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Physico-Chemical Variation of Properties of Lake Water Quality Parameters of Dal Lake, Srinagar, J&K

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ABSTRACT: Dal Lake is one of the foremost Himalayan lakes of the Kashmir Valley. Being an urban lake, it is the economic backbone of Srinagar city's tourist commerce, which beacons travellers from all over. Unfortunately the lake is a victim of proliferating anthropogenic pollution and is subjected to a steadily expanding rate of eutrophication and siltation. The period of water quality assessment was 8 months from October 2015 to May 2016. The results revealed higher values for nitrogen, indicating the excessive use of nitrogenous fertilizers in the vicinity of the lake and agricultural fields surrounding the lake. Phosphate values are also elevated indicating the eutrophic status of the lake. The results for alkalinity showed that the lake waters fall in the hard waters category.

KEYWORDS: - Dal Lake; Water quality, nitrogen; phosphate; total alkalinity; hard water,

I. INTRODUCTION

Dal Lake, a warm monomictic lake, situated at a height of 1587m above the sea level and at 34°07'N latitude and 74°52'E longitude with a catchment area of 316 square kilometers, is one of a progression of freshwater lakes of Kashmir valley. Dal Lake is a multi-basined, bull bow kind of lake, with shallow saucer-molded bowls framed by the changing course of stream Jhelum. The principle source of water for the lake is TelbalNallah in the Dachigam territory, various springs emerging from the base of lake and outwash from encompassing mountains. The outpouring of lake happens through a weir-n-bolt framework.

Atmosphere of Kashmir is montane valley atmosphere, with a professed icy season from October to March (mean temperature 7.5 degree Celsius) and warm summers mean temperature 19.8 degree Celsius). January is the coldest month (temperature of - 2 degree Celsius to 3 degree Celsius), and July the hottest (34 degree Celsius to 35 degree Celsius). The main proportion of the precipitation is received as snow (December-February). The waters of Dal Lake bolster a changeless drifting populace of somewhere in the range of 7000 individuals, with entire towns having essentially been illicitly made in the lake. The lake underpins an enormous drifting business sector, cultivation industry, an imperative fishery and a blasting traveler industry. Weeds are collected for dairy cattle feed. People use this lake, for personal purposes generating huge businesses out of it but producing numerous pollutant generating substances for it in the form of floating gardens and using fertilizers at large in the nearby paddy fields therefore these activities have deteriorated the lake ecosystem in diverse ways. The lake additionally goes about as a sump for a lot of the waste items from Srinagar. Violations of water from structures and by swelling of floating gardens and installation of lake bed materials and removing weeds on current solid land masses and obviously by transformation of floating gardens in to lasting land masses by way of accumulative weight and mass by planting of materials withdrawn from the lake. Solid waste management in the lake remains a great predicament for the following explanations that in wider terms Dal Lake is a city in itself in the interior of the city with following factors..

Dal Lake, subjected to a steadily expanding rate of eutrophication and siltation, has been assessed to thoroughly vanish inside the following 50 years. Siltation has expanded essentially since various streams and rivulets which joined the lake on its western edge were dammed or filled amid the development of a roundabout street around the old city in later past. The volume of nutrients achieves a top amid the mid-year months, when more than 1700 houseboats and many

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Vol. 7, Issue 1, January 2018

inns bolster an additional 500,000 individuals for every season. Jammu and Kashmir is one of the delightful parts of this planet with rich water assets. Dal Lake is world renowned water body which should be saved. The Government of Jammu and Kashmir has authorized an agency to spare this water body from contamination called Jammu and Kashmir Lakes and Waterways Development Authority (JKLWDA). This lake has truly been the focal point of Kashmiri progress and has assumed a noteworthy part in the economy of the state through its fascination of visitors and additionally its usage as a wellspring of sustenance and water. Considering the significance of this world acclaimed water body for Kashmiri human advancement and economy, the main objectives of this study was long term assessment of water quality of the Dal Lake

II. MATERIAL AND METHODS

STUDY AREA

The study is focused on Dal Lake which is situated in Srinagar city, capital of state Jammu and Kashmir, India (Figure 1). The lake is located at an altitude of 1587m and 34°07'N latitude and 74°52'E longitude. The main sources of feed to the lake are large perennial channel called TelbalNala which carries out runoff from the catchment area of about 145 km² and contributes to about 80% of the total inflow to the lake (Jellani 2006). Other streams such as PeshpawNala, Shalimar Nala, MerakhshaNala and Harshikul also contribute to the flow in the lake. These small streams feed to the lake around the shoreline along with some contribution from the groundwater. Kundangar et al. (1995) also reported presence of a number of springs within the lake basin itself acting as a permanent source of water to the lake. The division of the lake is into four basins Hazratbal, Boddal, Nigeen and Gagribal. The maximum depth of the lake is approximately 6m which is in the Nageen basin and the shallowest basin is Gagribal basin with a maximum depth of 2.5m.

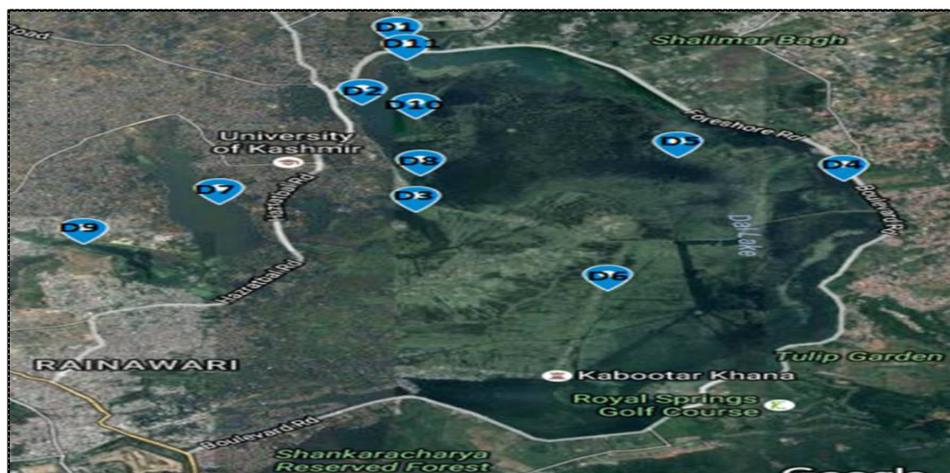


Figure 1:-Google map showing the shoreline of Dal Lake and sampling sites

III. SAMPLE COLLECTION AND ANALYSIS

Water quality Data was acquired from the Jammu and Kashmir Lakes and Waterways Development Authority (JKLWDA). The physico-chemical data was collected on a monthly basis from October 2015 to May 2016. The collected data is for the following parameters: Electrical conductivity (EC), Calcium, Magnesium, Chloride, Total Phosphate, Nitrate-Nitrogen, Ammonical Nitrogen, pH, Dissolved Oxygen (DO), Sulphate and Total Alkalinity. Sampling was generally done monthly from 11 locations as per the standard guidelines. Figure 1 shows the location of sampling sites and the location of sampling sites are shown in Table 1.

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Vol. 7, Issue 1, January 2018

Table 1:- Location of the sampling sites and their description.

Name of the site	Description of the site
D1	Inside Lake near the entry of TelbalNallah
D2	Dhobi Ghat area
D3	Central site near Sonilank
D4	Near Nishat Pipe line bund (Culvert 1)
D5	Central site near Char Chinari
D6	Near KabootarKhana
D7	Central site Nigeen
D8	Saderabal Area
D9	Pokhribal area
D10	Outlet site of Hazratbal STP
D11	Outlet site of Habak STP

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 1, January 2018

IV. RESULTS AND DISCUSSION

Physico-chemical characteristics of the selected water quality parameters is presented as follows:

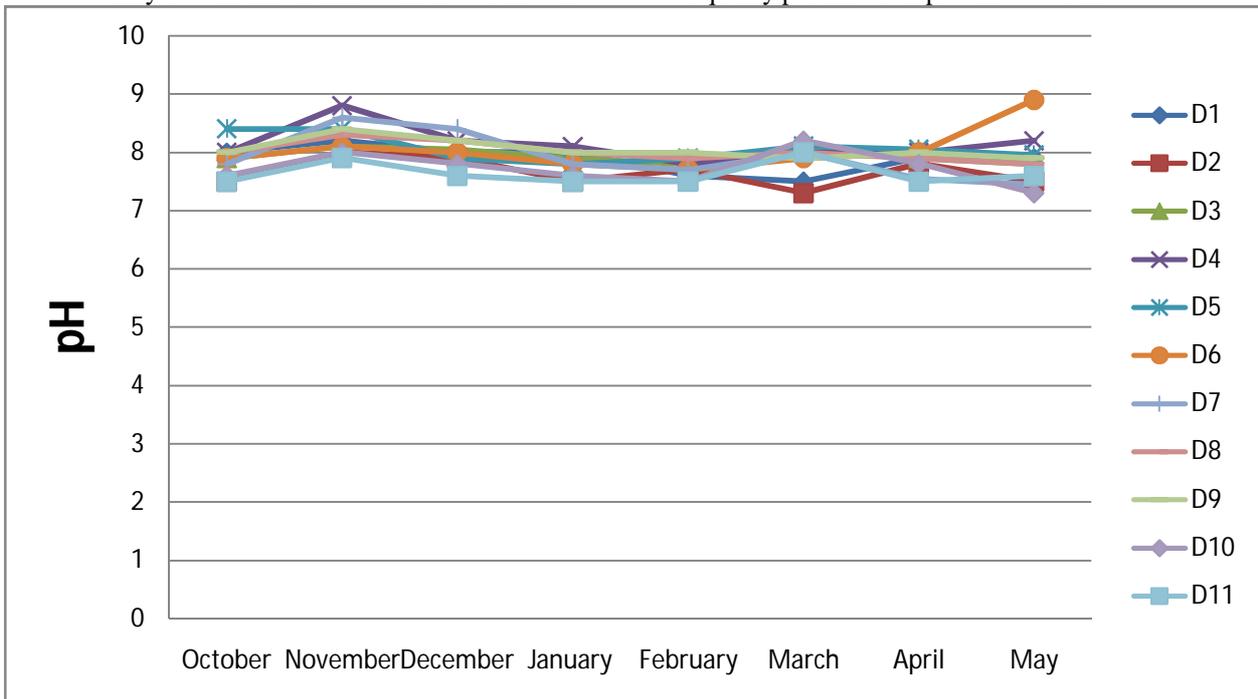


Figure 2:-Monthly variation of pH at various sites

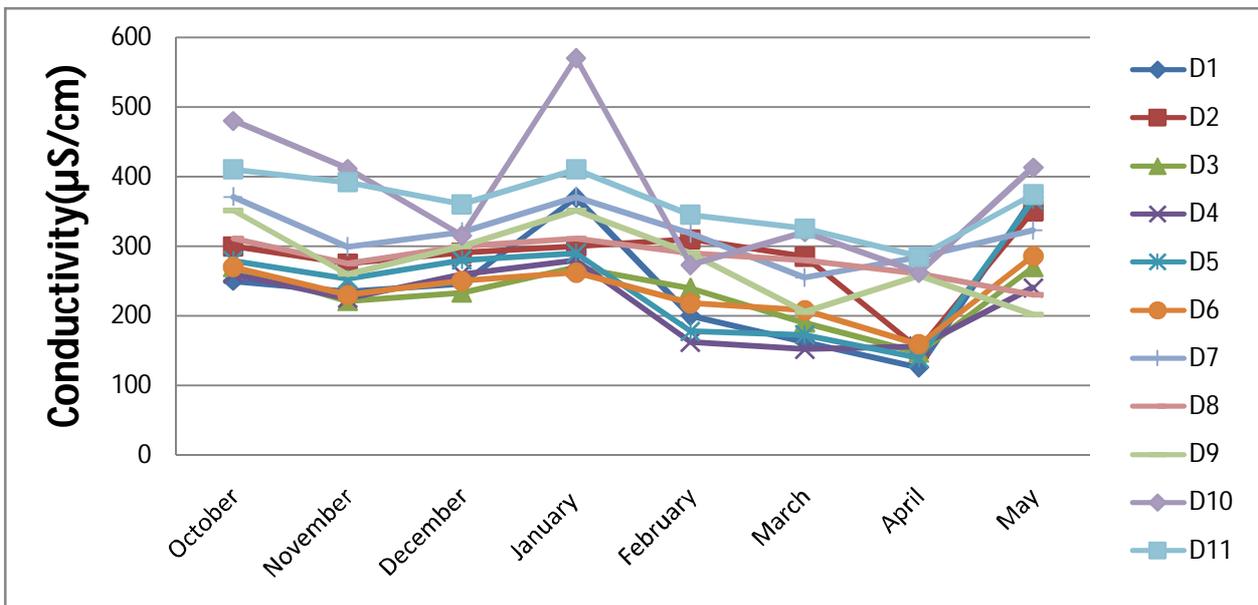


Figure 3:-Monthly variation of Conductivity at various sites

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 1, January 2018

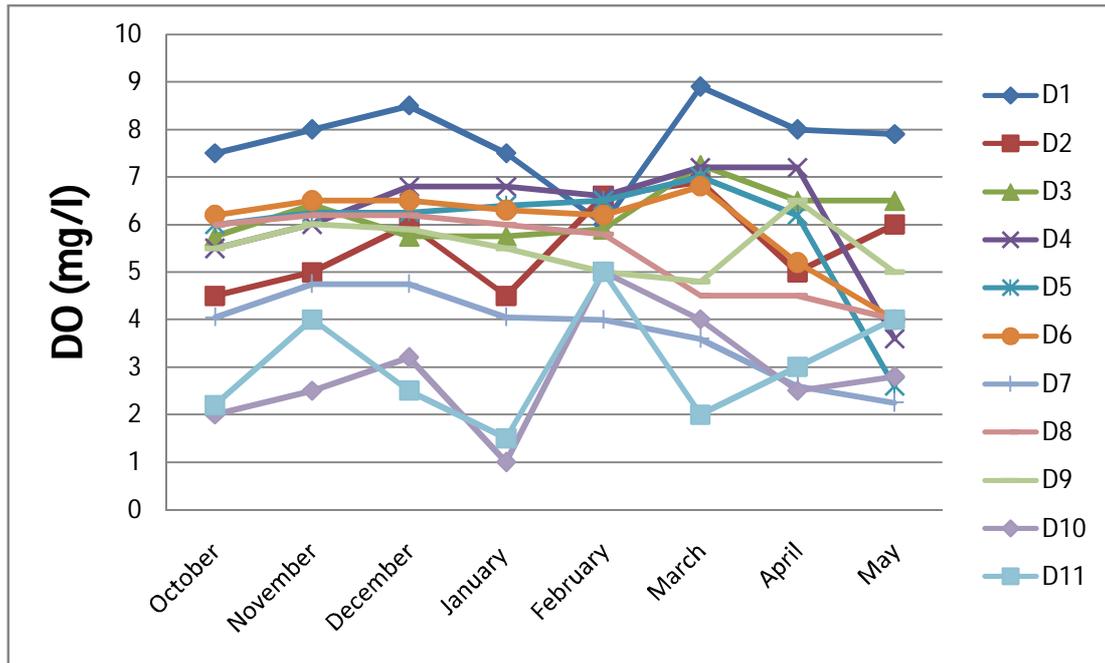


Figure 4:-Monthly variation of DO at various sites

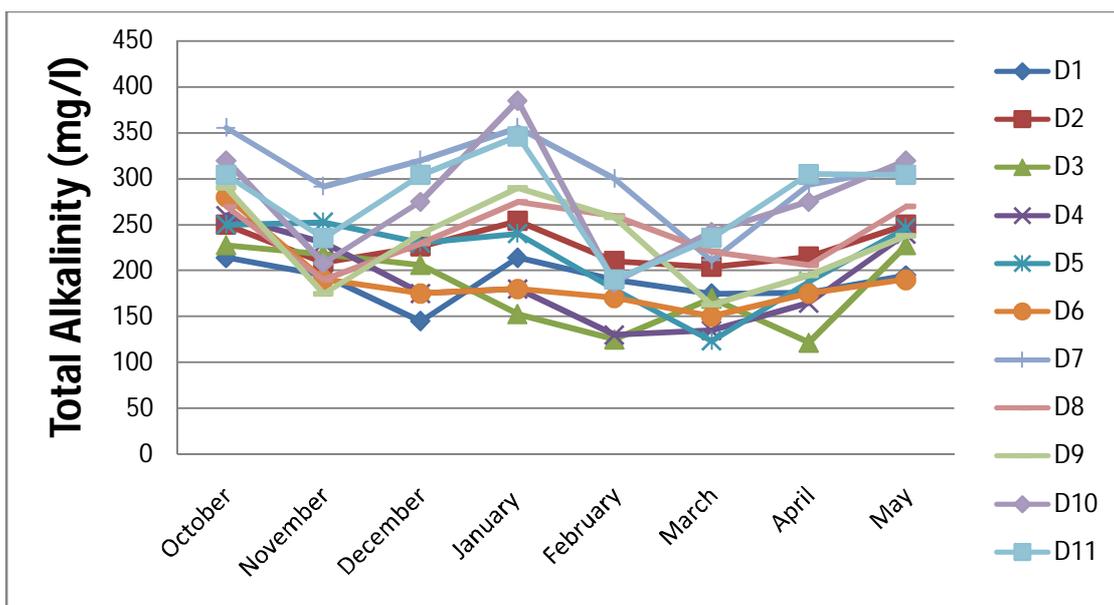


Figure 5:-Monthly variation of Total Alkalinity at various sites

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 1, January 2018

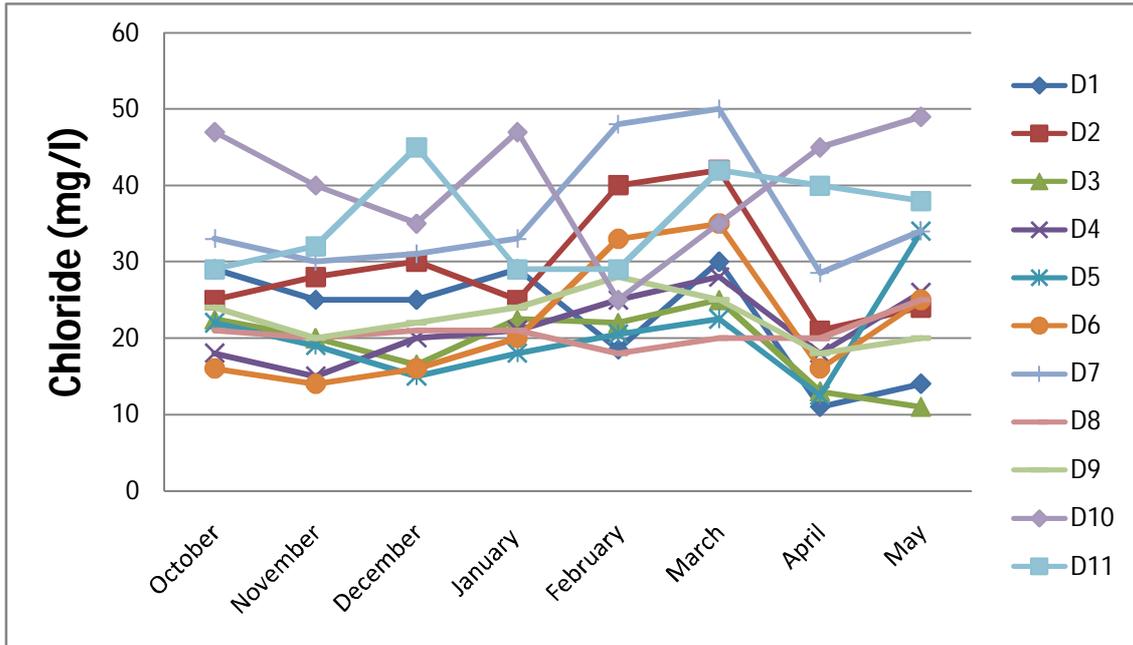


Figure 6:-Monthly variation of Chloride at various sites

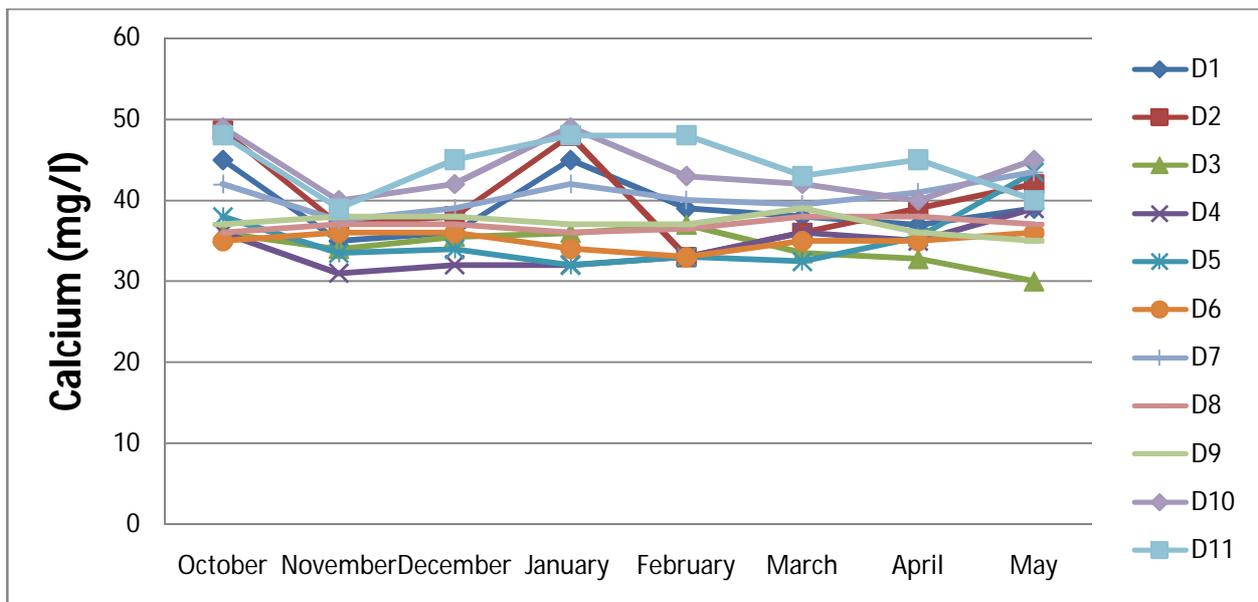


Figure 7:-Monthly variation of Calcium at various sites

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 1, January 2018

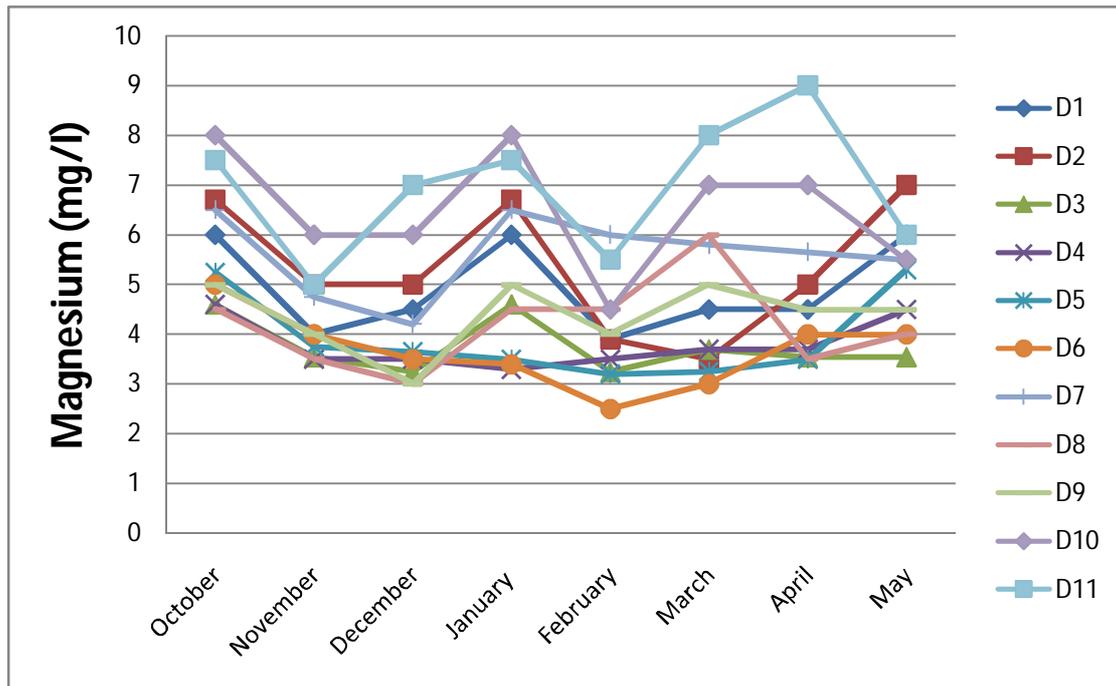


Figure 8:-Monthly variation of Magnesium at various sites

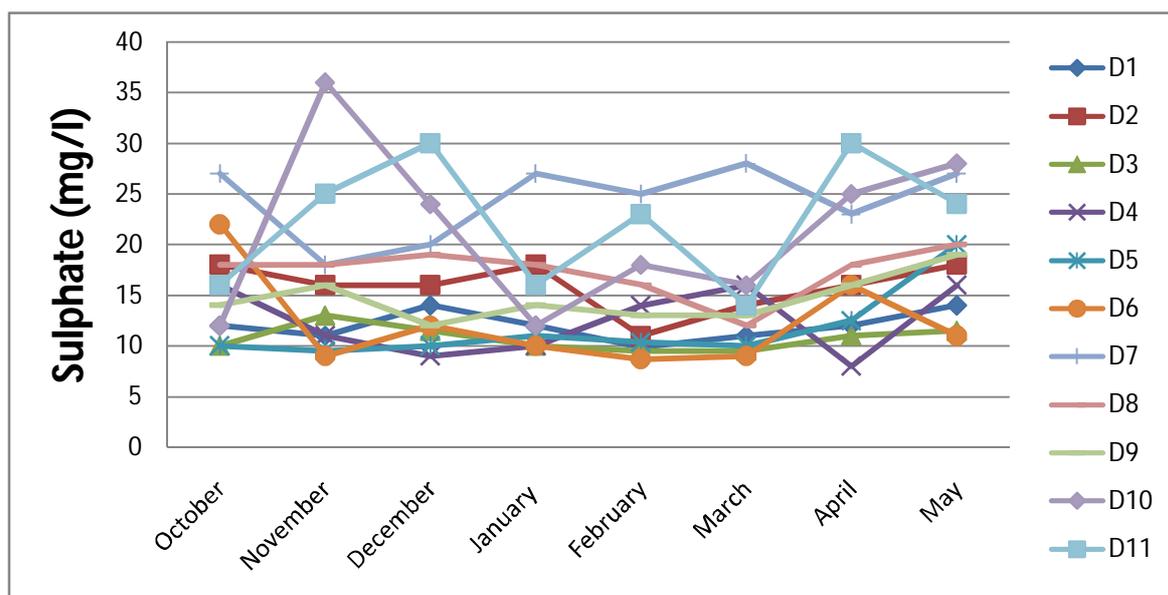


Figure 9:-Monthly variation of Sulphate at various sites

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 1, January 2018

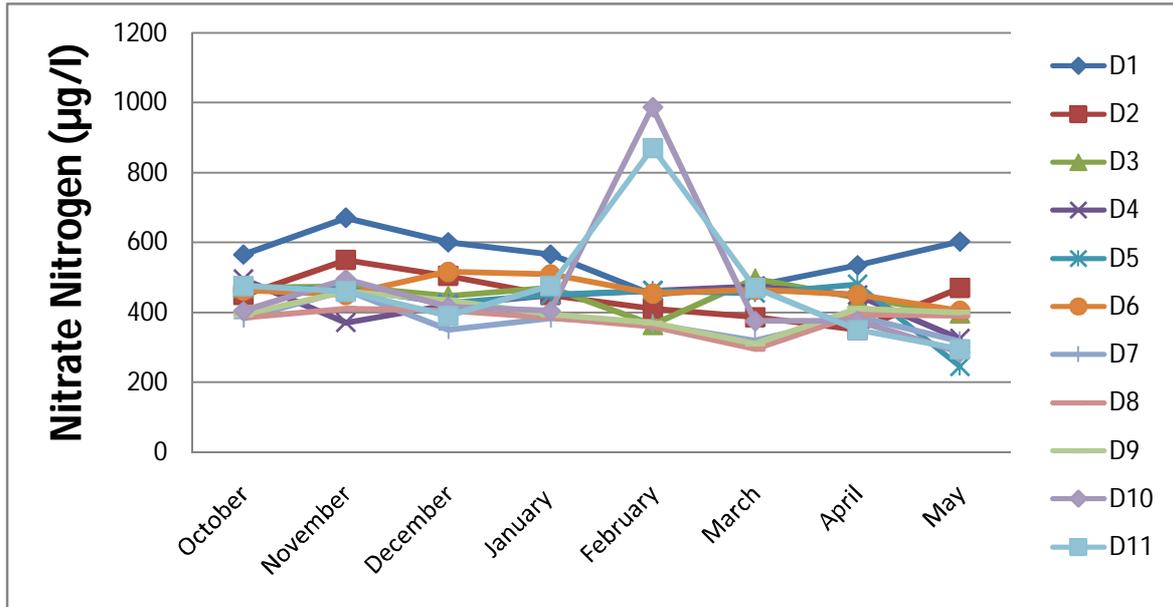


Figure 10:-Monthly variation of Nitrate Nitrogen at various sites

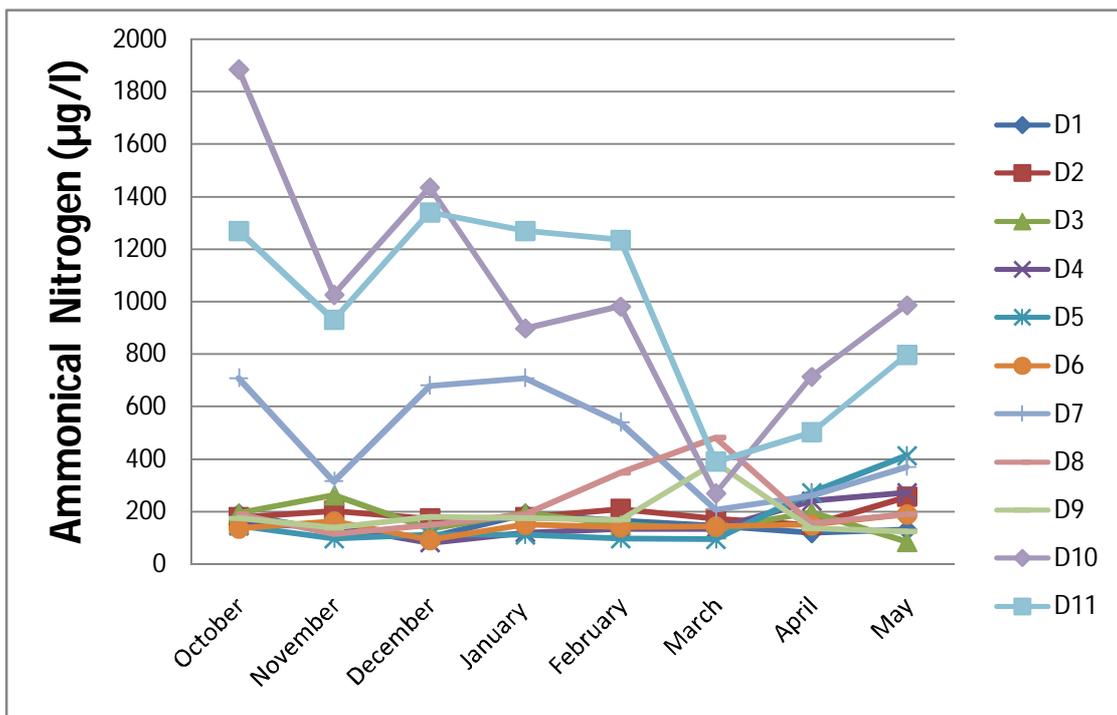


Figure 11:-Monthly variation of Ammonical Nitrogen at various sites

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 1, January 2018

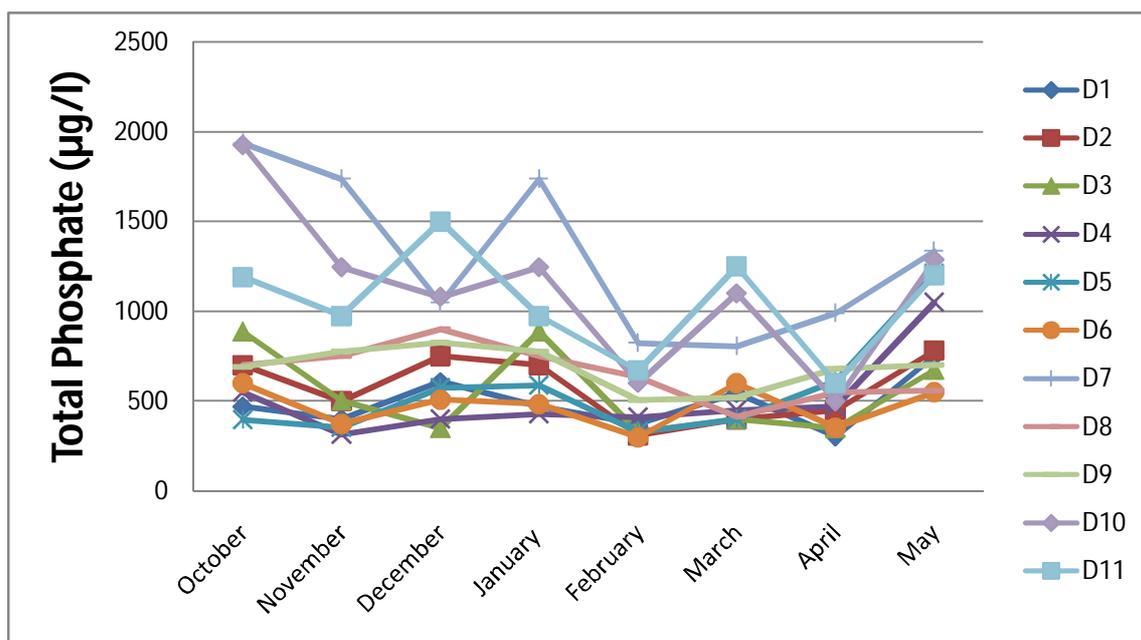


Figure 12:-Monthly variation of Total Phosphate at various sites

Dal Lake is characterized by alkaline pH values. pH shows considerable variations in the study period. Maximum pH value was detected at site D6 site near KabootarKhana at 8.9 in the month of May, and minimum value of 7.3 was found at site D2 corresponding to Dhobi Ghat area in the month of March. The pH recorded in the present study was in alkaline range suggesting that the lakes were well buffered throughout the study period. The high pH values indicate productive nature of the lake.

Low Conductivity (0 to 200 $\mu\text{S}/\text{cm}$) is an indicator of pristine or background conditions. Midrange conductivity (200 to 1000 $\mu\text{S}/\text{cm}$) is the normal background for most major freshwater lakes. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or bugs. High conductivity (1000 to 10,000 $\mu\text{S}/\text{cm}$) is an indicator of saline conditions. The electrical conductivity varies from 126 $\mu\text{S}/\text{cm}$ at site D1 (near entry of TelbalNallah) in the month of January to 570 $\mu\text{S}/\text{cm}$ in March, 2011 at D10 (Outlet site of Hazratbal STP). Electric conductivity depends upon the quantity of dissolved salts present in water and among the 11 sites the highest conductivity at site-D10 may be due to the high influence of STP discharge.

Maximum concentration of Dissolved Oxygen was observed at site D1 inside the lake near the entry of TelbalNallah with value of 7.41 mg/l in the month of March. Minimum value was found at site D10 in the month of January 1 mg/l. In summer and autumn dissolved oxygen is usually low because colder liquid is capable of dissolving more gas than warmer. Additionally there is more phytoplankton activity which consumes dissolved oxygen.

For total alkalinity, maximum concentration was detected at D10 near outlet site of Hazratbal STP at 385 mg/l in the month of January. Minimum was found at D3 site near Central site Sonalank at 121.5 mg/l in the month of April. Moyle et al classified the lake waters as soft, medium and hard on the basis of total alkalinity values. According to this classification waters having alkalinity up to 40 mg/l are soft, with 40 – 90 mg/l medium and above 90 mg/l as hard. Therefore the water of Dal Lake falls under the hard water type.

International Journal of Innovative Research in Science, Engineering and Technology

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Visit: www.ijirset.com

Vol. 7, Issue 1, January 2018

Maximum chloride concentration was found at site D7 near Central site Nigeenat 50 mg/l in the month of March and minimum concentration was discovered at D3 near Central site Sonalank at 11 mg/l in the month of May. Elevated chloride concentration at site D7 may be attributed to the proliferation of houseboats in the area. The high chloride value in summer is indicative of fecal and sewage proliferation augmented by high anthropogenic activity.

The maximum concentration of calcium was found at site D10 near outlet site of Hazratbal STP at 49 mg/l in January. Minimum calcium concentration was found at near Central site Sonalank at 30 mg/l in May. Greatest magnesium concentration was observed at site D11 near outlet of Habak STP at 9 mg/l in the month of April. The quantities of calcium in lake water are due to prevalence of lime rocks in the catchment. The elevated quantities of calcium and magnesium may be attributed to the addition of re-mineralised sewage effluent from the STPs.

The maximum concentration of sulphate was found at site D10 near outlet site of Hazratbal STP at 36 mg/l in the month of November, minimum sulphate concentration was found at site D4 Near Nishat Pipe line bund at 8 mg/l in April. Elevated sulphate concentration at sites D10 and D11 is because of the sewage discharge of the operating STPs, while high value at site D7 is because of the discharge of the stationed houseboats prevalent in the area. Sources of sulphate could be sewage effluent, combustion of fossil fuels (which accounts for the majority of sulphur in the atmosphere), which can return to the surface as sulphate through precipitation or dry deposition and crushed limestone (commonly used in parking lots and road construction).

Maximum concentration of nitrate nitrogen was found at D10 near outlet site of Hazratbal STP at 986 $\mu\text{g/l}$ in the month of February, minimum nitrate nitrogen concentration at D5 site near Central site near Char Chinariat 245 $\mu\text{g/l}$ in May. Highest value of nitrate nitrogen at site D10 may probably be because of the nutrient rich STP effluent whereas the minimum value was found at D5 because of the restricted access of pollutants there. Maximum concentration of ammonical nitrogen was found D10 near outlet site of Hazratbal STP at 1884 $\mu\text{g/l}$ in the month of October. Minimum ammonical nitrogen concentration was found at D3 site near Sona Lank at 85 $\mu\text{g/l}$ in the month of May. Peak values at D10 may again be ascribed to the nutrient rich STP effluents while low value at site D3 could be because of the limited anthropogenic disturbance of the area.

There were considerable fluctuations in total phosphate concentrations. Maximum total phosphate concentration was found at D10 near outlet site of Hazratbal STP at 1925 $\mu\text{g/l}$ in the month of October, and lowest total phosphate concentration was found at D6 site near Near Kabootar Khana at 300 $\mu\text{g/l}$ in February. Higher concentration of total phosphate at site D10 is attributed to direct drainage of sewage at this site. In general, lower concentrations were maintained in the winter months at all sampling sites. Phosphate enters the lakes through domestic wastewater, accounting for the accelerated eutrophication. Increased concentration of phosphate and nitrate nitrogen in lakes has resulted in enhanced productivity³⁶. Phosphorous is generally recognized as one of the key nutrients in the productivity of freshwaters as it is essential element determining. Sawyer et al (1945) suggested that 0.3 mg/l of orthophosphate and 0.15 mg/l of nitrate nitrogen are critical levels beyond which algal bloom may appear indicating cultural eutrophication.

V. CONCLUSIONS

The lake is eutrophic and will provide sustenance to varied number of organisms from phyto and zooplanktons, benthos to fishes and macrophytes due to the proliferation of chemical species required for generation of energy and production of organic compounds existing in the lake. Lake water quality is mainly influenced by waste water discharge and agricultural run-off by way of propagation of nutrients like nitrate-nitrogen, ammonium-nitrogen, phosphates and chlorides. Consequently, it can be established that the water quality of Dal Lake was observed to be polluted as a result of direct drainage of sewage from proximate inhabited areas including houseboats. Mushrooming of the hospitality sector in and around Dal Lake is also responsible for deterioration of its water quality. Physico-chemical data acquired

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Vol. 7, Issue 1, January 2018

in this study could be used as reference line when evaluating further variations caused by natural or anthropogenic activities in the lake.

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