International Journal of Modern Agriculture, Volume 9, No.4, 2020
ISSN: 2305 - 7246

EFFECT OF COAL MINING ON VEGETATION OF TALCHER AREA OF ODISHA, INDIA

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Abstract

Extensive coal mining activity in Talcher Coalfields of Angul district of Odisha has led to habitat degradation and a landscape dotted with mine spoils. The main aim of this study is to assess the impact of coal mining on vegetation of Talcher area. To make mining possible several forest are cleared and this leads to deforestation. The loss of vegetative land and forest land affects the vegetation of the area. Due to increase in energy consumption in India the mining of coal is also increasing causing more vegetation loss. Thus it is advisable that such activities have to strictly regulate and more plantation must done to keep control on loss of vegetation.

Key words: Coalfield, Degradation, Vegetation, Mining, Talcher

Introduction

Mining is the extraction of valuable minerals and other geological material from earth, usually from ore body, load, seam, or place of deposit. Mining put impact on social, ecological and economic aspect of country. India stands as largest coal reserver in the world. The coal mines are located in state of Odisha, Jharkhand, Bihar , Chhattisgarh , Madhya Pradesh and West Bengal (Mahalik and Satapathy, 2016). The coal of India not only fulfill the demand of own nation but also the demand of other nation .This provide foreign exchange earnings. India is the world third largest energy consumer due to its population. India's energy consumption is growing by 4.6 % per annum. Coal plays vital role in meeting country's energy demand. From the total nation's electricity generating capacity coal accounts 53% .Therefore the mining activities are increasing day by day to satisfy the demand. To make mining possible several forest are cleared and this leads to deforestation which causes loss of flora and fauna (Chabukdhara and Singh, 2016). The overburden also affects vegetation. As the area gets deforested, it is very difficult to create an artificial ecosystem. Unscientific mining of minerals poses a serious threat to the environment, resulting in reduction of forest cover, erosion of soil at a greater scale, pollution of air, water and land reduction in biodiversity (Davila et al., 2019). India is rich in important mineral resources and over the year of extraction of these have resulted ecosystem degradation (Swer and Singh, 2004). Talcher is one of the major industrial zone of Odisha. Talcher has highest coal deposit in India that is 51 billion tones. Talcher coalfield is a part of Mahanadi Coalfields Ltd. It contributed over 81MT to the total 143 MT coal produced by MCL during the period 2017-2018 . Due to extensive coal mining the loss of flora and fauna occurred and large scale destruction of tree, herb and shrub are the result.

Materials and method

Study area

The study was conducted in Talcher region of Odisha. Talcher also named as City of Black Diamond or Coal City of Odisha is one of the fastest growing industrial and coal hubs in the state. Because of its huge coal

reserves, the city has been ranked among the highest in terms of GDP in Odisha. It is also one of the 4 sub-divisions of Angul district in the Indian state of Odisha. Situated on the right bank of the river Brahmani, it is one of the fastest growing industrial and mining complexes of the country. The city is surrounded by the coalfields under MCL (Mahanadi Coalfields Limited) and has three Mega Power plants like NTPC, TTPS, and Jindal power plant. The latitude of Talcher, Odisha, India is 20.951542, and the longitude is 85.215668**.** Talcher, Odisha, India is located in the Towns place category with the gps coordinates of 20° 57' 5.5512" N and 85° 12' 56.4048'. Talcher coalfields, bounded by latitudes 23053'N & 21012'N and longitudes 84020'E & 85023'E, covers an area of about 1800 Km^2. It constitutes southeastern part of the Lower Gondwana basins within Mahanadi Valley. The major mines under MCL in Talcher are the Bhubaneswar OCP (Capacity-25 MT), Ananta OCP, Bharatpur OCP, Lingaraj OCP, Kaniha OCP, Jagannath OCP, Hingula OCP, Balram OCP, Nandira colliery (UG) and Dera UG (MM, 2013; Mahalik et al., 2018).

Figure 1. Map of study area

Field sampling

The vegetation in coal mining area of Talcher region of Odisha were studied during the month of June 2020. To find out the impact of coal mining on vegetation a comparative study was carried out. In this method Talcher area was divided into two parts, one is mined area and another one is unmined area. The data was collected by sampling using quadrats of 10m x 10m size. The total number of quadrats laid in each site was 10. The quantitative community characteristic such as frequency, density, dominance and Importance value index (IVI) was calculated (Mishra, 1968; Curtis, 1959). The species found in quadrates were identified with the help of flora of Odisha (Saxena and Brahmam, 1994-1996).

Data analysis

The relative value of density, frequency and dominance was calculated. They were summed up to get importance value index. Then the importance value index of each (Cottam and Curtis, 1956)

The following formulae were used for calculation:

$$\text{Frequency} = \frac{\text{Sampling unitsin which species occur}}{\text{Total sampling unit studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individual of single}}{\text{Total number ofquadrates taken}}$$

Basal area $= \pi r^2$(where r= radius, π=3.14)

After calculating frequency, density and basal area of the identified species, the relative frequency, relative density and relative dominance were calculated by using following formulae:

$$\text{Relative Frequency} = \frac{\text{Frequency of a single species}}{\text{Total frequency of all the species}} \times 100$$

$$\text{Relative Density} = \frac{\text{Frequency of a single species}}{\text{Total frequency of all the species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Basal area of sinle species}}{\text{Total basal area of all the species}} \times 100$$

Finally, the values of relative frequency, relative density and relative dominance were added to get the Importance Value Index (IVI).

IVI=Relative frequency + Relative density +Relative dominance

Results

A total of 59 species belonging to 29 families found in non mined area of Talcher and 31 species belonging to 23 families found in mined area of Talcher. The highest species number is represented by family Apocynaceae in unmined area followed by Amaranthaceae. The dominant species in unmined area is Moraceae. In mined area Poaceae is the dominant species. The dominant climber species in unmined area is Fabaceae. In mined area all the species of climber are equally distributed. Apocynaceae is the dominant shrub species in both mined and unmined area. Amaranthaceae and Asteraceae are the dominant herb species in unmined and mined area respectively. Moraceae and Casalpinaceae are the dominant tree species in unmined and mined area respectively. The IVI value *of Mangifera indica* and *Borassus flabellifer* (Table 1 and 2) was second highest in both the study area next to *Cynodon dactylon.* It was found that due to mining heavy forest has been lost. There is increase in open forest area .There were less change in non-forest area. Grass plays vital role mined area. The grass species is more in mined area compared to other species. Due to rooting at each node this grass species help in controlling soil erosion by binding soil particles.

Table 1. Observation table of unmined area, IVI (Important Value Index)

Scientific Name	Common Name	Family	Habitat	Relative Density	Relative Frequency	Relative Dominance	I.V.I
Abrus precatorius L.	Kaincha	Fabaceae	Climber	0.63	1.42	0.000668	2.050668
Aegle marmelos (L.)Corr.	Bela	Rutaceae	Tree	1.57	2.85	2.404183	6.824183
Alternanthera sessilis (L.) R.Br.	Kalama saga	Amaranthaceae	Herb	3.15	1.42	0.000668	4.570668
Amaranthus spinosus L.	Kanta saga	Amaranthaceae	Herb	3.15	1.42	0.000668	4.570668
Amaranthus viridis L.	Khada saga	Amaranthaceae	Herb	3.15	1.42	0.000668	4.570668
Annona squamosa L.	Aata	Annonaceae	Tree	0.63	0.71	1.669572	3.009572
Artocarpus heterophyllus Lam.	Panasa	Moraceae	Tree	1.26	2.14	6.678287	10.07829
Azadirachta indica A. Juss.	Nimba	Meliaceae	Tree	0.63	0.71	1.669572	3.009572
Borassus flabellifer L.	Tala	Arecaceae	Tree	6.3	2.85	9.616733	18.76673
Calosia argentea L.	Sirali	Amaranthaceae	Grass	0.96	1.42	0.000668	2.380668
Calotropis gigantea (L.)	Aarakha/ Akanda	Asclepediaceae	Shurb	0.96	1.42	0.267131	2.647131

Alton							
Carica papaya L.	Amrutavanda	Caricaceae	Tree	0.96	0.71	1.669572	3.339572
Catharanthus roseus (L.) G. Don.	Sadabihari	Apocynaceae	Herb	3.15	3.57	0.010685	6.730685
Ceiba pentandra (L.) Geartn.	Simuli	Bombaceae	Tree	0.63	1.42	1.669572	3.719572
Clitoria ternatea L.	Aparajita	Fabaceae	Climber	3.15	3.57	0.010685	6.730685
Coccinia grandis (L.) Voigit	BanaKunduri	Cucerbitaceae	Climber	0.63	0.71	0.016696	1.356696
Cuscuta reflexa Roxb.	Nirmuli	Cuscutaceae	Climber	1.26	1.42	0.066783	2.746783
Cynodon dactylon (L.) Pers.	Duba	Poaceae	Grass	31.54	7.1	0.000668	38.64067
Dalbergia sisso Roxb.	Sissu	Fabaceae	Tree	0.63	0.71	1.669572	3.009572
Datura metel L.	Dudura	Solanaceae	Shurb	0.63	0.71	0.267131	1.607131
Emblica officinalis Gaertn.	Anla	Euphorbiaceae	Tree	0.63	1.42	1.669572	3.719572
Eucalyptus tereticornis Sm.	Eucalyptus	Myrtaceae	Tree	1.26	2.85	1.669572	5.779572
Ficus hispida L.f.	Badi dimiri	Moraceae	Tree	0.63	0.71	0.00601	1.34601
Ficus racemosa L.	Pipali	Moraceae	Tree	0.31	0.71	1.669572	2.689572
Hyptis suaveolens (L.) Poit	Gangatulasi	Lamiaceae	Shurb	1.26	1.42	0.00601	2.68601
Ixora pavetta Andr.	Rangani	Rubiaceae	Shrub	0.31	0.71	0.00601	1.02601
Leucaena leucocephala (Lam.) de Wit.	DhalaBaburi	Mimosaceae	Tree	0.63	0.71	1.669572	3.009572
Mangifera indica L.	Amba	Anacardiaceae	Tree	3.15	2.85	15.02615	21.02615
Moringa oleifera Lam.	Sajana	Moringaceae	Tree	1.26	1.42	1.669572	4.349572
Mimosa pudica L.	Lajakulilata	Mimosaceae	Herb	2.2	2.14	0.010685	4.350685
Mirabilis jalapa L.	Rangani	Nyctagenaceae	Herb	0.63	0.71	0.010685	1.350685
Murraya koenigii (L.) Spreng.	Bhursunga	Rutaceae	Herb	3.15	4.28	0.010685	7.440685
Murraya paniculata (L.) Jack	Kamini	Rutaceae	Shrub	1.89	1.42	0.002671	3.312671
Neolamarckia cadamba (Roxb.) Bosser	Kadamba	Rubiaceae	Tree	0.63	0.71	1.669572	3.009572
Ocimum gratissimum L.	Banatulasi	Lamiaceae	Herb	1.26	2.85	0.066783	4.176783
Phoenix acaulis Roxb.	Khajuri	Arecaceae	Tree	0.31	0.71	1.669572	2.689572
Plumeria alba L.	Kathachampa (white)	Apocynaceae	Shurb	0.63	0.71	0.267131	1.607131
Plumeria rubra L.	Kathachampa(red)	Apocynaceae	Shrub	0.63	0.71	1.669572	3.009572
Paederia foetida L.	Pasaruni	Rubiaceae	Climber	1.26	1.42	0.016696	2.696696
Pongamia pinnata (L.) Pierre.	Karanja	Fabaceae	Tree	0.63	1.42	1.669572	3.719572
Saraca asoca	Asoka	Caesalpinaceae	Tree	1.26	2.85	1.669572	5.779572

(Roxb.) Wild.							
Sida acuta Burm.f.	Sunakhodika	Malvaceae	Shrub	0.63	0.71	0.00601	1.34601
Shorea robusta Gaertn.	Salo	Dipterocarpaceae	Tree	1.57	2.85	2.404183	6.824183
Streblus asper Lour.	Sashada	Moraceae	Tree	0.31	0.71	1.669572	2.689572
Tamarindus indica L.	Tentuli	Fabaceae	Tree	0.96	1.42	2.404183	4.784183
Tagetes erecta L.	Gendu	Asteraceae	Herb	1.26	0.71	0.016696	1.986696
Tagetes patula L.	Katakigendu / Kalikusuma	Asteraceae	Herb	0.63	0.71	0.016696	1.356696
Tectona grandis L.f.	Saguan	Lamiaceae	Tree	1.26	1.42	1.669572	4.349572
Terminalia arjuna (Roxb.) Wight & Arn.	Arjuna	Combretaceae	Tree	0.31	0.71	1.669572	2.689572
Terminalia bellirica (Gaertn.) Roxb.	Bahada	Combretaceae	Tree	0.31	0.71	1.669572	2.689572
Cascabela thevetia (L.) H. Lippold	Kaniyari	Apocynaceae	Shrub	1.26	1.42	0.267131	2.947131
Vernonia cinerea (L.) Less.	Pokasungha	Asteraceae	Herb	0.96	1.42	0.002671	2.382671
Wrightia tinctoria R.Br.	Pita keruan	Apocynaceae	Tree	0.63	0.71	0.00601	1.34601
Ziziphus mauritiana Lam.	Barakoli	Rhamnaceae	Shrub	0.31	0.71	1.669572	2.689572

Table 2. Observation table of mined area, IVI (Important Value Index)

Scientific Name	Common Name	Family	Habitat	Relative Density	Relative Frequency	Relative Dominance	I.V.I
Aegle marmelos (L.)Corr.	Bela	Rutaceae	Tree	0.420168	1.369863	2.641059	4.43109
Annona squamosa L.	*Aata*	Annonaceae	Tree	0.420168	1.369863	2.641059	4.43109
Azadirachta indica A. Juss.	Nimba	Meliaceae	Tree	0.420168	1.369863	0.422569	2.212601
Borassus flabellifer L.	Tala	Arecaceae	Tree	2.10084	2.739726	15.2125	20.05307
Celosia argentea L.	Sirali	Amaranthaceae	herb	8.403361	5.479452	0.001056	13.88387
Calotropis gigantea (L.) Alton	Arakha / Akanda	Asclepediaceae	shrub	0.840336	1.369863	0.422569	2.632769
Catharanthus roseus (L.) G. Don.	Sadabihari	Apocynaceae	Herb	1.260504	2.739726	0.016903	4.017133
Clitoria ternatea L.	Aparajita	Fabaceae	Climber	1.680672	2.739726	0.016903	4.437301
Coccinia grandis (L.) Voigit	Bana kunduri	Cucerbitaceae	Climber	2.10084	4.109589	0.016903	6.227332
Cuscuta reflexa Roxb.	Nirmuli	Cuscutaceae	Climber	0.420168	1.369863	0.016903	1.806934
Cynodon dactylon (L.) Pers.	Duba	Poaceae	grass	37.81513	13.69863	0.001056	51.51481
Datura metel L.	Dudura (kala)	Solanaceae	shrub	0.420168	1.369863	0.422569	2.212601
Eucalyptus tereticornis Sm.	Eucalyptus	Myrataceae	Tree	8.403361	12.32877	6.761111	27.49324
Ficus hispida L.f.	Badidimiri	Moraceae	Climber	0.420168	1.369863	0.004226	1.794257
Mangifera indica L.	Amba	Anacardaceae	Tree	2.521008	2.739726	15.2125	20.47323
Mimosa pudica L.	Lajakuli	Fabaceae	Herb	2.941176	5.479452	0.004226	8.424854
Murraya koenigii (L.) Spreng.	Bhursunga	Rutaceae	Herb	2.941176	1.369863	0.001056	4.312096
Murraya paniculata (L.) Jacq.	Kamini	Rutaceae	Shrub	3.361345	2.739726	0.026411	6.127481
Ocimum gratissimum L.	Banatulasi	Lamiaceae	Herb	1.680672	1.369863	0.026411	3.076946
Phoenix acaulis Roxb.	Khajuri	Aracaceae	Tree	1.680672	2.739726	3.803125	8.223523

Plumeria rubra L.	Kathachampa (Red)	Apocynaceae	shrub	1.260504	2.739726	2.641059	6.641289
Pongamia pinnata (L.) Pierre.	Karanja	Fabaceae	Tree	0.840336	2.739726	3.803125	7.383187
Saraca asoca (Roxb.) Wild.	Ashoka	Caesalpinaceae	Tree	0.420168	1.369863	10.56424	12.35427
Sida acuta Burm.f.	Sunakhodika	Malvaceae	Shrub	1.680672	2.739726	0.009508	4.429906
Shorea robusta Gaertn.	Salo	Dipterocarpaceae	Tree	1.680672	2.739726	3.803125	8.223523
Tamarindus indica L.	Tentuli	Fabaceae	Tree	0.420168	1.369863	23.76953	25.55956
Tagetes erecta L.	Gendu	Asteraceae	Herb	4.201681	2.739726	0.422569	7.363976
Tagetes patula L.	Katkigendu / Kalikusuma	Asteraceae	Herb	4.201681	2.739726	0.422569	7.363976
Tectona grandis L.f.	Saguan	Lamiaceae	Tree	0.420168	1.369863	3.803125	5.593156
Cascabela thevetia (L.) H. Lippold	Kaniyari	Apocynaceae	shrub	1.680672	5.479452	2.641059	9.801183
Vernonia cinerea (L.) Less.	Pokasungha	Asteraceae	Herb	2.10084	2.739726	0.422569	5.263136
Wrightia tinctoria R.Br.	Pita keruan	Apocynaceae	Tree	0.840336	1.369863	0.026411	2.23661

Figure 2. Vegetation in unmined region of Talcher area

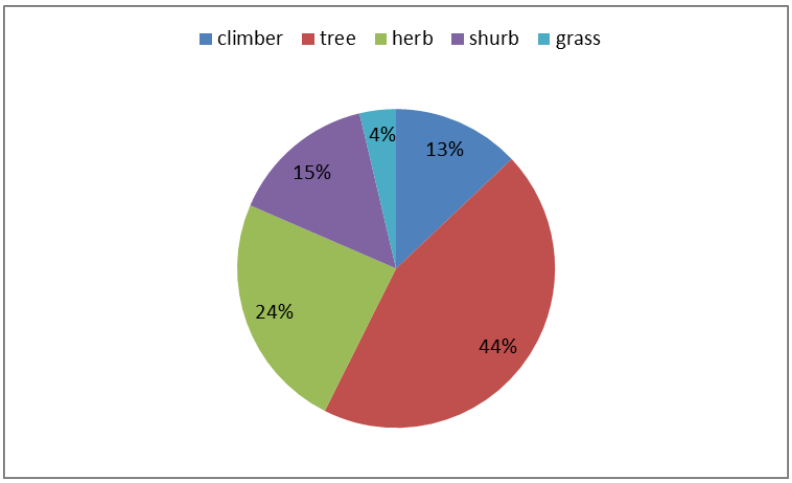
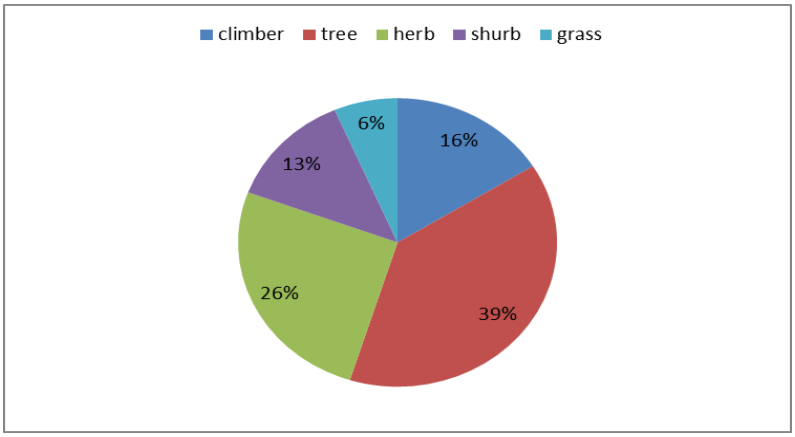


Figure 3. Vegetation in mined region of Talcher area



Conclusion

Coal mining has adversely affected the vegetation of Talcher area. In this study, it was observed that in comparison with unmined area the mining area have less and disturbed vegetation. With increased production of coal, the rate of degradation of environment has also increased. From comparison it was found that the number

of tree and shrub species is very less in mined area. The herb species is little less in mined area. The grass species is near about same in mined and unmined area. The high importance value index of grass in mining area suggests its ability to grow in the disturbed environment. The dense forest areas have been converted into the open forest. On the other side the other species including the crop species get adversely affected by mining. From the observation it can be concluded that a major initiation is required to control vegetation loss. Afforestation must be done to manage the loss of vegetation.

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