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Impact Assessment of mining activities on tree diversity at Limestone & Dolomite mining area – BSLC mines, Biramitrapur, Odisha

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Abstract
The Biramitrapur area was very rich in forest, wildlife and minerals. Now it is a town fully settled above the limestone, dolomite and dolomite ore. Extensive open mining has severely damaged the forest as well as the scenario of the region. Tree vegetation of undisturbed and disturbed in various sites of BSLC mines, Biramitrapur, is studied using standard quadrant method. Tree population structure showed a drastic reduction in their numbers and in their growth in disturbed sites (mined area) compare to that of the undisturbed sites (unmined area). The other parameter like basal area, crown size, etc. indicates also illustrated the impact of mining on the tree composition of the area.

Keywords: limestone dolomite mines, forest area, tree composition, species richness.

Introduction
Mining is an extraction of valuable minerals or other geological materials from the earth, usually from an ore which involves the removal of vegetation, soil and rocks (Nayak, 2010) [1]. Mining is essential in the economic development plan of any country endowed with mineral resources (Unanaonwi and Amonum, 2017) [2]. It causes massive damage to landscape and biological communities of the area (Sarma, 2005) [3].
The Biramitrapur-Odisha in India is a land rich in variety of resources and dense forests. Biramitrapur is a town and a municipality in Sundergarh district in the state of Odisha, India. It lies on the border of Odisha and Jharkhand, Simdega being the nearest district of Jharkhand. The area being mineral rich, a lot of industries lie in and around Biramitrapur. The area is especially rich in Limestone and Dolomite, which is under the mines B. S. L. Co Ltd, Biramitrapur. A BSLC mine is over an area of 793.043 hectares in village Chunam under Sundergarh district. Mining in this area is carried out from long ago. And due to continue mining it is destructing the forest area slowly every day.
Through the mining activities is essential for the various utilizations, and to the economy. The impact and effects on the surrounding, environment of the mining areas were getting destruct day by day. The whole area of the BSLC mines and nearby Sailata forest is degraded and disturbed due to large-scale limestone and dolomite mining, shifting cultivation and other human activities. Due to improper planning and negligence of regulations, mining activities results in an appreciable damage, degradation and deterioration of the biodiversity, some medicinal plants and ecological damage to water, air and soil occurs (Mahalik and Satapathy, 2016) [4]. So the reclamation n of this area is becoming very essential to preserve the environment.

Study Area
Biramitrapur is a town and a municipality in Sundergarh district in the state of Odisha, India. It lies on the border of Odisha and Jharkhand, Simdega being the nearest district of Jharkhand. The city nearest to Biramitrapur is Rourkela, which is roughly around 35 km away. The area being mineral rich, a lot of industries lie in and around Biramitrapur. The area is especially rich in Limestone and Dolomite. The Biramitrapur limestone and dolomite mines of Bisra Stone Lime Company Ltd. is a working mine since 1910. BSLC mines are over an area of 793.043 hectares. The closest river to Biramitrapur is Ludki, which flows from Jharkhand to Odisha. With coordinates 22.40N and 84.77E, elevation 243m (797ft) and with time zone IST (UTC+5:30).

Source: www.googlemymaps.com

Fig 1: Location of disturbed (tree shapes) and undisturbed (leaves shapes) forest area at BSLC ltd. Mines, Biramitrapur, Odisha.

Materials and Method

The vegetation survey was conducted at disturbed site (mined sites) of BSL mines (Pathpahar mines) and undisturbed site of nearby forest (Sailata) of mining site at Biramitrapur, Odisha. For tree composition, quadrates of 10 m × 10 m size were laid in random and systematic selection (Grieg - Smith, 1964) [5], by using standard quadrant method (Srivastava, 2001) [6] during January to March. Ten replications were taken in both cases (disturbed and undisturbed sites). Total 4 sites were taken from the disturbed area and 1 site from the undisturbed area.

The tree species found in the quadrants were identified. The relative density, density, basal area, relative basal area, average basal area, frequency, relative frequency and important value index values of recorded species were calculated and resultant frequency values will be classified. Species diversity, Concentration of dominance, Species richness and Evenness index will be calculated for both disturbed site and undisturbed site by standard method.

Result and Discussion

Species composition and distribution

During the study of the tree diversity and species composition, total 4 sites and 10 replications were taken in disturbed area and one site 10 replications were taken in undisturbed area. Each quadrant with (10×10) (100 m^2) were laid down randomly and studied.

Diversity analyses

The aim of the work was to study in detail about the tree species in mining areas and compares the tree species diversity and impact of mining on vegetation of disturbed sites and undisturbed sites at BSLC mines, Biramitrapur.

The study sites have covered with 43 different species. Out of 43 species, 12 major families were dominant in the study area. The sites were selected for sampling from both disturbed site (mined area) and undisturbed site (unmined area). 4 sites from disturbed area were taken viz. Pathpahar quarry area (site-1), Crusher plant area (site-2), Workshop road area (site-3), Khatangbeda-lease area (site-4), while only one site was taken from undisturbed viz. is Sailata local forest.

A good number of species of fabaceae were found on undisturbed and disturbed sites (fig-1.2). Many different tree species of family fabaceae was observed on undisturbed sites in compare to disturbed sites, which indicates the fertility and growing ability of the soil at undisturbed sites. This finding is also in tune, compared and correlated with the findings of (Dubey and Dubey, 2011; Benarjee *et al.* 2000) [7, 8].

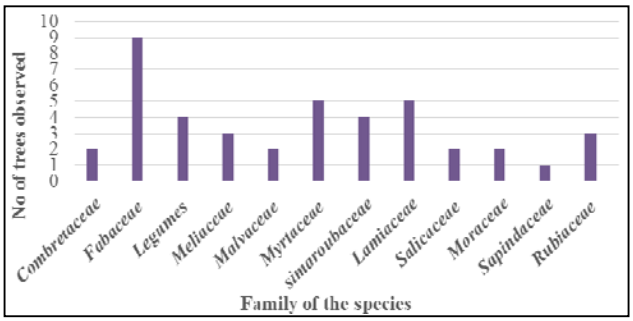

Fig 2: Frequently occurred families in sampling area

Tree species analyses

The density per quadrate, frequency values, dominance, and important value index (IVI), Simpson index, Shannon diversity index and local names of tree vegetation at undisturbed forest area and all sites of disturbed area are shown in Table 1.1 and 1.2 respectively. At undisturbed forest area, the most dominant tree species in undisturbed forest area was *Bombax ceiba (14.59)* with maximum IVI value followed by *Mangifera indica (14.57)* and the lowest was *Adina cordifolia (8.54).*

In some area of disturbed sites *Dalbergia latifolia* (133.69) found to be the highest IVI as it is an appropriate growing species easily survive in dump area. It shows less change with respect to the disturbance in the mining area (Varadarajan *et al.* 2017) [9].

And in some disturbed sites the IVI were found high in *Tectona grandis* (45.29). It was the topmost species for regeneration ranks and has the maximum growth and productivity according to the (Sharma and Sunderraj, 2005) **[10]**. In some area of disturbed sites *Ailanthus excels* (136.83) as it is a fast growing species easily survive in any condition.

Comparisons between disturbed sites with undisturbed sites

The Bisra stone lime company mining activity in the Biramitrapur, Odisha on many counts is disturbing to the environment. It was found that the impact of mining on vegetation was high in disturbed sites in compare to undisturbed sites. (Sarma, 2005; and Dubey and Dubey, 2011) [3, 7] observed the same findings. (Sarma, 2005) [3] recorded that the distribution pattern of the tree species found was contagious in the disturbed sites (mined area).

The basal area in the disturbed sites (mined area) where found lower than the undisturbed sites (unmined area) as shown in table-1.1 and 1.2 respectively. This was due to the low girth trees, which had regenerated in the disturbed sited (mined area). (Sarma, 2005) [3] also found the same observation.

The density of the tree species decreased considerably in the disturbed sites (mined area). An undisturbed site (unmined area) has the average density compare to disturbed sites. (Lyngdoh, 1995; Das gupta, 1999; Sarma, 2002; and Sarma, 2005) [11, 12, 13, 3] also had similar observations.

Shannon-Weaver index of diversity for tree species was much lower in the disturbed sites (mined areas) compare to the undisturbed sites (unmined area). This was also observed by (Lyngdoh, 1995; Das gupta, 1999; Sarma, 2002; and Sarma, 2005) [11, 12, 13, 3]. This shows the species richness in the undisturbed sites was higher and had varieties in compare to disturbed sites. (Raizada and Samra, 2000) [14] reported that diversity (H') of tree species in the natural forest was higher than the rehabilitated area.

Species diversity was low on disturbed area compare to

undisturbed area. But the species that grow here appear to have developed tolerance; similar observation was made by (Sarma, 2005) [3]. (Sarma, 2002) [13] while studying the impact of coal mining on the vegetation characteristics of the Nokrek Biosphere Reserve of Meghalaya, outlined that the composition of vegetation reduces in the mined areas with that of the adjacent unmined areas.

Table 1: Trees species and their detail parameters of disturbed area in BSLC Mines, Biramitrapur:

s. no	Local name	Botanical name	Family	Density	Frequency	Dominance	IVI	Simpson 's index	Shannon diversity index
1	Shisham	*Dalbergia latifolia*	Fabaceae	7.93	45	2.77	108.79	0.3061	-0.33
2	Neem	*Azadirachta indica*	Meliaceae	0.25	25	0.24	12.40	0.0003	-0.07
3	Chakunda	*Cassia tore*	Fabaceae	0.23	23	0.18	10.69	0.0002	-0.07
4	Teak	*Tectona grandis*	Lamiaceae	2.95	65	1.66	63.54	0.0424	-0.33
5	Karam	*Neolamarckia cadamba*	Rubiaceae	0.60	45	0.17	19.70	0.0018	-0.13
6	Sembal	*Bombax ceiba*	Malvaceae	0.10	10	0.23	7.01	0.00005	-0.03
7	Ber	*Ziziphus mauritiana*	Rhamnaceae	0.70	43	0.23	20.44	0.0024	-0.15
8	Chilbil	*Holoptelia integrifolia*	Ulmaceae	0.70	43	0.59	25.76	0.0024	-0.15
9	Palas	*Butea monosperma*	Fabaceae	0.43	20	0.16	11.08	0.0009	-0.10
10	Mango	*Mangifera indica*	Anacardiaceae	0.18	13	0.36	10.04	0.0001	-0.05
11	Jatropha	*Jtropha curcus*	Euphorbiaceae	0.28	18	0.25	10.56	0.0004	-0.08
Total				14.33	347.50	6.84	300	0.36	1.485

Table 2: Trees species and their detail parameters of undisturbed area in BSLC Mines, Biramitrapur:

s. no	Local name	Botanical name	Family	Density	Frequency	Dominance	IVI	Simpson's index	Shannon diversity index
1	Shisham	*Dalbergia latifolia*	Fabaceae	0.4	40	2.22	24.08	0.007	-0.210
2	Neem	*Azadirachta indica*	Meliaceae	0.5	40	1.61	24.44	0.011	-0.238
3	Chakunda	*Cassia tore*	Fabaceae	0.4	40	7.82	40.42	0.007	-0.210
4	Teak	*Tectona grandis*	Lamiaceae	0.4	40	0.99	20.49	0.007	-0.210
5	Karam	*Neolamarckia cadamba*	Rubiaceae	0.3	30	2.22	19.68	0.004	-0.176
6	Sembal	*Bombax ceiba*	Malvaceae	0.5	50	4.04	33.78	0.011	-0.238
7	Ber	*Ziziphus mauritiana*	Rhamnaceae	0.4	40	4.19	29.82	0.007	-0.210
8	Chilbil	*Holoptelia integrifolia*	Ulmaceae	0.4	40	2.61	25.21	0.007	-0.210
9	Palas	*Butea monosperma*	Fabaceae	0.5	40	1.75	24.82	0.011	-0.238
10	Mango	*Mangifera indica*	Anacardiaceae	0.5	40	5.01	34.34	0.011	-0.238
11	Jatropha	*Jtropha curcus*	Euphorbiaceae	0.4	40	1.81	22.89	0.007	-0.210
Total				4.7	440	34.26	300	0.093	2.387

Dominance –diversity curve

Dominance –diversity attributes the lesser number of species occurring in these stressed environments where conditions are not favourable for plant growth. A similar observation was made by (Sarma, 2005) [3]. These curves were used to interpret the dominance of species in the community in relation to resource apportionment and niche space (Whittaker, 1975) [15].

The curves for the disturbed site resemble with broken-stick series model (Poole, 1974) [17]. According to (Whittaker, 1965) [16], the normal series describes the partitioning of realized niche space among various species, and it is the consequences of the evolution of diversity in the species along the niche parameters that it exploits.

Dominance-diameter distribution curves (figure-1.3) showed that most of the trees in the disturbed sites (mined areas) were of medium girth classes. Undisturbed sites (unmined area) had all girth classes. (Sarma, 2005) [3] recorded the same observation.

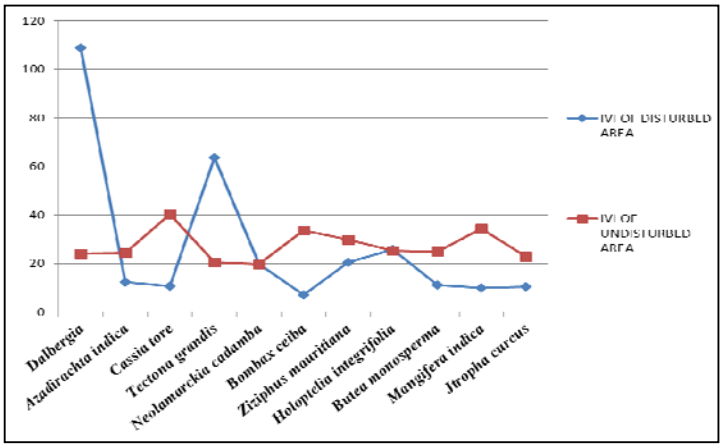

Fig 3: Line graph of important value index of disturbed site (mined area) and undisturbed site (unmined area)

The IVI of undisturbed area has in continues flow than of disturbed site. Undisturbed area has high IVI which indicates the species well represented in the stand. With a smaller number of individuals of all species but the trees are large and properly grown compare with others in the stand, disturbed area. The graph is constant and is showing stable reading as the trees species are evenly distributed in the undisturbed area. Distributions of trees in the disturbed area were observed uneven so the graph has irregular rise and fall, is fluctuating.

Conclusion

The mining area adversely affected the tree species and reproduction was very poor due to low. However, the reading shows that the plantation regeneration status in passive dump area, beside active dump, crusher area and lease pillar area is maximum and can be more sustainable in future from more potential efforts to the plantation. The result of this study can be useful to the mining areas to fight with the pollution and contamination occurred and to increase the tree species in the mining area. The tree diversity showed the drastic reduction in their number and richness in disturbed sites with that of undisturbed sites. So the development of the tree species is an important to maintain the environment and ecosystem safely.

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