Algal Biodiversity and Quality of Ponds Water within the Coal City Dhanbad

Suman Dhar¹, Kumar Nikhil²

¹M.Tech, Final Year, Student, Department of Environmental Science & Engineering, IIT-ISM, Dhanbad, Jharkhand India, +918509578033

²Principal Scientist, Natural Resource & Environment Management (NREM) Group, CSIR-CIMFR, Dhanbad, Jharkhand, India, +919931135322

Abstract: Coal city Dhanbad is famous for coal mining, source for many washeries, power plant, steel industries, fertilizer industries, brick clines, small industries and chimney bhatta’s. The great source of energy coal comes through underground and opencast mining resultant air, water, land pollution affecting vegetation and agriculture of that area. The water pollution and its severity are measured through algae as bio-indicator. The quality of ponds water within Dhanbad city were sampled and tested for few parameters. The availability of algal species and its diversity correlated with water quality of ten ponds studied has shown different results. The sampling and experiment undertaken in June, 2017 studied for algal species frequency, dominance, richness, evenness, diversity correlated with quality of ponds water in ten ponds located in coal city of Dhanbad.

Keywords: Algae, species, frequency, richness, diversity. Water quality.

1. 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, land pollution affecting vegetation and agriculture of that area. This can be accessed through environment 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, 142 and 146).

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 has 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. Other means of pollution abatement in industrial areas may be through roof top garden which are more affective (147 and 148).

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 (145). 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.
2. Material & Methods

2.1 Site Details

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.1). 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.

Ten ponds were selected as study areas and water samples were taken to study physio-chemical analysis of water quality parameters and identify the different algae’s located within the following study areas which are as follows (Fig.2.)

(a) BCCL Koylanagar is located at 23’ 48’ 2” N and 86’ 27’ 35” E.

(b) Saraithela 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.

2.2 Chemical parameter for water testing

Water and algal samples were collected from different areas pond within coal city Dhanbad in morning of June, 2017 by holding a container collector under water and filling completely. This was transferred into a large, clean container (ex. bucket/pail) that has been pre-rinsed with water in the pond. Continue collecting water around the pond and dump into same big bucket. 2. Thoroughly mix all the collected water in the bucket. 100 ml bottle was filled up to the neck with the same water sample, then cap tightly. This sample was collected for Water Quality Test. Same procedure was repeated for sampling for Algal Identification also.

1. Water Temperature (°C)

By Mercury thermometer (149) water temperature were recorded at sampling stations. Water temperature was measured at a depth of about 12 cm, with the help of hand held mercury thermometer (°C)

2. Hydrogen ion concentration (pH)

Electronic Method (IS:3025) (Standard Methods of APHA 1995). pH was determined with the help of universal pH paper and later was confirmed in the lab using hand held digital pH meter. This pH system was previously calibrated with pH 4.0, 7.0, 9.2 buffers at laboratory temperature.

3. Conductivity (μS cm⁻¹)

Electronic method Conductivity of surface water was measured in the field using digital conductivity meter.

4. Turbidity

Turbidity is expressed in Nephelometric Turbidity Units (NTU) and was measured in the laboratory using Digital-Nephelo-Turbidity meter. 5 ml of hydrazinesulphate and 5 ml of hexamethylenetetramine was taken in 100ml standard flask. The mixture was left a day, and after 24 hours it was made up to 100ml. 10ml of this solution was taken and diluted to 100ml. Nephelometer was adjusted at 40 NTU using this standard. Water samples were shaken before taking the readings in nephelometer. (150).

5. Total Hardness (mg/l)

Standard methods (APHA-1995) for hardness is generally caused by the calcium and magnesium ions present in water. 50ml of sample was taken in a conical flask and 1ml of buffer solution, 100-200mg of Eriochrome Black T indicator were added, the solution turns wine red. The contents were titrated against EDTA solution until the wine red colour changes to blue.

6. Nitrate (mg/l)

Brucine method (APHA-1995) for Nitrate content of the water sample was determined by Brucine method. 10ml of the surface water sample was taken in test tube, to which 2ml of sodium chloride and 0.5ml of brucinesulphalnic acid solution was added. A blank was also prepared in similar manner using 10ml distilled water. The test tubes were heated on water bath for 20 minutes. The optical density of the sample was measured at 410nm using spectrophotometer.

7. Sulphate (mg/l)

Turbidimetric method (APHA-1995) Sulphate content of the surface water sample was determined by Turbidimetric method. 100ml of the water sample was taken in a conical flask to which 5ml of conditioning reagent and 10mg of barium chloride crystals were added. A blank was also prepared in a similar manner using 100ml distilled water. The optical densities of these samples were measured at 420nm using spectrophotometer.

8. Phosphate (mg/l)

Stannous chloride method (APHA-1995) for Inorganic Phosphate content of the surface water sample was determined.
using stannous chloride method. 50 ml of the water sample was taken in a conical flask, 2 ml of ammonium molybdate and 5 drops of stannous chloride were added. A blank was also prepared in a similar manner using 50 ml distilled water. The optical density of these samples was measured at 690 nm using spectrophotometer.

2.3 Estimation of Algae

Water samples for the estimation of phytoplankton were collected simultaneously along with the samples for physico-chemical analysis. 1000 ml composite sample was sedimented after adding 15 ml 4% formaldehyde and 10 ml of Lugol's iodine. Sedimentation was done in glass columns for identification. This sediment was finally reduced to 20 ml and was preserved in a vial. From each vial onedrop was mounted on a slide and a cover slip was carefully placed. Five high powerfield (15x X 45x) observations, one in each corner of the cover slip and one at the center were made and the algal populations were estimated. These observations were repeated four to five times for each sample. Identification to species level was done using camera lucida photographs and by consulting taxonomic guides and monographs. Enumeration was done by Lackey's drop method (151; 152) and modified (153). Phytoplanktons were expressed as organisms/litre (Org/L).

Formula used for the calculation of organism as org/L is

\[ \text{org/L} = \frac{n \times v}{V} \times 1000 \]

n = No of phytoplankton counted in 0.1 ml concentrate.

v = Total volume of concentrate in ml.

V = Total volume of water filtered through net.

2.4 Statistical Analysis

In order to account all the environmental fluctuations of the study area, ponds wise analysis and comparison of different parameters of water like, Temperature, pH, EC, Turbidity, Total hardness, Nitrate, Phosphate and Sulphate. The data reveals the difference in them on different parts of the pond system. The data were statistically calculated for mean, mode, median, standard deviation, Standard error. These species diversity indices, viz., Shannon-Weiner diversity index (H'), Species richness (S), Margalef's richness (d) and Pielou's evenness index (J') were computed for algae (Plymouth Routines in Multivariate Ecological Research, (154).

1. Shannon-Weiner (163), diversity index was used to emphasize species richness.

\[ H' = -\sum \pi \log \pi \] (where \( \pi \) is the proportion of the total count arising from the ith species. The natural logarithm is used for biological interpretation.

2. Margalef's index was used to measure the number of species present for a given number of individuals.

\[ d = (S - 1) / \log N \] where \( S \) is the total number of species and \( N \) is the total number of individuals.

3. Evenness of the community was calculated using Pielou's evenness index (162).

\[ J' = \frac{H'}{H'_{max}} = \frac{H'}{\log S} \] where \( H'_{max} \) is the maximum possible value of Shannon diversity and \( S \) is the total number of species.

4.Species richness was defined as the number of species (S) caught at asampling station on each sampling date.

1. Shannon's species diversity index (H)

Shannon and Weaver (1949) index was estimated by (163):

\[ H' = -\sum \log \pi \cdot \log 2\pi \]

Where

\( S = \) total individual number of species

\( N = \) Total individual number of all species

\( \pi = S/N \)

2. Margalef's community diversity index (d')

by Margalef 1957 (155)


\[ d' = \frac{[S - 1]}{\log N} \]

Where \( d' = \) Margalef's index

\( S = \) The number of species of the particular sample

\( N = \) Logarithm of total number of individuals of all the species of the sample.

3. Species Richness index

Species richness indexes (SRI) were calculated using the following formula given below (161):

\[ \text{SRI} = \frac{[S - 2]}{\log N} \]

Where,

\( S - \) Number of species of the particular sample

\( N - \) Logarithm of total number (H) of the individuals of all the species of the sample

4. Species Evenness

Species evenness was calculated using the following formula (163):

\[ j = \frac{H'}{\log 2S} \]

Where

\( H' = \) Shannon and Weaver Index (1949)

\( S = \) Species number

2.5 Correlation Profile

In order to understand most representation values, variation spectrum, extent of difference and relationship of some of the environmental factors, standard statistical methods were applied which are listed below:

1. Average:

This was calculated with a view to find out a typical representation of all the observations, with the help of following formula:

\[ X = \frac{\sum X_i}{N} \]

2. Mean deviation:

It is an arithmetical mean of the deviation of all the observations from the mean:

\[ \text{Mean Deviation} = \frac{\sum |x - \mu|}{N} \]

3. Standard deviation (\( \sigma \))

It is the degree of spread of distribution which was acquired by taking the square root of variance which is as follows:

\[ \sigma = \sqrt{\frac{\sum (X - \mu)^2}{N}} \]
The measure of reliability of data, standard error of mean was obtained by following formula
\[ SE = \frac{\sigma}{\sqrt{n}} \]
SE = Standard Error of the Mean
\( \sigma \) = Standard Deviation of the Mean
n = Number of Observations of the Sample

3. Results & Findings

1. Algal species

The distribution of algae in ten ponds is presented in Table 1. The overall 36 algae species were found in all ten ponds of coal mining city Dhanbad.

<table>
<thead>
<tr>
<th>Name of Algae</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>S6</th>
<th>S7</th>
<th>S8</th>
<th>S9</th>
<th>S10</th>
<th>Total no. of Algae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aegmenellum</td>
<td>4000</td>
<td>4000</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
<td>1000</td>
<td>5000</td>
<td>2000</td>
<td>16,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amphora</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>4,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anabaena</td>
<td>3000</td>
<td>2000</td>
<td>5000</td>
<td>1000</td>
<td>2000</td>
<td>5,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anckistrodesmus</td>
<td>1000</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlamydomona</td>
<td>6000</td>
<td>5000</td>
<td>5000</td>
<td>16,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorella</td>
<td>4000</td>
<td>4000</td>
<td>4,000</td>
<td>12,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chroococcus</td>
<td>5000</td>
<td>4000</td>
<td>5,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closterium</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
<td>4,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coelastrum</td>
<td>2000</td>
<td>2,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cosmarium</td>
<td>1000</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyclotella</td>
<td>1000</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cymbella</td>
<td>1000</td>
<td>2000</td>
<td>3,000</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desmodesmus</td>
<td>2000</td>
<td>2000</td>
<td>1000</td>
<td>5,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diatom</td>
<td>5000</td>
<td>2000</td>
<td>7000</td>
<td>26,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dinoflagellates</td>
<td>1000</td>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucapsis</td>
<td>2000</td>
<td>2,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euglena</td>
<td>3000</td>
<td>2000</td>
<td>3,000</td>
<td>16,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glocopaca</td>
<td>2000</td>
<td>5000</td>
<td>4,000</td>
<td>21,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gomphonema</td>
<td>1000</td>
<td>2000</td>
<td>1000</td>
<td>5,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hantzschia</td>
<td>2000</td>
<td>2000</td>
<td>2000</td>
<td>6,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Korshikovella</td>
<td>1000</td>
<td>1,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merismopedia</td>
<td>3000</td>
<td>3,000</td>
<td>6,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Navicula</td>
<td>1000</td>
<td>6000</td>
<td>1000</td>
<td>12,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oedogonium</td>
<td>3000</td>
<td>3,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oscillatoria</td>
<td>1000</td>
<td>2000</td>
<td>7000</td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediastrum</td>
<td>2000</td>
<td>2000</td>
<td>1000</td>
<td>8,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phacus</td>
<td>4000</td>
<td>2000</td>
<td>8,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phormidium</td>
<td>4000</td>
<td>4,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenedesmus</td>
<td>2000</td>
<td>11000</td>
<td>8000</td>
<td>34,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirogyra</td>
<td>1000</td>
<td>2000</td>
<td>7000</td>
<td>31,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirulina</td>
<td>1000</td>
<td>9000</td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staurastrum</td>
<td>4000</td>
<td>1000</td>
<td>9,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetradron</td>
<td>1000</td>
<td>2000</td>
<td>1000</td>
<td>6,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulothrix</td>
<td>4000</td>
<td>4,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volvox</td>
<td>2000</td>
<td>5000</td>
<td>19,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

Table.1 reported that there are 36 different algal species found all over the ten ponds sampled and studied within the coal city Dhanbad.

2. Water Quality of Ponds

<table>
<thead>
<tr>
<th>Temperature</th>
<th>pH</th>
<th>EC</th>
<th>Turbidity</th>
<th>Total Hardness</th>
<th>Nitrate</th>
<th>Phosphate</th>
<th>Sulphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(SE)</td>
<td>0.486</td>
<td>0.137</td>
<td>0.111</td>
<td>6.388</td>
<td>26.31</td>
<td>1.774</td>
<td>0.079</td>
</tr>
<tr>
<td>(SD)</td>
<td>1.458</td>
<td>0.413</td>
<td>0.334</td>
<td>19.16</td>
<td>78.95</td>
<td>5.324</td>
<td>0.239</td>
</tr>
</tbody>
</table>

Table 2: Standard Deviation and Error of water quality parameters of ten ponds

Fig.3: Standard Deviation and Error of water quality parameters of ten ponds

The water quality shown in the Table 2 and Fig.3 for the ten ponds of coal city Dhanbad is poor in quality compared with the standards (156, 157, 158, 159 and 160).
3. Algal Diversity Studies

<table>
<thead>
<tr>
<th>Sampling Site</th>
<th>Species Richness</th>
<th>Shannon’s Diversity Index</th>
<th>Evenness Index</th>
<th>Margalef’s index</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCCL Koyalanagar</td>
<td>3.3375</td>
<td>2.28</td>
<td>0.92</td>
<td>1.0781</td>
</tr>
<tr>
<td>Saraidhela</td>
<td>4.1236</td>
<td>2.67</td>
<td>0.96</td>
<td>1.4224</td>
</tr>
<tr>
<td>Rajganj</td>
<td>3.6362</td>
<td>2.43</td>
<td>0.90</td>
<td>1.3014</td>
</tr>
<tr>
<td>Bhuli</td>
<td>3.3375</td>
<td>2.31</td>
<td>0.93</td>
<td>1.0781</td>
</tr>
<tr>
<td>Susnilewa</td>
<td>2.5969</td>
<td>2.09</td>
<td>0.91</td>
<td>0.8676</td>
</tr>
<tr>
<td>Bhuphore</td>
<td>3.0696</td>
<td>2.31</td>
<td>0.93</td>
<td>1.0485</td>
</tr>
<tr>
<td>Bank More</td>
<td>3.8960</td>
<td>2.59</td>
<td>0.93</td>
<td>1.3943</td>
</tr>
<tr>
<td>Wasseypore</td>
<td>3.1739</td>
<td>2.28</td>
<td>0.92</td>
<td>1.0604</td>
</tr>
<tr>
<td>Jharia</td>
<td>3.5738</td>
<td>2.09</td>
<td>0.81</td>
<td>1.2328</td>
</tr>
<tr>
<td>Dhaiya</td>
<td>2.8897</td>
<td>2.31</td>
<td>0.93</td>
<td>1.0267</td>
</tr>
</tbody>
</table>

Table 3: Shows the different algal indices within the ten ponds of coal city Dhanbad

Margalef’s diversity Index for the algal community within the ten ponds were 1.0781, 1.4224, 1.3014, 1.0781, 0.8676, 1.0485, 1.3943, 1.0604, 1.2328 and 1.0267 respectively.

Species richness or richness index of sampling of ponds in coal mining city Dhanbad were given in Fig-4. The species richness of 3.33, 4.12, 3.63, 3.33, 2.59, 3.06, 3.89, 3.17, 3.57 and 2.88 were observed in ponds from BCCL koyalanagar, Saraidhela, Rajganj, Bhuli, Susnilewa, Bhuphore, Bankmore, Wasseypore, Jharia and Dhaiya respectively (Table 3). The lowest and heighest values resulted were 2.88 and 4.12 at stations Dhaiyaand Saraidhela during June, 2017.

Species Evenness of all the ten sampling ponds in June 2017 are provided in (Fig.4). The species evenness ranged from a minimum of 0.81 for Jharia and maximum of 0.96 for Saraidhela pond. Rest of other ponds have 0.92, 0.90, 0.93, 0.91, 0.93, 0.93, 0.92 and 0.93 species evenness indices for BCCL koyalanagar, Rajganj, Bhuli, Susnilewa, Bhuphore, Bankmore, Wasseypore and Dhaiya respectively (Table 3).

Shannon and Weiner index (163) represents entropy. It is a diversity index taking into account the number of individuals as well as the number of taxa. It varies from 0 for communities with only single taxa to high values for community with many taxa each with few individuals. This index can also determine the pollution status of a water body. Normal values range from 0 to 4. This index is a combination of species present and the evenness of the species. Examining the diversity in the range of polluted and unpolluted ecosystems, the values of the index greater than 3 indicate cleanwater; values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 are characterized as heavily polluted (166). Moderate pollution can be inferred in this study for the all the ten ponds studied. The Shannon’s Diversity Index for all the ten ponds studied were found to be from 2.09 to 2.67 which is less than 3 means all ponds are moderately to heavily polluted (143, 144 and 145).

In environmental monitoring it is assumed that the adverse effects of pollution will be reflected in the reduction of diversity or change in the composition of species abundance (143, 144 and 145). Both these factors involve diversity as an index of a good ecosystem (167). The enriched or polluted ecosystems display a reduction in diversity (168 and 169). Shannon and Wiener index is widely adopted in pollution monitoring (170, 171) discussed the role of algal species and assemblage as bio-indicators. Simple species richness and dominance measures are invariably informative. There is considerable evidence that conservation strategies may be improved if information on species abundance patterns is taken into account.

4. Conclusion

The study shows that the algae abundance and diversity was affected by the ten ponds different environmental conditions. The algae abundance and diversity was evaluated as an indicator of pollution. Calculating the diversity indices during the period may indicate a negative inference. According to the indices of ten ponds has low dominance of species. From the Shannon Wiener diversity index it can be inferred that the water quality of the ten ponds is moderately polluted. The pollution is of autochthonic origin. From the study it is concluded that the ten ponds within coal city Dhanbad needs more care in quality parameters to check pollution for a healthy environment of the area. Constant removal of the pollutant and their debris can check this. Therefore, the lake has to be preserved for its intended use, a sustainable and aesthetic management planning is necessary for the conservation of this water body.

5. Acknowledgment

The authors are thankful to Director, CSIR-CIMFR, Dhanbad, Jharkhand, India, who had provided all sorts of facilities during in-house training project work and supported to bringing up this excellent experimental finding.

References


Dhanbad Branch Publication Seminar on World Environmental Day at BCCL Dhanbad (5th June, 1994).


Rural Jharkhand by Confederation of Indian Industry, Department of Industries, Govt. of Jharkhand, 15th June, 2005


[146] Mohnish Pichhode and Kumar Nikhil, 2017, Carbon Sequestration by Different Tree Species at Malanjkhand, district Balaghat, Madhya Pradesh, India, American
Journal of Engineering Research (AJER) [Communicated].


[156] Frank Rudolph Olson (July 17, 1910 – November 28, 1953, an American bacteriologist, biological warfare scientist, and Central Intelligence Agency (CIA) employee who worked at Camp Detrick (now Fort Detrick) in Maryland, to establish the top secret U.S. bioweapons program beginning in 1943, a time when interest in applying modern technology to warfare was undergoing a boom. Olson's duties included experiments with aerosolized anthrax. After 10 years, he was a senior bacteriologist at the program.


[164] Mr. Sudeep, B.M* and Prof. Shankar P. Hosmani, Algal biodiversity and application of Indices In assessing two lakes of Mysore district


Author Profile

Mr. Suman Dhar, M.Tech. Student Final Year, Department of Environmental Science & Engineering, IIT-ISM, Dhanbad, Jharkhand India. He has done his in-house training project work at NREM, CSIR-CIMFR, Dhanbad, Jharkhand, India in the year 2017 and publishing his experimental findings

Dr. Kumar Nikhil, Principal Scientist, Natural Resource & Environment Management (NREM) Group, Council of Scientific and Industrial Research (CSIR)-Central Institute of Mining & Fuel Research (CIMFR), Barwa Road, Dhanbad, Jharkhand, India gained more than 30 years of research experiences, involved in more than 60 projects in different capacity. More than 150 scientific publications on his name. Guided more than 60 students of B.Sc, M.Sc, B.Tech.,M.Tech. &Ph.D students in their research work