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A study on the seasonal trend of physicochemical parameters of Deepar Beel (wetland) near to Khonajan, a channel connecting the river Brahmaputra

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Abstract
Seasonal variation of physicochemical parameters of water was studied in Deepar beel at Dharapur area near to Khonajan, the channel connecting the beel with the river Brahmaputra. The adjoining area of the beel at the studied area and the channel were observed to fill with domestic households. Sometimes dumping of garbage was also observed near the study area from where effluents are observed to be released to the beel water through surface runoff water during heavy rains thus creating imbalance in the chemistry of water. The elevations of total alkalinity upto 116 mg.l^{-1} and total hardness upto 318 mg.l^{-1} along with nutrients like calcium, magnesium, potassium, sulphate, phosphate and subsequent decrease of dissolved oxygen particularly in summer season (March-May) are very interesting and appeared to be governed by rainfall. The high rainfall observed in summer season after comparatively dry season in winter has changed the property of water through allochthonous nutrient flux from the peripheral area where garbage was observed to dump. The low level of oxygen in summer months was not only due to higher temperature but also due to high organic load of water.

Keywords: seasonal trend, physicochemical, wetland, Khonajan, Brahmaputra

1. Introduction
The productivity of freshwater community that determines the fish growth is regulated by the dynamics of its physicochemical parameters along with its biotic environment (Wetzel, 1983) [2]. For successful utilization of freshwater ecosystem for the production of fish, the study of physicochemical factors which influence the biological productivity of the water body is very essential. The study of variation of physical and chemical properties of water is very important in limnology as the same regulates the fish food organism and other bio-community in an aquatic ecosystem thereby helping in the process of fish productivity, because the biological productivity of any water body is mostly influenced by the water quality of aquaculture system. So lack of knowledge on quality of water has resulted in weak ecological setup in general and low yield of fish production in particular.
In view of the importance of physicochemical parameters in freshwater ecosystem, the present work has been carried out in Deepar Beel at Dharapur area near Khonajan, the channel connecting the river Brahmaputra.

2. Materials and Methods
2.1 Study site: The present work deals with the seasonal fluctuation of physicochemical parameters of water in Deepar Beel at Dharapur area near to Khonajan, the lone channel connecting the Deepor Beel with the mighty river Brahmaputra at Dharapur area. The Khonajan channel is approximately 5 km in length and is surrounded by hundreds of families. The adjoining areas of the beel of the studied area and the channel are filled with domestic households and also some small factories. The effluent of those families and the factories is seen to directly release into the channel and even garbage dumping is also seen sometimes near the collection site. The water level increases tremendously during the rainy season and hence the water of the beel is recycled. There is a possibility of backflow of water from the beel to the river through the channel. Garbage dumping grounds are also observed at the sample collection site. During winter season, the water level decreases to a great extent and water is dried up in the peripheral region.

2.2. Sampling

To study the seasonal variation of physicochemical parameters, water samples were collected monthly from June 2015 to May 2016 from surface and bottom layers of the randomly selected spots following the sampling procedure of Jhingran *et al*. (1969) [10]. As the properties of surface and bottom water samples are mostly variable, so both the samples were mixed to represent the sample of the wetland as a whole. The water samples were collected in the morning between 8.00 A.M. and 8.30 A.M. The parameters were analysed at the laboratory of Department of Zoology, Pandu College following "Standard Methods for Examination of Water and waste Water", A.P.H.A. (1988) [1] and "Manuals on Water and Waste Water Analysis", N.E.E.R.I. (1988). To study the Physicochemical properties of water, most significant parameters like pH, Dissolved oxygen (DO), Free carbon dioxide, Total carbon dioxide, Bicarbonate ion, Total alkalinity as $CaCO_3$, Total hardness as $CaCO_3$, Calcium hardness as $CaCO_3$, Calcium, Magnesium hardness as $CaCO_3$, Magnesium, Sodium, Potassium, Sulphur as Sulphate Phosphorus as Phosphate has been selected for examination. The result is expressed as Mean ± SD. The rainfall data was collected from Weather Underground which a commercial weather service is providing real-time weather information via the internet.

The different seasons of the year were marked as winter (December to February); Summer (March to May); Monsoon (June to August) and autumn (September to November).

3. Result and Discussion

The observed variation in physicochemical parameters of the water of the studied site of Deepor Beel is depicted in the Table-1 citing their respective range, average value and Standard Deviation (SD).

Table 1: A summary of some physicochemical parameters of water showing the ranges, average and Standard Division (SD) (June 2015 to May 2016)

Parameters	Range	Mean	SD
pH	6.1-7.1	6.56	0.30
Dissolved Oxygen ($mg.l^{-1}$)	3.6-10.5	6.07	1.99
Free Carbon dioxide ($mg.l^{-1}$)	3.5-15.0	9.17	4.18
Total Carbon dioxide ($mg.l^{-1}$)	72.76-111.08	91.78	11.57
Bicarbonate Ion ($mg.l^{-1}$)	93.94-141.52	114.53	16.74
Total Alklinity as $CaCO_3$ ($mg.l^{-1}$)	77-116	93.88	13.72
Total Hardness as $CaCO_3$ ($mg.l^{-1}$)	62.5-318.0	138.58	93.35
Calcium hardness as $CaCO_3$ ($mg.l^{-1}$)	55.13-183.75	89.12	45.66
Calcium ($mg.l^{-1}$)	22.08-73.59	35.70	18.29
Magnessium hardness as $CaCO_3$($mg.l^{-1}$)	2.05-196.20	49.16	58.82
Magnessium ($mg.l^{-1}$)	0.50-47.87	13.43	14.61
Sodium ($mg.l^{-1}$)	10.70-17.60	13.79	2.43
Potassium ($mg.l^{-1}$)	0.91-6.24	3.51	1.87
Sulphate ($mg.l^{-1}$)	4.57-31.80	15.09	9.27
Phosphate ($mg.l^{-1}$)	0.024-0.090	0.06	0.02

The observed seasonal variation of pH in the studied site is depicted in Figure-1. The pH values show a range of mild acidic (6.1) to near neutral (7.1) water with an average of 6.56±0.30. The pH of water depends on the relative quantities of calcium, carbonate and bicarbonate (Sivakumar and Karuppasamy, 2008) [16].

The estimation of Dissolved oxygen ($mg.l^{-1}$) concentration has been depicted in Figure-2.The dissolved oxygen value shows a low to moderate range (3.6-10.5) with a mean of 6.07±1.99.The fluctuation of Dissolved oxygen concentration may be due to the combined influence of fluctuation of phytoplankton density, submerged vegetation density, temperature of water and organic load of water. Gautam *et al.*, 1993 [7]. Also reported that dissolved oxygen concentration is increased with phytoplankton densities. The high oxygen recorded during winter may be due to high solubility of oxygen at low temperature and less degradation of organic substances. This result corroborates with the findings of Singh *et al.*, 2002; [15]; Deka and Goswami, 2011[4]. The distribution of dissolved oxygen in the water is governed by a balance between input from the atmosphere, rainfall and photosynthesis and losses by the chemical and biotic oxidations (Sivakumar and Karuppasamy, 2008) [16]. The low level of oxygen recorded from August to October is very interesting which may be due to high temperature and low photosynthetic activity and from March to May may be due to high organic load coming from surface runoff water from nearby dumping areas. Seasonality of DO fluctuation showing higher concentration in winter and lower in hotter summer months is significantly noticed in the present study (Figure-2) as also experienced in natural shallow water bodies of Assam caused by the winter minima and summer maxima of temperature (Dey, 1981; Goswami, 1985; Agarwala, 1996 and Kalita and Goswami, 2006; Deka and Goswami, 2012) [6, 8, 2, 12, 3, 5].

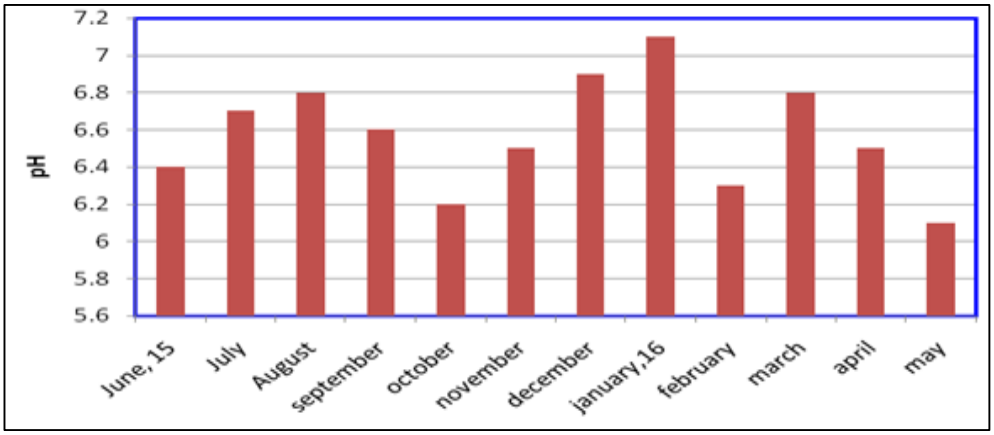

Fig 1: Monthly variation of pH of water

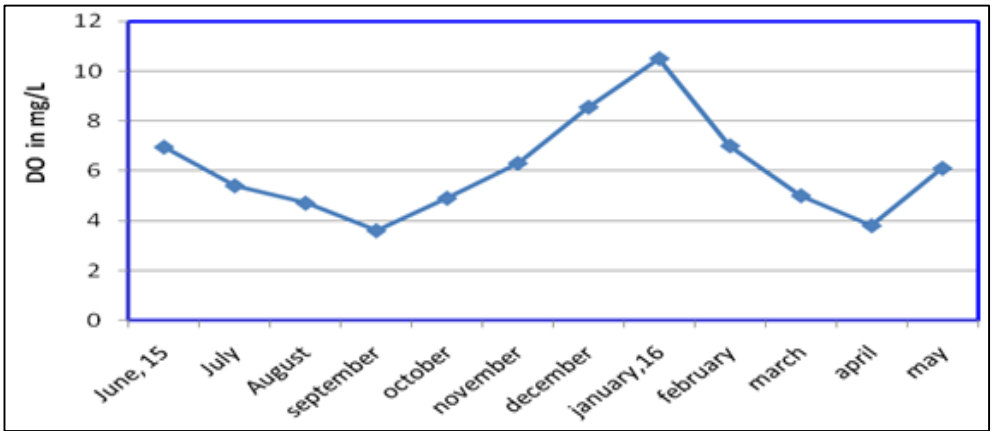

Fig 2: Monthly variation of DO ($mg.l^{-1}$) of water

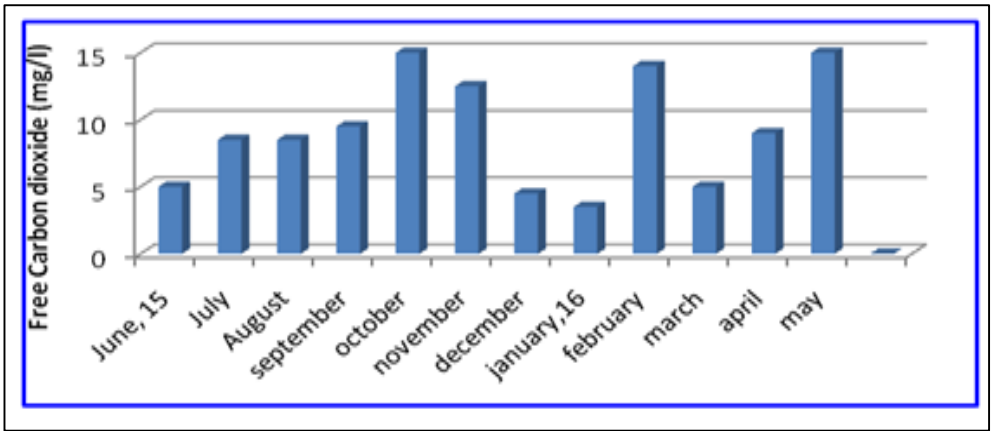

Fig 3: Monthly variation of FCO_2 ($mg.l^{-1}$) of water

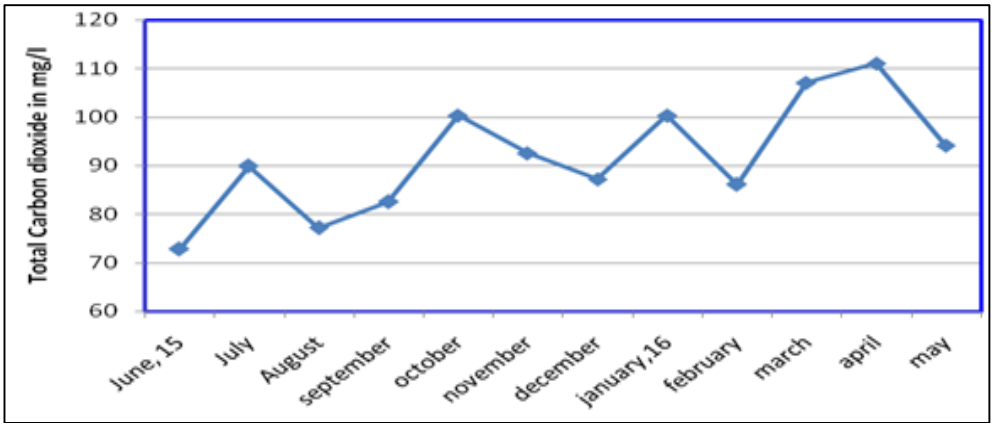

Fig 4: Monthly variation of TCO_2 ($mg.l^{-1}$) of water

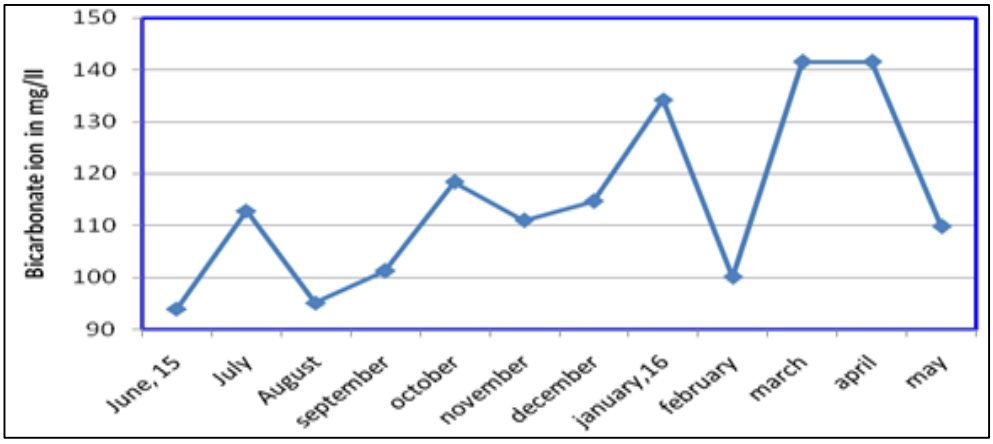

Fig 5: Monthly variation of Bicarbonate ion (mg.l^{-1}) of water

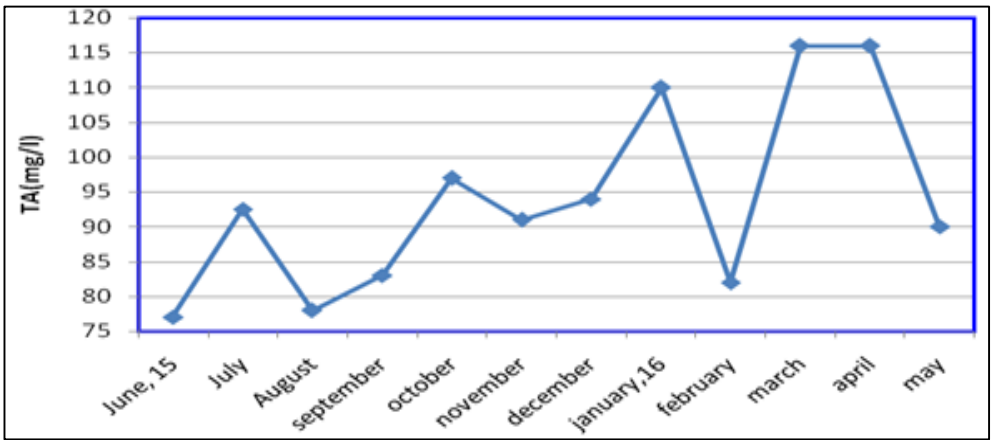

Fig 6: Monthly variation of Total Alkalinity (mg.l^{-1}) of water

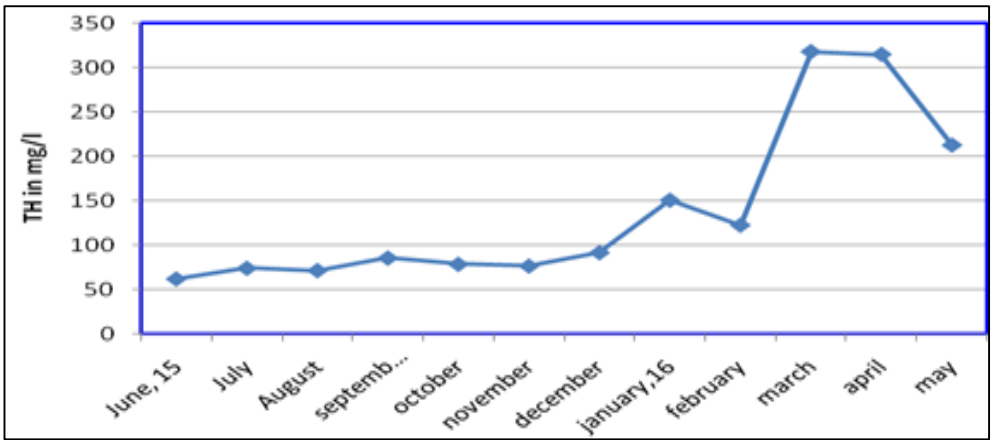

Fig 7: Monthly variation of Total Hardness (mg.l^{-1}) of water

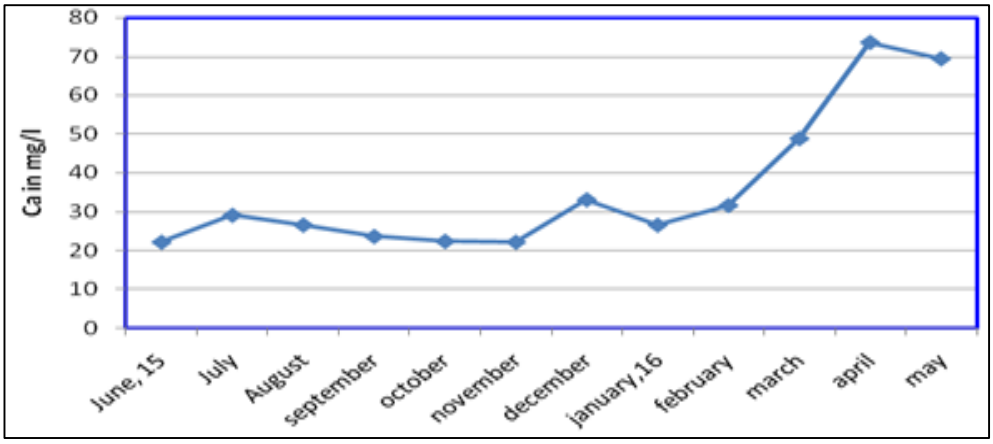

Fig 8: Monthly variation of Calcium (mg.l^{-1}) of water

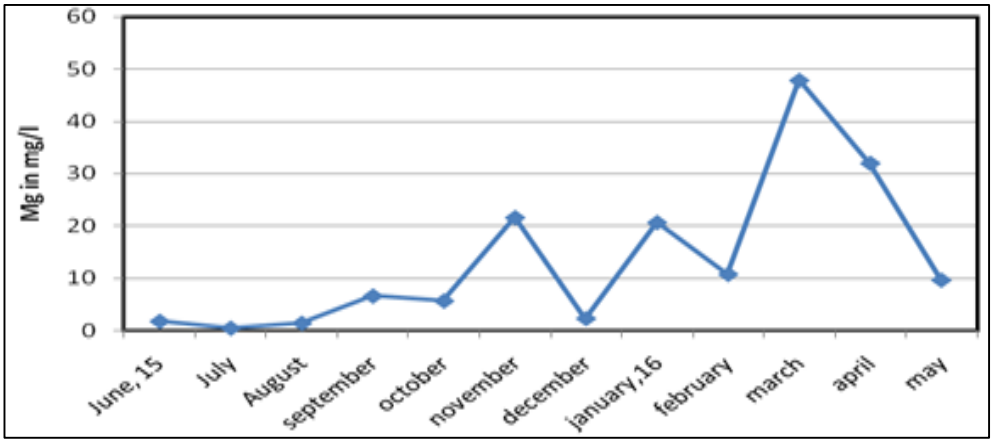

Fig 9: Monthly variation of Magnesium (mg.l^{-1}) of water

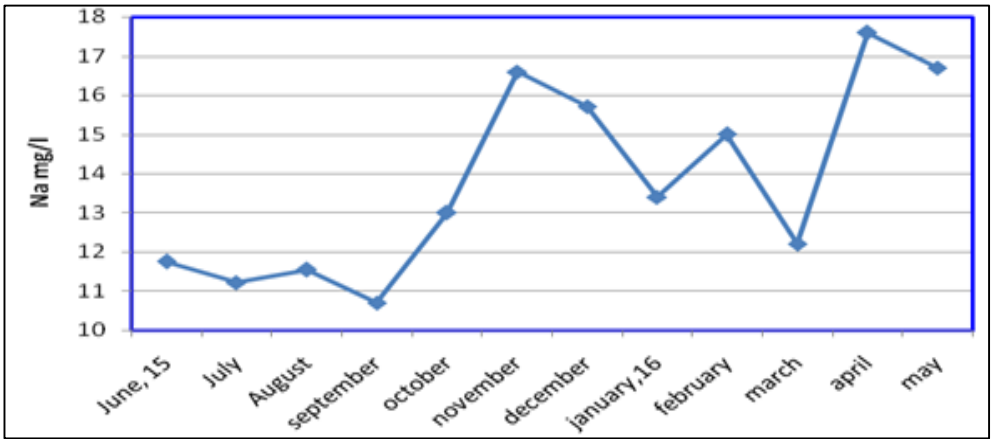

Fig 10: Monthly variation of sodium (mg.l^{-1}) of water

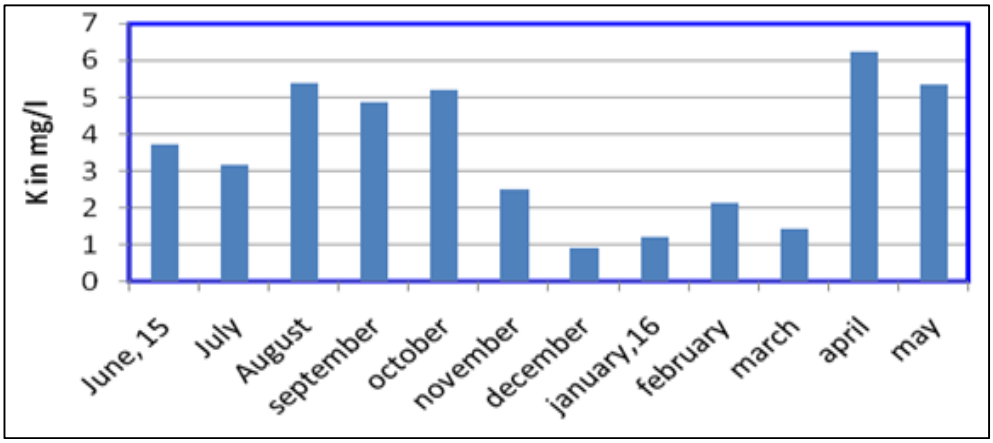

Fig 11: Monthly variation of Potassium (mg.l^{-1}) of water

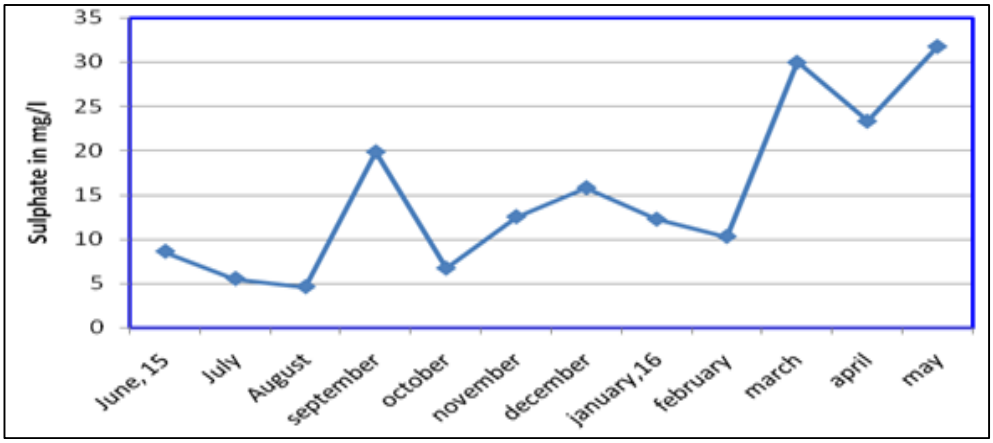

Fig 12: Monthly variation of Sulphate (mg.l^{-1}) of water

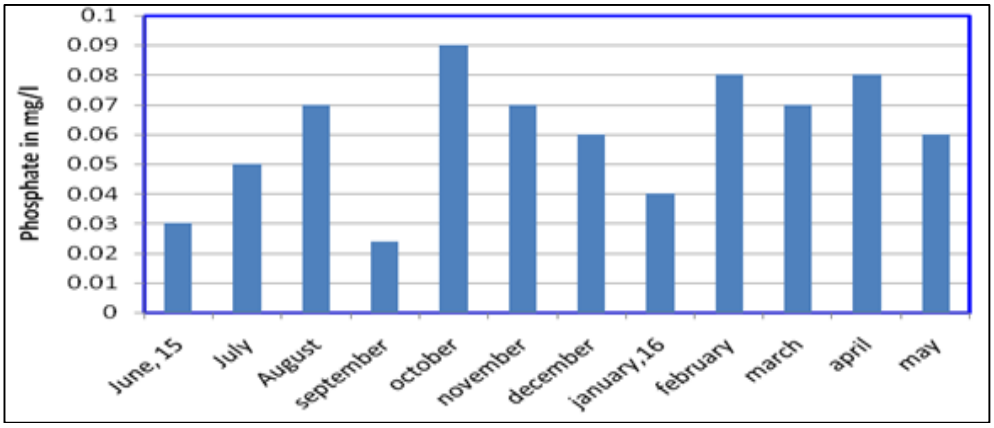

Fig 13: Monthly variation of Phosphate (mg.l^{-1}) of water

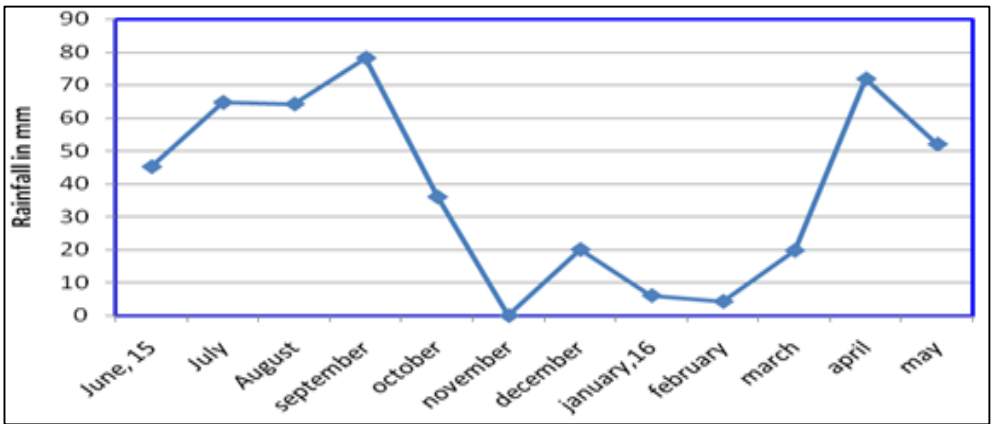

Fig 14: Monthly variation of rainfall (mm) of water

Free carbon dioxide (FCO_2) performs as a limiting factor and metabolic carbon dioxide is a stimulating factor in productivity (Kuentzel, 1969) [13] which accumulates due to microbial activity and community respiration (Trivedy *et al.*, 1987) [19] and at concentration of more than 15 mg.l^{-1} is detrimental to some fishes (Swingle, 1967) [18]. However, during study period the value of FCO_2 ranges from 3.5 to 15.0 mg.l^{-1} with an average of 9.17±4.18 (Figure-3). It is also observed that the concentration of Total CO_2 (mg.l^{-1}) is in between 72.76 and 111.08 mg.l^{-1} (Figure 4**)** with an average of 91.78±11.59. The Total CO_2 concentration of water depends on the pH, which is governed by the buffering effect of carbonic acid, carbonate and bicarbonate (Hutchinson, 1957). Interestingly, the present study experiences no CO_3^{-2} ion in water, however, regarding sole bicarbonate ion (HCO_3^{-2}), the water has high range (93.94 to 141.52 mg.l^{-1}) (Figure 5) because of formation of stable bicarbonates which do not further dissociate into carbonate because of higher quantities of FCO_2 produced by macrophytic decomposition (Hutchinson, 1957) and high organic load.

The total alkalinity (TA) of water has been depicted in Figure 6 which fluctuates in the range between 77 and 116 mg.l^{-1} with an average of 93.88±13.72. However P-Alkalinity is absent throughout the study period of one year. Two peaks of total Alkalinity was observed one in autumn and the other in early summer. The prominent peak during summer months of the year may be attributed to high rainfall in that period (Figure-14) which initiates allochthonous input of organic litter to the water from garbage present in nearby area through surface runoff water. Alkalinity is an important factor for fish and other aquatic organisms, as it buffers pH changes (Wetzel, 1983) [20], which occur naturally due to chlorophyll bearing vegetation and act as an important indicator of productivity.

The value of Total Hardness as $CaCO_3$ (TH) is interestingly found between 62.5 to 318.0 mg.l^{-1} with an average of 138.58±93.35 (Figure-7). The hardness, however, is solely alkaline (carbonate) hardness starting from the months of June, 2015 to December, 2015 except in the month of September where the water experiences non alkaline hardness (Non carbonate). Interestingly from January, 2016 to May, 2016 the water contains non alkaline hardness where the maximum value is as big as 202 mg.l^{-1}. The TH of water represents hard water since its lower limit is > 50 mg.l^{-1} (Swingle, 1967) [18]. It is amazing to note that a prominent peak is also recorded in summer months like total alkalinity. This may be attributed to the leaching of allochthonous nutrient flux (calcium and magnesium) through surface runoff water from garbage dumping peripheral area during high rains experienced in that particular period (Figure-14).The estimation Ca Hardness concentration and Ca in the studied area has been depicted in Table-1.The Ca Hardness and Ca of water of the studied area ranges from 55.13 mg.l^{-1} to 183.75 mg.l^{-1} and from 22.08 mg.l^{-1} to 73.59 mg.l^{-1} respectively. Jhingran, 1975 [11] suggested that Calcium is the most abundant ion in freshwater and is important in bone building.

The Magnesium Hardness and Magnesium of water fluctuates from 2.05 to 196.2 mg.l^{-1} and 0.50 to 47.87 mg.l^{-1} respectively (Table-1).

The concentrations of sodium of water in the studied site have been depicted in Figure-10. It fluctuates between 10.7 mg.l^{-1} and 17.6 mg.l^{-1} ($\bar{x}$=13.79 ± 2.43) with a lean period in the starting of the experiments followed by two consecutive peaks as in Figure-10.

It is observed that that the potassium varies between 0.91 $mg.l^{-1}$ and 6.24 $mg.l^{-1}$(**$\bar{x}$**=3.51 ± 1.87). The trend of fluctuation of potassium exhibits two prominent peaks one in late Monsoon to early Autumn followed by lean period during winter and the other in summer (Figure-11).

The sulphur of the water is estimated as sulphate which is depicted in Figure-12. The Sulphate ion varies between 4.57 and 31.80 $mg.l^{-1}$ ($\bar{x}$=15.09 ± 9.27). It is interesting to notice that sulphate ion exhibit a prominent peak during summer month which corroborate with the findings of Deka, 2012 [3, 5]. The available phosphorus in the form of phosphate has been depicted in Figure-13. The study shows a moderate range with an average of 0.06 ± 0.02 having a range between 0.024 and 0.090 $mg.l^{-1}$. The higher level of phosphate is recorded during autumn and summer seasons of the year. However, phosphate in water is one of the primary nutrients required by phytoplankton, which is estimated to be less than the normal range (0.1 $mg.l^{-1}$ to 0.2 $mg.l^{-1}$) as suggested by Sreenivasan, 1965.

4. Conclusion

The chemistry of the water so observes is very interesting. During the rainy season there is surface run-off of water to the beel which creates an imbalance in the chemistry of the water. The elevation of total alkalinity up to 116 $mg.l^{-1}$ and total hardness up to 318 $mg.l^{-1}$ along with nutrients like calcium, magnesium, potassium, sulphate, phosphate and subsequent decrease of dissolved oxygen in summer season (March-May) is interesting which is appeared to be governed by rainfall. The high rainfall observed in summer season after comparatively dry season in winter has changed the property of water. The surface runoff water during high rainfall leads to allochthonous nutrient flux from the peripheral area where garbage is observed to dump. The low level of oxygen in summer months is due to high organic load of water.

5. Acknowledgement

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