

Analysis of Physicochemical Parameters of Water and Sediments Collected from Rawal Dam Islamabad

¹Zubia Masood, ²Hameed Ur Rehman, ³A.B Baloch, ⁴Noor Ul Akbar, ²Muhammad Zakir, ⁴Irum Gul, ⁴Naila Gul, ⁵Nelofer Jamil, ⁶Nighat Din, ²Bibi Ambreen, ²Irfana Shahid, ²Tauqir Ahmad, ²Tilawat Shah, ²Muhammad Masab and ⁴Abdul Haseeb

¹Department of Zoology, University of Karachi, Karachi, Pakistan

²Department of Chemistry, Kohat University of Science and Technology, Kohat, 26000, KPK, Pakistan

³Government Degree College Bela, Lasbela District, Balochistan, Pakistan

⁴Department of Zoology, Kohat University of Science and Technology, Kohat district, KPK, Pakistan

⁵Department of Chemistry, Sardar Bahadur Khan Women University, Quetta, Pakistan

⁶Department of Zoology, Sardar Bahadur Khan Women University, Quetta, Pakistan

Abstract: Physicochemical parameters of water are of extreme significance in the distribution of aquatic life and also in the breeding of aquatic life. They also control chemical, biological and physical processes taking place in the environment. Physicochemical parameters of water also have influences on domestic life while physical and chemical parameters of soil affect many processes such as microbial activities, plant growth and mineral uptake by plants, cation exchange capacity and compactness of soil etc. For this purpose water and sediments of Rawal dam Islamabad were analyzed for physical and chemical factors in order to study their quality. Six samples of water were collected from Rawal dam Islamabad during breeding season of fish and was analyzed for physicochemical factors. Similarly one sample of sediments was also collected and analyzed for physical and chemical parameters. Results showed that water quality of Rawal dam Islamabad is convenient for both aquatic life and domestic purposes. Physicochemical parameters of soil were also within the normal range.

Key words: Physicochemical Parameters • Water • Soil • Rawal Dam

INTRODUCTION

Water is a universal solvent important and essential to human beings for various activities such as cooking, drinking, agricultural and Industrial processes, human recreation and waste disposal. The two main problems humans face with water are the quantity and quality of water. Water quality is a term that is rarely defined but is frequently used, perhaps because it has no fixed definition, but obviously fairly well understood by users. Thus, water quality is a reflection of the source environment and the anthropogenic activities, including the use and management measures. The properties of water quality are comprised of amount of dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), organic content, pH value, temperature, infectious agents, toxic substances and mineral matter [1].

Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems [2]. Rivers and water reservoirs called dams play a major and important role in fishery, irrigation of agricultural lands and electricity production and also water is used for drinking purposes. Many factors which determine the water quality of a reservoir comprises seasonal precipitation, geologic origin of the catchment basin, seasonal climatic changes, wind action and pattern of hydrological cycle or water cycle prevalent in the dam. Temperature is one of the important and major factors influencing freshwater ecosystems, spatial and temporal distributions of organisms. Invertebrates are very much sensitive to fluctuations in temperature. Dissolved oxygen (DO) concentration and the pH of rivers, dams and other water bodies are also significant parameters which determine distribution of aquatic organisms particularly the fish [3].

The physicochemical properties of soil polluted by metals are altered which make the soil unfavorable for the growth of plants. Organic matter, redox potential, clay minerals, pH and temperature interrelationships between toxic metals themselves are the physicochemical parameters which can influence the interactions between soil microorganisms and toxic metals. Several forms of nitrogen are present in wastewater, for example as ammonium (NH_4^+) and nitrate (NO_3^-), ammonia (NH_3) and as organic compounds. Wastewater without treatment may have nitrogen and is mostly present in the form of ammonium (NH_4^+). Nitrogen is an important and essential nutrient for biological growth. It is one of the main components in all living organisms such as plants and microorganisms such as fungi [4].

Water is an excellent solvent. It dissolves the minerals and salts from the rocks in which it is stored. Therefore, the physical and chemical parameters of the particular area will be varied from another area. The quality of water changes and varies with depth of water. Seasonal changes are governed and controlled by the extent and composition of dissolved salts depending upon subsurface environment [5]. The quality of water in any ecosystem gives important information about the available resources for supporting life in that ecosystem. Good quality of water depends on many of its physicochemical factors and biological characteristics. To assess that monitoring of these factors it is essential to identify magnitude and source of any pollution [6]. Water quality degradation and deterioration in reservoirs or dams usually comes from excessive input of nutrients, acidification, organic pollution heavy metal contamination, eutrophication and obnoxious and abnormal methods of fishing practices. The influences of these "imports" into the reservoirs and dams do not only influence the socio-economic functions of the reservoirs negatively, but also result in loss of structural biodiversity of reservoirs [7].

Rawal Lake in Pakistan is an artificial reservoir that provides the water needs for the cities of Rawalpindi and Islamabad. It is located in Islamabad park area at longitude of $73^\circ 7' \text{ E}$ and latitude of $33^\circ 41' \text{ N}$. Korang River along with some other small streams coming from Margalla Hills have been set to form this artificial lake which covers an area of 8.8 km^2 . Its catchment area is 106.25 Sq mi . Crest level of Rawal dam is 1.742 ft and its crest length is 700 ft . Maximum height of dam is 133.5 ft . Area of reservoir is 3 Sq mi . and its maximum depth is 102 feet . Live storage, dead storage and gross storage capacities of Rawal dam are $43,000 \text{ acre feet}$, $45,000 \text{ acre feet}$ and $47,000 \text{ acre feet}$ respectively. Water supply of Rawal dam for drinking purposes in Rawal pindi is $19.5 \text{ million US gallons per day}$

while in Islamabad its water supply for drinking purposes is $2.5 \text{ million US gallons per day}$. Korang River is the outlet stream of Rawal Dam. Rawal Lake is located within an isolated section of the Margalla Hills National Park. There are 15 fish species belonging to 11 genera that are present in Rawal Lake. The fish species in Rawal Lake and its tributaries include: Doula (*Channa channa*), Rahu (*Labeo rohita*), Thaila (*Catla catla*), Mori (*Cirrhinus mrigala*), Carp fish (*Cyprinus carpio*) and Tilapia (*Tilapia mossambica*). Water and soil from Rawal dam was collected for the analysis of physicochemical parameters including pH, Conductivity, TDS, Color, Temperature, Odor and elasticity.

Methodology

Collection of Samples: Water and sediment samples were collected from the reservoir of Rawal dam Islamabad for the analysis of their physicochemical parameters. Six samples of water were collected from the reservoir of Rawal dam in a plastic bottle and six soil samples were collected from the shoreline of Rawal dam. Soil sample was enclosed in a polythene bag. Both water and soil samples were taken to the laboratory where they were treated and analyzed for seven physicochemical parameters including pH, conductivity, odor, color, temperature, elasticity and total dissolved solids (TDS).

Sample Treatment: Soil sample was oven dried at 110°C . After all the moisture was dried in the soil, it was ground to a fine powder. 7 grams of powder soil was taken and was mixed with 15 ml distilled water in order to prepare soil slurry. After mixing of soil and distilled water, they were stirred consistently so that soil slurry was prepared. Soil slurry was subjected to the analysis of physicochemical parameters. Water sample was directly subjected to physicochemical analysis.

Sample Analysis: pH of water and soil was measured using pH meter (Model 3505 Jenway). pH meter was calibrated using the buffer solutions of $\text{pH}=4$ and $\text{pH}=8$. After calibration, pH of soil slurry and water was measured and readings from pH meter were recorded as results. Conductivity was measured using conductivity meter (Model 103 Jencose). Conductivity meter was calibrated using 0.1 molar solution of KCl. After calibration water and soil sample were subjected to conductivity meter and readings from conductivity meter were recorded as results. Thermometer was used to measure the temperature of both water and soil slurry. Thermometer was first adjusted at 0°C after which temperature of soil and water was measured.

RESULTS

Physical parameters include color, odor and temperature of water while chemical parameters include, dissolved oxygen contents, pH and electrical conductivity alkalinity and hardness. All these factors have their own significance as they are part of environment necessary for the continuity of life processes. For example pH is a measure of hydronium ion concentration or measure of acid-base equilibrium achieved by compounds dissolved in water as well as extent of coagulation and flocculation process of chemicals. Similarly electrical conductivity gives an idea about the concentration of electrolytes in water and soil and is the limiting factor. Electrical conductivity (EC) which is a measure of water's ability to conduct an electric current is related to the amount of dissolved minerals and salts in water, but it does not give an indication of which element is present but higher value of EC is a good indicator of the presence of contaminants and pollutants such as chloride, sulphate, sodium and potassium while hardness of water is defined as the measure of concentration of dissolved calcium and magnesium ions in water [8].

pH: pH of water and soil samples is shown in the Table 1 and Figure 1. Recorded pH of water sample was 7.21 while the pH of soil was 7.26. The pH of soil is one of the most important physicochemical parameters. It affects mineral nutrient soil quality and

much microorganism activity [9]. According to WHO normal range of pH for water and soil is 6.5-8.5 [10]. pH of both water and soil samples was recorded within normal range given by WHO.

Conductivity: Conductivity of water and soil samples is given the Table 1 and is shown in Figure 2. The conductivity of water is affected by the suspended impurities and also depends upon the concentration of ions in the water [11]. According to WHO normal range of electrical conductivity for water is 400-600 μ S/cm [10].

Conductivity of water was recorded below the normal range. Conductivity of soil was also recorded below the normal range.

Total Dissolved Solids (TDS): Values of TDS are given in the Table 1 and Figure 3. According to WHO normal range of TDS for water is 50-250mg/ml [10]. Value of TDS recorded for water was 100mg/50ml which is within the normal range given by WHO. The quantity of TDS is proportional to the degree of pollution. The TDS is recorded more during rainy season. This is because of the addition of solids from runoff water [5]. Value of TDS for soil was recorded to be 170mg/50ml which is below the normal range. TDS analysis has great implications in the control of physical and biological waste water treatment processes [6].

Table 1: Physicochemical parameters of water and soil samples collected from Rawal Dam Islamabad

Type of sample	pH	Conductivity (μ S/cm)	Color	Odour	Temperature	TDS	Elasticity
Water sample	7.21	0.41	Colorless	Odorless	30C	100mg/50ml	Non elastic
Soil sample	7.26	0.42	Red brown	Odorless	28.2C	170mg/50ml	Elastic

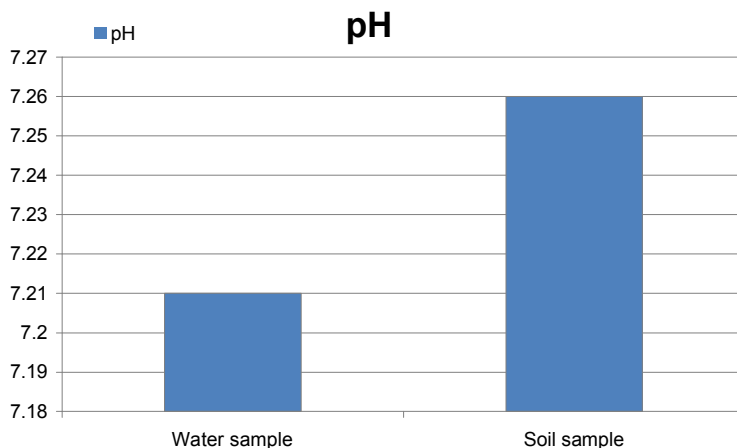


Fig. 1: pH of water and soil samples

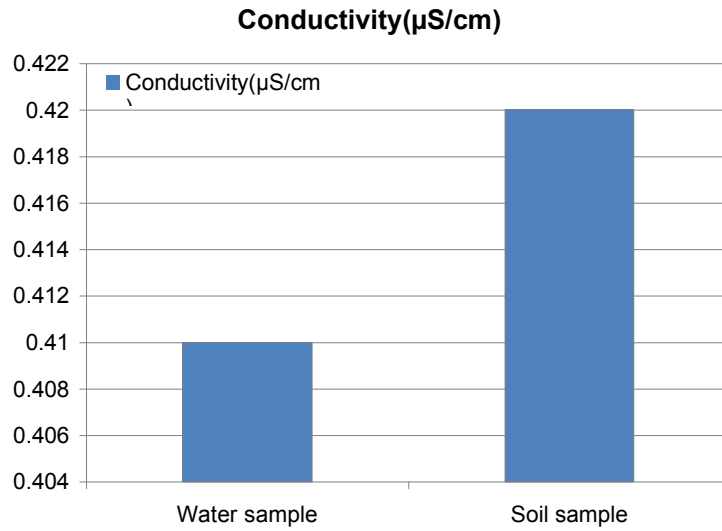


Fig. 2: Conductivity of water and soil samples

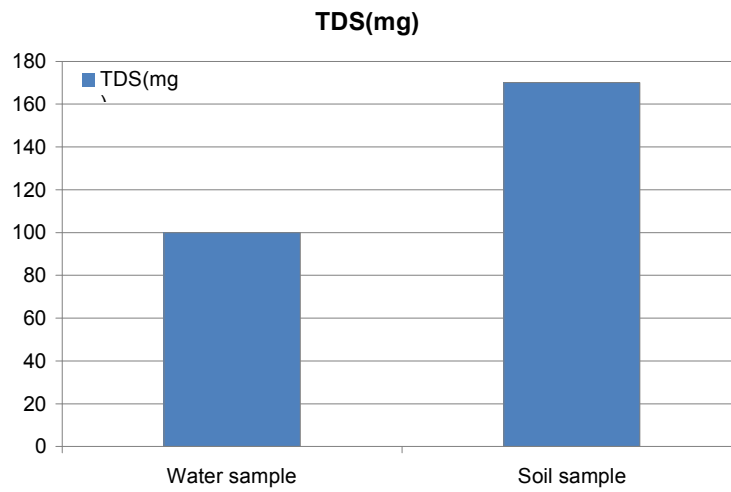


Fig. 3: TDS of water and soil samples

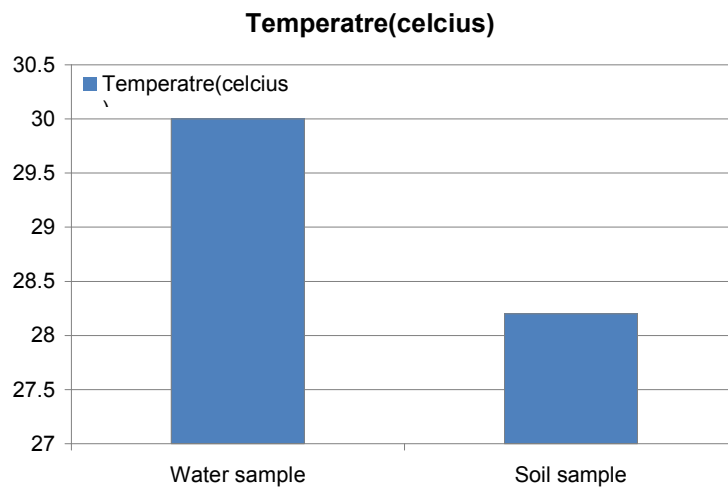


Fig. 4: Temperature of water and soil samples

Temperature: Values of temperature of water and soil samples are given in the Table 1 and figure 4. High value of water temperature was recorded i.e. 30 °C. High temperature of water was recorded because of low water level and high atmospheric temperature [6]. In an established system the temperature of water controls the rate of all chemical processes, reproduction and immunity and affects fish growth. Drastic temperature alterations can be fatal to fish [12]. Temperature of soil was also recorded high i.e. 28°C.

Color: Water sample collected from Rawal dam was colorless while soil sample had brown color.

Odour: Both water and soil samples collected from Rawal dam were odorless.

Elasticity: Water sample collected from Rawal dam was inelastic while soil sample was elastic.

DISCUSSION

Present study was conducted in order to analyze physicochemical parameters of water and sediments collected from Rawal dam Islamabad. Six samples of water were collected during breeding season of fish. Six samples of soil were also collected for physicochemical analysis. Results of physicochemical parameters are shown in figures and are given in the tables.

pH values from 7.2 to 8.5 are suitable for aquatic life [13]. pH value according to Target Water Quality Range (TWQR) for domestic use is 6.0 to 9.0 [13]. Water of Rawal dam Islamabad is suitable for both aquatic life and domestic purposes because its pH is within the normal range. Values of electrical conductivity and TDS were also found below the normal range [10]. Temperature of water was recorded higher which is due to high atmospheric temperature. Temperature of soil was also recorded higher and this might be due to high temperature of water.

The results revealed that water of Rawal dam is suitable for both domestic purposes and for aquatic life.

CONCLUSION

From the obtained results of physicochemical parameters of water collected from Rawal dam Islamabad it was shown that all the physicochemical parameters were in the normal range according to WHO and TWQR which indicates that water of Rawal dam is convenient for

aquatic life and also for domestic life. Physicochemical parameters recorded for sediments were also within the normal ranges.

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