Comparison of Water Chemistry of Manchar Lake with WHO Drinking Water Quality Standards

Wali Mohammad Achakzai, Shagufta Sadrazai, Wazir Ali Baloch, Samiullah, Mohammad Anwar Panezai, Zubia Masood and Anila Naz Somroo

Abstract: The present study was conducted on one of the largest shallow, floodplain and freshwater lakes of South Asia to know the relationships of water quality with drinking water. The water quality of the lake is degrading very quickly from the last two decades. One of the causes is Main Nara Valley Drain (MNVD) receiving effluents from various parts of Sindh Province. Consequently concern has grown regarding the water quality of the lake. The purpose of the study was to evaluate the possible changes in water of lake due to waste water discharge from agricultural and domestic sectors. The minimum and maximum mean values (six stations) of physicochemical parameters ranged from temperature (17.83-34.03 °C), pH (7.63-8.45), E. Conductivity (4.04-10.05 µS/cm), Total Dissolved Solids (2101-6529 mg/l), Transparency (61-98.83 cm), Dissolved Oxygen (3.95-9.10 mg/l), Salinity (2.22-5.9 ppt), Alkalinity (120-350 mg/l), Chloride (886-1453 mg/L), Total hardness (800-1575 mg/L), Calcium hardness(475-1250 mg/L), Magnesium hardness(100-375 mg/L), COD(40-320 mg/L) and BOD (21.55-118 mg/L) were determined on monthly basis. The physicochemical properties of Manchar Lake were beyond the limit of WHO for drinking purposes. The results were compared with WHO water quality guidelines.

Key words: Water chemistry, Manchar Lake, WHO, MNVD

INTRODUCTION

Manchar Lake: Manchar is the largest shallow natural floodplain freshwater lake in Pakistan situated at a distance of 18 km from Sehwan city of Jamshoro District. The location of the lake is 67 deg, 38 min, 29.11 sec east longitude, latitude extend as from 26 deg, 25 min, 12.45 sec north and altitude is 34.14 meters (Fig. 1). The lake has a shallow basin which was formed as muddy depression bordered by Lakhi hills in south, Khirthar mountain range in the west, Indus River in the east and a protective embankment is on the eastern and northern side of the lake [1]. The lake looks like saucer in shape and its depth does not exceed more than 3.6 meters (12 feet) in any part of the lake. During rainy season, the flood water covers around 250 km², but the level of water reduced up to 60 km² in dry months (April-June) of the year. The area of the lake fluctuates due to entry of flood water from Indus River. The process of eutrophication has considerably reduced the depth of lake due to scanty rain fall in Sindh province. The lake was completely dried twice in last five decades [2].

Water Quality: The quality of water can be affected by human activities and polluted water is one of the major sources in environmental pollution. Most of the underdeveloped countries have suffered the influence of environmental pollution due to chaotic economic growth associated with misuse of natural resources [3]. Water quality is the main factor controlling state of diseases and health in animals [4]. The quality of surface water is largely determined both by weathering, soil erosion and by environmental pollution (industrial wastewater discharge). Industrial wastes are the main source of water
Fig. 1: Map of Manchar Lake showing sampling stations

pollution [5]. Sub-tropical lakes are more diverse in temperature than temperate lakes [6]. Temperature is very vital parameter as it decrease or increase can affect the quality of water and life present in water. Barnabe [7]. reported that temperature effects the oxygen concentration of water quantity and quality of autotrophic plants and also indirectly influences the quantity and quality of heterotrophs and rate of photosynthesis. Due to seasonal changes the temperature of water varies throughout the year. Rapid increase in temperature can affect the animals, because of insufficient time for physiological adaptation.

WHO [8] reported that in Pakistan drinking water is obtained from surface, groundwater, springs, lakes, rivers and other small water bodies. The ongoing procedure of removal of agricultural and industrial wastes into natural water bodies causes ground and surface water contamination. Freshwater lakes are highly affected by pollution. Manchar Lake is much polluted and causes serious health hazards to the community living near the lake. The ground water in the vicinity is unfit for drinking because of high salinity. The lake water is significant for fishermen and farmers. The poor quality of lake water is due to excess evaporation, toxic metals, scanty rain and high temperature.

Manchar Lake is important for different aspects such as, source of drinking water, irrigation and wild life purpose and a source of cheap diet rich in protein. Ecological changes in aquatic medium depends upon water chemistry, Therefore present study provides the information about the influence of water chemistry on fish biodiversity and production of Manchar Lake.

**MATERIALS AND METHODS**

**Water Chemistry:** Water samples were collected monthly between August 2011-July 2012 from six stations (1. Danister, 2. GulshahPir, 3. Mudiput, 4. Central point Aroni, 5. Garkno, 6 Jarang) of Manchar Lake. All field meters and equipment were checked and calibrated according to the manufactures specification. Samples were collected in 250ml glass bottle for DO (Dissolved oxygen) and BOD (Biological Oxygen Demand), also sample were collected in plastic bottle for other physicochemical parameters, pre-cleaned by washing with non-ionic detergents, rinsed in tap water. The actual samplings were done in each defined stations by dipping each sample bottle below the water surface, projecting the mouth of the container against the flow direction. The samples were then transported in cooler boxes. Standard methods of for analysis were used [9]. pH meter (WTW 740 Germany pH) used to determine the pH, mercury thermometer used to know the temperature, Electrical conductivity EC meter (WTW inoLab Cond: 720 Germany) was used to determine the conductivity, salinity and TDS (Total Dissolved Solids) at all sampling stations. Transparency was determined by Secchi disk at sampling site. Dissolved oxygen, chemical oxygen demand (COD), biological oxygen demand (BOD), total hardness (with EDTA), calcium hardness, magnesium hardness, alkalinity (with sulphuric acid), chloride (with silver nitrate), total nitrogen (Kjeldhal method) of the samples were determined by titration. Global positioning system (GPS) eTrex (Garmin, USA) was used for searching same sampling site during study.
RESULTS

Fourteen water parameters were compared with WHO standards (Table 1). The monthly variations in these water parameters are shown in Figure 2. These water parameters are discussed as under

**Temperature:** Temperature is very important for allaquatic organisms. The temperature showed variation in almost all six stations because of the enormous size of the lake and time period of recording the temperature, mean values (six stations) ranged from 17.83 to 34.03 °C. The minimum water temperature was 17.4 °C recorded at station 5 in the month of January; whereas maximum 34.9°C observed in June at station 5. The mean values show two peaks, one in May and the other in June.

**pH:** Minimum mean value of pH was 7.63 in September and maximum was 8.45 in March. pH was alkaline throughout the year. The minimum value of pH was 7.1 in September at station 6 and maximum 8.9 in March at station 3. The peak of pH was observed during algal bloom.

**Electrical Conductivity:** Maximum mean values of Electrical conductivity were 4.07µS/cm and 10.05µS/cm in months of January and June respectively. The highest value was 12.35µS/cm recorded during the month of June at station 1 and the lowest value 3.73µS/cm at station 1 in January.

**Dissolved Oxygen:** Mean values of dissolve oxygen ranged from 3.95 to 9.10 mg/L. The minimum DO was 3.67 mg/L recorded at station 6 in the month of May; whereas maximum value was 9.73 cm observed in January at station 1. Higher values of DO were observed in cold months (December-February), whereas the lower values were observed in hotter months (May-June). The value of DO was lower at higher temperature and salinity.

**Salinity:** Salinity showed more variations during allmonths of the present study. The minimum mean value of salinity was 2.22 ppt observed in August and 5.9 ppt in June. The minimum salinity was 1.9 ppt observed at station 3 in August and maximum 6.8 ppt in June at station 1.

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<td>mg/L</td>
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Fig. 2: Continued
Alkalinity: Mean Alkalinity varied between 155 mg/L in September and 282 mg/L in February. At Station 1 the minimum value was 120 mg/L in September and 350 mg/L observed in February at station 6.

Chloride: The minimum mean value of chloride was (886mg/L) observed in November and Maximum (1453 mg/L) in May. The minimum value at Station 2 was (779.9 mg/L) in November and maximum (1524 mg/L) in May at station 5.

Total, Calcium, Magnesium Hardness: There was slight increase found in dry months (February to August), since the water kept evaporating and leaving through outlets which resulted in these results. There was slight decrease in rainy months (September to December) due to entry of freshwater. The highest mean value of total hardness was 1445 mg/L in July, Calcium hardness was 1129 mg/L in July and magnesium hardness was 316.7 mg/L recorded in July while the lowest mean value of Total hardness was 854.17 mg/L in September, Calcium hardness was 551 mg/L in September and magnesium hardness was 195 mg/L in December. Maximum total hardness was 1557 at station 4 in July and minimum 800 mg/L recorded in September at station 3. Maximum calcium hardness was 1250 at station 4 in July and minimum 475 mg/L recorded in September at station 3. Maximum magnesium hardness was 375 at station 1 in July and minimum 100 mg/L recorded in September at station 2.
Chemical Oxygen Demand: Mean value of COD was between 100-273 mg/L in the months of December and June respectively. The highest value of COD was 322 mg/L in June at station 4 and lowest 40 mg/L in December at station 4. Higher values of BOD was between 100-273 mg/L in the months of December and June respectively. The highest value of COD was 322 mg/L in June at station 4 and lowest 40 mg/L in December at station 4.

Biological Oxygen Demand: Mean value of BOD ranged from 46.8 to 99 mg/L in July and January respectively. The highest value of BOD was 118 mg/L in January at station 1 and lowest 21.55 mg/L in August at station 2.

DISCUSSION

Manchar Lake is an important natural resource for irrigation and fisheries for population lived around the vicinity. The usual trend of water temperature in Manchar shows the lowest in January, while highest in May to July. The temperature and pH showed almost similar trend with Mahar et al. [10] from Manchar Lake, Korai et al. [11] and Lashari et al. [12] from Keenjhar Lake district Thatta.

The range of electrical conductivity, TDS, Salinity and total hardness showed slightly higher values (Table 1) compare to Mahar et al. [10] and Kazi et al. [11] from Manchar Lake. Thus our finding concluded that lake water further deteriorated. Present results of electrical conductivity are close to the work of Kumar et al. [13] in Kawar Lake, India. The values of TDS were higher in winter and lower in summer. Similar findings were reported by Lashari et al. [12] from Keenjar Llake. Higher values of salinity were recorded during summer (May- June) and these results are supported by Kubly [14]. The values of Hardness were higher as compare to Korai et al. [11].

Sakare and Joshi [15] recorded higher values of alkalinity ranged from 672-1023 as compare to our results (Table 1). Higher values of transparency were observed in Manchar Lake (Table 1) compare to Lashari et al. [12] from Keenjhar Lake (78 cm). The trend of dissolved oxygen in lake water showed higher values in winter but lower in summer. There is an agreement with our findings that the solubility of oxygen increase with decrease in temperature [16]. Higher values of chloride (Table 1) in water samples exceeded the WHO proposed drinking water quality criteria, WHO 2004. Versari et al. [17] reported that chloride concentration higher than 200 mg/l are considered to be a risk for human health.

The values of COD and BOD are given in a Table 1. The values of COD and BOD were slightly higher than Kazi et al. [18]. The values of COD were higher in winter than summer. Kulshrestha et al. [19] also reported same trend of COD in Pillur reservoir. Higher values of BOD were observed. Our results are strongly supported by Kazi et al. [18] reported higher values of BOD due to anthropogenic pollution produced by people who lived in boats day and night for fishing from Manchar Lake.

CONCLUSION

The physicochemical properties of Manchar Lake were beyond the limits of WHO. The Lake water is unfit for drinking and for all fishes. The lake has become saline. The main cause of degradation of the lake is the discharge of industrial, agricultural wastes and of municipal sewage water from the MNVD (Main Nara Valley Drain). We also concluded that due to polluted water of the Lake has seriously deteriorated the number and production of fishes from the last two decades. Thus during present study low number of fishes and production were recorded mainly due to high alkalinity, hardness, salinity and chloride contents of the lake.

REFERENCES