abundance of plants by the side effects of mining. During the process of research, the different plants are collected from different polluted sites in the mining areas where there has been a considerable accumulation of suspended particulate matter and coal dust is found. There is a considerable reduction in the height of plants in all polluted sites. The water retention capacity of soil in the coalfield is also affected due to mining and this, in turn, addicts the field productivity (Dhar, 2000).

Land degradation and consequent land loss is the unique type of environmental effect associated with mining and is generally not encountered in this scale in any other industrial activity. Opencast mining in scale and in intensity creates a most severe form of land degradation and therefore, coalfield communities all over the region hold strong views against open casting as mining operations.

Material and Methods

Jharia Coalfields are situated in Jharia Block and also the adjoining area which is six kilometers north to the head quarter of Dhanbad District in the state of Jharkhand India. The study area is located between 23.75 degree N Latitude 86.42 degree East Longitude and the elevation is 77 m above sea level. The area experiences a seasonal tropical dry climate with three distinct seasons, viz Summer (March to June), Rainy (July to October) and winter (November to February). Annual average rainfall of the area is 1260 mm of which 80% falls during the rainy season. The mean air temperature varies from 15 Degree (December) to 27 Degree (May).

The methodology encompasses the study of vegetation in and around the major open cast projects and also it includes the study of vegetations in non-coal bearing adjoining area. All the areas taken for the study were visited regularly and periodically in three major seasons in order to study the prevailing vegetation with reference to herbaceous dicots. Collected plants were preferably studied in situ and when required herbaria were prepared for ex situ identification. These plants are identified in situ with the help of flora/keys (Hainses flora). They are pressed in herbarium presses, dried and preserved for future work as well as identification.

A pollutant is a substance or energy introduced into the environment that has undesired effects or adversely affects the usefulness of a resource. Pollutants are particulate as well as gaseous. Particulate matter is the sum of all solid and liquid particles suspended in air, many of which are hazardous. For air quality monitoring, four monitoring sites namely Ena colliery, Dhansar, Bastacolla and Bhagatdih were selected in different directions and distances in coal mining area of JCF. A reference site, Central Institute of Mining and Fuel Research (CIMFR), was also selected for comparing the air quality, situated at six km in north direction from Jharia. The present research is based on both primary as well as secondary Data. Primary data have been collected from the regular visit of the study area and secondary data have been collected from Dubey, *et. al*., (2012). In coal bearing area (Jharia) and non-coal bearing area (Baliapur), the frequency of selected plants species has been determined by quadrate method on random basis.

Table 1: Shows the different plant species in coal bearing area (Jharia)

Sl.no	Name of the plant species	No. of individual in each quadrate										Total no. of individual	No. of quadrate in which species Occurred	Total no. of quadrate	Frequency %
		1	2	3	4	5	6	7	8	9	10				
1	*Argemone mexcana*	*	2	3	*	*	2	4	*	*	*	11	4	10	40%
2	*Datura metel*	1	*	*	*	*	*	*	*	*	*	1	1	10	10%
3	*Eupatorium perfoliatum*	2	*	2	1	*	1	*	2	*	4	12	6	10	60%
4	*Boerhaavia diffusa*	*	*	*	*	3	*	*	*	*	*	3	1	10	10%
5	*Cassia tora*	2	3	*	*	5	*	*	*	*	3	13	4	10	40%
6	*Euphorbia hirta*	*	2	*	1	*	*	*	2	*	*	5	3	10	30%
7	*Blumea lacera*	2	*	*	*	*	*	*	*	*	*	2	1	10	10%
8	*Sida rhombifolia*	5	*	*	2	*	*	4	*	*	3	14	4	10	40%
9	*Xanthium strumarium*	*	*	2	*	*	1	*	*	3	*	6	3	10	30%
10	*Tephrosia purpurea*	*	*	*	*	1	*	*	*	*	2	3	2	10	20%

Table 2: Shows the different plant species in non-coal bearing (Baliapur).

sl.no	Name of the plant species	No. of individual in each quadrate										Total no. of individual	No. of quadrate in which species Occurred	Total no. of quadrate	Frequency %
		1	2	3	4	5	6	7	8	9	10				
1	*Argemone mexcana*	5	2	3	*	*	2	4	3	5	3	27	8	10	80%
2	*Datura metel*	3	*	3	*	2	2	*	3	*	2	15	6	10	60%
3	*Eupatorium perfoliatum*	2	3	*	2	*	2	4	*	2	3	18	7	10	70%
4	*Boerhaavia diffusa*	*	2	3	*	3	*	4	5	*	1	18	6	10	60%
5	*Cassia tora*	2	3	2	3	4	4	5	*	*	3	26	8	10	80%
6	*Euphorbia hirta*	4	2	3	5	*	3	2	7	*	6	32	8	10	80%
7	*Blumea lacera*	*	1	3	*	2	4	1	3	*	*	14	6	10	60%
8	*Sida rhombifolia*	4	2	5	3	*	2	2	4	3	5	30	8	10	80%
9	*Xanthium strumarium*	2	4	4	*	*	4	2	4	3	*	23	7	10	70%
10	*Tephrosia purpurea*	4	5	2	*	3	*	2	2	*	3	21	7	10	70%

Results and Discussion

The herb frequency is comparatively more in the unmined/control area than the mined areas. The frequency does not vary much between the sites. On the basis of observation, From Table 1 to 2, it is apparent that there is an appreciable decline in the frequency of plant species in mined areas as compared to unmined area.

The minimum percent of in frequency is 10% and maximum percent of frequency is 60% has been recorded in the mining area. Thus, in all the selected plant species show a significant decrease in the frequency has been recorded in comparison to the control area.

The minimum percent of in frequency is 60% and maximum percent of frequency is 80% has been recorded in the control area.

- In respect to frequency, it has been observed that the un-sustained coal mining has resulted into decline in the frequency of plant species under study area. This decline is related to the inhospitable condition of soil and its moisture as well as the creation of over burden. It has been observed that many of the plant species show retardation in overall growth due to mining activity in a un-sustained manner. The adjoining areas to the study sites which are generally non coal bearing show better plant diversity with proper frequency.
- Some overburden has been found to be invaded by species of *Eupatorium perfoliatum, Sida rhombifolia, Tephrosia indica, Cassia tora,* initially and then by some other successful plant species that are slightly preferring xeric habitat. Furthermore, the successful invaders (plant species) on overburdens will be observed and it may lead to the development of vegetation on overburdens.
- Analysis of vegetation on coal mine spoil dumps has been compared with vegetation of normal area along with a few growth pattern parameters and it has been observed that species frequency, density, abundance are affected on the mine spoils due to inhospitable or hostile conditions of the soil and over all climate. The capacity of some plant species to tolerate drought, low soil nutrients and climatic stresses (Helm 1995, Skeel & Gibson) may contribute to their success in colonizing the mine spoil. The numbers of plant species were not noticed on 3 – 6 year-old dumps due to the sterility of the top soil. There is a decline in the frequency, density, abundance as well as growth pattern of plant species under study. This decline is related to the inhospitable condition of soil and its moisture. The substratum/soil has particles of irregular shapes and sizes leading to rapid percolation of water resulting in a deficiency of moisture. Similarly, the soil in the mined area, especially on overburden in the study area, is deficient in nutrients which are responsible for retardation in overall growth of plant species. However, the conservative characters are affected qualitatively but not quantitatively.

The graph shows the frequency of selected plants in coal-bearing area (September to December).

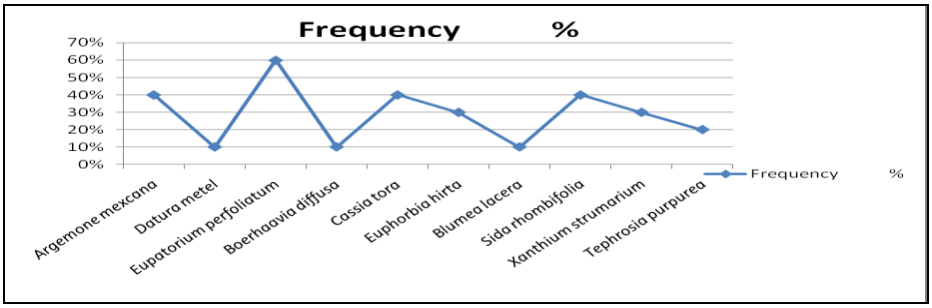

Fig 1: In the coal-bearing area during September to December the frequency of selected plants are less shows in comparison to the non-coal-bearing area.

The graph shows the frequency of selected plants in Non-coal bearing area (September to December).

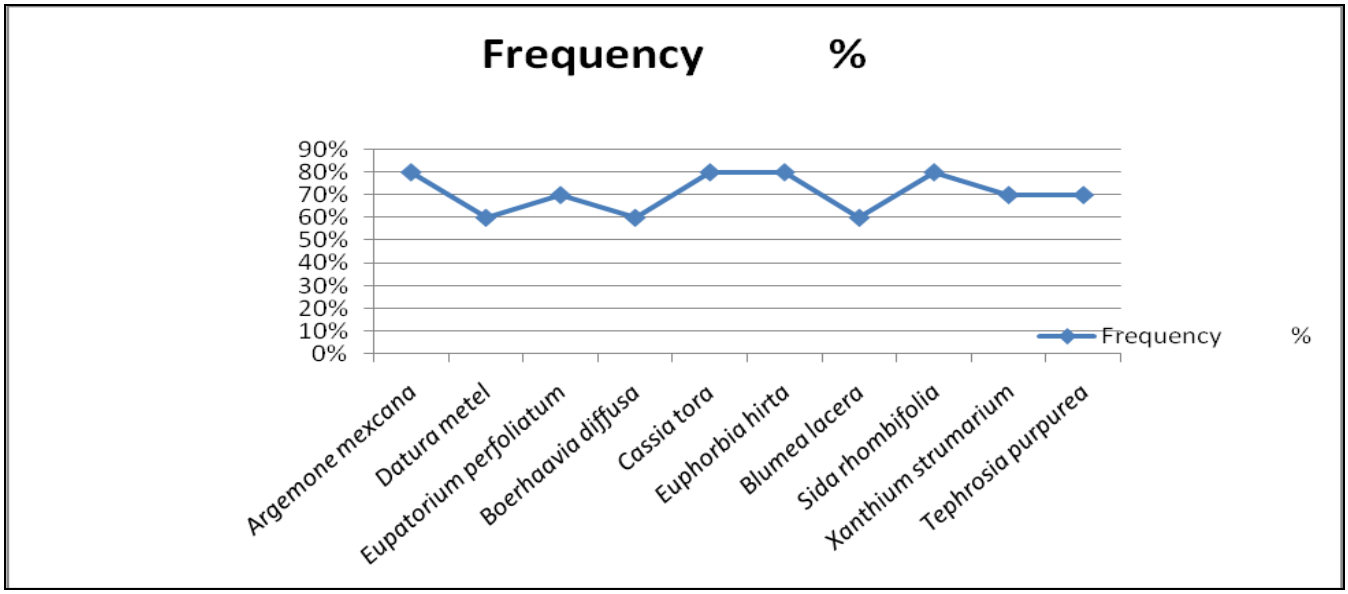

Fig 2: In the non-coal bearing area during September to December the frequency of selected plants are in a normal condition.

Conclusion

From the above finding, it has been concluded that un-sustained coal mining has resulted in decline in the frequency, density, abundance as well as growth pattern of plant species under study area. This decline is related to the inhospitable condition of soil and its moisture as well as the creation of over burden. It has been observed that many of the plant species show retardation in overall growth due to mining activity in a un-sustained manner, so it is suggested that mining especially open cast should be done scientifically in order to conserve plant diversity. The adjoining areas to the study sites which are generally non coal bearing show better plant diversity with proper frequency and density, Although, Some overburden have been found to be invaded by species of *Eupatorium perfoliatum, Xanthium strumarium, Sida rhombifolia,, Tephrosia indica, Cassia tora,* initially and then by some other successful plant species that are slightly preferring xeric habitat. Furthermore, I would like to conclude that the successful invaders (plant species) on overburdens will be observed and it may lead to development of vegetation on overburdens by creating some artificial condusive habitat. This will lead to the development of vegetation and successively soil building process will take place and course of time complete vegetation will be expected.

On the other hand, burning of coal also leads to increase in concentrations of particulate and gaseous pollutants in the atmosphere causing severe air pollution around coal mining areas (Tripathi and Gautam, 2007). Environmental ill–effects of coal mining are potentially very broad including air, soil and water pollution and loss of biota (Moody, 2005). Therefore the environmental impact of coal mining areas must be assessed periodically for air quality assessment (Jones, 1993). Efforts should be taken to minimize the extent of air pollution by employing latest techniques by involving the coal companies as well as local people. The overburden resulted as a result of unsustained open cast mining should be leveled after mining and spoiled strata should be reclaimed progressively in consultation with local people. Specific legislation must be enacted as a necessity of the day. So that in future the spoiled land may become useful in course of time.

References

1. Dubey B, Pal AK, Singh G. Atmospheric Pollution Research, 2012; 3:238-246.
2. Dhar BB. Environmental impact and abatement of noise pollution, National Workshop on environmental management of mining operation, Varanasi, India. 2000, 168-204.
3. Goswami S. Coal Mining, Environment and Contemporary Indian Society, Global J. Human Soc. Sci. U.S.A (B), 2013; 13(6):17-26.
4. Helm DJ. Native grass cultivars for multiple revegetation goals on a proposed mine site in south-central Alaska. Restoration Ecology, 1995; 20:111-122.
5. Monio M, Iglesias DA. Plants and the environment, ESPERE Climate Encyclopaedia, 2012, 05-12.
6. Shaojun W. International Conferences on Computer Distributed Control and Intelligent Environmental Monitoring. 2012, 679-682.
7. Moody R. The Risks We Run: Mining, Communities and Political Risk Insurance, International Books, Utrecht, the Netherlands. 2005, 51-63.
8. Singh AN, Raghubanshi AS, Singh JS. Plantations as a tool for mine spoil restoration. Current Science, 2002; 82:1436-1441.
9. Skeel VA, Gibson DJ. Physiological performance of *Andropogon gerardii*, *virgatum*, and *Sorghastrum nutans* on reclaimed mine spoil. *Restoration Ecology*, 1996; 4:355-367.
10. Tripathi AK, Gautam M. Biochemical parameter of plants as indicators of air pollution. Journal of Environmental Biology, 2007; 28:127– 132.