Biological Forum – An International Journal **14(3): 1682-1689(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of surface Water quality Parameters at different Sites of Wular Lake of Kashmir Himalayas

Saima Andleeb*, Irfan Ahmad, Asim Iqbal Bazaz, Mehak Hafeez, Azra Shah and Durdana Qazi
Division of Fish Genetics & Biotechnology, Faculty of Fisheries,
SKUAST-Kashmir, Rangil, Ganderbal (J&K), India.

(Corresponding author: Saima Andleeb)*
(Received 02 August 2022, Accepted 07 September, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Due to overpopulation and development activities that have exploited and degraded the water resources at our disposal, water quality has become a global problem. f this context, an attempt has been made to evaluate the water quality in Lake Wular of Jammu & Kashmir, India. It is an ox-bow type lake of fluviatile origin and India's largest fresh water lake located in Bandipora district in the UT of Jammu and Kashmir. Parameters like total phosphorous, nitrate nitrogen, ammonical nitrogen, dissolved oxygen, water temperature and pH were determined at the sampling sites and detailed analysis of samples were carried out using the methods outlined in American Public Health Association. Site E recorded maximum average concentration of total phosphorous concentration (408.8±16.48µg/l) as well as maximum average of nitrate nitrogen (440.7±41.04 µg/l). Negative significant correlation was recorded between nitrate and phosphate levels of the lake (r= -0.816; P<0.01). Mean concentration of ammonical nitrogen recorded was maximum of 368.32±11.87 µg/l in the month of February. Dissolved oxygen concentration ranged between 6.42±0.18 to 8.68±0.22 in summer and winter months respectively. Also, there was also a positive correlation between temperature and pH (r=0.807, p<0.01) and pH and dissolved oxygen (r= 0.579; P<0.01). From the present study, it was concluded that Wular Lake falls under eutrophic category.

Keywords: Ammonia, Dissolved oxygen, Nitrate, Phosphate, Wular Lake.

INTRODUCTION

Wular, an ox-bow type lake of fluviatile origin and India's largest fresh water lake is located in Bandipora district in the UT of Jammu and Kashmir. One of the largest freshwater lakes in Asia lies between 34° 16' to 34° 26' N Latitude and 74° 32' to 74° 42' E Longitude with an elevation of 5,180 meters above Sea level. As a result of tectonic activity the lake basin was formed and is fed by the Jhelum River. The outline of the lake is asymmetrically irregular. But it has somehow elliptical resemblance in shape. The mountainous ranges surround the lake on the North-eastern and the North-western sides which drain their run-off in the lake through various Nallahs. Southern side of the lake is the "Delta of the Jhelum" into which the river empties itself before seeking a passage, out of the lake, to Baramulla. It joins with the Wular Lake at Banyari (Hajin) and leaves the lake at Ningli (Sopore). The present area of the lake as per the revenue records has been recorded as 130.25 sq.kms, out of which 3.70 sq.kms is under agricultural use, 0.15 sq.kms under human occupancy and 60.50 sq.kms under agriculture and forestry and remaining the net water spread area (water body) of the lake as 65.90 sq.kms. But during floods the water-spread area extends and the lake acts as a large absorption basin, as all the rivers and streams ultimately pour into it (Dar *et al.*, 2012). The lake acts as huge absorption basin for floodwaters and also maintains flow to hold up hydropower generation, agriculture as well as sports activities therefore, it plays an essential role in Hydrography of Kashmir valley. The lake along is an important habitat for fish, accounting for 60% of the fish production within the state of Jammu and Kashmir (Rumysa *et al.*, 2012).

Due to anthropogenic influences (agricultural practices, sewage runoff, increased exploitation of water resource and urban sprawl) and natural processes (changes in precipitation, erosion, and weathering of crustal materials), the water quality of Wular Lake has been deteriorated from past decades (Rumysa *et al.*, 2012; Sheikh *et al.*, 2014).

The tremendous anthropogenic pressure have been progressively produced large number of pollutants which are directly discharged into the Wular Lake, and have resulted in grievous degradation of water quality, restriction of sustainable development of the local economies. Moreover, escalating nutrient inputs from both natural as well as human activities has resulted in Lake Eutrophication (Kundangar *et al.*, 1996; Shah and Pandit 2012). The present research work aims to assess the environmental contamination in Wular Lake.

METHODOLOGY

A. Selection of sampling sites

For the present study, five sampling sites were selected from Wular lake *viz.,* Kulhama, Laherwalpora and Ashtung from January to July 2019 (Fig. 1).

Site A: Kulhama: It is the small fishing village in the district Bandipora. The site is located towards the eastern side of the lake near to the vintage park between geographic coordinates of 34^o 22′53.1″N and 74^o 39′11.5″ E.

Site B: Laherwalpora: Geographically this site lies between 34^o 23′47.4″N and 74^o 35′9.1″E. This village is among the largest fishing villages of the district Bandipora. Moreover this site is highly influenced by agriculture and domestic sewage.

Site C: Ashtung: It is a small fishing village located on the north-western side of the lake between geographic coordinates of 34^o 24′14.8" N and 74^o 32′34.9″ E.

Site D: Gurura: This is also small village on the banks of Wular lake. Geographically it lies between 34^o 22′37.6″E and 74^{o}40′21.7″N.

Site E: Lankreshipora: This is a moderate size fishing village located towards eastern side of the lake having geographical coordinates of 34.3977^o N and 74.6390^{o}E.

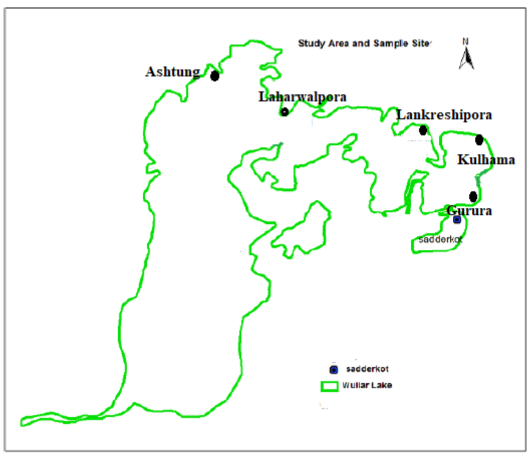

Fig. 1. Location of study sites in Wular lake.

B. Water Chemistry

Surface water samples were collected by hand from the each sampling site 1 in one litre polyethylene bottles marked distinctly. The sampling was done usually between 11:00am to 2:00 pm. Parameters like water temperature and fixing of Dissolved oxygen were determined at the respective sampling sites and detailed analysis of samples were carried out in AEM Laboratory at Faculty of fisheries, SKUAST- Kashmir using the methods outlined in American Public Health Association (2005). Following parameters were analyzed:

C. Water Temperature

The temperature of water samples were determined by using infrared thermometer. The reading obtained was expressed in ^{o}C (Fig. 2).

Fig. 2. Detection of temperature using infrared thermometer.

D. Dissolved Oxygen

Iodometric method was used for determining the concentration of Dissolved oxygen. The D.O. concentration was calculated from the given formula and the results were expressed in mg $L^{-1.}$

E. pH (Hydrogen ion concentration)

The pH of the water samples was determined by using a hand held digital pH meter (Eutech, Singapore). Before use, the pH was standardized with buffer solutions (pH 4 and 7).

F. Nitrate Nitrogen

Determination of nitrate nitrogen was done using "phenol disulphonic acid". The intensity of the colour was measured on spectrophotometer (Systronics, India) set at 410nm, using distilled water blank. Results were compared with standard curve and were expressed in µg/l.

G. Total phosphorous

Total phosphorous concentration was estimated by digesting 25ml of water sample containing 1ml concentrated sulphuric acid and 5ml nitric acid to 1ml colourless solution using spectrophotometric method.

H. Ammonical Nitrogen

The concentration of ammonical nitrogen was estimated by phenate method.

I. Statistical Analysis

The data collected were statistically analyzed by "PAST-3" software. Data was subjected to one-way analysis of variance (ANOVA) and correlation, $p< 0.005$ was considered as statistically significant.

RESULTS AND DISCUSSION

A. Total Phosphorous

In the present study, Site A recorded the lowest average total phosphorus concentration of 368.86±19.85 µg/l while as highest average total phosphorus concentration of 408.8±16.48 µg/l was recorded from site E (Table 1 and Fig. 3). The overall higher total phosphorous values of the lake were recorded in summer months while as lowest values were recorded in winter months. Minimum values of total phosphorus during winter season could be ascribed to reduced usage of pesticide and fertilizers in arable lands surrounding the lake catchment, while as maximum values of total phosphorus towards summer season could be due to the anthropogenic inputs of fertilizers and pesticides rich in phosphate applied to the agriculture fields surrounding the lake and mineralization of decomposed materials. The result obtained is in complete agreement with Dixit *et al.* (2013). Similar results were found by Kaul and Handoo (1980) who reported appreciable decline in total phosphorus values during winter. Agriculture run-off, untreated domestic sewage, washing of clothes and vehicles are the primary sources of $PO4^{-3}$ in summer (Bhat *et al.*, 2017). The elevated levels of nitrogen and phosphorus, particularly the latter, are owing to enormous amounts of domestic sewage and agricultural runoff infiltrating the basin not just through drains but also through the Dal lake (Siraj *et al.*, 2018).

Table 1: Monthly variation in total Phosphorous (µg/L) at 5 different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	325.7	301.5	357	398.3	408.2	422.5	368.86±19.85	**<0.01**
Site B	377.3	341.8	377.2	413.5	411.2	474.2	399.2±18.46	
Site C	375	327.2	367.9	395.2	425.7	445.8	389.46±17.38	
Site D	371.4	383.8	369.3	418.6	427.3	419.5	398.31±10.76	
Site E	385.3	359.7	388.3	422.4	421.9	475.2	408.8±16.48	
Mean ±SE	**366.94±10.55**	**342.8±13.99**	**371.94±5.20**	**409.6±5.45**	**418.86±3.87**	**447.44±12.02**		

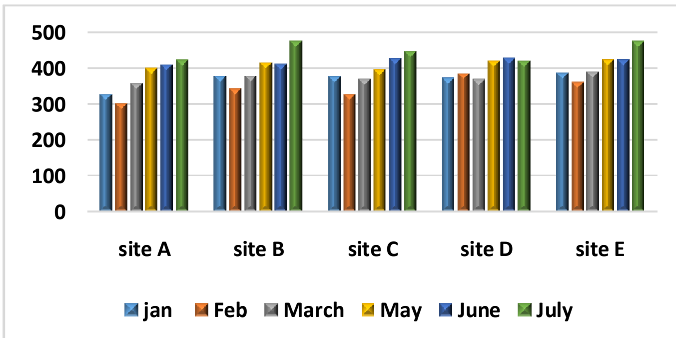

Fig. 3. Monthly variation in total phosphorous concentration (µg/L) at 5 different sites.

B. Nitrate nitrogen

In the present study, Site B recorded the lowest average nitrate nitrogen concentration of 415.66±40.75µg/l while as highest average nitrate nitrogen concentration of 440.7±41.04µg/l was recorded from site E (Table 2 and Fig. 4). Nitrate nitrogen shows seasonal higher values in winter which is the reflection of low denitrification rate and also non-utilization by plants in this season. This is in agreement with the findings of Shah *et al.* (2017) who reported higher concentration of nitrate during winter and lower concentration in warmer months while studying the dynamics of physico-chemical limnology of a shallow wetland in Kashmir. Highly elevated levels of nitrate nitrogen during winter due to a decreased biological activity (bacterial denitrification and algal assimilation) in winter Ratnayaka *et al.* (2009). The nitrate- nitrogen levels >150µg/L is an indicator of Eutrophication and as such the Wular Lake falls under Eutrophic category was reported by Ganpati (1960).

Table 2: Monthly variations in Nitrate nitrogen (µg/L) at 4 different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	527.1	511.3	481.3	397.6	308.8	336.4	427.08±37.91	**<0.01**
Site B	514.4	524.7	477.3	337.2	318.3	322.1	415.66±40.75	
Site C	523.3	506.4	431	393.4	362.5	311.5	421.35±33.68	
Site D	529.4	512.5	493.2	385.8	359.4	319.4	433.28±36.41	
Site E	544.3	538.5	500.4	401.9	344.7	314.4	440.7±41.04	
Mean ±SE	**527.7 ±4.87**	**518.68±5.79**	**474.64±12.13**	**383.18±11.79**	**338.74±10.81**	**320.76±4.32**		

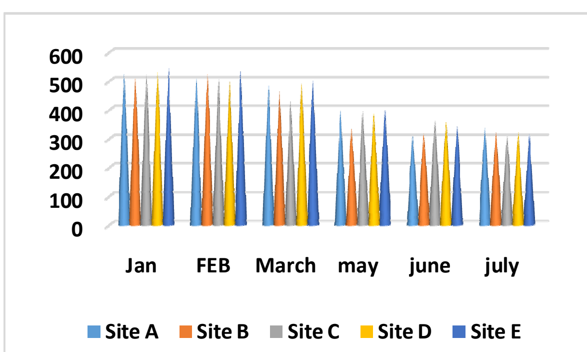

Fig. 4. Monthly variation in total nitrate nitrogen concentration (µg/L) at 5 different sites.

C. Ammonical nitrogen

In the present study, Site C recorded the lowest average ammonical nitrogen concentration of 304.06±23.83 µg/l while as highest average ammonical nitrogen concentration of 324.08±21.92µg/l was recorded from site A (Table 3 and Fig. 5). The winter high values of ammonical nitrogen at all the study sites may be explained on the basis of relatively low nitrification of ammonical nitrogen due to low temperatures, which retards the nitrification process (Kaya *et al*., 2010). Finlay *et al*. (2007) obtained the similar results during their study. On the other hand, during warmer months the lower concentration of ammonia is due to the photosynthetic assimilation by autotrophs during their growth in summer (Pandit, 1999). The findings of present study are in agreement with Kayranli *et al*. (2010). They reported high levels of ammonical-nitrogen during winter and attributed it to the relatively low nitrification of ammonical-nitrogen due to low temperatures, which negatively affects the nitrification. Dar (2015) obtained the similar results, higher values of ammonia during winter and lower values in summer.

Table 3: Monthly variations in Ammonical nitrogen (µg/L) at 4 different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	367.4	373.6	364.8	305.5	293.8	239.4	324.08±21.92	<0.01
Site B	355.7	391.5	332.7	321.4	305.5	218.6	320.9±23.83	
Site C	388.9	328.5	333.7	269.6	291.8	211.9	304.06±23.83	
Site D	330.4	391.4	295.4	315.3	299.4	252.4	314.05±18.81	
Site E	371.5	356.6	374.7	294.9	301.4	216.9	319.33±24.89	
Mean ±SE	**362.78±9.69**	**368.32±11.87**	**340.26±13.96**	**301.34±9.12**	**298.38±2.50**	**227.84±7.73**		

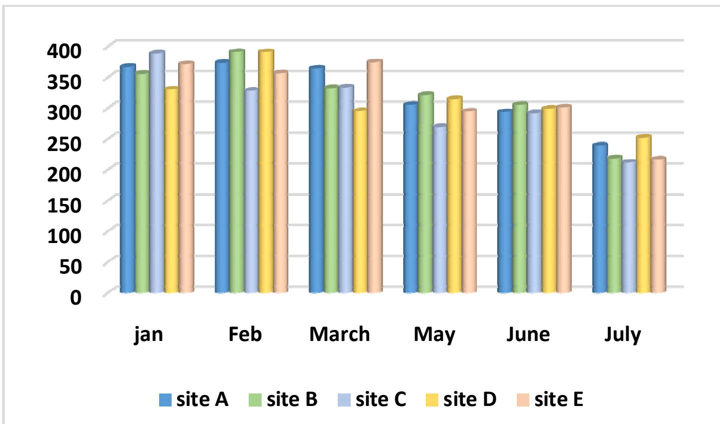

Fig. 5. Monthly variation in total ammonical nitrogen concentration (µg/L) at 5 different sites.

D. Dissolved Oxygen

In the present study, Site D recorded the lowest average dissolved oxygen concentration of 7.5±0.34 µg/l while as highest average dissolved oxygen concentration of 8.03±0.37 µg/l was recorded from site B(Table 4 and Fig. 6). Bushati *et al*. (2010); Kumar and Jha (2015) have also recorded similar seasonal variations. The respiratory rate of microorganisms and other species can be attributed to low levels of dissolved oxygen in summer. Channar *et al*. (2014), while high dissolved oxygen concentrations can be ascribed to low biological activity during winter (Channar *et al*., 2014). Naik *et al*. (2015) reported the higher values of dissolved oxygen in colder and lower values during warmer months, clearly reflecting an inverse relation of dissolved oxygen with the temperature. The higher concentration of dissolved oxygen at site B and Site C is due to luxuriant growth of submerged macrophytes which act as main sources of aeration for the lake, thereby enhancing light penetration and hence photosynthesis (Srivastava *et al*., 2008). DO levels were highest (2.6 mg/l) in February and lowest (0.2 mg/l) in July. The basin's relatively lower DO content, despite its abundant macro-vegetation, can be attributed to hyper-eutrophication, which is generated by a rapid rate of organic matter decomposition throughout the year (Siraj *et al*., 2018).

Table 4: Monthly variations in Dissolved oxygen (mg/L) at 4 different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	8.7	8.2	8	7.7	6.8	6.2	7.6±0.38	<0.01
Site B	9.3	8.5	8.6	7.7	7.3	6.8	8.03±0.37	
Site C	8.3	8.7	8.1	7.8	7.1	6.2	7.7±0.37	
Site D	8.1	8.1	7.9	7.9	7	6	7.5±0.34	
Site E	9	8.5	8.2	7.4	6.6	6.9	7.76±0.38	
Mean ±SE	**8.68±0.22**	**8.4±0.10**	**8.16±0.12**	**7.7±0.08**	**6.96±0.12**	**6.42±0.18**		

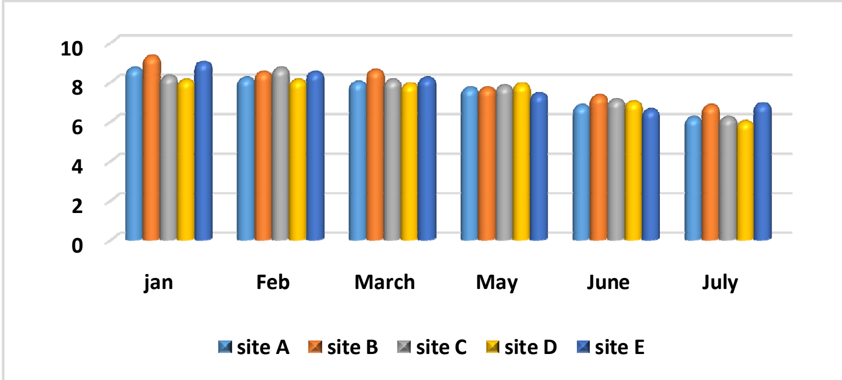

Fig. 6. Monthly in dissolved oxygen concentration (µg/L) at 5 different sites.

E. Water temperature

In the present study, Site E recorded the lowest average temperature of 14.2±4.10°C while as highest average temperature of 14.66±4.30 °C was recorded from site D (Table 5 and Fig. 7). Also highest average water temperature values were reported during summer months compared to winter. Increase in water temperature is attributed to the increase in solar radiation due to comparatively longer day length. Similarly, a gradual reduction in solar radiation may explain fall in temperature during winter months and again it begins to increase during warmer months. Ganie *et al*. (2015) reported that cold, low ambient temperatures and shorter photoperiods could be ascribed to lower water temperatures in winter. Dar (2015) reported that the meteorological conditions such as trade winds, sunshine durations and absorption of the solar radiation by the shallow lake water body might be responsible for the monthly variations. Siraj *et al.* (2018) reported that water temperature changed in close connection to air temperature, with peaks in July and lows in January and February.

Table 5: Monthly variation in water temperature (°C) at different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	3.7	4.8	7.9	17.3	24.6	27.3	14.26±4.19	<0.01
Site B	3.8	4.1	6.9	19.3	25.3	25.6	14.16±4.25	
Site C	4.1	4.3	7.2	20.1	23.9	27.9	14.58±4.33	
Site D	3.9	4.4	7.8	19.9	24.9	27.1	14.66±4.30	
Site E	4	4.9	7	19.7	22.9	26.7	14.2±4.10	
Mean ±SE	**3.9±0.70**	**4.5±0.15**	**7.36±0.20**	**19.26±0.50**	**24.32±0.42**	**26.92±0.38**		

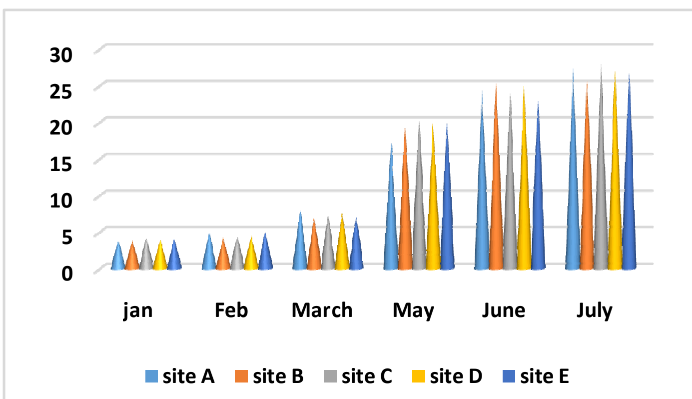

Fig. 7. Monthly variation of temperature at 5 different sites.

F. pH

In the present study, Site B recorded the lowest average pH of 7.68±0.21 while as highest average pH of 7.85±0.29 was recorded from site D (Table 6 and Fig. 8). Also highest average pH values were reported during summer months compared to winter. The pH recorded in the present study was in neutral to alkaline range suggesting that the lakes were well buffered throughout the study period. Lower pH during winter is because of the increased decomposition of organic matter under least water depth (Reimer *et al*., 2008). Hassan *et al*. (2015) while studying the influence of land use/land cover on the water chemistry of Wular Lake in Kashmir Himalaya (India) reported the neutral to alkaline pH throughout the study period. The findings of the present study are in close proximity with the findings of Naik *et al.* (2015), who reported lower values of pH during winter months.

Table 6: Monthly variation in pH at 4 different sites.

Site	January	February	March	May	June	July	Mean ±S.E	P Value
Site A	7.9	7.2	6.8	7.7	8.1	8.8	7.75±0.28	<0.01
Site B	7.2	7.6	7.2	7.5	8	8.6	7.68±0.21	
Site C	7.4	7.1	7.3	7.9	8.2	8.9	7.8±0.27	
Site D	7.9	6.9	7.7	7.3	8.5	8.8	7.85±0.29	
Site E	7.5	7	7.1	8.1	7.9	8.9	7.75±0.28	
Mean ±SE	**7.58±0.13**	**7.16±0.12**	**7.22±0.14**	**7.7±0.14**	**8.14±0.10**	**8.8±0.05**		

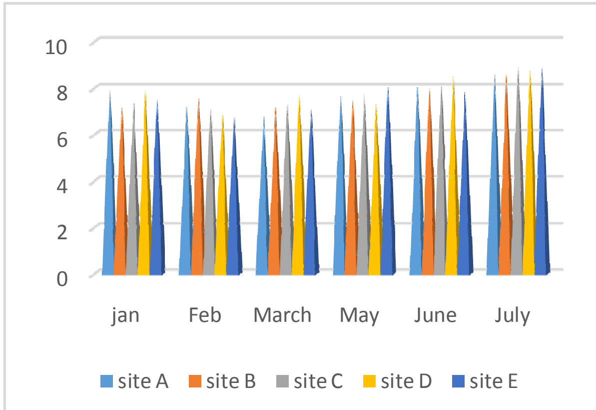

Fig. 8. Monthly variation of pH at 5 different sites.

Table 7: Correlation between different parameters.

	Total Phosphorous	ammonia	pH	Temperature
Nitrate nitrogen	-0.8162	0.8347*	-0.743	-0.973
Temperature	0.844*	-0.859	0.807*	
Dissolved oxygen	0.644*	-0.493	0.5791*	0.685*

*= significant at 0.01 (1%) level of significance

A significant positive correlation was found between temperature and pH (r=0.807, p<0.01), between temperature and total phosphorous (r=0.844, p< 0.01), between temperature and dissolved oxygen (r=0.685, p<0.01) and between pH and dissolved oxygen (r=0.579, p<0.01) (Table 7 and Fig. 9-11).

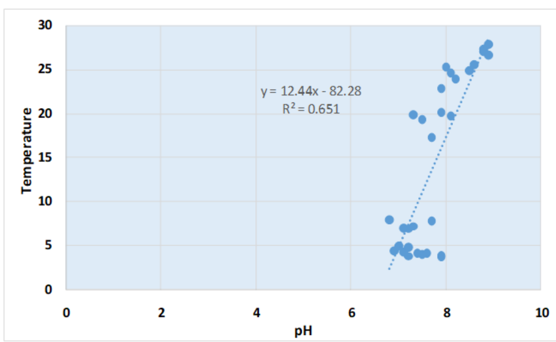

Fig. 9. Scatter plot showing correlation between water temperature and pH.

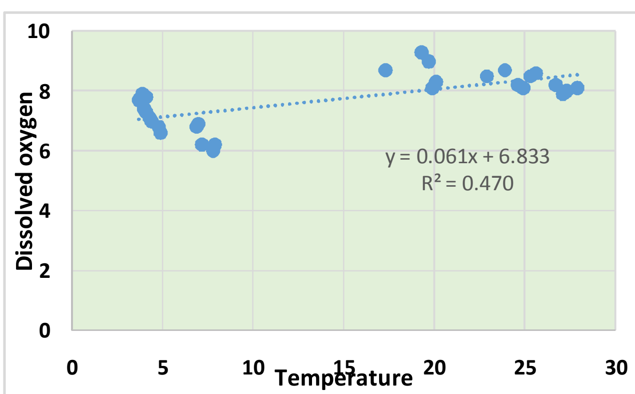

Fig. 10. Scatter plot showing correlation between water temperature and dissolved oxygen.

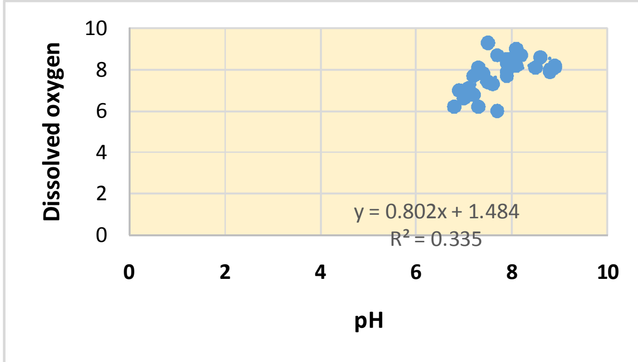

Fig. 11. Scatter plot showing correlation between dissolved oxygen and pH.

CONCLUSION

From the current study, it is concluded that the physico-chemical characteristics of the water have either directly or indirectly impacted the trophic status of the Lake as a result of significant anthropogenic pressure, pollution load, organic matter outcome, massive amounts of raw sewage, direct drainages, etc. These shifting circumstances have brought this Lake to a critical stage in terms of ecology, and if suitable conservation measures are not implemented in the future, the Lake would certainly degrade further. As a result, adequate management measures must be implemented by government officials and local residents to prevent the lake from degrading further.

Acknowledgement. The author is highly thankful to Division of AEM, Faculty of Fisheries, SKUAST-K for providing laboratory facilities during research program. Thanks are also due to fellow colleagues for their support and help during lab course and field visits.
Conflict of Interest. None.

REFERENCES

Bhat, R. A, Rehman, S, Mehmood, M. A, Dervash, M. A., Mushtaq, N, Bhat, J. I. A. and Dar, G. H. (2017). Current status of nutrient load in Dal Lake of Kashmir Himalaya. *Journal of Pharmacognosy and Phytochemistry 6*(6), 165-169.

Bushati, N., Neziri, A. and Hysko, M. (2010). Investigation on physico-chemical and microbiological of the parameters of Lake Shkodra. Department Biochemistry, Faculty of Natural Sciences, University of Shkodra, Albania, Republic of Macedonia pp. 1-5.

Channar, A. G., Rind, A. M., Mastoi, G. M., Almani, K. F. Lashari, K. H., Qurishi, M. A. and Mahar, N. (2014). Comparative study of water quality of Manchar lake with drinking water quality standard of world health organization. *American Journal of Environmental Protection, 3*(2), 68-72.

Dar, N. A. (2015). Distribution, production and biochemical status of dominant macrophytes in Wular Lake, A Ramsar site in Kashmir Himalaya. Ph.D Thesis submitted to P.G department of Environmental Sciences, Faculty of Physical and Material Science, University of Kashmir Srinagar, 190006, J&K.

Dar, S. A., Desai, A. Y., Rather, A. M., Sayani, A. N., Parmar, E. R., Arjamand, S. and Chesti, A. (2012). Fishing gears operated along the Wular Lake, Jammu & Kashmir, India. *Eco. Env. & Cons. 20 (Suppl.):* pp. (S45-S47).

Dixit, P. R., Kar, B., Chattopadhyay, P. and Panda, C. R. (2013). Seasonal Variation of the Physicochemical Properties of Water Samples in Mahanadi Estuary, East Coast of India. *Journal of Environmental Protection 4*, 843-848

Finlay, J. C., Sterner, R. W. and Kumar, S. (2007). Isotopic evidence for in-lake production of accumulating nitrate in Lake Superior. *Ecol Appl., 17*(8), 2323–2332

Ganapati, S. V. (1960). Ecology of tropical water. In*: Proceeding of Symposium on Algology* ICAR, New Delhi 214-218.

Ganie, M. A., Parveen, M. and Balkhi, M. H. (2015). Physico-Chemical Profile of Three Freshwater Flood Plain Lakes of River Jhelum, Kashmir (India). *International Journal of Multidisciplinary Research and Development*, *2*(11), 527-532.

Hassan, Z., Shah, J. A., Kant, T. A., and Pandit, A. K. (2015). Influence of land use/land cover on the water chemistry of Wular Lake in Kashmir Himalaya (India). *Ecological Processes, 4*: 9.

Kaul, V. and Handoo, J. K. (1980). Physicochemical characteristics of Nilnag - a high altitude forest lake in Kashmir and its comparison with valley lakes; *Proc. Indian National Sci. Acad. B., 46*(4), 528-541.

Kaya, A., Fontaneto, M., Segers, D,, Egers, H. and Altindag, A. (2010). Temperature and salinity as interacting drivers of species richness of planktonic rotifers in Turkish continental waters. *Journal of Limnology, 69*(2), 297-304.

Kayranli, B., Scholz, M., Mustafa, A. and Hedmark, A. A. (2010). Carbon storage and fluxes within freshwater wetlands: A critical review. *Wetlands, 1*, 111-124.

Kumar, R. and Jha, A. K. (2015). Physico-chemical Studies on Kamla River Water. *International Journal of Advanced Research in Computer Science and Software Engineering, 5*(5), 1411-1415.

Kundangar, M. R. D., Sarwar, S. G. and Husssain, J. (1996). Zooplankton population and nutrient dynamics of wetlands of Wular lake, Kashmir, India," In: *Environment and Biodiversity in the Context of South Asia*, P. K. Jha, G. P. S. Ghimire, S. B. Karmacharya, S. A. Baral, and P. Lacoul, Eds., pp. 128–134, *Ecological Society* (ECOS), Kathmandu, Nepal.

Naik, G., Rashid, M. and Balkhi, M. H. (2015). Changes in Physico-chemical Parameters at different Sites of Manasbal Lake of Kashmir, *India. Fish Aquac J., 6*, 148.

Pandit, A. K. (1999). Trophic structure of plankton community in some typical wetlands of Kashmir, India. In: Limnological Research in India (SR Mishra) Daya Publishing House. Delhi, pp: 190-224.

Ratnayaka, D. D., Brandt, M. J. and Johnson, K. M. (2009). *Water Supply*, In: Butterworth-Heinemann, Boston, Mass, USA, 6th edition.

Reimer, A., Landmann, G. and Kempei, S. (2008). Lake Van, Eastern Anatolia, hydrochemistry and history. *Aquat Geochem.*

Rumysa, K., Sharique, A. A., Tariq, Z., Farooq, M., Bilal, A. and Pinky, K. (2012). Physico chemical status of Wular Lake in Kashmir, *Journal of Chemistry, Biology and Physics Science*, *31,* 631–636.

Shah, J. A. and Pandit, A. K. (2012). Physico-chemical characteristics of water in Wular Lake' A Ramsar Site in Kashmir Himalaya,". *International Journal of Geology, Earth and Environmental Sciences*, *2*(2) 257–265.

Shah, J. A., Pandit, A. K. and Shah, G. M. (2017). Dynamics of physico-chemical limnology of a shallow wetland in Kashmir Himalaya (India). *Sustainable Water Resource Management, 3*, 465-477.

Siraj, S., Tabassum, S. and Bashir, A. (2018). Assessment of Physico-chemical Parameters and rotifera of Brarinambal basin of Dal Lake, Kashmir. *International Journal of Theoretical & Applied Sciences, 10*(1): 126-131

Sheikh, J. A., Jeelani, G., Gavali, R. S. and Shah, R. A. (2014). Weathering and anthropogenic influences on the water and sediment chemistry of Wular Lake, Kashmir Himalaya. *Environmental Earth Sciences*, *71*(6), 2837–2846.

Srivastava, J., Gupta, A. and Chandra, H. (2008). Managing water quality with aquatic macrophytes. *Rev. Environ. Sci. Biotechnol.*, *7,* 255–266.

How to cite this article: Saima Andleeb, Irfan Ahmad, Asim Iqbal Bazaz, Mehak Hafeez, Azra Shah and Durdana Qazi (2022). Evaluation of surface Water quality Parameters at different Sites of Wular Lake of Kashmir Himalayas. *Biological Forum – An International Journal, 14*(3): 1682-1689.