THE IMPACT ON BIO-DIVERSITY DUE TO HUMAN ACTIVITIES IN OPEN-PIT MINING IN TALCHER

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Abstract

Environmental issue: The decreasing in plant biodiversity in the nearby area is due to deforestation and change in the composition of the atmosphere in the environment because of the presence of dust and harmful chemical particle.

Living with my family in mining area, I was fascinated to investigate the plant biodiversity locally. The curiosity had further instigated me when I completed an ESS field trip with my friends and ESS teacher to the mining area. This study trip inspires me to investigate the plant biodiversity in different location of the open pit mining in Talcher which is very close to my residence area.

A deep apprehension all around the world today is that the biodiversity loss is because of human ignorance. Outstanding to habitat destruction and over exploitation putting stress on nature leads to a serious consequence on the biodiversity. Biodiversity hold over human livelihood and its occupation. The Indian subcontinent has its unique identity in the world due to great Biodiversity of natural ecosystems and rich plant diversity in its different parts.,(Social capital and social wellbeing, 2004)*It contains around 49,000 plant species, 2.4% total geographical area and 8% biodiversity of the world. But in recent decades the biodiversity is decreasing in alarming speed due to anthropogenic activities. Talcher is a place in eastern India, having diverse flora and fauna and also filled with mineral ores and fossil fuel (coal). In recent decades due to globalization multinational company are coming to Talcher for mining. The waste (dust) generated from the mining and transportation enter into the nearby area.*

Key words:*Open-pit mining, biodiversity, mining effects, mining pollution.*

1. INTRODUCTION

1.1 Identifying the problem

Open-pit mining is a type of strip mining in which the ore deposit extends very deep in the ground, necessitating the removal of layer upon layer of overburden and ore. In many cases, logging of trees and clear-cutting or burning of vegetation above the ore deposit may precede removal of the overburden. The use of heavy machinery, usually bulldozers and dump trucks, is the most common means of(Protect Ecuador, 2013) removing overburden. Open-pit mining often involves the removal of natively vegetated areas and is therefore among the most environmentally destructive types of mining, especially within tropical forests. “To what extent has a human intervention (Open-pit Mining) has impacted the biodiversity in Talcher”?

Mining can contaminate soils over a large area. Agricultural activities near a mining project may be particularly affected. According to a study commissioned by the (Samuel Obiri, 2016)European Union: “Mining operations routinely modify the surrounding landscape by exposing previously undisturbed earthen materials. Erosion of exposed soils extracted mineral ores, tailings, and fine material in waste rock piles can result in substantial sediment loading to surface waters and drainage ways. In addition, spills and leaks of hazardous materials and the deposition of contaminated windblown dust can lead to soil contamination.

1.2 **Soil Contamination** : Human health and environmental risks from soils generally fall into two categories: (1) contaminated soil resulting from windblown dust, and (2) soils contaminated from chemical spills and residues. Fugitive dust can pose significant environmental problems at some mines. The inherent toxicity of the dust depends upon the proximity of environmental receptors and type of ore being mined. High levels of arsenic, lead, and radionuclides in windblown dust usually pose the greatest risk. Soils contaminated (Springler, Gaurav Sablok, 2019)from chemical spills and residues at mine sites may pose a direct contact risk when these materials are misused.

1.3 Connection of the Environmental issue to the research question:

The global issue is connected to the research question as the mining has directly ruined the vegetation cover due to open pit mining and infrastructure (road) development and thus the forest biodiversity and ultimately the ecosystem in forest area which is responsible for climate change in Talcher, Odisha. Simpson's diversity index has been used in past research to investigate the plant biodiversity. .To explore the local environmental problem the present investigation was carried out in the month of November, 2018 in Talcher district, The concern area were visited close to mining area for carrying out the recorded study of fauna diversity present around five kilometres to know the impact of open pit mining .I investigated the plant biodiversity in different location of the mining site, then I have analysed the collected primary data by applying Simpson's diversity index.

2.0 Review of Literature

Mishra (2017)explodes about sustainable mining exploration and creation of rural and tribal communities living near mining areas, these have not been translated into implementable solutions. Natural resources are being diverted from rural and tribal areas to meet the ever-increasing needs and desires of the wealthiest groups.With the above context, this paper, taking into account both villages of experiment and control, attempted to explore the effect of coal mining on local environment. (Ministry of mines, 2016)Although it deals with local environment, it has focused mostly on the sociological impact of mining on air,water and noise pollution.The data collected indicate that the concentration of suspended particulate matter at only a few sampling locations is alarmingly high.

2.1: Hypothesis & Research framework

1. I hypothesize that plant growing in mining areaswill have fewer chances of growing and low biodiversity.
2. Due to open pit mining the plants become acidic.If the Ph is below 7, the soil and plant are acidic.(Altmann, 1999)
3. Opencast coal mining activities are known to cause serious environmental pollution if proper preventive and control measures are not adopted. (Wiemeyer, 2003)

3.0 Research Methodology

The research is carried using Simpson`s diversity Index. The following procedure is followed to obtain the Simpson`s diversity Index:

1. Identify the suitable study side in various location around the mining area to quantify the number of plant species near to the mining area and far from it.
2. Go to the study site with full safety with the help of guide and take assistance (ESS teacher and mining site supervisor)
3. In the study side hammer the nail in the soil firmly without damaging the vegetation.
4. Fix four nails to make a square
5. Tie each end of the nails using a thread, to make 1X1m quadrant
6. Similarly, make 20 quadrants randomly in each study site
7. Select the plant species for the study of the population frequency
8. Observe the species A in the quadrant and mark in the table
9. Similarly check for the species A in other quadrants respectively and record the data in the table.
10. Observe the presence of species B in all other quadrants and mark in the table
11. Repeat the same procedure for other species and record in the table
12. We can calculate the Simpson's diversity index of each side
13. Try to avoid edge effect during data collection from the quadrant

***3.1 .1Independent Variables*:**
Position of the sampling site

3.1.2 Dependent Variables:
Plant richness and evenness

3.1.3 Controlled Variables:
Size of the quadrants (2m2)
Sampling season (winter season)
Same observer will be counting the species

3.1.4 Equipment List

- Gloves
- Goggles
- Weight balance
- Measuring tape
- Permanent Marker

- Safety jacket
- Gumboot
- Thread
- Iron nail

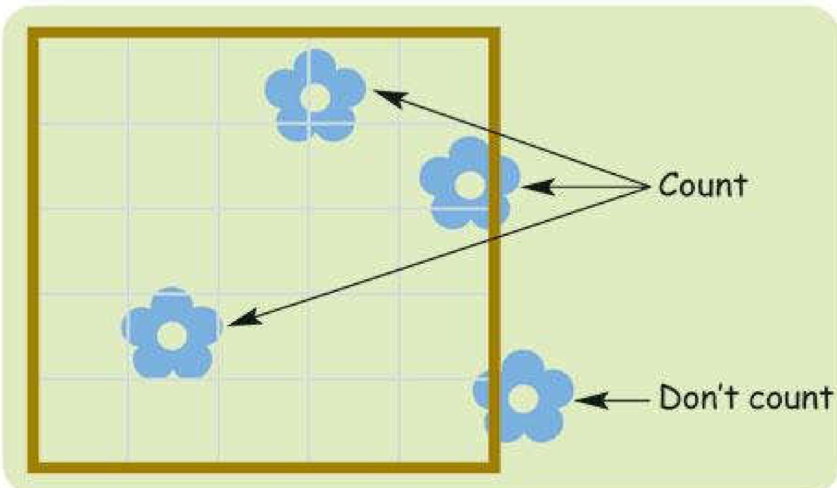


Figure No.1 Risk Assessment, Ethecaland

3.2 Risk Assessment , Ethecaland (Ministry of coal, 2018)
Environmental considerations:

- Do not leave any object in the sampling side
- During sampling take care of the plant minimal damage to the plant inside the quadrant
- Use knee boat to avoid the thorns and any other sharp object
- Cover the body with apron to avoid mosquito and tick
- Wear gloves,speck and mask to avoid from allergic dust which affect respiratory tract
- Apply sunburn cream to avoid the sensitive skin
- Collect your equipment together and check it for hazards such as sharp edges Go to a mining site with safety, and full guide assistance, by wearing protective

gear, helmet, gloves, and avoiding damage to the sensitive environment during the field work.

3.4 Primary data Collection:

SITE-A

Table no.1- Site-A data

No of Quadrants	Species-A	Species-B	Species-C	Species-D	Species-E	Species-F	Species-G	Species-H	Species-I	Species-J	Species-K
1	1	0	0	1	0	0	0	0	1	0	0
2	0	1	0	0	0	0	0	0	0	0	1
3	1	0	0	0	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0	0	0	0	0
5	1	0	1	1	0	0	0	0	0	1	0
6	0	0	0	0	1	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0	0	0	1
8	0	1	0	1	0	0	0	1	0	0	0
9	1	0	0	0	0	0	0	0	0	0	1
10	0	0	1	0	0	0	1	0	0	1	0
11	0	0	0	0	0	0	0	0	1	0	1
12	1	0	0	0	0	1	0	0	0	1	0
13	0	0	1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	1	0	0	0	0
15	1	0	0	1	0	0	0	0	0	0	0
16	0	1	0	0	0	1	0	0	1	0	0
17	0	0	1	0	1	0	0	0	0	1	0
18	1	1	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	1	0	0	0	0	1
20	0	0	0	1	0	0	0	0	0	0	0

TT	7	5	4	5	2	4	2	1	4	4	5
N(N-1)	42	20	12	20	1	12	1	0	12	12	20

N= 152
N(N-1) = 152(152-1) =22952
n = 7+ 5 + 4 + 5 + 2+ 4+ 2+ 1 + 4+ 4 + 5 = 43•42= 1806
$=N(N-1)/\sum n(n-1)$
=22952/1806= 12.70
dd = 12.70

SITE-B

Table No.2 – Site-B Data

No of Quadrants	Species-A	Species-B	Species-C	Species-D	Species-E	Species-F	Species-G	Species-H	Species-I	Species-J	Species-K
1	1	0	0	0	0	0	0	0	1	0	0
2	0	0	0	0	1	0	0	1	0	0	0
3	0	1	0	0	0	1	0	0	0	1	0
4	1	0	0	1	0	0	0	0	0	1	0
5	0	0	1	0	0	0	1	0	0	0	1
6	0	1	0	0	0	1	0	0	1	0	0
7	1	0	0	0	0	0	0	0	1	0	0
8	0	1	0	0	0	0	0	0	0	0	1
9	0	0	0	1	0	0	0	1	0	0	0
10	0	0	0	0	1	0	0	0	1	0	0
11	1	0	1	0	0	0	0	0	0	0	1
12	1	0	0	0	0	0	1	0	0	0	0
13	0	1	0	0	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0	0	0
15	0	0	1	0	1	0	0	0	0	0	0
16	1	0	0	1	0	0	0	1	0	0	0

17	0	1	0	0	0	1	0	0	1	0	0
18	1	0	1	0	0	0	0	0	0	1	0
19	0	1	0	0	0	0	0	0	0	0	1
20	1	0	0	0	0	0	0	0	0	0	0
TT	9	6	4	3	3	3	2	3	5	3	4
N(N-1)	72	30	12	6	6	6	1	6	20	6	12

N= 177
N(N-1) = 177(177-1) =31152
n = 9+ 6 + 4 + 3 + 3 + 3 + 2+ 3 + 5 + 3 + 4 = 45•44= 1980
=$N\ (N-1)/\sum n\ (n-1)$
=31152/1980= 15.77
dd = 15.77
SITE-C

Table No.3 – Site-C data

No of Quadrants	Species-A	Species-B	Species-C	Species-D	Species-E	Species-F	Species-G	Species-H	Species-I	Species-J	Species-K
1	0	1	0	0	0	0	1	0	0	1	0
2	1	0	0	0	0	1	0	1	0	0	1
3	1	0	0	0	0	0	0	0	0	1	0
4	0	0	1	0	0	0	1	0	0	0	0
5	0	0	0	1	0	1	0	0	0	1	0
6	0	1	0	0	1	0	0	0	1	0	0
7	1	0	1	0	0	0	1	0	0	0	0
8	0	0	0	0	0	0	1	0	1	0	0
9	0	0	0	0	1	0	0	0	0	0	1
10	0	1	0	1	0	1	0	1	0	0	0
11	0	0	0	1	0	0	0	0	0	1	1
12	1	0	0	0	0	0	0	0	1	0	1

13	0	1	0	0	0	0	1	0	0	0	0
14	1	0	0	1	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	1
16	0	0	1	0	0	0	0	1	0	0	0
17	0	1	1	0	1	0	0	0	0	0	0
18	1	0	0	0	0	0	0	0	0	1	0
19	0	0	0	1	1	0	0	1	0	0	0
20	1	0	0	0	0	0	0	0	0	0	0
TT	7	5	4	5	4	3	5	4	3	5	5
N(N-1)	42	20	12	20	12	6	20	12	6	20	20

35910/2450= 14.65
N= 190
N(N-1) = 190(190-1) =35910
n =7+ 5 + 4 + 5 + 4 + 3 + 5 + 4 + 3 + 5 + 5 = 50•49 = 2450
=$N\ (N-1)/\sum n\ (n-1)$
=35910/2450= 14.65
dd = 14.65
SITE-D

Table No.4 Site- D data

No of Quadrants	Species-A	Species-B	Species-C	Species-D	Species-E	Species-F	Species-G	Species-H	Species-I	Species-J	Species-K
1	0	1	0	1	0	0	0	1	0	0	1
2	1	0	0	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	1	0	1	0	0	1	0	0	0	0	1
6	0	0	0	0	1	0	1	0	0	0	0

7	0	0	0	0	0	1	0	0	0	0	1
8	1	0	1	0	1	0	1	0	0	0	0
9	0	0	0	1	0	1	0	0	0	0	1
10	0	1	0	0	1	0	0	1	1	0	0
11	0	0	0	0	0	0	1	0	0	1	0
12	1	0	0	0	1	0	0	1	0	0	1
13	0	1	0	0	0	0	0	0	0	1	0
14	0	0	1	0	0	1	0	0	0	0	1
15	0	1	0	1	0	0	0	0	1	0	0
16	1	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	1	0	0	0	1	1	0
18	0	1	0	0	0	0	1	1	0	0	1
19	0	0	0	1	0	1	0	0	0	1	0
20	1	0	0	0	1	0	1	0	1	0	0
TT	6	5	3	4	6	5	6	4	4	5	6
N(N-1)	30	20	6	12	30	20	30	12	12	20	30

49062/2862= 17.14

N= 222
N(N-1) = 222(222-1) =49062
n =6 + 5 + 3 + 4 + 6 + 5 + 6 + 4 + 4 + 5 + 6 = 54•43 = 2862
$= N\ (N-1)/\sum n\ (n-1)$
=49062/2862= 17.14
dd = 17.14

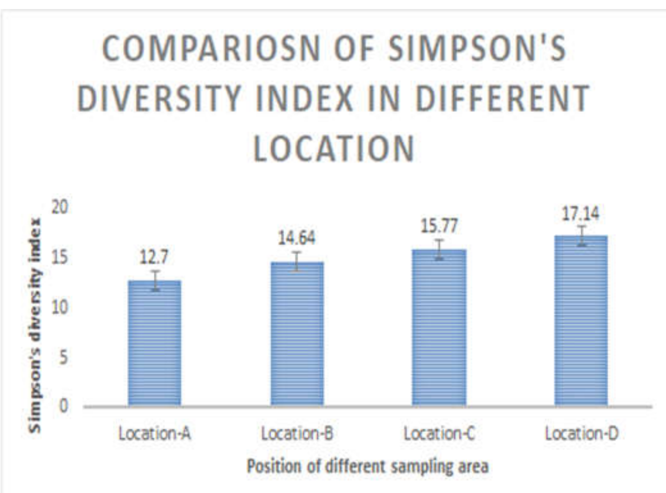
Simpson's diversity index of different location:
Location A:15.77 A: 12.70
Location B:12.70 B:14.64
Location C:14.64 C:15.77
Location D:17.14 D:17.14

Soil ph in different locations:

Table No.5 – Soil ph value in different locations

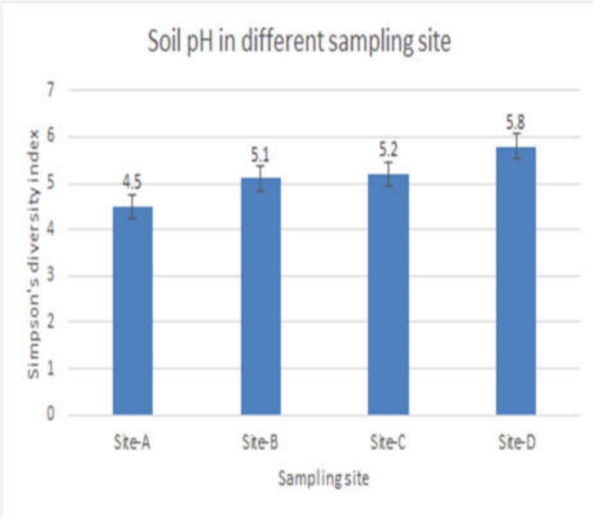
SITES	***Sample-1***	***Sample-2***	***Sample-3***	***Sample-4***	***Sample-5***	***Average Mean***
Site- A	***4.3***	***4.7***	***4.9***	***4.0***	***5.0***	***22.9/5= 4.5***
Site- B	***4.9***	***5.2***	***5.0***	***5.7***	***4.9***	***25.7/5= 5.1***
Site- C	***5.1***	***4.8***	***4.9***	***5.3***	***5.9***	***26/5= 5.2***
Site- D	***5.9***	***4.9***	***6.2***	***5.5***	***6.5***	***29/5= 5.8***

(Bart Haegeman, 2013)**Graph 1:** Processed data comparing the total number of individuals of invertebrates of each family for both types of forest



The Bar graph in figure-1 shows the Simpson’s diversity index of plant of different plant population. It is apparent from the graph that the sampling site (A) close to mining shows least Simpson’s diversity index value, that is 12.7 and the sampling site(D) far away from the mining shows 17.14. The Simpson’s diversity index in between these two sampling is 14.6(B-site) and 15.77(C-site).

Figure no. 2 Comparison of Simpson`s Diversity Index



The bar chart 2, shows the soil pH in different location of sampling site. It can be seen from the graph that the site-D which is 4 km from mining, soil pH is 5.8. The sampling site-A which is proximity to mining area i.e. 1 km from mining, soil pH is 4.5. The sampling site-B and site-C in between sampling sit A and D shows of soil pH 5.1 and 5.2 respectively.

(Dhruv Katoria, 2013)

Figure no.3 Soil ph in different locations

4.0 Results & Analysis:

The primary data collected from different location around the mining area in Angul area revealed that the plant biodiversity decreasing in an alarming speed close to open pit mining area. The soil close to mining is 4.5 is (MITTAL, 2015),acidic in nature and the soil 4km from the mining site is 5.8 which is slightly acidic in nature, suitable for plant growth and development. The difference in pH level between A and D is 1.3, but from site B and C are 0.7 and 0.6 respectively. The Simpson’s diversity index proximal to the open pit mining area is 12.7 i.e. less than 30% less than the site D. The diversity index B and C are 15.2% and 24% higher than site-A respectively.

5.0 Conclusion

5.1: Discussion on results

It is evident from the graph that the plant biodiversity adjacent to the mining area is relatively low as compared to the other sites far afield from it. This indicates that some plant species not able to withstand the changes in biotic and abiotic factors such in soil pH and anthropogenic activities which leads to extinction. Therefore, the analysed data gives clear to the research question. The secondary data collected could support the present research data.

5.2 **Limitations of the Study & recommendations for further research**

Includes collecting primary data on both plants and diversity in different habitat. Notification: The area of the quadrats could have been reduced 0.5m2 this could have strengthened the results(Souvik Bhattacharjya, 2013)
Fauna and macro invertebrate above ground and below ground could have been considered

How do the local communities feel/interact with the reserve? Finding secondary data to compare my data to, as this was very difficult.
Strength of this investigation was efficacy of the methodology used for primary and secondary data collection and the statistical tools used to deduce a conclusion to support the hypothesis. The limitation and weakness of this research exploration were there were certain ambiguity recording species diversity, as some plant species may have counted twice. Additionally, Attention was not always 100% on the surroundings – some species might have passed unspotted. Only seasonal data were recorded.

5.3 Practical Application

A potential solution to environmental issue:

Creating a special buffer zone area to protect existing plant species and to avoid the environment from hazardous pollution is a sustainable solution to open pit mining. (CSE Mining & Environment , 2013). The buffer zone
area needs to create with endemic key stone species which will take less time to restore the degraded ecosystem. The buffer zone area having the capacity to absorb the dust and won't allow to spread long distances and also same time it will help to protect other species. The buffer zone has to create with several interpretation zones. i.e. Butterfly zone, herb and shrub zone and bird watching zone etc.

Development of buffer zone around open pit mining need funding, manpower and intellectual person having proper knowledge about the local climatic condition and socioeconomic pressure of the people living there. Weak socio-political structure and representation in the field of environment, lack of training, equipment and motivation can limit the development of buffer zone. lack of sufficient infrastructure could limit the control of illegal hunting and logging. The buffer zone developed close to international border can brings the conflicts between the countries.

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