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Original Research Paper

Vegetation Dynamics in Plantation Sites of Collieries

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ABSTRACT

Mining operation exerts long lasting effects on the ecosystem and environment. The key impact includes deforestation, degeneration and degradation of natural resources, environmental pollution, health risk, ecological and socio-ecological instabilities. The magnitude of impact depends on the methods, scale and mining activity concentration, technological interventions etc. The study was carried out in three plantation sites to evaluate the floristic structure, composition, diversity and litter biomass. In different sites a total of 4 tree species, 5 sapling species, 18 seedling species and 7 shrub species were found. A total of 440 trees ha^{-1} were encountered in eucalyptus plantation, 480 trees ha^{-1} in teak plantation and 960 trees ha^{-1} in mixed plantation. The total density of saplings, seedlings and shrubs ranged from 60-860 saplings ha^{-1}, 2400-8960 seedlings ha^{-1} and 240-960 shrubs ha^{-1}, respectively, across the sites. The total litter biomass varied from 1.98-4.01 t ha^{-1}, being lowest at teak plantation and highest under eucalyptus plantation. The mining activities resulted in an appreciable damage to natural vegetation and its dynamics. A long term strategy is essential for restoration and conservation of the fragile ecosystem of collieries.

INTRODUCTION

Globally, India ranks among the top five players in terms of production of several important minerals. Judicious utilization of mineral resources promotes the economic development of a nation and its people. Since 1947, India's mining industry has shown rapid growth. In the pre-plan period prior to 1950, India produced 24 types of minerals (Khatua & Stanley 2008). Minerals are the basic raw materials which contribute to the growth of both developed and developing countries. The state Chhattisgarh is bestowed with rich natural vegetation as well as large reserve of mineral resources. During the past decades, there has been a phenomenal increase in mining, causing large scale destruction and deterioration of the environment. The extraction of minerals from nature often creates imbalances, which adversely affect the ecosystem and environment. The unscientific mining poses a serious threat, resulting in the reduction of forest cover, high soil erosion, pollute the natural resources and reduction of biodiversity (Kumar et al. 2015).

Forest ecosystems have rapidly been transformed into areas for the occupation of the human population and for economic purposes (Allen et al. 2010). Mining operations, whether small or large scale, are extremely disruptive and damaging. The main impacts are deforestation, alteration of landscapes (Rai et al. 2010), damage to flora and fauna, wildlife habitat, health hazards (Singh et al. 2011), changes in soil stratification, biological diversity, alteration of the structure and functioning of ecosystems; these changes resulted variation in water and nutrient dynamics and trophic interactions (Almas et al. 2004, Ghose 2004). Rise in biotic interferences degrades the quality of the stand (Jhariya et al. 2012 & 2014, Pawar et al. 2014a & b) and led to depletion of natural resources. At present time the plantation of forest species is considerably growing in tropics (Kumar et al. 2013 & 2014, Bhagat et al. 2014, Sinha et al. 2014 & 2015, Kumar et al. 2015). Plantation activity in and around the collieries is carried out to restore, reclaim and rehabilitate the degraded ecosystems of mined out landscape. The success of plantation depends upon species potential, physical, environmental limitations, site conditions, edaphic-biotic components and its interactions. The recovery of degraded environment can be understood as reconstructions of its structure and function (Carpanezzi 2005). The success of recovery of natural ecosystems lies in the restoration of ecological processes responsible for the reconstruction and maintenance of a functional community (Gandolfi et al. 2007). The individual species success and community composition are governed by local site variables. The species which fit to site conditions are able to survive and establish and become an integral part of the community. Therefore, the present study was undertaken to assess the impact of mining on vegetation dynamics as affected by its proximity.

MATERIALS AND METHODS

The present study was carried out at Bishrampur collieries in Surajpur district of Chhattisgarh during the year 2014-2015. Surajpur is one of the major districts (out of total 27 districts) of Chhattisgarh having diverse natural resources. Surajpur forest division is situated in the northern part of Sarguja division of Chhattisgarh. About 2351.145 km^2 of the area in the district lies under forests. The vegetation found in the district is sub tropical deciduous forest. Bishrampur area is located at 23°21'N and 82°85'E with an average elevation of 527 m. Many open-cast and underground mining centres are located in and around the Bishrampur. Due to excessive mining, large forests have been clear felled for open-cast mining of coal in the Bishrampur areas.

Three plantation sites viz., Eucalyptus, Teak and Mixed (Cassia+Mangium) plantation were selected for the study. The vegetation was analysed for its structure, composition, diversity and litter biomass in different plantation sites. The trees and sapling species were analyzed by randomly laying 10 m × 10 m size quadrats in each plantation site. The girth at breast height (i.e., 1.37 m above the ground) of all the trees and saplings in each quadrat was measured and recorded individually. For tree species, the individuals > 30 cm GBH were categorized as tree, <30 cm but > 10 cm as saplings. Inside 10 m × 10 m quadrats, 5 m × 5 m quadrats were laid for the enumeration of seedling (<10 cm GBH) and shrub separately for each species. Similarly, another quadrat of 50 cm × 50 cm size within 10 m × 10 m quadrat was laid for measuring litter, respectively. The vegetation data were quantitatively analyzed for frequency, density and abundance (Curtis & McIntosh 1950). The importance value index was calculated by following Phillips (1959). Diversity parameters were determined using the Shannon-Weaver information function (Shannon & Weaver 1963). Concentration of dominance was measured by following Simpson's index method (Simpson 1949). Vegetations were also measured for species richness (Marglef 1958), equitability (Pielou 1966) and Beta diversity (Whittaker 1972). A/F ratio (abundance to frequency) for different species was determined by eliciting the distribution pattern.

RESULTS AND DISCUSSION

Structure and Composition

Tree layer: The density of trees in eucalyptus plantation was 440 individuals ha^{-1} with the total basal area of 25.29 m^{2}ha^{-1} (Table 1). A/F ratio (abundance to frequency) indicated that eucalyptus plantation is showing a random distribution pattern. The total density of trees in teak plantation was 480 individuals ha^{-1} with the total basal area of 7.06 m^{2}ha^{-1}. A/F ratio for teak plantation is showing a random distribution pattern. In mixed plantation the total density of trees was 960 individuals ha^{-1} and the maximum density was recorded by *Acacia mangium* (500 individuals ha^{-1}), while the minimum by *Cassia siamea* (460 individuals ha^{-1}) with the total basal area of 15.34 m^{2}ha^{-1}. The importance value index (IVI) of the tree species was highest for *Acacia mangium* and lowest for *Cassia siamea*, respectively. Abundance to frequency ratio showed that *Cassia siamea* distributed randomly and *Acacia mangium* distributed contagiously.

Sapling layer: Sapling layer comprised a sum of 5 species with 4 families in the different plantation sites (Table 2). The density of sapling layer in eucalyptus plantation was 60 individuals ha^{-1} with the total basal area of 0.18 m^{2}ha^{-1}. A/F ratio in this site showing a regular distribution pattern. The total density of sapling layer in teak plantation was 860 individuals ha^{-1} with the total basal area 1.75 m^{2}ha^{-1}. In teak plantation the saplings were distributed randomly. In mixed plantation a sum of 560 individuals ha^{-1} was found and the maximum density was recorded by *Acacia mangium* (280 individuals ha^{-1}), while the minimum by *Pongamia pinnata* and *Tectona grandis* (each 20 individuals ha^{-1}) with the total basal area of 1.37 m^{2}ha^{-1}. The IVI was found higher for *Acacia mangium* while least for *Cassia siamea*, respectively. A/F ratio indicated that *Cassia siamea* showing regular distribution, *Acacia mangium* distributed randomly, while *Pongamia pinnata* and *Tectona grandis* distributed contagiously over the site.

Seedling layer: In seedling layer a sum of 18 species with 10 families were recorded in different plantation sites (Table 3). Eucalyptus plantation representing a total of 8 species with 4 families, teak plantation contains 10 species with 6 families, whereas 11 species with 7 families were recorded in mixed plantation. The total density of seedling in eucalyptus plantation was 3360 individuals ha^{-1} and the maximum density was recorded by *Eucalyptus* sp. (2400 individuals ha^{-1}), while the minimum by *Acacia mangium, Dalbergia sissoo, Syzygium cumini* and *Woodfordia fruticosa* (80 individuals ha^{-1} for each). The frequency of individual species varied from 20-100%. The IVI ranged between 16.19-147.62. A/F ratio revealed that *Butea monosperma* distributed regularly (12.5% of the total), whereas about 75% species were distributed randomly and remaining (12.5%) species showing the contagious type of distribution pattern. In teak plantation, a sum of 2400 seedlings ha^{-1} was measured, the maximum density was recorded by *Cassia siamea* (800 individuals ha^{-1}), while the minimum by *Azadirachta indica, Butea monosperma, Dalbergia sissoo, Diospyros melanoxylon, Leucaena leucocephala* and *Senna alata* (80 individuals ha^{-1} for each), respectively. The frequency of individual seedlings varied from 20-60%. The IVI ranged between 14.48-84.78. A/F ratio ranged between

0.006-0.500, reflecting that *Leucaena leucocephala* was distributed regularly (10% of the total), whereas nearly 70% species were distributed randomly and about 20% of the species distributed contagiously. In mixed plantation, a sum of 8960 individuals ha^{-1} was observed and the maximum density was recorded by *Acacia mangium* (4720 individuals ha^{-1}), while the minimum by *Butea monosperma*, *Casearia graveolens* and *Syzygium cumini* (80 individuals ha^{-1} for each). The frequency of individual species varied from 20-80%. The IVI of individual species ranged between 8.06-109.59. A/F ratio indicated that *Dalbergia sissoo* and *Tectona grandis* were distributed regularly (18.18% of the total), whereas 54.55% species were distributed randomly and rest of the species (27.27%) were distributed contagiously.

Shrub layer: A sum of 7 shrub species with 6 families were found in the different sites of mining areas (Table 4). Eucalyptus plantation representing 2 species, teak plantation contains 5 species, whereas 4 species were recorded under the mixed plantation. The density of shrub species in eucalyptus plantation was 240 individuals ha^{-1} with the total basal area of 0.40 m^{2}ha^{-1}. A/F ratio showed that *Caesalpinia crista* and *Ziziphus rotundifolia* were distributed contagiously. In the teak plantation, the total density was 960 individuals ha^{-1} with the total basal area of 0.75 m^2 ha^{-1}. Abundance to frequency ratio indicated that *Carissa opaca, Leea asiatica*, *Phoenix acaulis* and *Ziziphus rotundifolia* showing regular distribution, whereas *Lantana camara* distributed randomly. In mixed plantation, a sum of 720 individuals ha^{-1} was recorded and the maximum density was contributed by *Ziziphus rotundifolia* (160 individuals ha^{-1}), while the minimum by *Butea superba* and *Leea asiatica* (each 80 individuals ha^{-1}) with the basal area 0.75 m^{2}ha^{-1}. The IVI values of shrub species was found higher for *Lantana camara* and least for *Leea asiatica*, respectively. It is evident from the data presented in Table 5, *Lantana camara* and *Ziziphus rotundifolia* showing regular distribution, while *Butea superba* and *Leea asiatica* distributed randomly over the site.

Diversity indices: The diversity indices (Table 5) of the tree species showed that the value of Shannon index in different plantation sites varied upto 1.00, Simpson's index from 0.5-1.0, species richness from 0.00-0.15, equitability upto 1.44 and Beta diversity from 2.00-4.00, respectively. Whereas, for the sapling layer the value of Shannon index in different plantation sites varied upto 1.37, Simpson's index 0.44 to 1.0, species richness upto 0.47, equitability upto 0.99 and Beta diversity 1.25 to 5.00, respectively. In seedling layer Shannon index varied from 1.61 to 2.72, Simpson's index 0.20 to 0.52, species richness 0.86 to 1.16, equitability 0.78 to 1.18 and Beta diversity 1.64 to 2.25, respectively. For the shrub layer the value of Shannon index values in different plantation sites varied from 0.92-2.19, Simpson's index from 0.24-0.56, species richness from 0.18-0.58, equitability from 1.20-1.36 and Beta diversity from 1.40-3.50, respectively.

Litter biomass: The litter biomass in different plantation sites of coal mine was calculated and presented in Table 6. Total litter biomass was 4.01 t/ha in eucalyptus plantation site, of which 61.34% constituted by leaf litter and remaining (38.40%) by wood litter. While in the teak plantation it was 1.98 t/ha, of which 98.48% contributed by leaf litter and remaining (1.01%) by wood litter. In the mixed plantation, the total litter biomass was 2.78 t/ha, of which 66.91% constituted by leaf litter and remaining (33.09%) by wood litter, respectively.

Information of vegetational structure and composition provides an idea on habitat suitability, ecosystem productivity and successional pathways (Silver et al. 2004, Wang et al. 2004). As large forests have been clear felled in the Bishrampur for open-cast coal mining, the major challenges include loss of top soil, reduction of forest cover and destruction of habitats of ground flora species, which is essential for maintaining nutrient cycling and ecological balance. These are chemically, physically and biologically unstable and deficient. Mining activities not only reduces the diversity and abundance of vegetation but also reduces the plant productivity and encourages to invasion of inferior/undesirable species in the region (Kumar et al. 2015, Jhariya et al. 2013). The chief environmental impacts due to mining are changes in soil stratification, reduced biotic diversity and alteration of structure and functioning of ecosystems (Almas et al. 2004, Ghose 2004). The habitat conditions in these sites have reduced the chances of regeneration of many species, thereby reducing the presence of higher number of species in this region. Sarma et al. (2010) reported that the number of tree species was low in all the mining sites due to various activities during the mining as compared to adjacent unmined area. Majority of species showed contagious distribution pattern in the unmined and mined areas. The tree density was more (1040 stems ha^{-1}) in the unmined area than the mined areas (515 and 646 stems ha^{-1}). The trees of medium girth class contributed to the maximum stand density in the mined areas, while in the unmined site the trees of low girth class contributed to the maximum stand density. Hashemi (2010) investigated the plant species diversity in north of Iran and reported a total number of 114 plant species, belonging to 76 genera and 31 families were gathered in the region of study. Rahman et al. (2010) reported that a total of 715 individuals, 22 invasive species belonging to

Table 1: Structure of tree layer in different plantation sites of coal mine.

Species	Eucalyptus Plantation					Teak Plantation					Mixed Plantation				
	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F
Acacia mangium	-	-	-	-	-	-	-	-	-	-	100	500	7.21	155.05	0.05
Cassia siamea	-	-	-	-	-	-	-	-	-	-	100	460	8.13	144.95	0.046
Eucalyptus spp	100	440	25.29	300	0.044	-	-	-	-	-	-	-	-	-	-
Tectona grandis	-	-	-	-	-	100	480	7.06	300	0.048	-	-	-	-	-
Total	100	440	25.29	300	0.044	100	480	7.06	300	0.048	200	960	15.34	300	0.096

F= Frequency, D= Density (individuals ha^{-1}), BA= Basal area m^2 ha^{-1}, A/F= Abundance to Frequency ratio, IVI= Importance Value Index

Table 2: Structure of sapling layer in different plantation sites of coal mine.

Species	Eucalyptus Plantation					Teak Plantation					Mixed Plantation				
	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F
Acacia mangium	-	-	-	-	-	-	-	-	-	-	100	280	0.54	131.26	0.028
Cassia siamea	-	-	-	-	-	-	-	-	-	-	100	240	0.78	141.43	0.024
Eucalyptus spp	60	60	0.18	300	0.017	-	-	-	-	-	-	-	-	-	-
Pongamia pinnata	-	-	-	-	-	-	-	-	-	-	20	20	0.03	14.18	0.05
Tectona grandis	-	-	-	-	-	100	860	1.75	300	0.086	20	20	0.02	13.09	0.05
Total	60	60	0.18	300	0.017	100	860	1.75	300	0.086	240	560	1.37	300	0.152

F= Frequency, D= Density (individuals ha^{-1}), BA= Basal area m^2 ha^{-1}, A/F= Abundance to Frequency ratio, IVI= Importance Value Index

Table 3: Structure of seedling layer in different plantation sites of coal mine.

Species	Eucalyptus Plantation				Teak Plantation				Mixed Plantation			
	F	D	IVI	A/F	F	D	IVI	A/F	F	D	IVI	A/F
Acacia mangium	20	80	16.19	0.050	-	-	-	-	80	4720	109.59	0.184
Acacia nilotica	40	240	31.19	0.038	-	-	-	-	-	-	-	-
Azadirachta indica	40	240	31.19	0.038	20	80	14.48	0.050	40	240	15.71	0.038
Butea monosperma	40	160	25.24	0.025	20	80	14.48	0.050	20	80	8.06	0.050
Casearia graveolens	-	-	-	-	-	-	-	-	20	80	8.06	0.050
Cassia fistula	-	-	-	-	40	320	35.62	0.050	-	-	-	-
Cassia siamea	-	-	-	-	20	800	84.78	0.500	80	2400	64.66	0.094
Dalbergia sissoo	20	80	16.19	0.050	20	80	14.48	0.050	20	400	22.14	0.250
Diospyros melanoxylon	-	-	-	-	20	80	14.48	0.050	-	-	-	-
Eucalyptus spp.	100	2400	147.62	0.060	-	-	-	-	-	-	-	-
Jatropha curcas	-	-	-	-	40	240	30.05	0.038	40	240	15.71	0.038
Leucaena leucocephala	-	-	-	-	60	80	24.83	0.006	-	-	-	-
Pongamia pinnata	-	-	-	-	-	-	-	-	40	240	15.71	0.038
Senna alata	-	-	-	-	20	80	14.48	0.050	-	-	-	-
Syzygium cumini	20	80	16.19	0.050	-	-	-	-	20	80	8.06	0.050
Tectona grandis	-	-	-	-	40	560	52.34	0.088	60	320	20.71	0.022
Woodfordia fruticosa	20	80	16.19	0.050	-	-	-	-	-	-	-	-
Ziziphus mauritiana	-	-	-	-	-	-	-	-	20	160	11.58	0.100
Total	300	3360	300	0.36	300	2400	300	0.931	440	8960	300	0.91

F= Frequency, D= Density (individuals ha^{-1}), A/F= Abundance to Frequency ratio, IVI= Importance Value Index

17 families were recorded and among invasive species, shrubs constitute 10 species, herbs 9 species and vines 3 species, respectively. Sobuj & Rahman (2011) compared the plant diversity of natural forest and plantations in Bangladesh and reported that a total of 52 (16 tree species, 15 shrubs, 21 herbs) in the natural forest, on the contrary, 31 species of plants (11 tree, 8 shrubs, 12 herbs species) were identified in plantation forest. Oraon et al. (2015) reported that natural regeneration potential of shrubs was more in disturbed site as compared to undisturbed site.

The spatial distribution of species is considered as adaptability potential and suitability of a species to the environ-

Table 4: Structure of shrub layer in different plantation sites of coal mine.

Species	Eucalyptus Plantation					Teak Plantation					Mixed Plantation				
	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F	F	D	BA	IVI	A/F
Butea superba	-	-	-	-	-	-	-	-	-	-	20	80	0.031	76.93	0.05
Caesalpinia crista	20	160	0.28	185.43	0.10	-	-	-	-	-	-	-	-	-	-
Carissa opaca	-	-	-	-	-	60	320	0.47	123.39	0.022	-	-	-	-	-
Lantana camara	-	-	-	-	-	20	80	0.23	48.71	0.05	100	400	0.018	143.27	0.01
Leea asiatica	-	-	-	-	-	40	160	0.01	35.53	0.025	20	80	0.003	26.69	0.05
Phoenix acaulis	-	-	-	-	-	40	160	0.00	35.23	0.025	-	-	-	-	-
Ziziphus rotundifolia	20	80	0.12	114.57	0.05	60	240	0.04	57.66	0.017	40	160	0.005	53.38	0.025
Total	40	240	0.40	300	0.15	220	960	0.75	300	0.139	180	720	0.057	300	0.135

F= Frequency, D= Density (individuals ha^{-1}), BA= Basal area m^2 ha^{-1}, A/F= Abundance to Frequency ratio, IVI= Importance Value Index

Table 5: Diversity pattern of tree, sapling, seedling and shrub layers in different plantation sites of coal mine.

Plantation	Layers	Shannon Index (H')	Simpson's Index (Cd)	Species richness (d)	Equitability (e)	Beta Diversity (βd)
Eucalyptus	Tree Layer	00.00	1.00	0.00	0.00	4.00
	Sapling Layer	0.00	1.00	0.00	0.00	5.00
	Seedling Layer	1.61	0.52	0.86	0.78	2.25
	Shrub Layer	0.92	0.56	0.18	1.32	3.50
Teak	Tree Layer	0.00	1.00	0.00	0.00	4.00
	Sapling Layer	0.00	1.00	0.00	0.00	5.00
	Seedling Layer	2.72	0.20	1.16	1.18	1.80
	Shrub Layer	2.19	0.24	0.58	1.36	1.40
Mixed	Tree Layer	1.00	0.50	0.15	1.44	2.00
	Sapling Layer	1.37	0.44	0.47	0.99	1.25
	Seedling Layer	2.07	0.36	1.10	0.86	1.64
	Shrub Layer	1.66	0.38	0.46	1.20	1.75

Table 6: Forest floor biomass (t/ha) in different plantation sites of coal mine.

Plantation	Leaf litter	Wood litter	Total
Eucalyptus	2.46±0.13	1.54±0.39	4.01±0.33
Teak	1.95±0.16	0.02±0.09	1.98±0.22
Mixed	1.86±0.15	0.92±0.14	2.78±0.18

ment. The site condition and biological peculiarities may regulate the distribution pattern of species. AF ratio was used to assess the distribution pattern of the species. In the collieries sites, it was found that most of the species were distributed contagiously and randomly, whereas a few species distributed regularly. This can be attributed to the interaction of various factors that are acting together on the population. Such as, clumping indicates inefficient mode of seed dispersal (Richards 1996). While comparing dispersion pattern of trees in tropical to temperate climates of the world, Armesto et al. (1986) concluded that clumping is the characteristic of natural forests which confirms with the prevalent contiguous distribution of species in the natural forest. Odum (1971) has emphasized that contiguous distribution is the most common pattern in nature. Likewise, Kumar et al. (2015), Sinha et al. (2015), Oraon et al. (2014), Kittur et al. (2014) and Jhariya (2014) described that most of the recorded species followed contagious and random distribution pattern, whereas regular distribution was found almost negligible.

The biodiversity of an area is widely influenced by disturbance regimes. Ecosystems and its functioning, is typically described by one of the key parameters i.e., species diversity (Scherer-Lorenzen et al. 2005). The species diversity provide information on trophic structures and susceptibility to invasion (Nicholas & Nicholas 2003). Diversity in this mining landscape is fluctuating at an unprecedented degree as a compound response to various biotic changes and interferences. Sarma et al. (2010) worked on the impact of coal mining on plant diversity of Meghalaya, and reported that the Shannon diversity index for tree and shrub species were low in mined areas as compared to unmined areas. Sobuj & Rahman (2011) reported that Shannon index were 2.70, 2.72 and 3.12 for trees, shrubs and herbs, respectively, in the natural forest. However, it was 2.35 for tree species, 2.31 for shrub species and 2.81 for herb species in the plantation forest. Kumar et al. (2014) worked floristic diversity assessment in mining areas and found that the density of tree species was 11.67/100 m^2, shrub density was 8.33/9m^2 and herb density was 41.11/m^2, respectively. Kumar et al. (2010) reported *Tectona grandis* was found to be most suitable tree species for plantation program in dry tropic regions as it has high litter deposition and decomposition rate, and thus it has an advantage in degraded soil restoration and suitable land management. Sahu et al. (2013) reported the forest floor biomass in different age series of plantation sites of the study area and stated that it increased with the age of the stand and varied from 2.19-2.66 t ha^{-1}. Pawar et al. (2014c) reported that the fresh leaf litter was significantly lower at highly disturbed sites (1.41 t ha^{-1}), whereas, it was statistically similar in least (2.38 t ha^{-1}) and moderately (2.35 t ha^{-1}) disturbed sites. The wood litter was higher in highly disturbed sites (1.03 t ha^{-1}); whereas it was statistically similar with least disturbed sites (0.70 t ha^{-1}). Higher total litter was recorded from least disturbed sites (3.55 t ha^{-1}), however it was statistically similar to moderately (3.46 t ha^{-1}) and highly (2.75 t ha^{-1}) disturbed sites.

CONCLUSION

The consequences of mining operation have now become a matter of serious concern because of its negative impact on ecosystem and environment. Any deterioration in the physical, chemical and biological quality of the environment may affect the flora, fauna and human health. Mining has influenced the flora and soil biota at countless magnitude. Large scale operations of mining activities have contributed directly or indirectly to the depletion of biodiversity in the collieries. Plant covers are open up at various places to expedite excavation of coal, development of mining infrastructure and dumping of overburdens. The direct impacts on biodiversity in the mining areas may range from death of plants and animals due to mining activity, disturbance of wildlife habitat due to blasting and heavy machines, whereas, indirect impacts may include changes in nutrient cycling & food chain, and instability of ecosystem. Plantation practice can be helpful for restoration of lands damaged by various biotic interference. Plantations impart a favorable role in the biological reclamation of mine spoil. For plantation, priority must be given to native species, those having fast growth rate and ability to fix atmospheric nitrogen. However, large areas of collieries are maintained under the plantations. The site condition and management perspectives are the key concern for the good growth and development of the species in mined out landscape. The optimum growth depends upon the favourable locality conditions, correct choice and range of adoption of the species. Proper management practices should be applied for the betterment of the site. Strategic and applied research is needed to develop and design management options to facilitate restoration of mined out habitats.

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