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"Biodiversity Conservation And Natural Resource Management With Special Reference To Herbaceous Dicot Plants In Jharia Coalfields"

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ABSTRACT

India's biodiversity is one of the most significant in the world. The country has several problems such as over population, large number of cattle heads growing demand for land energy and water supply. Jharkhand is very fortunate due to its richness of natural resources and industries like coal mining. Mine sites are usually cleared off all vegetation and kept free of vegetation during the course of operation. Mining operations have had a devastating effect on the land and flora, laying many areas barren, which were verdant with luxuriant forest. There is destruction of vegetation, soil resource, water resource; underground resource and great intensity of various pollutions have been observed. Though coal is an essential resource but conservation of phytodiversity is not less important. The surface cover slowly reduced to shrubs and bushes growing profusely in the rainy seasons and drying in winters. Bantulsi (*Ocimum vulgare*) became the most common bush of the coalfields capable to sustain the particulate pollution because of the nature of the leaf. Forest as a result slowly disappeared from the Jharia coalfields even though very little under the influence of direct mining. These areas were rich in flora and fauna before the advent of mining but suffered heavy losses due to mining activities especially open cast minings. The author wants to disclose all the environmental impact of coal mining projects with its possible preventive measures. So the conservation of phytodiversity in the coal mining areas is immense which will also help to understand the management of Jharia coalmines.

Key words: - Biodiversity; Coal mines; Environment; Management; Vegetation.

INTRODUCTION

Bio means "life" and diversity means "variety". Hence biodiversity refers wide variety of life on the earth. Loss of biodiversity has series economic and social costs for any country. It is very important for human life; we depend on plants, microorganisms, earth's animals for our food, medicine and industrial products. India's biodiversity is one of the most significant in the

world. As many as 45, 000 species of wild plants and over 77,000 of wild animals have been recorded, which comprise about 6.5 percent of the world's known wildlife. An assessment of wildlife habitat loss in tropical Asia in 1986 showed that the country had only 6,15,095 km^2 out of its original wildlife habitat of 30, 17,009 km^2 i.e. loss of about 20 percent. In the last few decades India has lost at least half its forests, polluted over 70 percent of its water bodies, built on or cultivated much of its grasslands and degraded most of its coasts. Under such circumstances none can say how many species have already lost. The country has several problems such as over population, large number of cattle heads growing demand for land energy and water supply.

In 1980, the Government of India enacted the forest (conservation) Act prohibiting the diversion of forest land for any non- forest purpose without the prior approval of the central Government. The term forest land refers to reserved forest, protected forest or any area recorded as forest in the Government record including privately owned forest land. An important stipulation specified by the government at the time of according approval for diversion of forest land is the requirement of compensatory afforestation over an equivalent area of non forest land or twice the area in case of degraded forest land.

Jharkhand is very fortunate due to its richness of natural resources and industries like coal mining, Steel, Aluminium, Zinc, Lead, Thermal Power Plant explosive factory, fertilizer and many other industries. Mine sites are usually cleared off all vegetation and kept free of vegetation during the course of operation. Mining operations have had a devastating effect on the land and flora, laying many areas barren, which were verdant with luxuriant forest of deciduous trees like Arjun, Bargad, Baheda, Bhelwa, Gamhar, Gular, Jamun, Karanj, Katahal, Mahua, Mango, Neem, Palas, Pipal, Sal, Samul, Tendu etc. industries are trying their best to re-vegetate the barren area and over burden dumps by direct plantation of exotic species of Accasia spp, Albizia sp, Eucalyptus spp. etc.

MATERIAL AND METHODS

DESCRIPTION OF STUDY SITES

Jharia Coalfields are situated in Jharia Block and also the adjoining area which is six kilometer south to the head quarter of Dhanbad District in the state of Jharkhand India. The study area is located between 23.751568^0N Latitude 86.420345^0 East Longitude and the Elevation is 77 Meter or 253 Feet above sea level. The area experiences a seasonal tropical dry climates with three distinct season, 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 from15^0 (December) to27^0 (May).

The study sites were selected in the close area of Jharia, where phytodiversity was almost severely affected and also in the radius of 4-6 km. The study of vegetation in and around five major open cast projects like Rajapur open cast project, Ghanoodih open cast project, kuya open cast project, Dhansar open cast project & North Tisra open cast project and also it includes the study of vegetations in non coal bearing adjoining area which will serve as control. All these projects are run by B.C.C.L.

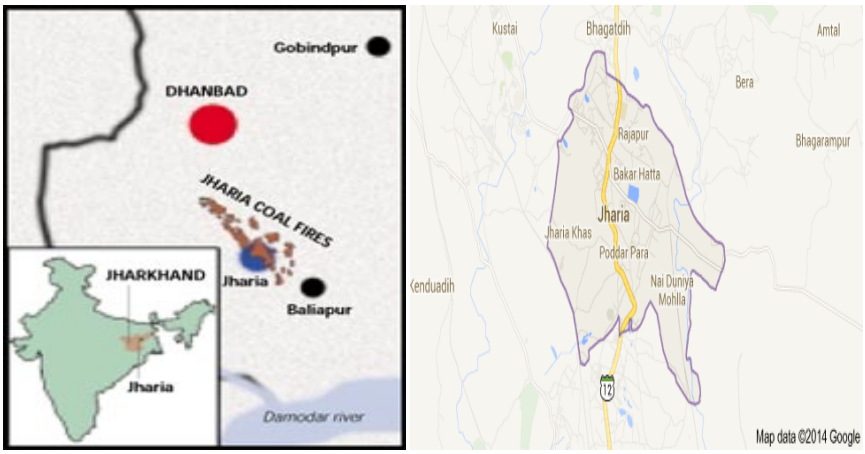


Figure:-1 shown the study area

The methodology encompasses the study of vegetation in and around five major open cast projects and also it includes the study of vegetations in non coal bearing adjoining area. All the five areas taken for 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 preserve for future work as well as identification.

This survey is primarily aimed at the studied of morphology, frequency, density, abundance, of plants listed for both mining as well as un mined areas for the sake of comparison.

Study Area

Sl No.	Location	Area	Site Details
1	Rajapur open cast project	Jharia Coalfield	Low Vegetation
2	Ghanoodih open cast Project	Jharia Coalfield	Low Vegetation
3	kuya open cast Project	Jharia Coalfield	Poor Vegetation

4	Dhansar open cast project	Jharia Coalfield	Poor Vegetation
5	North Tisra open cast project	Jharia Coalfield	Poor Vegetation

Table:-1 Showing the location, area and site details of Jharia coalfields.

The selected areas have been frequently visited in different seasons in order to study the herbaceous plants growing in an around the open cast mines an over burdens due to open cast mining. Collected plants were preferably studied in situ and when required herbaria were prepared for ex situ identification. Studied of frequency, density & abundance have been listed for both mining as well as un mined areas for the sake of comparison.

STATISTICAL ANALYSIS

Data on various growth and other parameters are recorded from 34-40 randomly selected plants to study the statistical analysis. Then from the analyzed data, with the help of mathematical calculator, attempts have been made to calculate the mean from the formula of Singh & Choudhary, 1985.

$$Mean(X) = \frac{\sum x}{n}$$

OBSERVATION

Observations of morphological as well as ecological studies at different sites are presented below. Impact of open cast coal mining directly effect on the results and observations carried out in frequency, density & abundance of the various plants on different sites are recorded. The results are tabulated and supported by figures and are analyzed statistically. Necessary photographs are also taken to supplement the visual observations. In course of study, I confined my observations to the various genera of herbaceous dicots such as *Amaranthus spinosus, Alternanthera sessilis, Blumea lacera, Eupatorium perfoliatum, Parthenium hysterophorus, Tridax procumbens, Xanthium strumarium, Cassia tora, Cleome gynandra, Euphorbia hirta, Tephrosia, indica, Sida rhombifolia, Boerhaavia diffusa, Argemone mexicana, Datura metel, Solanum nigrum etc.* These genera are selected to study the: - (a) Frequency (b) Density (C) Abundance

(a) Mean Frequency plants

The herb frequency is comparatively more in the unmined/control area than the mined areas. So, it is clear that almost all selected plants species show decrease in the mean frequency at all the five study sites under investigation. The mean frequency of the control area in all the selected

plant species is recorded normal but percent decrease in the mean frequency has been recorded at all the five study sites. The minimum percent of decrease in mean frequency 57.14 % and maximum percent of decrease in mean frequency 91.42% is recorded at the mining area. Thus, in all the selected plant species show significant decrease in the frequency has been recorded at all the five study sites in comparison to the control area.

(b) Mean Density of plants

The plants density is comparatively more in the unmined/control area than the mined areas. So, it is clear that almost all selected plant species show decrease in the mean density at all the five study sites under investigation. The mean density of the control area in all the selected plant species is recorded normal but percent decrease in the mean density has been recorded at all the five study sites. The minimum percent of decrease in mean density 65.88% and maximum percent of decrease in mean density 93.75% is recorded at the study area. Thus, in all the selected plant species show significant decrease in the density has been recorded at all the five study sites in comparison to the control area.

(c) Mean Abundance of plants

The plants abundance is comparatively more in the unmined/control area than the mined areas. So, it is clear that almost all selected plants species show decrease in the mean abundance at all the five study sites under investigation. The mean abundance of the control area in all the selected plant species is recorded normal but percent decrease in the mean abundance has been recorded at all the five study sites. The minimum percent of decrease in mean abundance 12.38% and maximum percent of decrease in mean abundance 60 % is recorded at the mining area. Thus, in all the selected plant species show significant decrease in the abundance has been recorded at all the five study sites in comparison to the control area.

RESULT & DISCUSSION

The results of ecological studies at different sites have been studied. Impacts of open cast coal mining directly effect on the results of frequency, density & abundance of the various plants on different sites have been done. The mining activity directly ruins the vegetation cover. The areas due to over burden don't contain plants as the top soil layer has been totally absent. The results are tabulated and supported by graphs and figures. Necessary photographs are also taken to supplement the visual observations.

(a) Frequency of the selected plants on study area

On the basis of observation, From Table 2 and Graph 1 ,it is apparent that there is appreciable decline in the frequency of plant species in mined areas as compared to unmined area. The frequency of the control area in all the selected plant species is recorded normal but out of which 34 herbaceous plant species, such as *Sida rhombifolia, Cassia tora, Alternanthera sessilis,* is 60% decrease in the frequency of study area. Plant species such as *Eupatorium perfoliatum, Tephrosia indica, Euphorbia hirta, Xanthium strumarium, Solanum nigrum, Blumea lacera,* have recorded 70% decrease in the frequency of study area. Plant species such as *Argemone mexicana, Parthenium hysterophorus, Amaranthus spinosus, Boerhaavia diffusa,* have recorded 80% decrease in the frequency of study area. Plant species such as *Tridax procumbens, Solanum torvum, Cleome gynandra,* have recorded more than 90% decrease in the length of leaves at all the five study sites. The minimum percent of decrease in mean frequency 52% and maximum percent of decrease in mean frequency 91.42 % is recorded at the mining area. Thus, in all the selected plant species show significant decrease in the frequency has been recorded at all the five study sites in comparison to the control area.

(b) Density of the selected plants on study area

On the basis of observation, From Table 3, and Graph 1, it is apparent that there is appreciable decline in the density of plant species in mined areas as compared to unmined area. However, a few plant species such as *Cassia tora, Sida rhombifolia, Eupatorium perfoliatum, Tephrosia indica, Argemone mexicana, Xanthium strumarium, Alternanthera sessilis, Solanum nigrum, Blumea lacera,* have recorded 80% decrease in the density of study area. Plant species such as *Parthenium hysterophorus, Euphorbia hirta, Amaranthus spinosus, Boerhaavia diffusa, Solanum torvum,* have recorded 90% decrease in the density of study area. Plant species such as *Tridax procumbens, Cleome gynandra,* have recorded more than 90% decrease in the density at all the five study sites. The minimum percent of decrease in mean density 65.88% and maximum percent of decrease in mean density 93.75 % is recorded at the study area. Thus, in all the selected plant species show significant decrease in the density has been recorded at all the five study sites in comparison to the control area.

(c) Abundance of the selected plants on study area

The plants abundance is comparatively more in the unmined area than the mined areas. The density does not vary much between the sites. From Table 4, and Graph 1, it is clear that almost all selected plants species show decrease in the abundance at all the five study sites under investigation. The abundance of the control area in all the selected plant species is recorded normal but plant species such as *Cassia tora, Tephrosia indica, Eupatorium perfoliatum, Alternanthera sessilis, Argemone mexicana, Blumea lacera, Solanum nigrum,* have recorded 30% decrease in the abundance of the study area. Plant species such as *Sida rhombifolia, Parthenium hysterophorus, Amaranthus spinosus, Xanthium strumarium, Boerhaavia diffusa,* have recorded 40% decrease in the abundance of the study area. Plant species such as *Euphorbia hirta, Tridax procumbens, Cleome gynandra, Solanum torvum,* have recorded 60% decrease in

the abundance of the study area at all the five study sites. The minimum percent of decrease in mean abundance 12.38% and maximum percent of decrease in mean abundance 63.63% is recorded at the mining area. Thus, in all the selected plant species show significant decrease in the abundance has been recorded at all the five study sites in comparison to the control area.

DISCUSSION

Opencast mining is the predominant mode of coal mining worldwide, but it is less environmental friendly. The large opencast mines have 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. But, due to coal mining, number of natural and semi natural habitat is being destroyed. The vegetation which ultimately is responsible for sustenance of life on earth undergoes severe damage.

Rao (1971) studied the effect of coal dust and fruiting behavior of *Mangifera indica* (mango) and Citrus lemon, found so many changes in growth patterns. Rao (1980) in his experiments of the effect of air pollution (gaseous pollutants and particles) has concluded that absorption and accumulation of pollutants in plants and other ecosystem components such as soil and surface ground water. Primary producers (plants) are also prone to injury to pollutants accumulation. The growth ability of species and biochemical cycle is affected.

Review of literature indicates that air pollution due to coal mining has great impact on vegetation and soil condition (Hill and Lamp, 1980). Further the mining activities and coal based industries in coal fields have greatly added in the severity of the air pollution and physico- chemical properties of the soil, the participation factor and the response of plants.

On the basis of above results obtained for Frequency, Density & Abundance are summarized in the table. The table shows the entire plant species with Frequency, Density & Abundance at all the five study sites of Jharia Coalfields on the comparative account. In the present investigation in order to evaluate the effect of air pollution and soil damage on herbaceous dicots, several ecological parameters like Frequency, Density & Abundance have been observed that *Eupatorium perfoliatum, Xanthium strumarium, Sida rhombifolia,, Tephrosia indica, Cassia tora,* found to be better invasive on basis of their frequency, density and abundance. Species richness and diversity of non-grass herbaceous and woody species showed a gradual improvement with the increase in the age of the dumps, and this finding is in conformity with the observation of Iverson & Wali (1982) and Borpujari (2008). Diversity did not show any trend with respect to the woody species. Such differential trends of species richness and diversity between grass and non-grass herbaceous vegetation implies that a successful stable colonization of the former favours the gradual succession recruitment of the latter on the perturbed mine spoil.

CONCLUSION

- In respect to frequency, density and abundance, it has been observed that the un-sustained coal mining has resulted into decline in the frequency, density, abundance of plant species under study area. This decline is related with the inhospitable condition of soil and its moisture as well as creation of over burden.

- Species like *Alternanthera sessilis, Eupatorium perfoliatum, Sida rhombifolia, Tephrosia indica* etc. were recorded up to 80% frequency in control area but below 40% in mined area. Species like *Amaranthus spinosus, Blumea lacera, Tridax procambens* etc. were recorded up to 70% frequency in control area but below 30% in mined area. Species like *Datura metel, Solanum nigrum, Solanum torvum* were recorded up to 50% frequency in control area but below 20% in mined area.

- It has been observed that many of the plant species show retardation in overall growth due to mining activity in un-sustained manner. The adjoining areas to the study sites which are generally non coal bearing show better plant diversity with proper frequency, density and abundance.

- Lack of vegetation cover on such dumps often leads to acute problem of soil erosion and environmental pollution. Therefore, development of vegetation on the dumps is essential for the conservation of biodiversity and stable environment in the coalfield area.

- Some overburden have been found to be invaded by species of *Eupatorium, Sida, Tephrosia*, 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 development of vegetation on overburdens. Species richness and diversity of herbaceous species showed a gradual improvement with the increase in the age of the dumps.

In course of my study, I came across some old overburden with patches of herbaceous plants along with grasses. This encouraged me to work on the restoration of these overburden. So that in future they may be covered with greeneries and automatically the surrounding area will have less pollution and reduced soil erosion. Lastly I came to the conclusion that open cast coalmining has resulted in loss of phytodiversity due to disturbance of top soil.

Suggestion:-

- Considering the adverse effect of open cast coal mining on phytodiversity, the more sophisticated underground mining with latest technique should be employed keeping in mind not to disturb the biodiversity of the area.
- Considering the cost effectiveness of open cast coal mining, it is suggested to employ techniques of sustainable mining.

- The mining waste should be retreated for restoration of vegetation in order to maintain phytodiversity which will be effecting in checking the pollution.
- For the sake of restoration successful plant invaders such as *Eupatorium perfoliatum, Sida rhombifolia, Tephrosia indica, Ocimum basilicum,* and *Alternanthera sessilis* should be grown on mine waste after artificial enrichment.
- Steps should be taken for restoration of aquifers employing proper slope to the mined overburden.
- Some recent and more recent overburden dumps should be leveled after completion of coalmining and plantation practices should be done by supplementing the substratum. It may lead to the development of plant communities to a lesser or greater extent and ultimately the area will have green cover in course of time.

Note: - Study areas are shown in serial no.1 2 3 4 5 6 (1. Rajapur open cast project, 2. Ghanoodih open cast Project, 3. kuya open cast project, 4. Dhansar Open cast Project 5. North Tisra open cast project 6. Unmined area.

The table shows the entire plant species with Frequency at all the five study sites of Jharia Coalfields

Name of Plant Species	Frequency In % 1 2 3 4 5 6	UMA/control area	Mean frequency in % of plants	% Decrease in frequency of plants
Alternanthera sessilis	30 40 30 30 20 70	70	30	57.14
Sida rhombifolia	40 40 40 30 20 80	80	34	57.5
Cassia tora	40 30 40 20 30 80	80	32	60
Eupatorium perfoliatum	30 40 10 40 20 80	80	28	65
Euphorbia hirta	30 20 30 20 30 80	80	26	67.5
Solanum nigrum	20 20 10 20 10 50	50	16	68
Xanthium strumarium	20 20 10 10 20 50	50	16	68
Tephrosia indica	30 20 20 20 20 70	70	22	68.57

Blumea lacera	30 20 10 10 20 60	60	18	70
Amaranthus spinosus	20 20 10 10 10 50	50	14	72
Parthenium hysterophorus	30 30 20 10 20 80	80	22	72.5
Boerhaavia diffusa	30 20 10 10 10 60	60	16	73.33
Argemone mexicana	30 10 20 20 10 60	60	16	73.33
Tridax procambens	10 00 10 10 00 60	60	06	90
Cleome gynandra	10 00 10 10 00 70	70	06	91.42

Table:-2 Shown the frequency & mean frequency in % of the different plant species in mined and unmined/control area.

The table shows the entire plant species with Density at all the five study sites of Jharia Coalfields

Name of Plant Species	Density 1 2 3 4 5 6	UMA/control area	Mean Density in / sq m of plants	% Decrease in Density of plants
Cassia tora	1.3 1.2 1.3 0.8 1.2 3.4	3.4	1.16	65.88
Alternanthera sessilis	0.5 0.6 0.6 0.5 0.3 1.5	1.5	0.5	66.66
Eupatorium perfoliatum	0.9 1.1 0.3 1.6 0.5 3.4	3.4	0.88	74.11
Solanum nigrum	0.5 0.6 0.2 0.4 0.2 1.5	1.5	0.38	74.66
Blumea lacera	0.6 0.5 0.2 0.2 0.5 1.6	1.6	0.4	75
Sida rhombifolia	0.6 0.5 0.5 0.8 0.6 2.5	2.5	0.6	76
Tephrosia indica	0.8 0.4 0.3 0.6 0.5 2.3	2.3	0.52	77.39
Argemone mexicana	0.5 0.2 0.3 0.3 0.2 1.4	1.4	0.3	78.57
Xanthium strumarium	0.3 0.4 0.2 0.1 0.2 1.2	1.2	0.24	80
Parthenium hysterophorus	0.8 0.7 0.5 0.2 0.5 2.8	2.8	0.54	80.71
Amaranthus spinosus	0.4 0.5 0.1 0.2 0.2 1.5	1.5	0.28	81.33
Boerhaavia diffusa	0.5 0.4 0.3 0.2 0.2 1.9	1.9	0.32	83.15
Euphorbia hirta	0.6 0.4 0.5 0.5 0.7 3.6	3.6	0.54	85

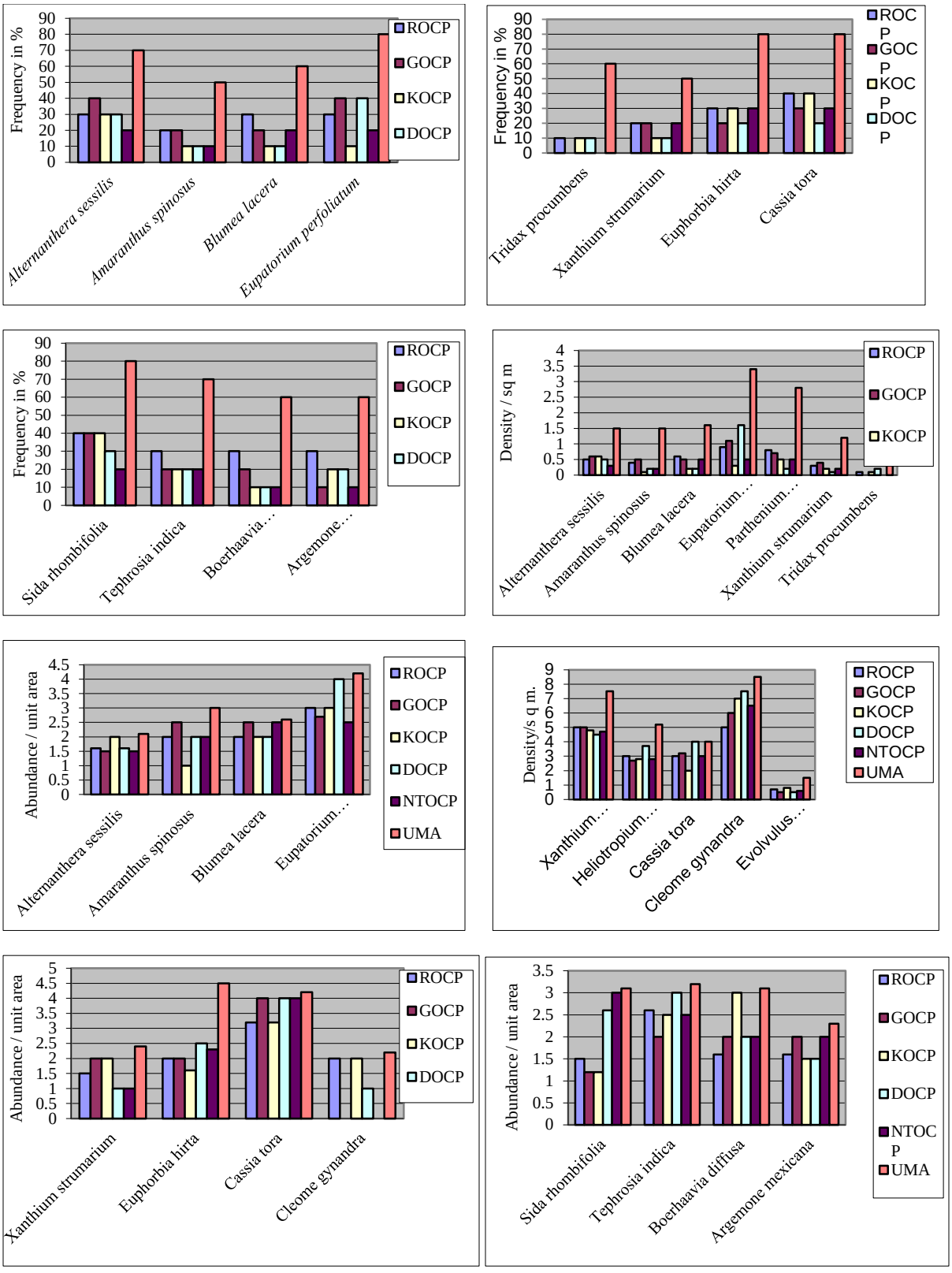
Tridax procambens	0.1 00 0.1 0.2 00 1.2	1.2	0.08	93.33
Cleome gynandra	0.2 00 0.2 0.1 00 1.6	1.6	0.1	93.75

Table:-3 shown the Showing the density & mean density/ sq m of the different plant species in mined and unmined/control area.

The table shows the entire plant species with Abundance at all the five study sites of Jharia Coalfields

Name of Plant Species	Abundance 1 2 3 4 5 6	UMA/control area	Mean Abundance of plants	% Decrease in Abundance of plants
Cassia tora	3.2 4.0 3.2 4.0 4.0 4.2	4.2	3.68	12.38
Blumea lacera	2.0 2.5 2.0 2.0 2.5 2.6	2.6	2.2	15.38
Tephrosia indica	2.6 2.0 2.5 3.0 2.5 3.2	3.2	2.52	21.25
Alternanthera sessilis	1.6 1.5 2.0 1.6 1.5 2.1	2.1	1.64	21.90
Solanum nigrum	2.5 3.0 2.0 2.0 2.0 3.0	3.0	2.3	23.33
Argemone mexicana	1.6 2.0 1.5 1.5 2.0 2.3	2.3	1.72	25.21
Eupatorium perfoliatum	3.0 2.7 3.0 4.0 2.5 4.2	4.2	3.04	27.6
Boerhaavia diffusa	1.6 2.0 3.0 2.0 2.0 3.1	3.1	2.12	31.61
Parthenium hysterophorus	2.6 2.3 2.5 2.0 2.5 3.5	3.5	2.38	32
Amaranthus spinosus	2.0 2.5 1.0 2.0 2.0 3.0	3.0	1.9	36.66
Xanthium strumarium	1.5 2.0 2.0 1.0 1.0 2.4	2.4	1.5	37.5
Sida rhombifolia	1.5 1.2 1.2 2.6 3.0 3.1	3.1	1.9	38.70
Euphorbia hirta	2.0 2.0 1.6 2.5 2.3 4.5	4.5	2.08	53.77
Cleome gynandra	2.0 00 2.0 1.0 00 2.2	2.2	1.0	54.54
Tridax procambens	1.0 00 1.0 2.0 00 2.0	2.0	0.8	60

Table:-4 Showing the abundance & mean abundance of the different plant species in mined and unmined/control area.



Graph:-1 Showing the frequency, density & abundance of the different plant species in mined and unmined/control area.

Selected plant species in the study areas

Cassia tora

Argemone mexcana

Tephrosia indica

Boerhaavia diffusa

Sida rhombifolia

Eupatorium perfoliatum

Xanthium strumarium

Datura metel

Blumea lacera

Figure:-2 Shown the different plant species in study areas.

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