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Research Article

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Assessment of Water Quality Prameters at Different Sites of Anchar Lake

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ABSTRACT

The present work deals with the assessment of water quality parameters of Anchar lake to detect the physic-chemical nature of water at four different sites in order to access the physical properties and chemical nature of water and correlation between the parameters chosen for assessment at monthly intervals. In this study it is indicated that lake is highly polluted due to anthropogenic activity such as sewage effluent and waste material thrown by the peoples living at the periphery of the lake. The lake can be considered highly eutrophic as evidenced by its shallow depth (0.6-2.2), low transparency (0.19-0.75), and higher concentration of nitrates, phosphate and ammonia. The correlation among various parameters showed positive and negative trend.

Key words: *Water, Physico-chemical parameters, Anchar lake, Correlation. Pollution load.*

INTRODUCTION

Water is the most common fluid in nature. Water is also a vital resource for agriculture, aquatic life, manufacturing and other human activities. in urban areas peoples through wastes materials from their homes into such water bodies, this may greatly reduce the quality of water. Most of the rivers and lakes in urban areas of developing countries are the end of effluent discharged from the industries[24]. Asian countries experienced rapid industrial growth and this is making environmental conservation a difficult task[26].

The Anchar lake is a shallow basined lake with fluviatile origin, situated near Soura 14 km to the north-west of Srinagar city at an altitude of 1585 msl and lies within the geographical coordinates of 34°-20′ to 34°-26′ N latitude and 74°-82′ to 74°-85′ E longitude in a semi urban conditions[2] The lake is sprawled over an area along east side of Srinagar to Gandarbal road. The Anchar lake is considered an example of ecologically sick lake, mostly infested with weeds. On the eastern bank major portion of peripheral areas has been encroached by the local population. They have filled a large area within the lake and changed into vegetable gardens. The lake is a single basined, open drainage type water body fed by Sind nallah and numerous small channels.

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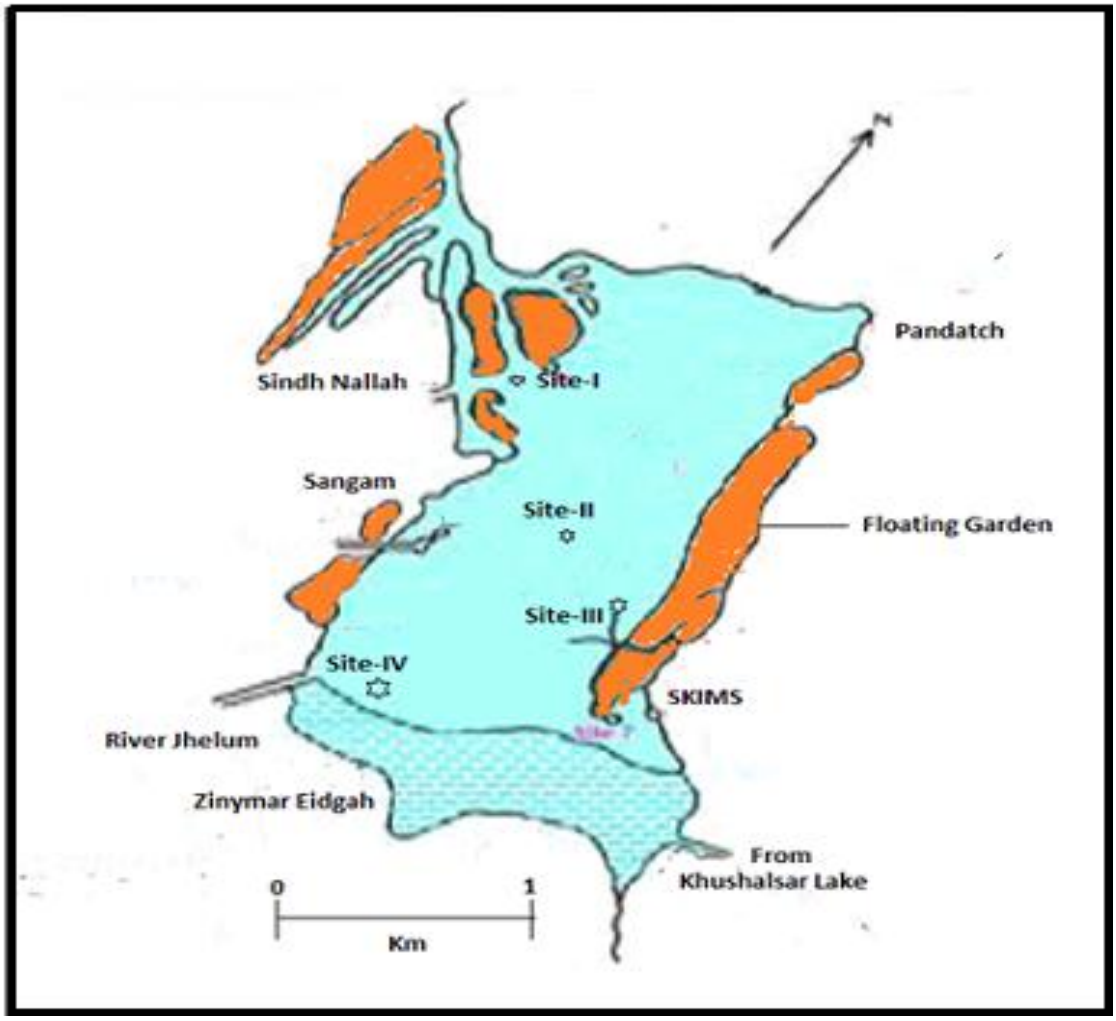
Anchar lake also receives water from Dal Lake through a channel named Amir Khan via Khushalsar lake which in turn connected with the Nigeen lake. The lake is also fed by the springs in and along the periphery. Further a number of channels from agriculture fields, effluents from settlements and surface runoff from catchment area, directly drain into it throughout the year. The lake outfalls into river Jhelum at Sangam on its north east direction. The lake cover an area of 680 hectares half of which has now become marshland (Fig. 1)



Map Showing Study Sites

MATERIAL AND METHODS

The present study was carried on Anchar Lake In this investigation four different sites (S1, S2, S3. S4) were selected for the collection of weekly water samples. The sampling site-I is situated on the western shore of the lake were sindh nallah enters into the lake. Sampling site-II is located near the centre of lake were submerged vegetation growth is found abundantly. Sampling site-III is located towards the north east region of the lake. At this site the lake receives more effluents and waste water from the drainage system of SKIMS and the site-IV is located near the Sangam Village were lake exit into the river Jhelum.

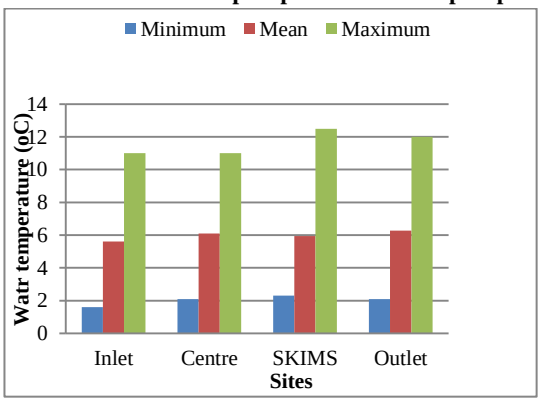
Water quality of the lake was assessed by various physico-chemical parameters *viz.* air temperature, water temperature, depth, transparency, pH, dissolved oxygen, free carbon dioxide, total alkalinity, nitrate nitrogen, ammonical nitrogen, orthophosphate and total phosphorus. Surface water samples were collected in 1 litre plastic bottles

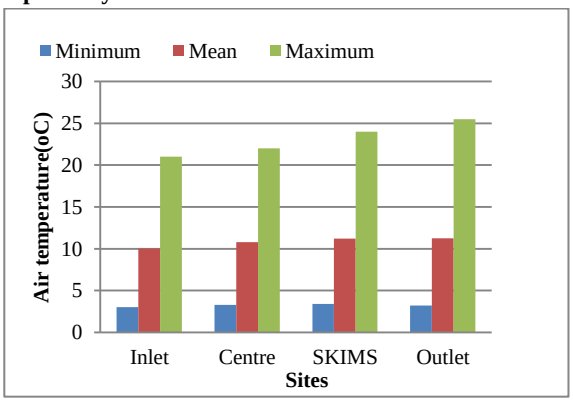
from each sampling site. For dissolved oxygen, D.O bottles of 125 ml capacity were used and the fixation of samples was done in the field as per the Wrinkler's modified method. Air temperature, water temperature and pH were determined at the sampling spot and samples were immediately transported to the AEM laboratory, Faculty of Fisheries SKUAST-K for further detailed analysis by using the A.P.H.A[3] and Adoni[1].

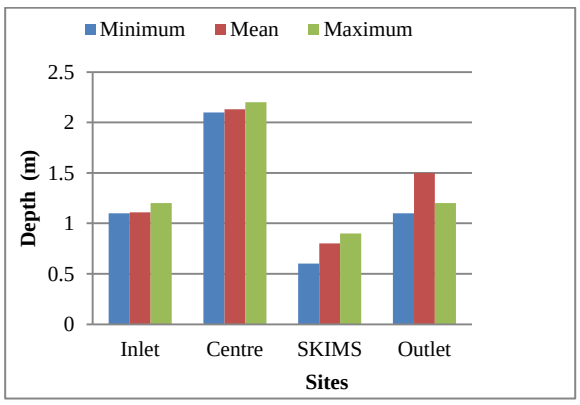
Table 1: The overall minimum, maximum and Mean and standard deviation of physico-chemical characteristics of water of Anchar Lake

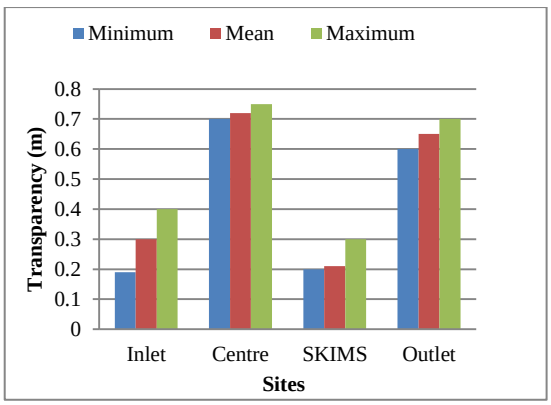
S.No.	Parameter	Minimum	Maximum	Mean±SD
1	Air temperature (^oC)	3	25.5	10.82±8.08
2	Water temperature (^oC)	1.6	12.5	5.975±3.69
3	Maximum depth (m)	0.6	2.2	1.3±0.52
4	Transparency (m)	0.19	0.75	0.48±0.23
5	pH	6.9	8	7.51±0.31
6	Dissolved oxygen (mg/l)	4	8.5	6.69±1.48
7	Free CO_2 (mg/l)	6.5	21	12.76±3.79
8	Total alkalinity (mg/l)	98	197	151±26.28
9	Nitrate nitrogen (µg/l)	260	690	468.5±115.96
10	Ammonical nitrogen (µg/l)	100	292	171.04±54.28
11	Orthophosphate (µg/l)	110	285	166.21±60.94
12	Total phosphorus(µg/l)	301	655	416.5±137.89

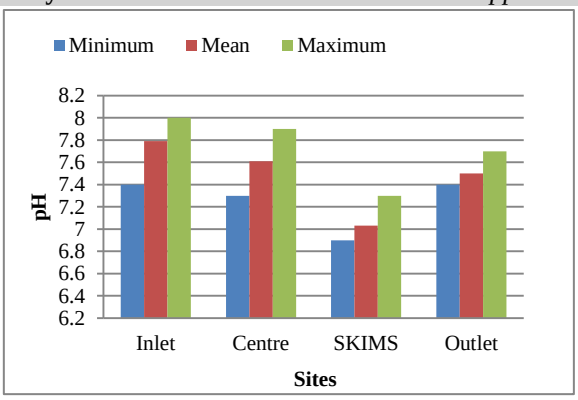
Fig. 2: Graphs showing minimum, mean and maximum variation of Air temperature, Water temperature, Depth, Transparency, pH, Dissolved oxygen, Free Carbon dioxide, Total alkalinity. Nitrate nitrogen, Ammonical nitrogen, Orthophosphate and Total phosphorus respectively at four sites of Anchar Lake

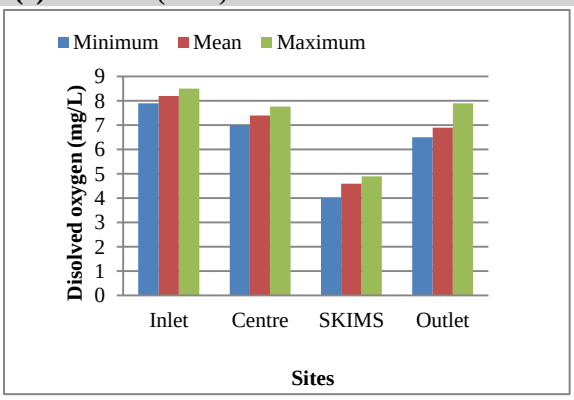


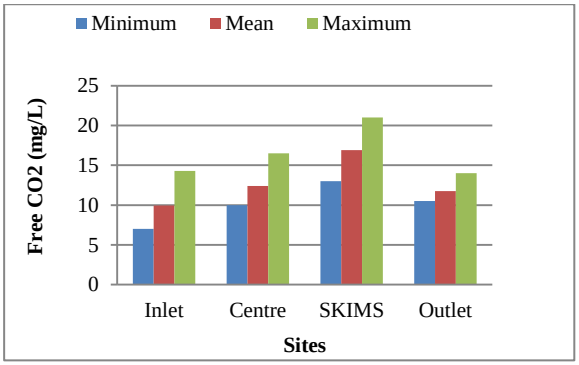


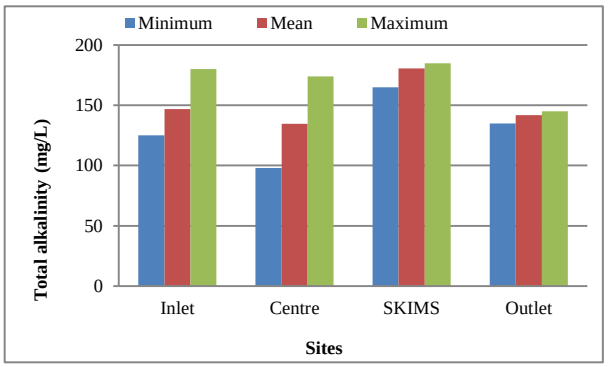


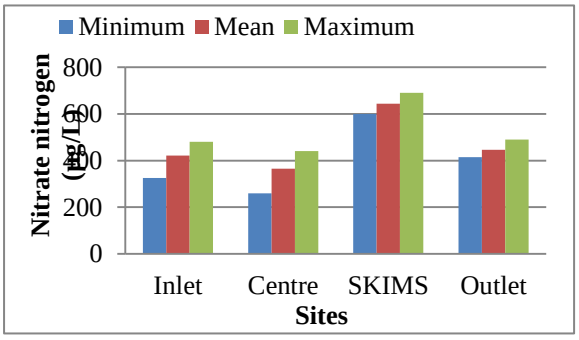


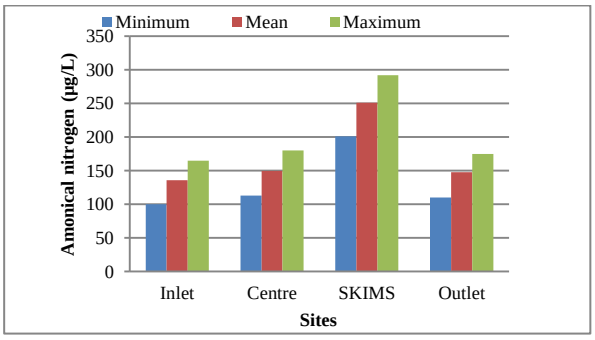


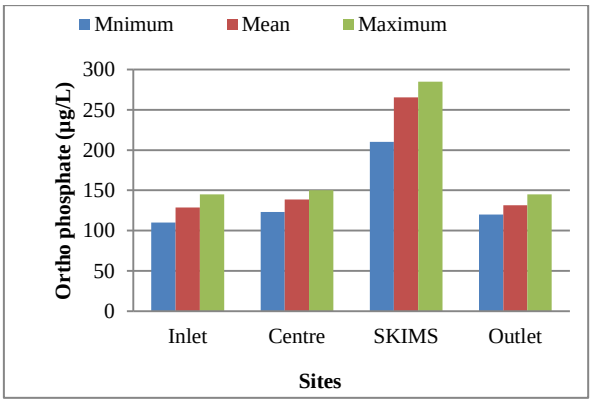


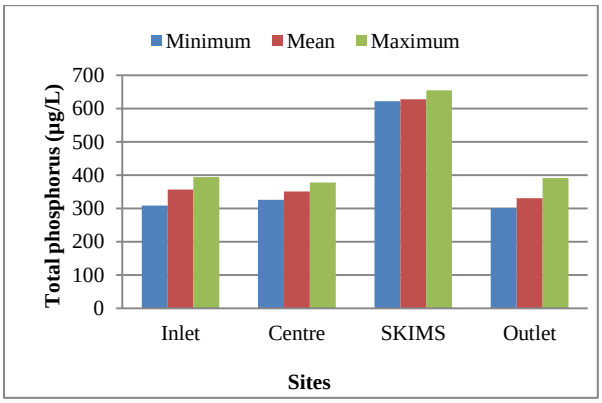












RESULT AND DISCUSSION

Air temperature

Temperature is one of the major important factor that can affect the speed of chemical reaction, solubility of chemical compounds and also effect the interaction of pollutants with their environment[6]. Air temperature strongly influences lake temperature because it affects three important heat exchange process between water and atmosphere –convective heat exchange, evaporative heat exchange and the atmospheric emission of long wave radiation[14]. During the present study the overall mean air temperature was recorded

10±8.08 ^{o}C. The minimum air temperature of 3^{o}C was recorded in winter and a maximum air temperature of 25.5^{o}C in spring (Table 1). The lowest air temperature in winter season was due to short photoperiod, cold atmosphere while the highest air temperature during summer season was due to clear atmosphere and higher solar radiation. These results are in conformation with Sushil *et al.*[28], Indresha and Patra[16], Umerfaruq and Solanki[29]. They also recorded the highest air temperature in summer season and lowest air temperature in winter season. Monisa and Balkhi[21], also recorded the same results while working on Dal lake ecosystem

The air temperature has a significant positive correlation with water temperature ($p \leq 0.01$, $r = 0.974$) (Table 2), it means that as the air temperature increases in summer season water temperature also increase and vice versa. This is in confirmation with work of Chandrakiran *et al.*[13], who also observed that the change in air temperature are closely proportional to the water temperature and hence, simultaneous measurement of both air and water temperature are important in determining the status of water body.

Water temperature

Water temperature is plays a critical factor in aquatic ecosystems. The response of water temperature to air temperature depends on the size of water body. It affects biological reactions, physical and chemical characteristic of water Balaji[8]. It is necessary to study the temperature variation in water body, because water density and oxygen content are temperature related and hence individually affects osmoregulation, respiration, behaviour and metabolism of animals. The present data showed fluctuation in the water temperature which are more are less concomitant with those of atmospheric temperature. Such a pattern of fluctuation has also been recorded by Yousuf[32]. The overall mean value of water temperature was found to be 5.97±3.69 ^{o}C (Table 1). The maximum water temperature of 12.5^{o}C was recorded during the summer season and the minimum water temperature of 1.6 ^{o}C during the winter season. (Table1). The highest water temperature in summer season was due to high solar radiations and clear atmosphere while as the lowest temperature was due to high water level, less solar radiation and low atmospheric temperature. These results are in conformation with Ahanger *et al.*[2], who said that water temperature increase during warmer months and decrease during colder months and it plays an important role in governing the water quality. Mahmoud reported that the decrease or increase in water temperature are mainly dependent on the climatic conditions, sampling times, and was also affected by specific characteristic of water environment such as turbidity, plant cover and humidity.

The water temperature has a significant positive correlation with CO_2 ($p \leq 0.01$, $r = 0.557$), transparency ($p \leq 0.05$, $r = 0.851$) (Table 2).

Table 2: The correlation between various physico-chemical parameters of Anchar Lake

	1	2	3	4	5	6	7	8	9	10	11
2	0.974**										
3	-0.121	-0.095									
4	-0.42	-0.121	0.757**								
5	-0.365	-0.365	0.420*	0.377							
6	-0.298	-0.311	0.502*	0.360	0.850**						
7	0.555**	0.557**	-0.298	-0.287	-0.797**	-0.701**					
8	-0.438*	0.497**	0.449*	-0.528**	-0.178	-0.442*	0.010				
9	-0.169	0.187	0.673**	-0.656**	-0.608**	-0.727**	0.363	0.727**			
10	-0.209	-0.190	0.408*	0.494*	-0.634**	-0.687**	0.473*	0.592**	0.871**		
11	0.083	0.064	0.508*	-0.620**	-0.791**	-0.807**	0.706**	0.578**	0.82**	0.871**	
12	-0.036	-0.072	0.537**	-0.689**	-0.723**	0.786**	0.583**	0.672**	0.855**	0.834	0.916**

** Correlation is significant at the 0.01 level

* Correlation is significant at 0.05 level

1=Air temperature, 2=Water temperature, 3=Depth, 4=Transparency, 5=pH, 6=Dissolved oxygen, 7=Free carbon dioxide, 8=Total alkalinity, 9=Nitrate nitrogen, 10=Ammonical nitrogen, 11= Orthophosphate, 12= Total phosphorus.

Depth

During the present study the mean depth of lake was found to be 1.3±0.52 m. The minimum depth of 0.6 m was recorded at SKIMS (Site-III) which is due to erosion from nearby catchment resulting in accumulation of sediment and dumping waste material from the adjacent area. Maximum depth of 2.2 m was recorded at the centre which is least effected by sedimentation as it is not directly impacted by the inflowing water from Sindh nallah. Pandit[22], Bhat *et al.*[11] and Sushil *et al.*[28], in their study, they have observed that the depth of water is dependent on the volume of water column, discharge rate of inflow and the amount of precipitation received in the form of rain and other anthropogenic activities.

During the present investigation, the depth has a significant positive correlation with Transparency ($p \leq 0.01$, $r=0.757$) (Table 2) which is in conformation with Monisa[20] who also recorded the positive correlation between depth and transparency at different basins of Dal lake.

Transparency

Transparency is one of the important physical property of water, indicative of the degree to which sun light can penetrate through water. Transparency of natural water is an indicator of productivity Balaji[8]. During the present study the mean transparency was (0.48±0.23 m) (Table 18). The higher transparency value of 0.75 m (Table 1) was observed at the centre in winter, which may be due to low organic matter production with poor planktonic growth. while as the lowest transparency value of 0.20 m (Table 18) was observed at SKIMS (Site-III) in summer season, due to algal blooms and inflow of sewage. The results are in agreement with Ahangar *et al.*[2], Bhat *et al.*[11] and Sushil *et al.*[28]. They observed that maximum transparency of the Anchar lake was due to the settlement of sand, silt and clay during winter while minimum transparency was due to bloom of planktonic algae.

In the present study transparency recorded significant positive correlation with dissolved oxygen ($p \leq 0.01$, $r= 723$) (Table 2). Bhat *et al.*[10] also recorded the significant positive correlation between transparency and dissolved oxygen in Anchar lake.

pH

pH is the measure of acidity or alkalinity of water, hence it is an important factor for water quality analysis. The term pH reflects the activity of hydrogen ion in natural waters it also shows the variation due to photosynthetic activity wherein PH increase due to utilization of carbon dioxide. During the present study the overall mean pH was found to be (7.51±0.31) (Table 1) depicting an alkaline nature of Anchar Lake. During the present investigation the pH ranged (6.9 to 8), \the minimum pH was found during the summer season at the SKIMS (Site-III). While as higher pH was found during winter season at inlet (Site-I). The fluctuation in pH has been related to photosynthetic activities and also with dissolved oxygen by many workers[30,18,5].

The pH recorded a significant Negative correlation with CO_2 ($p \leq 0.01$, $r= -0.797$) and NH_4-N ($p \leq 0.01$, $r= -0.634$) (Table 19) while as significant positive correlation with dissolved oxygen ($p \leq 0.01$, $r=0.850$) (Table 1).

Dissolved oxygen

Dissolved oxygen is one of the most important parameter is assessing the quality of water, which is essential to maintain biotic forms in water. Oxygen content of water varies with temperature, turbulence, photosynthetic activity of algae, higher plants and atmospheric pressure[11]. It is considered as the factor which can reveal the nature of entire ecosystem. During the present study the overall mean dissolved oxygen was (6.69±1.48 mg/L) (Table 18). The range of dissolved oxygen was (4 mg/L to 8.5 mg/L) (Table 1). The lower value of dissolved oxygen, was recorded at SKIMS (Site-III), during summer season, was due to increased amount of organic matter, agricultural runoff and presence of sewage, the organic matter gets decomposed at faster rate at higher temperature thereby reducing oxygen level of water. Higher dissolved oxygen was recorded in winter which is as a result of increased solubility of oxygen at lower temperature.

Yousuf and Shah[33], Bhat *et al.*[11] also opined that, the lowest value of dissolved oxygen during summer in Anchar lake due to increased amount of organic matter and sewage which consumes dissolved oxygen for decomposition.

Dissolved oxygen in the present study showed a significant negative correlation with free CO_2 ($p \leq 0.01$, $r = -0.701$) (Table 1), which means that with the increase in dissolved oxygen content CO_2 content decreases.

Free CO_2

Free carbon dioxide is the indicator of the biological respiration activities of ecosystem. It alters the pH of water by forming carbonic acid, which further dissociate into carbonate and bicarbonate. During the present study the mean free CO_2 in was found to be (12.76±3.79 mg/L) (Table 1). The range of free CO_2 concentration was found to be (6.5mg/L to 12 mg/L) (Table 19). The minimum value of free CO_2 was recorded at the inlet may be due to decrease in temperature by entering the fresh water from Sindh nallah, which subsequently increase the oxygen holding capacity of water, while as the maximum free CO_2 was recorded at SKIMS site may be due to waste water and sewage effluents, fertilizers and other point and non-point source from the agricultural fields, which increase the free CO_2 concentration The result is in conformation of Ahanghar *et al.*[2], who also revealed that CO_2 liberated during respiration and decay of organic matter which depends upon the water temperature, depth rate of respiration, decomposition of organic matter and chemical nature of bottom, which holds true during the present investigation.

The free CO_2 recorded the significant negative correlation with pH (($p \leq 0.01$, $r = -0.797$) and dissolved oxygen ($p \leq 0.01$, $r = -0.701$) (Table 2). Similar results have been observed by Bahura[7] and Bhat *et al.*[10], during their study.

Total alkalinity

Alkalinity is a measure of buffering capacity of water and is important for aquatic life in a fresh water system[17]. During the present study, overall mean alkalinity was (151±26.28 mg/L) (Table 1). The range of alkalinity was found to be (98 mg/L to 197 mg/L). The lower value of alkalinity was found during Summer at the centre (Site-I), which may be attributed to the decrease in bicarbonate ions and dissolution of calcium carbonate ions in water column, while as the higher alkalinity was found at the SKIMS (Site-III) during the winter. The result is in conformation with Sahai and Shrivastava[25], who observed low concentration of bicarbonate in summer in Chilka Lake owing to the increased use by phytoplankton and submerged macrophytes. Umerfaruq and Solanki[29], also observed the higher alkalinity during winter months and said that the accumulation of organic matters produced by decomposition of vegetation which in turn, added carbonate and bicarbonate in the lake.

Nitrate nitrogen (NO_3-N)

Nitrates are the essential nutrients for photosynthetic autotrophs and in some cases have been identified as the growth limiting nutrient. The presence of nitrate in any aquatic ecosystem depends on the activity of nitrifying bacteria on nitrogen source of domestic and agricultural origin. The conversion of nitrate from ammonia in nitrification process chiefly depends upon the presence of oxygen. Increase in concentration of nitrate is harmful as it increase the growth of algal blooms which makes water unsuitable for use. During the present study, overall mean nitrate nitrogen was (468.±115.96 µg/L). The range of nitrate nitrogen was found to be (260 µg/L to 690 µg/L) the minimum concentration was recorded at the centre, while as the maximum concentration was observed at the SKIMS site during the summer months which could be due the presence of high amount of domestic sewage, decaying of organic matter and the agricultural runoff bringing with it nitrate fertilizers and detergents. This is in agreement with the finding of Bhattacharya *et al.*[12] and Singh *et al.*[27] who reported higher concentration of nitrate during summer and lower concentration in winter, respectively in upper stretch of Gangetic West Bengal and major rivers in Imphal. Abubakr and Kundangar[4] also reported the progressive

increase in nitrogen and phosphorus in lakes and attributed it to sewage contamination while studying the changing biodiversity of seven lakes of Kashmir. They also attributed the progressive increase of phosphorus and nitrogen in Anchar and Manasbal lake the main culprit in in changing the trophic status of lake.

Ammonical nitrogen (NH_4-N)

Ammonia dissolves in water to form ammonium hydroxide and hydroxyl ions these ammonium ions are readily taken up by aquatic autotrophs with preference over nitrates, thus usually preventing it to reach to toxic level. The higher concentration of ammonia is generally found in polluted waters[25]. In the present study the mean concentration of ammonical nitrogen was recorded as (17.04±54.28 µg/L) (Table 18) and the range of ammonical nitrogen was found to be (100 µg/L to 292µg/L) (Table 1). The highest value was recorded during the spring season near the SKIMS (Site-III) which might be due to the entry of domestic sewage, use of nitrogenous fertilizers in nearby agricultural fields, while as the lower value was recorded during the winter season. The result is agreement with Sushil *et al.*[28] who also reported the higher concentration of ammonia in Anchar lake and attributed it due to organic pollution and agricultural wastes. Wetzel also attributed that high level of ammonia in the lakes may be its release from the sediments under low oxygen level at which nitrification of ammonia ceases and the absorptive capacity of the sediments is reduced.

Ammonical nitrogen recorded a significant positive correlation with free co_2 ($p \leq 0.05$, $r = 0.473$), while as significant negative correlation with dissolved oxygen ($p \leq 0.01$, $r = -0.687$) and pH ($p \leq 0.05$, $r = -0.634$) (Table 2)

Orthophosphate (PO_4-P)

Phosphorus is an essential element for fertility of lakes and is regarded as key nutrient in the productivity of waters. In natural waters phosphorus exist as soluble phosphate, which, when in higher concentration, cause eutrophication of fresh water system[9,23]. Phosphorus enters the surface waters from human generated wastes and land runoff. During the present study, the overall mean orthophosphate was (166.21±60.94 µg/L) and the range was found to be 110 to 285 µg/L (Table 1). The low orthophosphate content was found at the inlet site during the winter, it may be due to inflow of fresh water from Sindh nallah and higher dissolves oxygen and pH, while as the higher value was found in summer at the SKIMS site, which may be due to the influx of sewage, agricultural runoff probably contaminated with phosphate (applied as fertilizer). The result is in complete agreement with Herney *et al.*[15], which corresponded higher value of phosphate during warmer season to rapid evaporation and mineralization of decomposed materials in water.

Total phosphorus

Presence of phosphorus in excess of 30 µg/L in water bodies is regarded as a major nutrient triggering eutrophication Welch (1980). It is available in different forms viz. orthophosphate, condensed phosphate and organically bound phosphate[9] and is considered as critical limiting nutrient of fresh water system Rabalais[23]. During the present study, the mean total phosphorus was (416±137.89 µg/L) and the range was found to be (301 to 655µg/L) (Table 1). The minimum valve of total phosphorus was found during colder months at the outlet of the lake, it may be due to the out flowing water which carries all nutrients (especially phosphate) into the river Jhelum, while as the higher value was found in summer at the SKIMS site, which may be due to the influx of sewage, agricultural runoff probably contaminated with phosphate (applied as fertilizer) rapid evaporation and other effluents. The result is in complete agreement with Herney *et al.*[15]. The same has been inferred by Abubakr and Kundangar[4] that increase in nitrogen and phosphorus in lake waters are attributed to sewage contamination.

Total phosphorus has a significant positive correlation with free co_2 ($p \leq 0.01$, $r=0.583$) and orthophosphate ($p \leq 0.01$,

r=0.916) (Table 2), while as significant negative correlation with dissolved oxygen ($p \leq 0.01$, r=0.786) and pH ($p \leq 0.01$, r=0.723)

CNCLUSION

- The present study showed detailed physico-chemical characteristic and the statistics obtained from the physic-chemical analysis of the water quality clearly indicates that most of the important quantities such as pH, alkalinity. phosphate ammonia and nitrates are above the thresh hold limit.
- The correlation coefficient indicates both positive and negative correlation between them and the values of correlation helps in proper treatment of sewage and other effluent to minimize drastic effect on the aquatic life in the lake.
- To sustain the ecology and aquatic life in the lake there should be awareness programs regarding how to protect the lake so that aquatic life will be saved near in future.

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