Limnological Studies of Sen Pokhar of Nonihat, Dumka

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ABSTRACT

The Limnological studies of Sen Pokhar of Nonihat, Dumka were conducted from April, 2013 to March, 2015. Monthly analysis of several parametesr like temperature, P^H, transparency, hardness, TDS, Free Co_2, DO, BOD, COD were done to know the water quality of the said pond.

Keywords : Limnological, Sen Pokhar, Nonihat, Dumka

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INTRODUCTION

Limnology deals with the biological productivity of inland water with its all causal physical, chemical, biological and meteorological factors which determine the quality and quantity of biological production (Welch, 1952). It also deals with abiotic and biotic components of the ecosystem, which provides valuable information regarding structure and function of ecosystem. According to Sharma (1984), study of physical, chemical, geological and biological aspects of freshwater is termed as 'Limnology'. The increasing industrialization, urbanization and developmental activities and consequences of pollution of water have brought a revolution to study ecology of inland water.

The physiochemical properties of water from the different water bodies keeps on changing and it varies in different water bodies in varying seasons. The physico chemical properties of water also varies due to various other reasons like the source of the runoff, activities done in the concerned water bodies, industrial effluents, sewerage etc.

In India physico-chemical properties of lentic water bodies were analysed by Nasar (1975), Bilgrami *et al.* (1979), Mandal (1979), Goel *et al.* (1985), Kumar and Siddique (1997), Pandey and Sharma (2003), Devi *et al.* (2003), Tiwari and Mishra (2005), Bundela *et al.*

(2012), Patralekh *et al.* (2012) etc.

Nonihat is a Village in Jarmundi Block in Dumka District of Jharkhand State, India. The village has a historical past as it was a part of Handwa state. The under taken research site Sen Pokhar of Nonihat, Dumka, is an artificial, historic, multiutility and perennial pond. It was escavented by Jagannath Sen about 200 years ago under the Handwa state. Earlier this pond was "lakharaj" that means 'tax free'. The geographical location of this village is $24^0 39'N$ latitude and $87^0 06'E$ longitude. It is about 145 meter high from mean sea level. This pond is approximately 175 meter in length and 152 meter in width and its depth is 5 meter. It is almost squarish to rectangular in shape. The overall area of this pond is about 2.5 hectare. It is a perennial unmanaged water body, which receives large amount of dung, faecal materials, organic matters, salts, minerals and inorganic matters from the surrounding areas during rainy season.

MATERIALS AND METHODS

The analysis for physio-chemical of water was done by following standard methods, prescribed in reputed manuals and work books, published by APHA, AWWA, WPCF, FISWA, NEERI, Trivedi and Goel (1984) and Adoni (1985) etc.

Water samples were properly collected by hand in

one litre polythene bottles in morning hours from the pond. Water samples were collected from one meter away from the bank and below the surface of water 5 to 10 cm layer. Some of the parameters were analyzed in the field while most of the analyses were completed within 48 hours of the collection. The samples were preserved as implicated by Trivedi and Goel (1984).

RESULTS AND DISCUSSION

Physico-Chemical analysis shows the changes in different parameters and their influence on biological qualities of the aquatic system at different levels. The meteorological conditions largely influence the temperature and transparency and other abiotic components and contribute thermal stratification along with diurnal and seasonal fluctuations. The distribution and abundance of phytoplankton are also influenced significantly by physico-chemical factors, which are of great limnological interest.

The physico-chemical characteristic of pond water is very important to analyze the aquatic ecosystems, to assess the productivity of the aquatic environment. Keeping all these view in mind Physico-Chemical and Biological study of Sen Pokhar of Nonihat, Dumka has been taken into consideration. The analysis of physico-chemical parameters of water samples of Sen Pokhar of Nonihat, Dumka was carried regularly. Data were collected at monthly intervals covering the following factors - atmospheric temperature, water temperature, transparency, total sold, pH, dissolve Oxygen, free CO_2, hardness, calcium, magnesium, BOD, and COD.

After taking and consideration of all important factors and parameters, the present investigation was under taken to understand seasonal variations as well as co-relation pattern between these parameters. Data were collected at monthly intervals covering all important factors. Results of different physico-chemical factors recorded from Sen Pokhar of Nonihat, Dumka during the year April 2013 to March 2015.

Temperature

Temperature is very vital physical property of aquatic ecosystem. It is also influences various others parameters such as pH, Conductivity, Saturation level of gases and various forms of alkalinity (Trivedy and Goel, 1984). A rise in temperature in the water leads to the spreading up of the chemical reactions, reduces the solubility of gases and amplifies the taste and odours (Trivedy and Goel, 1984).

During the two years of investigation minimum temperature $7.90^{0}C$ was recorded in the months of January 2015 and maximum temperature $41.80^{0}C$ was in the month of May 2014. The average temperature was $25.94^{0}C$. The range of temperature was minimum in winter season from $07.90^{0}C$ to $29.20^{0}C$. Maximum range, in summer season from $17.10^{0}C$ to $41.80^{0}C$ and moderate range in rainy season from $18.70^{0}C$ to $34.10^{0}C$. The standard deviation was 5.85.

Atmospheric temperatures showed positive co-relation with almost all parameters, taken in this study except, transparency and dissolved oxygen. (Graph - 1).

Water Temperature

Water temperature followed the trend of variation in ambient temperature, but is influenced by substrate composition, insolation, turbidity, sewage effluent discharges and rain water inflows.

The water temperature of Sen Pokhar of Nonihat, Dumka during study period ranged from $17.65^{0}C$ to $33.15^{0}C$. The minimum water temperature observed in January 2015 and maximum in June 2014. The average value of the water temperature was $25.71^{0}C$ and standard deviation was 4.36.

Water temperature showed positive co-relation with atmospheric temperature, total solid, pH, free CO_2, hardness, Calcium, BOD and COD while, negative co-relation with transparency, dissolved Oxygen and Mg. (Graph - 2).

Transparency

Transparency of water varies greatly with the nature of the bottom of pond, degree of exposure and nature of sediments. It is affected by rain, floods, dissolve solids and salts etc. Planktonic population also affects transparency. The transparency of water of Sen Pokhar of Nonihat, Dumka varied from 12.90cm September 2014 to 61.20cm February 2015

with an average of 33.99cm, with standard deviation 0.18.

Transparency showed positive co-relation with dissolve oxygen, hardness, calcium, magnesium and COD while, negative co-relation with atmospheric temperature, water temperature, total solid, pH, F_{CO_2} and BOD. (Graph - 3).

Hydrogen Ion Concentration (pH)

Most natural water is generally alkaline due to the presence of sufficient quantities of carbonates. pH of water shows drastically change with time due to the exposure to air, biological activity and temperature. In natural water, pH also changes diurnally and seasonally due to variation in photosynthetic activity which increases the pH due to consumption of CO_2.

The pH of water of Sen Pokhar of Nonihat, Dumka fluctuated between 7.12 in August 2013 and 8.13 in June 2013. The average value of pH during study period was 7.50 with standard deviation 0.01.

pH showed positive co-relation with atmospheric temperature, water temperature, hardness, Calcium, Mg, BOD and COD while, negative co-relation with total solid, pH, Do_2 and F_{CO_2}. (Graph - 4).

Dissolved Oxygen (DO$_2$)

Dissolved Oxygen concentration in natural water is of primary importance as it regulates the metabolic process of plant and animal community. It is an indicator of water quality. DO concentration of water is constantly changing because of the biological, physical and chemical processes. The photosynthetic activity of aquatic vegetation is the major factor controlling the amount of Dissolved Oxygen in the water.

During two years of observation of Sen Pokhar of Nonihat, Dumka the amount of DO varied from 5.79mg/L in August 2014 to 13.61 mg/L in December 2014. The average value of DO concentration was 8.69mg/L for the two years of observation with standard deviation 2.31.

Dissolved oxygen showed positive co-relation with transparency, hardness, Calcium and Mg while, negative co-relation with atmospheric temperature, water temperature, transparency, total solid, pH,

F_{CO_2}, BOD and COD. (Graph - 5).

Free Carbon Dioxide (Free CO$_2$)

Free CO_2 is highly soluble in water and its solubility depends upon the atmospheric pressure. Generally, free CO_2 is produced during decomposition of organic matter. Free CO_2 is the most Important and integral components of the food matters of aquatic autotrophs. Carbon required for assimilation, essentially comes from dissolved free CO_2 in water. The free CO_2 was not detected throughout the study period. It showed its presence only in few months of the study period.

During the study period, the amount of free CO_2 varied from 2.44 mg/L in May 2014 to 7.30 mg/L in September 2014. The average value of free CO_2 during investigation period of the pond was 3.25mg/L with standard deviation 2.65.

Free CO_2 showed positive co-relation with atmospheric temperature, water temperature, total solid and BOD while, negative co-relation with transparency, pH, Do_2, F_{CO_2}, Calcium, Mg and COD. (Graph - 6).

Total Solids

The total solid is the sum total of suspended solids and dissolved solids. The total solid is affected by the percentage of dissolved solids and suspended solids in water. It is also influenced by temperature, water level and amount of organic matters.

In Sen Pokhar of Nonihat, Dumka total solid was found from April to November but remained completely absent during December to March.

In two years of observation total solids fluctuated in between 281.75ppm January 2014 to 1307.00ppm August 2014 with an average value 661.83ppm. The standard deviation was 268.61.

Total solid showed positive co-relation with atmospheric temperature, water temperature, free CO_2, BOD and COD while, negative co-relation with transparency, hardness, pH, Do_2, Calcium and Mg. (Graph - 7).

Hardness

Hardness is the property of water which prevents the

lather formation with soap and increases the boiling point of water. According to Trivedy and Goel (1984), principal cations imparting hardness are Calcium and Magnesium. The anions responsible for hardness are mainly silicates, nitrates, carbonate, bicarbonate, chloride and sulphate. Permanent hardness is caused mainly by sulphate and chlorides of the metals.

During the investigation of Sen Pokhar of Nonihat, Dumka the hardness varied from 51.41mg/L in August 2014 to 103.95mg/L in May 2013. The average value of hardness during two year was 77.62mg/L. The standard deviation was 15.64.

Hardness showed positive correlation with most of the parameters except total solid, free CO_2 and BOD. (Graph - 8).

Calcium (Ca)

Calcium is most abundant micro nutrients of the natural water. Concentration of Calcium is regulated by several factors such as, leaching from rocks, dissolution of Calcium salts and their reduction at high pH. Concentration of the Calcium is reduced at higher pH due to it's precipitation as $CaCo_3$. The domestic sewage and industrial effluents are good source of Calcium ions, so their disposal increases the Calcium concentrations in water.

During the two years of investigation of the Sen Pokhar of Nonihat, Dumka water, the value of Calcium varied from 63.97mg/L in October 2014 to 106.90mg/L in May 2013. The average value of Calcium during the two year was 84.12mg/L. The standard deviation was 11.79.

Calcium showed positive correlation with almost all parameters except, total solid, free CO_2 and BOD. (Graph - 9).

Magnesium (Mg)

It is the constituent of chlorophyll pigment of autotrophs. The concentration of Magnesium is extremely variable in natural water and their level increases in water principally due to the leaching of various kinds of rocks.

During the two years of observation the value of

Magnesium varied from 7.20mg/L September 2013 to 31.38mg/L May 2013. The average value of Mg during two year of observation was 17.03Mg/L with standard deviation 7.29.

Magnesium showed positive correlation with most of the parameters except, water temperature, total solids, free CO_2 and BOD (Graph - 10).

Biochemical Oxygen Demand (BOD)

The BOD is the amount of oxygen required for the oxidation of a waste by micro-organisms like bacteria. In natural water, BOD results from the respiration of planktonic organisms and bacteria. It is an indicator of organic pollution (Trivedy and Goel, 1984).

During the two years of investigation of Sen Pokhar of Nonihat, Dumka value of BOD ranged from 2.65mg/L in January 2015 to 7.36mg/L in July 2014. The average concentration of BOD was 4.89mg/L with standard deviation 1.41.

It showed positive co-relation with atmospheric temperature, water temperature, total solid, pH, free CO_2 and COD while, negative co-relation with transparency, hardness, DO_2, Calcium and Mg. (Graph - 11).

Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) is the measure of oxygen, consumed during the oxidation of the oxidizable organic matter by a strong oxidizing agent (Trivedy and Goel, 1984). It is an important chemical factor to understand the salient feature of freshwater ecosystem. The determination of COD value is of great importance where BOD value cannot be determined accurately.

During the two years of observation of Sen Pokhar of Nonihat, Dumka value of COD fluctuated between 6.75mg/L in December 2014 to 47.00mg/L in May 2013. The average concentration of COD was 21.69mg/L with standard deviation 12.46.

COD showed positive co-relation with almost all parameters taken for this study, except dissolved oxygen and free CO_2 (Graph - 12).
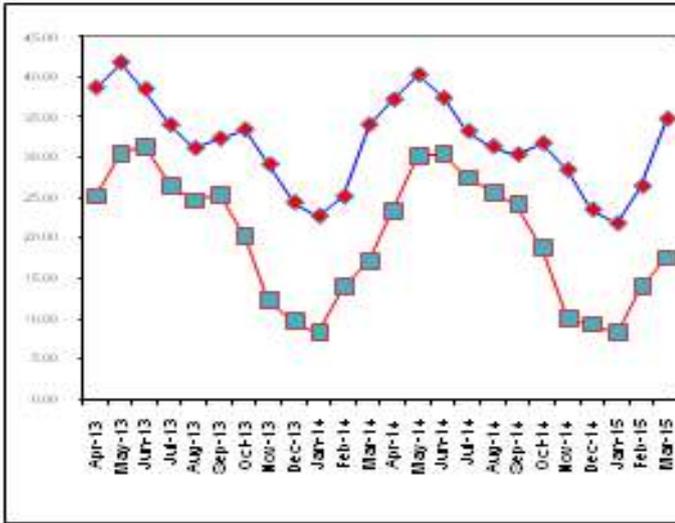
GRAPH-1

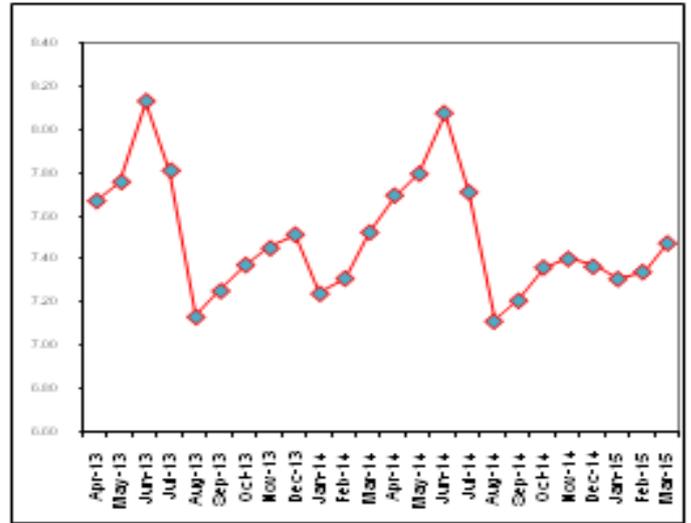Chart showing monthly variation of Atmospheric Temperature (^0C)

GRAPH-4

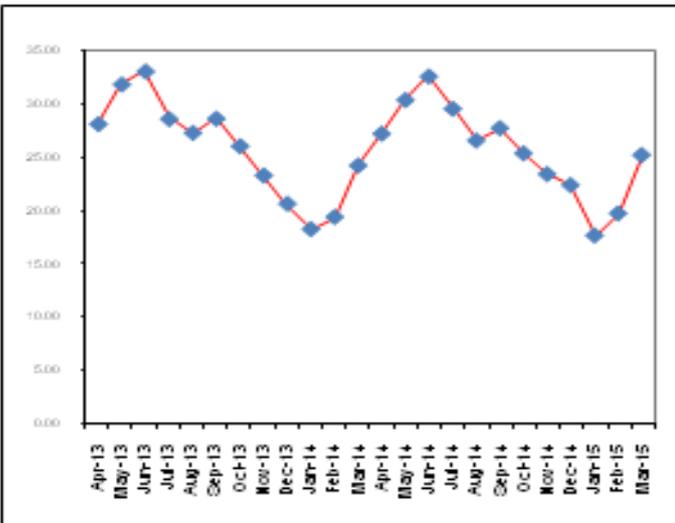Chart showing monthly variation of pH

GRAPH-2

Chart showing monthly variation of Water Temperature (0C)

GRAPH-5

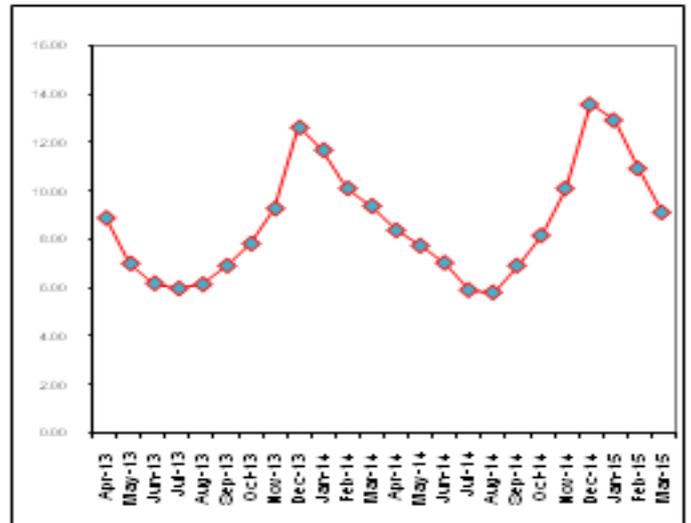
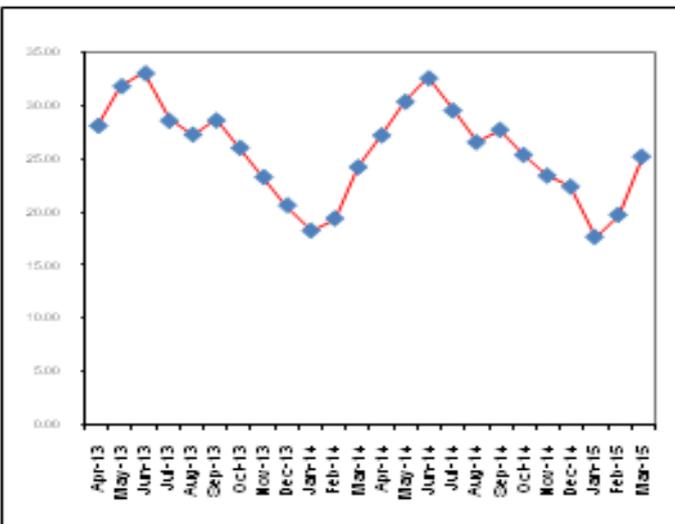Chart showing monthly variation of Dissolve Oxygen (Mg / L)

GRAPH-3

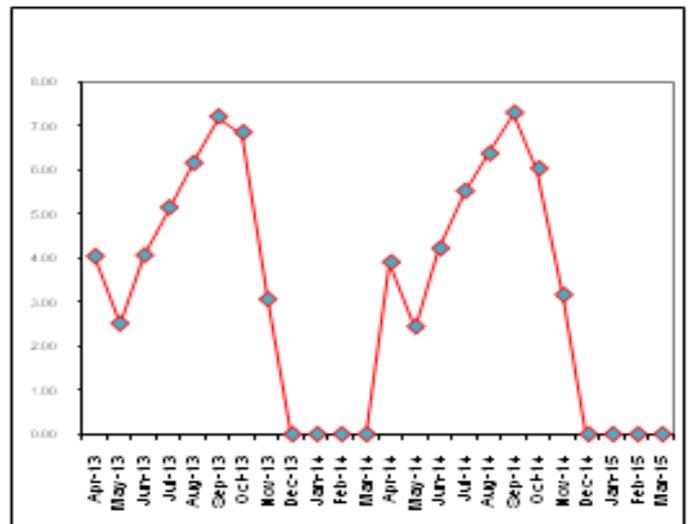Chart showing monthly variation of Transparency (cm)

GRAPH-6

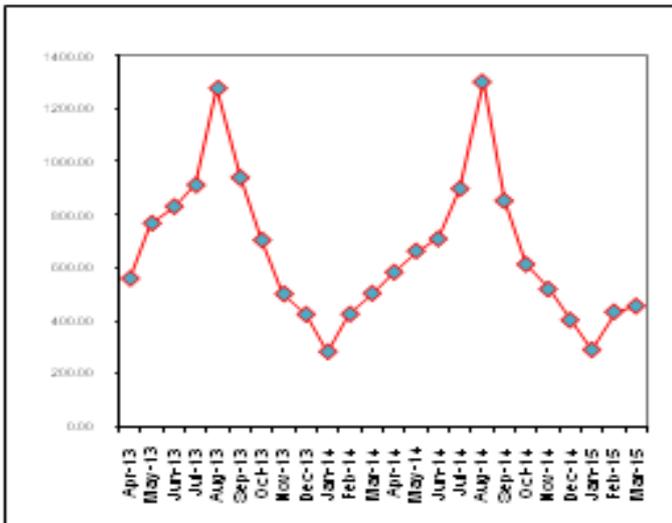Chart showing monthly variation of Free CO2 (Mg / L)

GRAPH-7

Chart showing monthly variation of Total Solid (ppm)

GRAPH-10

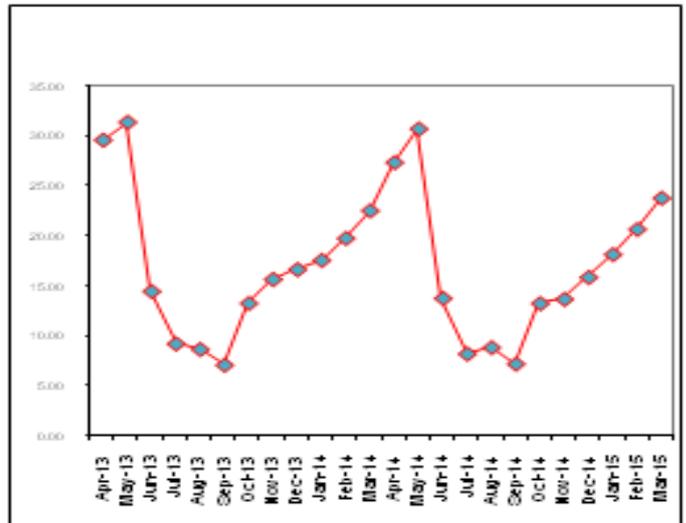
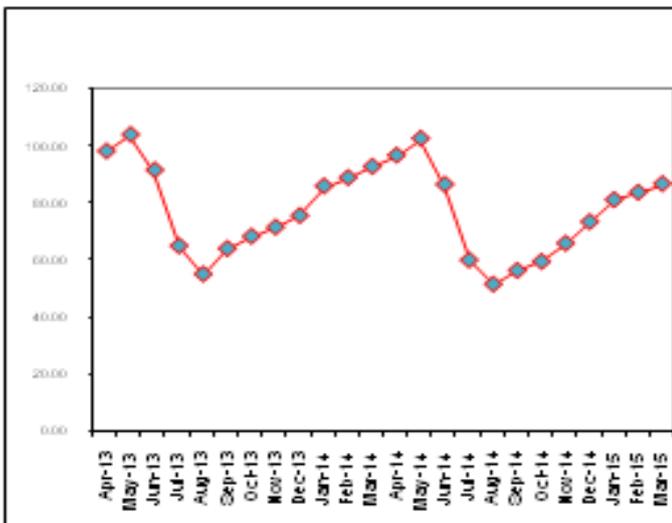Chart showing monthly variation of Magnesium (Mg++) (Mg/L)

GRAPH-8

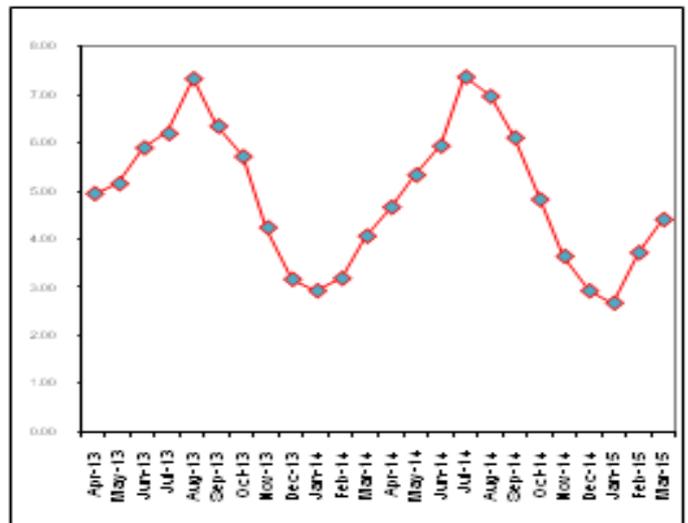Chart showing monthly variation of Hardness (Mg/L)

GRAPH-11

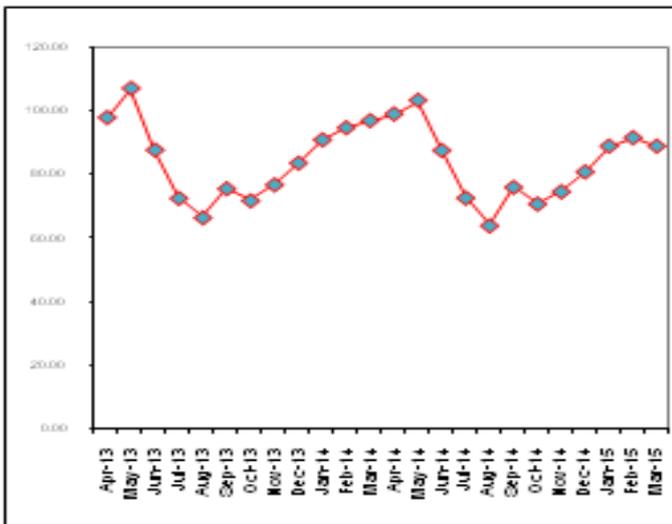Chart showing monthly variation of BOD (Mg/L)

GRAPH-9

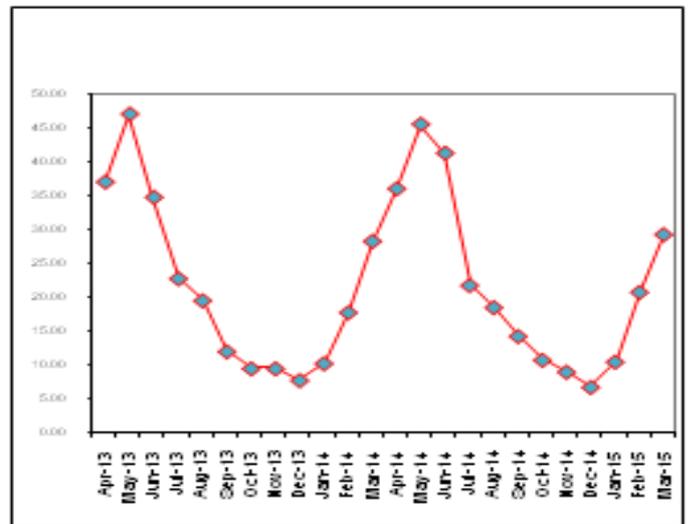Chart showing monthly variation of Calcium (Ca) (Mg / L)

GRAPH-12

Chart showing monthly variation of COD (Mg/L)

Co-relation cofficient (r) of different physico-chemical parameters of Sen Pokhar of Nonihat

Negatively Significant   Significant   Highly Positively Significant

	A.T	W.T	TR.	T. S.	PH	DO	F.CO2	HAR	Ca	Mg	BOD	COD
A.T	0.952	0.466	0.616	0.620	0.846	0.559	0.220	0.162	0.158	0.760	0.802	
W.T.		0.632	0.647	0.640	0.832	0.628	0.073	0.003	0.021	0.785	0.676	
T.R.			0.743	0.073	0.692	0.883	0.627	0.663	0.642	0.759	0.093	
T.S.				0.020	0.851	0.794	0.518	0.535	0.500	0.925	0.175	
PH					0.302	0.017	0.549	0.434	0.331	0.180	0.718	
DO						0.797	0.244	0.288	0.290	0.937	0.609	
F.CO2							0.582	0.605	0.556	0.847	0.004	
HAR								0.969	0.902	0.418	0.690	
Ca									0.903	0.452	0.652	
Mg										0.440	0.621	
BOD											0.305	
COD												

CONCLUSION

Sharp monthly variation in the physico-chemical properties of water of Sen pokahr was observed. It has been observed that several environmental factors is affecting the physico-chemical properties of water. As this pond is perennial, and its ecosystem is self-regulatory and self-sustaining. It is found that whenever, the concentration of these physico-chemical factors crossed the threshold limit. The delicate balance of its ecosystem is disturbed, which results into the eutrophication.

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