Algal Distribution Pattern and Quality of Water in the Different Aquatic Environment of District Dhanbad, Jharkhand

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Abstract:` ***The present paper gives the idea about the Algal biodiversity in Dhanbad district which was investigated in clean and polluted environment in and around the coalmine areas and samples were collected in different zones of coal mining with different degrees of pollution. Different species of algae were found in different zones. The species richness varied in non-polluted zones & polluted zones. This work will help in determination of range of variation among algal community & water quality in this area. The total abundance of green algae was compared from non-polluted zones with polluted zones.***

Keywords: Coalmines, Algae, Biodiversity, Water quality, Polluted Zone

1. Introduction

Algae are major producer of organic compound .it has an important impact in aquatic food chain. Since algae indicate the level of population, in water bodies as bio-indicator, and it helps in quality and conservation of water. Dhanbad is a prominent city in Jharkhand .famous for coal mining and its allied industries within the areas.

Due to expanding population & their need water sources in Dhanbad districts are facing many adversities & challenges. Algae are unicellular or multicellular organisms that Photosynthesize, but lack the parts such as leaves, roots, seeds and flowers of the higher' vascular plants (mosses, flowering plants, liverwort etc.,) has a complete 'organism with all the functions of a plant. Algae have a wide ranging of classification, falling within several groups from plants through to protists (single celled organisms) and even bacteria (blue-green algae). They can commonly be found in aquatic—both freshwater and marine—environments, but can be found in damp terrestrial environments or even dry environments where they can live in symbiosis with fungus as lichen. Many algae species move themselves through the water column, while others float, attach themselves to objects in water or are terrestrial.

Algae form an important part of many ecosystems and have a vast variety of body shapes, biochemistries and life cycles. Algae is good indicator of pollution because they have wide temporal and spittle distribution, respond quickly to the change in environment due to pollution. Some algae shows the types of pollution (GrLaliberte, et.al., 1994), such as many blue green algae occur in nutrient less water, while some grows organically polluted water (Lokhorst, 1996). Algae grow well in water containing a high concentration of organic wastes. *Green algae, Chlamydomonas, Euglena, Diatoms, Navicula, Synedra blue green algae, oscillatoria* and *phormidium* are emphasized to tolerate organic pollution.

Algae are having symbiotic relation with bacteria in aquatic ecosystem. Algae support aerobic bacterial oxidation of organic matter producing oxygen through photosynthesis while release carbon-dioxide and nutrients in aerobic oxidation used for growth of algal biomass (Lukesova and Komarek, 1987). Algae and Bio-purification of waste water is major importance to the environment, because this will develop an efficient, low cost, and environment friendly process. Algae have a solution to emerging environment problems, they removes excess wastes efficiently at minimal cost.

2. Types of Algae

- Diatoms - are delicate, single-celled organisms with cell walls made of silica making them almost look like little glass houses. They are free floating or attached to objects or other algae in the waterway. They can be found in almost all water types. They can be pennate (pen-shaped) or centric (like a cylinder). Pennate are the most common. Eg.fragillaria
- Green Algae (Chlorophytes) - This is the most common type of algae and is the culprit for common pond scum. While commonly green, not all green algae is green. . Eg.spirogyrra
- Dinoflagellates (Dinophyta)- These algae get their name from the flagella (hair- like projection used for locomotion) they possess. The cell wall of many dinoflagellates is divided into plates of cellulose like a suit of armour. Dinoflagellates are the organisms responsible for the toxic 'red tides' e.g.peridinium

Blue-Green Algae (Cyanobacteria): It is actually a bacteria that has the ability to photosynthesize. It is one of the most commonly known types of algae, probably due to the toxic conditions some species can create when they bloom. An algal bloom occurs when algae flourish to such an extent that they dominate the water column, often discolouring the water or creating a scum on the surface e.g. Nodularia.

3. Material and Method

The selected study areas was chosen within the District Dhanbad, Jharkhand, India is located at 23°45 N 86°12 E and 23.9 ° N 86.2° E with an average elevation of 139 M. Five ponds, drinking wells, hand-pump and opencast coal mines each were selected and water samples were taken for the study and to identify the different type of algal species and chemical analysis of water located within the following eight blocks which are as follows (**Fig.1**).

1) Tundi is located at 23°59 N and 86° 27 E.
2) Govindpur is located at 23.836 N and 86.518 E
3) Baliapur is located at 23.720 N and 86.527 E.
4) Jharia is a mining area located at 23°45'06" and N 86°25'13" E with an average elevation of 227 M
5) Dhanbad is located at 23°45 N 86°12 E and 23.9 ° N 86.2° E.
6) Nirsa is located at 23°48 N 86°27E / 23.8°N 86.45°E
7) Topchaci is located at 23.86°N 86.29°E
8) Baghmara is located at 23°47N 86°43E / 23.78°N 86.72°E.
9) Samples were collected in the period of June 2014 to July 2014.

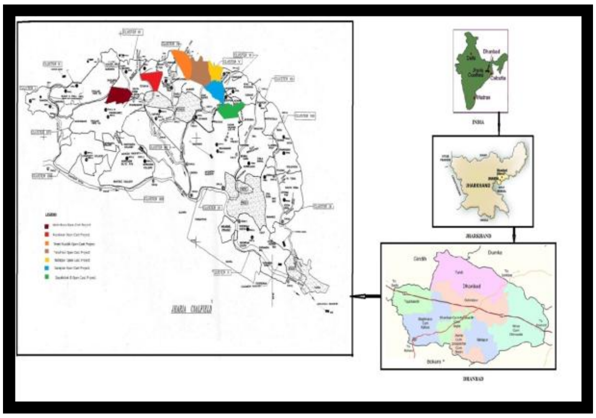

Figure 1: Map of Sampling Sites

Algal samples are carefully observed noting down the shape and arrangement of the cells .the experimental procedure is conducted until a specimen is identified. After the identification is done , a diagram of organism is drawn on sheet .magnifications of microscope are used to identify the species and type of algae within the samples. The study of algal samples were identified with the help of standard books & monographs (Fritsch, 1935; Prescott, 1982; and Deshikachary, 1985).

All the sampling and chemical analysis is done for parameters studied for water samples were done by standard methods.

4. Results and Discussion

4.1 Algal Distribution Pattern

More than 218 different combination of algal communities belonging to over 8 species were collected & identified from different type of water resources from the eight blocks of district Dhanbad and given in **Table.1**.

Table 1: Algal Species Distribution

SITE	Algal species identified	Total
NIRSA	SP=9;DI=10; VX=2 ; CY=3;CL=1;OS=9	34
BAGHMARA	SP=10 ; DI= 10 ; OS=6 ; EU=2 ; CY=3;	31
TUNDI	SP=10; DI=10 ; EU=2 ; OS=6; CY=2	30
DHANBAD	SP=10; DI=10; OS=7; EU=1; VX=1	29
TOPCHACHI	SP=10; DI=10; OS=6; EU=2	28
BALIAPUR	SP=10; DI=10; OS=6; VX=2	28
GOVINDPUR	SP=10;DI=10;OS=8; CL=1	29
JHARIA	SP=7; DI=7; OS=3; CL=2	19
	TOTAL	218
SP- SPIROGYRA , DI- DIATOM, VX- VOLVOX , OS-OSCILLATORIA, CY- CYNOBACTERIUM , CL-CLAUSTERIUM, EU – EUGLENA		

The variation in algal population can be observed and the factors affecting the type and growth of algae depend upon the presence of nitrate, sulphite, iron, total hardness and pH of the water. The various algal populations observed in the district Dhanbad shows that the species like spirogyra were observed in majority in all the areas studied and spirogyra and diatoms were among the dominant species. Thus, the dominance of filamentous green algae is in the district (Ashutosh and Nikhil,2014; Nikhil, 2014; Pawan and Nikhil, 2014 and Deepanjali and Nikhil,2014).

4.2 Water Quality

Water samples collected showed the presence of nitrate, iron, sulphate & total hardness which were too high as compared with prescribed Indian Standards Specification for drinking water IS10500. The sample in which algal growth was healthier has fewer nitrates compared to the unhealthy growth ones.

(a) pH

Table 2: pH in the water samples

Block	Pond Water	Well Water	Hand Pump	Mine Water
Baghmara	7.63	--	7.33	--
Nirsa	8.01	7.50	7.01	7.75
Topchaci	7.50	--	7.70	--
Govindpur	7.28	--	5.00	--
Tundi	7.20	7.50	7.01	--
Dhanbad	7.38	--	7.75	--
Baliapur	7.92	--	7.75	--
Jharia	7.01	--	--	7.13

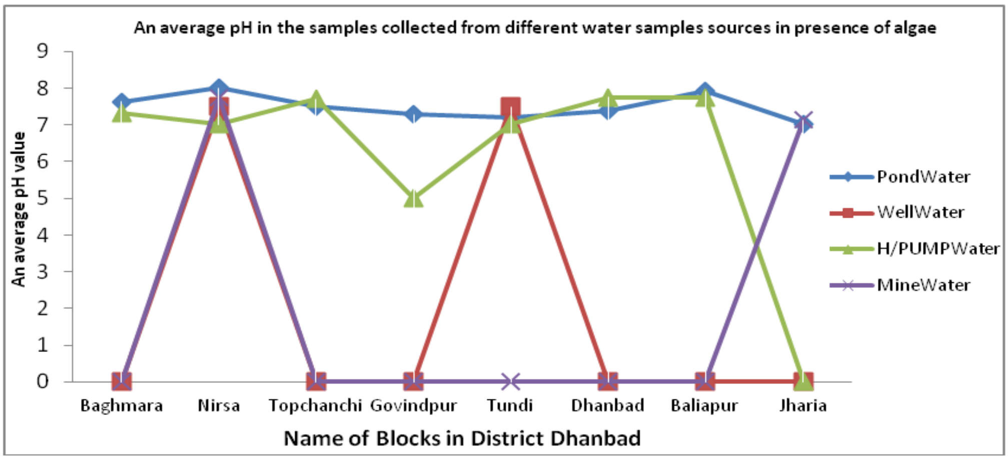

Figure 2: pH in the water samples

The pH in most of the water samples shows neutral and in one and two shown 5.01 and 8.01 which is well within permissible limit (**Table.1**). Commonly algae neutralize the pH of water from acidic to neutral (**Figure.2**) (Kshirsagar, 2013). Most probably water in dhanbad district have slightly acidic pH in nature (Nikhil, 2005a,b; Ghanshyam and Nikhil,2014; Gaurav, e.al., 2014; Iqbal and Nikhil, 2014; Pawan and Nikhil, 2014 and Ashutosh and Nikhil, 2014).

(b) Nitrate

The overall nitrate concentration on an average found in the entire sample collected varied from 2.53 to 16.25ppm (**Table.2 and Figure.3**) which is lower than desirable limit of 45ppm prescribed by Indian Standards and CPCB, New Delhi. Though the presence of nitrate is due to the use of Urea and DAP (Diammonium poshphate) as a commonly used fertilizer in district Dhanbad in paddy, wheat, vegetables crop during winter and rainy season. This finally leached down come from ground water and runoff during rainy season and collected in the ponds. Presence of algae has lowered down the available nitrate in the surface, ground as well as mine water (Gaurav, et. al., 2014 and Shekhawat, et. al., 2012).

Table 3: Nitrate (ppm) in the water samples

Block	Pond Water	Well Water	Hand Pump	Mine Water
Baghmara	14.18	--	9.29	--
Nirsa	2.53	7.56	5.83	5.63
Topchaci	5.42	--	7.01	--
Govindpur	7.22	--	5.01	--
Tundi	14.14	5.17	16.25	--
Dhanbad	8.44	--	5.10	--
Baliapur	6.10	--	6.25	--
Jharia	5.15	--	--	5.63

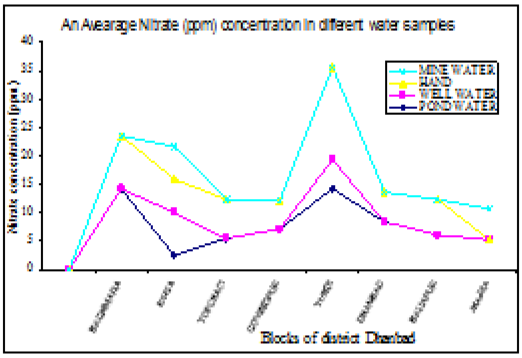

Figure 3: Nitrate (ppm) in the water samples

(c) Total Hardness

The total hardness found in all the water samples collected ranging from 250 to 700ppm. The desirable limit for the total hardness is 300ppm whereas permissible limit is 600ppm only by CPCB, New Delhi. In the present study more than 600ppm the total hardness was only found in the pond and handpump water of Baghmara along with pond, handpump and minewater of Nirsa Block (**Table.3**). Though, Jharia is having coal mining but the total hardness of the water is only ranging from 350 to 450 which is more than desirable limit but less than permissible limit. All the water sample studied were having total hardness approaching toward desirable limit and below than permissible limit ranging from 250 to 450 (**Figure.4**). Moreover, all the samples were growing algae by which these samples were having less hardness which is admitted by many researchers (Rao, et.al., 2011). However, in district Dhanbad in all type of water the total hardness in general found to be high.

Table 4: T/Hardness (ppm) in the water samples

Block	Pond Water	Well Water	Hand Pump	Mine Water
Baghmara	625.56	--	495.83	--
Nirsa	660.25	706.45	560.75	695.66
Topchaci	386.57	--	376.37	--
Govindpur	308.35	--	408.50	--
Tundi	380.75	355.77	301.64	--
Dhanbad	366.92	--	272.25	--
Baliapur	258.35	--	318.75	--
Jharia	402.41	--	--	381.25

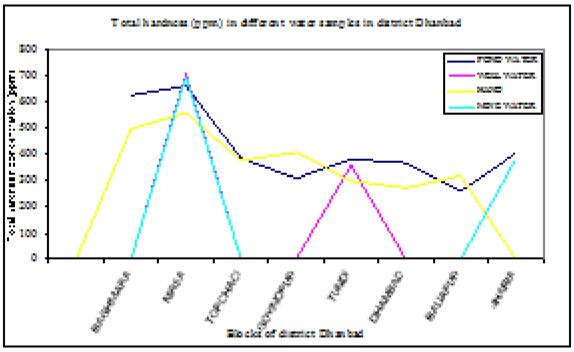

Figure 4: T/Hardness(ppm) in the water samples

(d) Sulphate

Azarpriya, et.al., 2014 reported that sgnificant reduction of SO4-2 in wastewater at final stage, which was by 95.8 and 92 % in presence of *Oscillotaria* and *Nostoc* respectively at 50 % concentration of wastewater. These results are in agreement with studies of Chandra *et al.*, (2004) who reported more than 99 % reduction in SO4-2 of tannery effluent with *Nostoc*. Same trend was recorded by Ahmad *et al.*, (2013) who also reported considerable reduction in SO4-2 using *Chlorella* and mixed algal culture. Elumalai *et al.*, (2013) reported removal of very high amount of SO4-2 using consortium of algae as compare to single culture of *Chlorella* and S*cynedesmus.* Kumar and Chopra, (2012) recorded very high reduction in SO4-2 in municipal wastewater by using microbiological technology.

Table 5: Sulphate (ppm) in the water samples

Block	Pond Water	Well Water	Hand Pump	Mine Water
Baghmara	18.33	--	12.86	--
Nirsa	7.55	5.15	6.25	6.65
Topchaci	10.83	--	7.56	--
Govindpur	10.65	--	5.67	--
Tundi	7.63	5.37	7.53	--
Dhanbad	8.75	--	5.56	--
Baliapur	11.65	--	7.35	--
Jharia	4.98	--	--	6.56

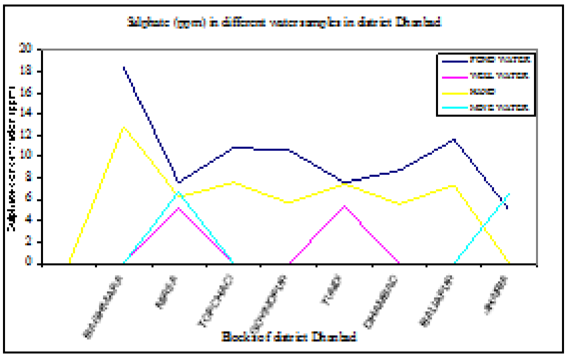

Figure 5: Sulphate (ppm) in the water samples

In present study the SO4-2 removal capacity of all the eight algal species in different combination and concentration was at par indicating equal efficiency for eliminating of SO4-2 from all the four category of water collected from the eight blocks within Dhanbad district. In **Table.4** the maximum range of sulphate in all the water samples varies from 5 to 25ppm only whereas the desirable and permissible limit for Indian condition is 200 and 400ppm respectively. This is positively supported by the presence of algae in this water samples advocate the findings (**Figure.5**).

(e) Iron

The overall concentration of iron varies not less than from 1.33 to 2.97ppm. Baghmara is having high iron content in pondwater 2.97ppm and 2.28ppm in handpump water. However, iron is more than 2.00ppm in all samples except in nirsa well, handpump and mine water followed by Topchaci in all two types of water samples. Whereas, Tundi & Baliapur handpumpwater is also less than 2.00ppm which have permissible limit of 0.3ppm and sometimes it may be extended 1.00ppm (**Table.6**).

Table 6: Iron (ppm) in the water samples

Block	Pond Water	Well Water	Hand Pump	Mine Water
Baghmara	2.97	--	2.28	--
Nirsa	2.22	1.58	1.65	1.33
Topchaci	1.75	--	1.88	--
Govindpur	2.38	--	2.65	--
Tundi	2.28	2.11	1.88	--
Dhanbad	2.25	--	2.11	--
Baliapur	2.55	--	1.53	--
Jharia	2.17	--	--	2.36

This shows that Dhanbad water is having very high content of iron and which had been decreased due to the presence of algae significantly decreased the iron concentration in all the water samples in mining and non-mining areas (**Fig.6**). This finding is in with the agreement of Sonal and Reeta, 2013. It was found that Chlorella species (Asku, 1992; Bajguj, 2011 and Harris and Ramelow, 1990), Cladophora species (Vymazal,1984), Oedogonium species (Chatterjee, et.al., 2011) and Spirogyra species (Barhmbhatt,et.al.,2012 and Gupta, et.al.,2001) were all effective in lowering down the iron content in water and used for phyto-remediation of wastewater commonly used.

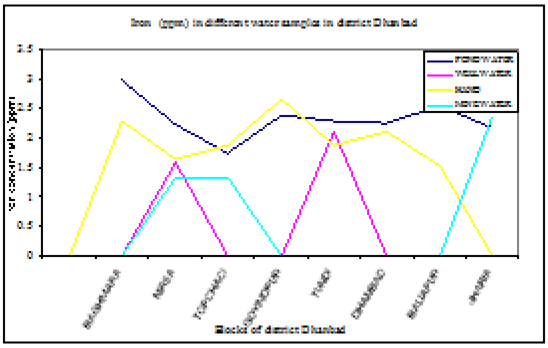

Figure 6: Iron (ppm) in the water samples

5. Conclusion

This study was done in a short period of time for alagal species distribution and water quality assessment from different sources within district Dhanbad in pre-monsoon season. This will help as guidelines and data base in many research program. This type of study is proposed to be done in all the three seasons of the year and to be continued for three to four years and by taking more samples of each category/source will give a clear picture of algal biodiversity in this type of coalmining areas where pollution is actively present in air, water and land. Finally, this data base will help in evaluating in general the water quality and phyto-remediation potentialities of these algae in coal mining areas where pollution is a major concern. Consider all these abilities of algae to purify the polluted water of is worth to emphasise that algal technology in waste water treatment system are expected even more common in future years.

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