

# Boyd's Diversity Index of Ponds in Coal Mining City Dhanbad, Jharkhand, India

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**Abstract**— Ten ponds in coal mining city Dhanbad were selected for this study to calculate the Boyd's diversity index for algae in summer season and a total of 36 species were recorded. To elucidate the community structure in each pond, Boyd's index was calculated. The diversity index of Boyd's indicates the pollution index of different ponds in coal mining city Dhanbad affected by different sources. In ten ponds the indices do not go hand in hand indicating higher diversity with higher pollution level. Algal biodiversity indices can be used in detecting the level of pollution in ponds.

**Index Terms**— Boyd's diversity index, Algae, Coal mining and Lackey's drop method

## I. INTRODUCTION

Dhanbad is famous for coal mining in India, surrounded by major power plants and coal washeries supported power generation and major industrialization in this eastern zone. Due to underground with opencast coal mining the land use changes in original topography and land degradation had taken place in great ways. Cumulative effects of intensive mining and old quarries had resultant air, noise, surface and ground water with land pollution reduced the vegetation and agriculture in this area. The utilization of coal in power plant generation flyash as a waste product resultant air water and land pollution. This can be accessed through environmental impact assessment and environmental management plan. Overall this has resultant in the major changes in socio-economic. But the quality of life has been affected in this area with all other developments (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 45, 66, 78, 87, 100, 102, 105, 106, 107, 122, 123, 124, 129, 131, 132, 140 and 142).

The effect of mining through modeling and simulation were assessed for effective environmental management to achieve sustainable development (47, 49, 69, 70, 71, 72 and 73).

Flora and fauna drastically affected due to many environmental pressure. This leads to changes in the availability of terrestrial and aquatic flora and fauna with avian species. In this connection a study has been undertaken to investigate the availability of different algal biodiversity which is a very good indicator of different type of environment. Algae have different potentiality for the sustainable development of this disturbed area (108, 110, 111, 113, 114, 115, 116, 118, 119, 120, 127, 133, 134 and 141). Water environment is most concern in the mining areas. For

the reclamation of wastewater with land, bio-approach is effective one to restore many things.

Through this approach solve the food and environmental problems in this area (31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 65, 67, 74, 75, 79, 80, 81, 82, 83, 84, 85, 90, 91, 92, 93, 94, 96, 104, 109 and 135).

The bio-treatment of polluted water vis-a-vis socioeconomic development had found effective in this area. Bio-purification also include using algae (62, 63, 64, 68, 76, 77, 86, 88, 89, 95, 97, 98, 99, 101, 103, 112, 117, 121, 125, 126, 128, 130, 136, 137, 138 and 139).

The task of finding, developing and maintaining suitable water supplies has not been limited to modern times. It has had to be faced wherever large numbers of people have crowded together in small spaces; and therefore the popular indifference towards safe, clean water has prevailed.

Planning for the maximum development of our water resources for long time benefit of all our people when properly conceived, can bind together individual and the community, farmer and urbanate as few other conservation activities can do (143). Ponds are valuable water systems and intensively used for production of drinking water, for fisheries and bathing with washing of clothes. The ecological nature of many ponds, however have desecrated, mainly as a consequence of eutrophication (144). Algal diversity in ponds plays an important role in their conservation. More the diversity, more useful is a water body. In the present investigation ten ponds have been selected; of these remains unprotected and free for public use. The algal biodiversity has been studied and diversity indices have been discussed.

## II. MATERIALS AND METHODS

### A. Study Site

Ten ponds were selected as study areas and water samples were taken to study physic-chemical analysis of water quality parameters and identify the different algae located within the following study areas which are as follows (Fig.1.)

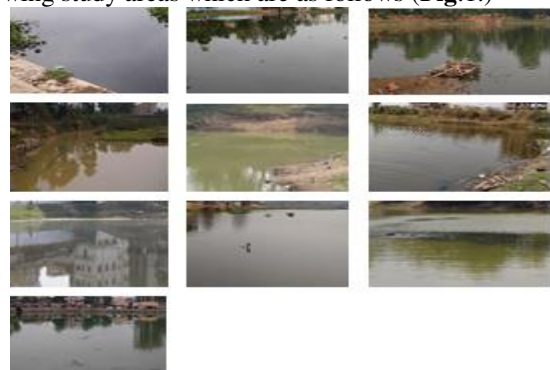


Fig.1: Photographs of ten ponds in coal mining city Dhanbad (a-j)

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- (a) BCCL Koylanagar is located at 23° 48' 2" N and 86° 27' 35" E.
- (b) Saraidhela is located at 23° 48' 51" N and 86° 27' 12" E.
- (c) Rajganj is located at 23° 52' 36" N and 86° 20' 25" E.
- (d) Bhuli is located at 23° 49' 9" N and 86° 22' 32" E.
- (e) Susnilewa is located at 23° 50' 8" N and 86° 26' 9" E.
- (f) Bhuiphore is located at 23° 49' 3" N and 86° 28' 43" E.
- (g) Bank More is located at 23° 47' 16" N and 86° 24' 49" E.
- (h) Wasseypore is located at 23° 47' 25" N and 86° 25' 9" E.
- (i) Jharia is located at 23° 44' 37" N and 86° 24' 55" E.
- (j) Dhaiya is located at 23° 49' 14" N and 86° 25' 59" E.

The selection of different ponds in coal mining city Dhanbad is selected on the basis of its maximum utilization by the nearby community for their daily uses like washing, bathing except drinking purposes (Fig.2). As they get drinking water supply either from Jharia water board from Topchanchi lake or Maithon water supply from Maithon dam. These lakes are live throughout the year. The excess drain water in rainy season comes in these pond of that area.

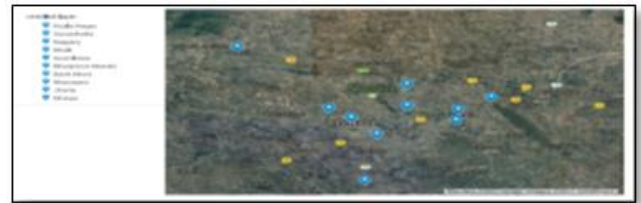


Fig.2: Map showing the sampling location points of ponds within Coal City Dhanbad, Jharkhand, India

### B. Estimation of Algae

Water samples were collected from all ten ponds for algal population's analysis in black colored plastic carboys of one liter. Filamentous algae and other floating debris were avoided. For each sample collected, 25 ml of 4% formaldehyde was added (145) with few drops of Lugol's iodine. Sedimentation was done in glass columns. The sediment was finally reduced to 20 ml and was preserved in a glass vial. From each vial one drop was mounted on a slide and a cover slip was carefully put over it. Five high power fields (15x 45x), one in each corner of the cover slip and are at the center were made and the algal populations were estimated.

These observations were at random and were repeated four times for each sample. This procedure was repeated for each sample and the number of each organism was extra plotted to extract number of organism/L (146). Algae count was done by Lackey's Drop Method (147) as mentioned in APHA (148) and by Saxena, the modified method (149).

Formula used for the calculation of algae as units /l is

$$\text{Algae Unit /L} = \frac{n \times v}{V} \times 100$$

Where as

N= No. Of algae counted in 0.1ml.concentrate.

C= total volume of concentrate in ml.

V= total volume of water filtered through net

### C. Boyd's diversity index

The diversity index of Boyd indicates the order of pollution of a water body. The main parameter in the index is the number of genera of phytoplankton in a water body and is calculated using the mathematical formula.

$$H = \frac{S - 1}{\ln N}$$

S is the number of genera of algae;

N is the total number of algae and ln is the natural logarithm.

## III. RESULT AND DISCUSSION

The resultant values indicate the pollution status of the water body under study. If the values obtained are >4 it indicates less pollution and clean water, values of 3 –2 indicate moderate pollution and values <1 indicate that water is heavily polluted. The distribution of algae in ten ponds is presented in Table 1.



Name of Algae	Number of Algae										Total no. of Algae
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
Actinastrum	2000			2000		2000		2000			8,000
Agmenellum	4000	1000		1000	2000		1000	5000	2000		16,000
Amphora	1000	1000		1000				1000			4,000
Anabaena									3000	2000	5,000
Ankistrodesmus				1000							1,000
Chlamydomonas	6000		5000							5000	16,000
Chlorella		4000					4000			4000	12,000
Chroococcum		5000	4000			4000	5000				18,000
Closterium			1000						1000	2000	4,000
Coelastrum		2000									2,000
Cosmarium	1000				2000						3,000
Cyclotella	1000										1,000
Cymbella	1000		2000				3000	1000	2000	1000	10,000
Desmodesmus		2000	2000				1000				5,000
Diatom	5000	2000	2000			2000	2000	7000	3000	3000	26,000
Dinoflagellates	1000							2000			3,000
Eucapsis								2000			2,000
Euglena		3000	2000			2000	3000		3000	3000	16,000
Gleocapsa	2000		5000		4000	4000	2000	4000			21,000
Gomphonema			1000	2000	1000			1000			5,000
Hantzschia	2000			2000					2000		6,000
Korshikoviella				1000							1,000
Merismopedia				3000	3000						6,000
Navicula	1000	4000				6000	1000				12,000
Oedogonium							3000				3,000
Oscillatoria		1000	2000	3000	6000	1000	4000		7000	6000	30,000
Pediastrum		2000	2000			2000	1000		1000		8,000
Phacus				4000			2000		2000		8,000
Phormidium					4000						4,000
Scenedesmus		2000	11000			9000	8000		4000		34,000
Spirogyra		1000	2000	6000	7000	2000	3000		4000	6000	31,000
Spirulina		1000								9000	10,000
Staurastrum		4000			1000			2000	1000	1000	9,000
Tetradron			1000	1000	2000	1000		1000			6,000
Ulothrix								4000			4,000
Volvox		2000	5000			1000	5000		3000	3000	19,000
Total number of Species	12	16	15	12	10	12	16	12	14	12	36
Total number of Phytoplankton/l	27,000	37,000	47,000	27,000	32,000	36,000	48,000	32,000	38,000	45,000	3,69,000

Table.1: Total algal population in ten different ponds of coal mining city Dhanbad

The calculated value of Boyd's diversity index is shown in Table 2.

S.N	Name of Site	No. Of species (S)	Total number of algae (N)	In N	Diversity index $H' = \frac{S-1}{\sum n_i N}$	Order of Pollution
1.	BCCL Koylanagar	12	27,000	10.203	0.767	Heavily polluted
2.	Saraidhela	16	37,000	10.518	0.595	Heavily polluted
3.	Rajganj	15	47,000	10.757	0.650	Heavily polluted
4.	Bhuli	12	27,000	10.203	0.767	Heavily polluted
5.	Susnilewa	10	32,000	10.373	0.937	Heavily polluted
6.	Bhuiphore	12	36,000	10.491	0.791	Heavily polluted
7.	Bank More	16	48,000	10.778	0.611	Heavily polluted
8.	Wasseypore	12	32,000	10.373	0.781	Heavily polluted
9.	Jharia	14	38,000	10.545	0.682	Heavily polluted
10	Dhaiya	12	45,000	10.714	0.809	Heavily polluted

4=Clean water, 3-2=moderately polluted, <1 = heavily polluted

Table.2: Boyd's diversity index for order of pollution

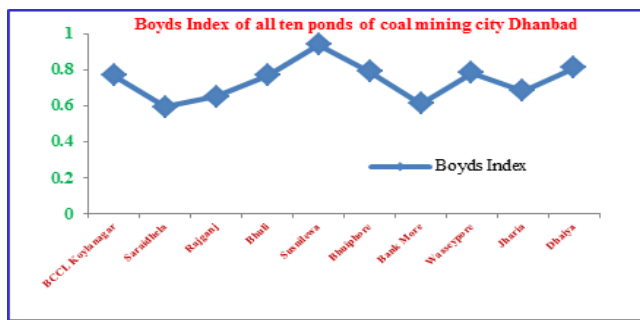


Fig.3: Boyd's index plotted for ten ponds in coal mining city Dhanbad

As per the diversity index of Boyd, Susnilewa ponds nearby Dhanbad airstrip (0.937) is moderately polluted as the index reaching 1 and followed by Dahiya, Bhuiyphore, Wasseypur, Bhuli, BCCL Koyalnagar, Jharia, Rajganj, Bankmore and saraidhela in ascending order for heavily polluted (Table. 2).

On an average the ponds according to Boyd index is heavily polluted from major disturbances due to different points sources (151). The diversity index (<1.00) indicates that most of the ponds are heavily polluted (Fig.3). The major reason behind the pollutions is that the sampling is done in the summer season which causes the concentration.

#### IV. CONCLUSION

The Boyd's index (1981) indicates that all ten ponds are heavily polluted with distribution of algae which have very close relation to the pollution.

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