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Research Article

PHYSICO-CHEMICAL ANALYSIS OF RIVER SWAT AT BATKHELA DISTRICT MALAKAND, KPK PAKISTAN

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ABSTRACT

Physico-chemical parameters are the water quality parameters which include physical and chemical characteristics of water which shows that whether the water quality was good or not good for aquatic life. Physico-chemical characters of River Swat water at Batkhela, District Malakand Khyber Pukhtunkhwa, Pakistan was studied from April to July 2014. The aim of the study was to determine the water quality parameters of River Swat at Batkhela, District Malakand and to know that whether the observed values was normal, above or below the normal range and to know that these values was normal or could produce any toxic effect on both aquatic flora and fauna. The water quality parameters were checked through Aqua Check 5 in 1, water quality test strips for total chlorine, hardness, pH, alkalinity and Total chlorine, made by Hatch Company of the United State of America. Total Dissolved Solids and electrical conductivity was checked through Tintometer Multi-direct Machine. Air and water temperature was determined by common mercury thermometer ranged from 0 to 110 ^{0}C and dissolved oxygen was measured through dissolved oxygen meter. During the study months the mean values recorded for the water quality parameters were, pH of water was 6.95, Total Alkalinity 135 ppm, Total Hardness 95 ppm, Total Chlorine 0, Air temperature 26.5℃, Water temperature 17℃, Total dissolved solids 0.49 ppm, Electrical conductivity 104µS/cm, and Dissolved Oxygen 5.91 ppm. The results of the present study reveal that River Swat water at Batkhela, District Malakand has good water quality. The water quality parameters are in normal ranges and the water has no adverse effect on growth, survival and reproduction of both aquatic flora and fauna of River Swat.

Keywords: Physical chemical parameters, Chemical chemical, River Swat, District Malakand,

INTRODUCTION

Water is a transparent fluid. Water forms the world streams, lakes, ocean and rains. Water is the major constituent of the fluids of all living organism. Physico-chemical parameters are very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Some physical test are performed for testing of its physical appearance such as temperature, pH, TDS etc, while chemical tests should be performed for its dissolved oxygen, alkalinity, hardness and other characters (Patil *et al.,* 2012).The main objective of present work is to study is to the physical, chemical parameters and biodiversity of River Swat.

MATERIALS AND METHODS

Study area

The Swat River is a river in Khyber-Pakhtunkhwa Province, Pakistan. Its source is in the Hindukush Mountains, from where it flows through

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the Kalam Valley and Swat District. In then skirts Lower Dir District and flows through Malakand District to enter the Kabul River at Charsadda in the Peshawar valley. The Swat River irrigates large areas of District Malakand such as lands of Thana, Alladand, Bathela, Khar, Totakan, etc. and contributes to the fishing industry of the region. There are two main hydro-electric power projects on canals from the Swat River which generate electricity for local usage. Churchill Bridge on River Swat is one of the attractions for visitors. The scenery attracts many tourists from all over Pakistan during the summer. River Swat at Batkhela is given in the Figure 1 and 2.

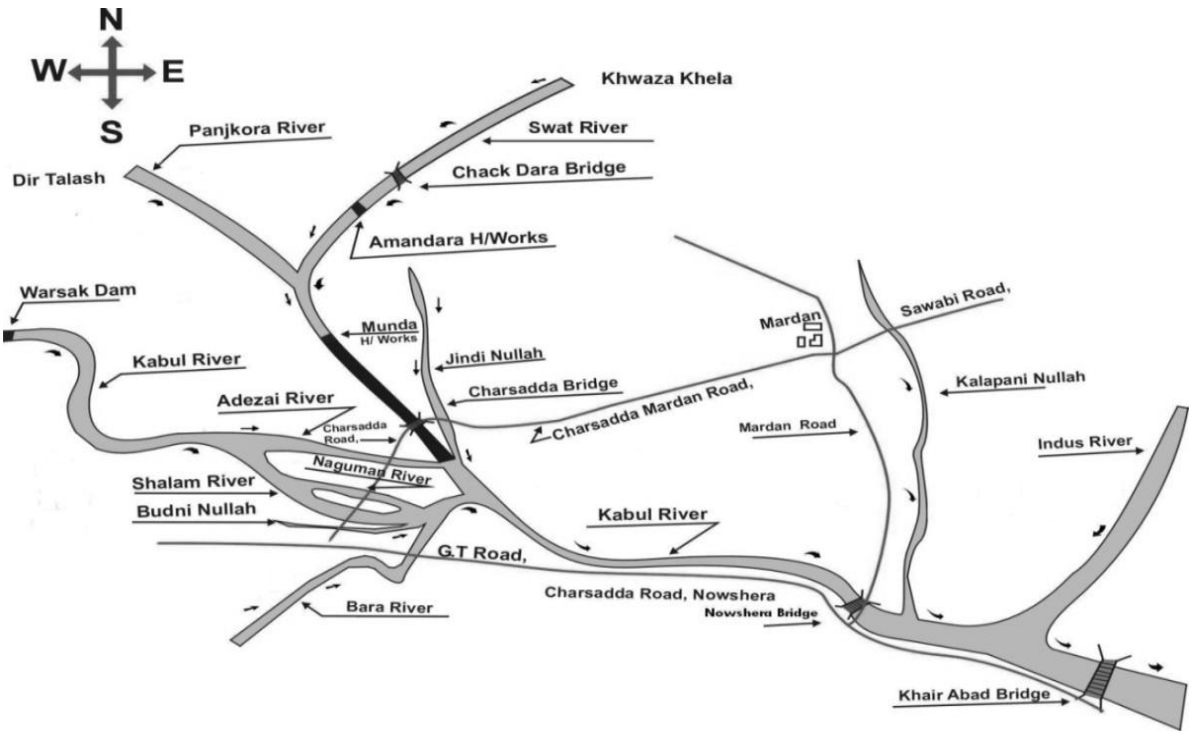

Figure 1. Map of River Swat at Batkhela, District Malakand.

Figure 2. River Swat at Batkhela, District Malakand.

Collection and analysis of water samples

To know about the nature of a particular water body it is important to measure accurately the physico-chemical parameters of that water body. Water samples were collected in a clean plastic bottle with a capacity of about 1.5 liter. The bottles were first washed with water of the sampling site. Water was collected from the depth of about 1-2 feet below the surface of water. Water were collected from different sites of the river and brought to the laboratory for physical and chemical analysis. Samples were collected with great care. The samples were collected twice a month and analyzed by Tintometer, Multidirect Machine. The average values were presented on monthly basis.

RESULTS

The physico-chemical parameters of River Swat were observed during the study period the values vary from month to month due to the changed environmental conditions. The values of each parameter observed during analysis from April to July 2014 are shown in the table 1.

Air Temperature

Values of Air temperature were observed during the study months of April, May, June and July varies from each other. The changes in air temperature may be due to the climatic changes and intensity of the sunlight. The average values of air temperature observed during the study period are shown in the table 1.

Water Temperature

The observed values of water temperature during the study months, April, May, June, and July, are different from each other. The difference in water temperature may be due to intensity of light and changes in environmental conditions. Water temperature values for four months are listed in the table 1.

Total Alkalinity

Total Alkalinity values observed during the study months fluctuate. Fluctuation in values of alkalinity may be due to climatic changes. The mean observed value for alkalinity is 135 ppm during the study period. The alkalinity values are shown in the table 1.

Total Chlorine

The observed values of total chlorine during the study period were zero. Values of total chlorine are shown in the table 1.

pH

pH values observed during the study period, April, May, June, and July are listed in the table 1.

Total Hardness

The values of Total Hardness observed during the study period fluctuate. Fluctuations in values are shown in the table 1.

Dissolved Oxygen

Dissolved Oxygen observed during the study months, April, May, June, and July are shown in table 3.7 with a mean value of in the table 1.

Total Dissolved Solids

The observed values of Total Dissolved Solids are shown in table 3.8. There is a little bit variation in the values due to changing climatic condition.

Electrical conductivity

Electrical Conductivity is related with dissolved solids. The observed values of electrical conductivity are shown in the table 1.

Table 1. Average physico-chemical parameters of River Swat from April to July 2014.

Month	Air Temperature ^{0}C	Water Temperature ^{0}C	Total Alkalinity ppm	Total Chlorine ppm	pH	Total Hardness ppm	Dissolved Oxygen ppm	Total Dissolved Solids mg/l	Electrical conductivity µS/cm
April	24	15	150	0	7.2	70	5.9	0.4	97
May	26	16	140	0	7.0	85	6.0	0.5	102
June	27	18	130	0	6.9	105	5.9	0.5	105
July	29	19	120	0	6.5	120	5.8	0.6	120
Mean value	26.5	17	135	0	6.9	95	5.9	0.5	106

DISCUSSION

Air temperature is a measure of how hot or cold the air is. It is the most commonly measured weather parameter. Heat is a form of energy measurable in term of temperature by thermometer. Temperature of the surrounding describes the surrounding temperature conditions. In natural environment human exposed from arctic cold to weak tropical heat regions. Air temperature influences body temperature. The body tends to maintain a constant temperature by reflex responses which lower or raise the temperature as per need. In excessive cool the body needs additional supply to maintain a constant body temperature. In very warm air the body absorbed heat from the surrounding. The body temperature would rise by about 2^0 C per hour if not offset by evaporating cooling from the lungs, skin, and by radiation. The atmospheric temperature is a factor by the help of which body maintain a constant temperature of 37^0 C, that is necessary for survival. Variation in body temperature leads to stress in the body that has been called as "Thermal Stressor." There are evidences that mental performance is negatively affected by thermal stressors (Batra and Gargs, 2005). Physical changes to fresh water ecosystem resulting from changes in air temperature will degrade and diminishes available habitat for fishes, reduce reproductive success and compelled fishes on migration.

In the present study average observed air temperature value during the study months are found to be within range of 29 and 24^0 C with a mean value of 26.5^0 C. Air temperature of River Swat with a mean value of 26^0 C was compared with that of River Kurram with a mean value of 20.3^0 C. Air temperature of River Swat was high as compared to that of air temperature of River Kurram. The difference in air temperature may be due to difference in geological conditions and different study months of different years.

Temperature simply means the degree of hotness or coldness. Fish are exothermic and obtain heat from their external environment and are unable to control their body temperature. Simply we can say that fish are cold blooded animals and their body temperature depend upon the external environment, mean their body temperature change with the change occur in the external environment temperature. Each species required their optimum temperature for growth, survival and reproduction, and due to such requirement the fish are divided into three classes that are, cold water fish like Trout etc, tolerate temperature range of 07 to 15. Semi cold water fish like *Tor putitora*, etc. tolerate temperature range of 15 to 20. Warm water fish like Carps etc, tolerate temperature range of 20 to 35. So its mean every species have their optimum range of temperature in which they can grow, survive and reproduced well. The greatest source of temperature in water bodies is the solar irradiance by direct absorption (Wetzel and Likens, 1979). According to Ali, (1999) suitable temperature for fishes lies within range of (16 to 40^0 C). In the present study the water temperature value was recorded to be in between 15 and 19^0 C with a mean value of 17^0 C.

Mean water temperature value of River Swat (17^0 C) was compared with the mean water temperature value of River Indus (20.25^0 C) (Khan *et al.,* 2014). Mean water temperature value of River Indus was higher than the mean water temperature value of River Swat. The difference in water temperature may be due to different study period and geography of the area. The difference in water temperature may because the River Indus water is warm while the water of River Swat is semi cold.

Alkalinity of water is described as the presence of all those substance in water which can resist the change in pH when an acid is added to water. Total alkalinity of water is due to carbonate and bicarbonate anions. As for fish intake, too much acid is not good for the body and health. Alkalinity neutralizes water to be suitable for fish intake and for fish usage by neutralizing it. Without alkalinity, water forms would be acidic and will cause harm to all aquatic life. Alkalinity is the acid neutralizing capacity of solutes in a water sample, reported in mg/L per. Alkalinity consists of the sum of titratable carbonate and noncarbonated chemical species in a filtered water sample. The total alkalinity of 20_200 mg/l is good for pond culturing (Boyd and Claud 1979; Tucker, 1984). Standard value for total alkalinity is 0 to 400 mg/l (Meade, 1989).

In current observation values of total alkalinity fluctuate between 150-120 ppm with a mean value of 135 ppm. Observed Alkalinity values falls under the normal range. Mean alkalinity value of River Swat was (135 ppm) and compared with the mean alkalinity value of River Indus with a mean value of (188.4 ppm) (Khan *et al.,* 2014). Total alkalinity value of River Swat was less than the total alkalinity value of River Indus. The difference in the alkalinity may be due to the geological changes, physical and chemical environment of the study area.

Chlorine is a greenish-yellow gas that dissolves easily in water. Free chlorine (chlorine gas dissolved in water) is toxic to fish and aquatic organisms, even in very small amounts. Actually the chlorine results in the water may be in the form of sodium chloride (NaCl) or sodium ions or chloride ions. Among the halogens (Cl, Br, I, F), chloride is the most abundant. The chloride is required by the plants cells for photosynthesis to release oxygen in fish pond. In contrast, free chlorine is very toxic substance even at low concentration. Even at great dilution chlorinated organic

may harm or even kill algae, zooplankton, and large number of commercially important fishes (Goldman, 1983). The Standard value for the chloride is 10 to 600 mg/l (SAWQG, 1996).

Department of Environmental Management (DEM) has set acceptable chloride concentration exposure limits for freshwater organisms at 860 ppm to prevent acute (immediate) exposure effects and at 230 ppm to prevent chronic (long-term) exposure effects. For drinking water, DEM has set a maximum contaminant level of 250 ppm chloride. When the chloride concentration level reaches 250 ppm the water starts to taste salty. Indian standards for drinking water have recommended 250 mg/l as desirable limit. While 1000 mg/l as permissible limit for chloride concentration. High concentration of Cl^- produce hypertension, effect metabolism of body, and increase the electrical conductivity of water (Paliwal, 1971).

In the present study amount of chlorine was found to be 0 ppm. The absence of Chlorine shows that the water of River Swat water is suitable for the production of fish fauna, algae, and planktons (zoo and phytoplankton) growth.

pH simply means measure of the degree of the acidity or the alkalinity of a solution as measured on pH scale of 0 to 14. When the water have pH equal to 07 so such water is called pure water, and when water have pH less than 07 so it's called acidic water and when water have pH above than 07 so it's called alkaline water. The pH has great effect on the growth, survival, and reproduction of the fish. For instance the carp fish died in five days at pH of 04 to 05. So its mean that every species can grow, survive and reproduce at their required pH level. If the pH level move above or move below than the required level of the fish so it can badly affect the fish. The water having pH range of (6.5 - 09) is suited for the growth of the aquatic organism (Ali, 1999). Standard water quality for aquaculture has a pH of 6.5 - 08 (Meade, 1989).

Normal range for freshwater ecosystems is 6 to 8. Increase in the range at either side is harmful to biota. Fluctuations in pH are dependent on Photosynthetic activity by phytoplankton consuming carbon dioxide and releasing carbonate during the daytime resulting in rise in pH while during the night time respiration releases carbon dioxide and lowers pH. Increase in mean temperature and yearly precipitation due to climate change leads to increased groundwater levels and increased runoff with subsequent increase of soluble organic material and base cations in the runoff can affect pH both in negative and positive directions.

In the present study pH values ranged between 6.7 and 7.2 with a mean value of 6.95. Muhammad *et al*. (1998) reported a pH of 6.7 for River Swat at Mingora, Pakistan. Mean recorded value of pH of River Indus was 7.5 (Khan *et al*., 2014). Current value (6.95) was compared with the previous study. River Indus pH was founded high and River Swat pH was founded low. The changes in values may be due to changes in environmental conditions, different study period and pollution etc.

Water's hardness is determined by the concentration of multivalent cations. Common cations found in hard water include Ca^{2+} and Mg^{2+} (Weingartner, 2006). The Hardness caused by calcium ions are called calcium hardness while if it is caused by the magnesium ions are called magnesium hardness, while total hardness is equal to calcium plus magnesium ions hardness. There are many different divalent salts; however, calcium and magnesium ions are the most common sources of water hardness (Wurts and Dourborow, 1992).

In the present study period values of total hardness fluctuate between 70 and 120 ppm with a mean value of 95 ppm. Mean value for total hardness in the present study (95 ppm) was compared with the value recorded from River Indus (204.9 ppm) (Khan *et al.*, 2014). The observed was found less. It may because of different study area and there is no much pollution in river swat as compared to River Indus. Muhammad *et al*. (1998) reported total hardness value of River Swat at Mingora (21.6 ppm) and was less than that of River Swat at Batkhela. The difference in values may because of different study period. Now a day's pollution there is so much pollution as compared to 1998.

Dissolve Oxygen (DO) is the quantity of O_2 dissolved in water. Oxygen is critical to the survival of aquatic plants and animals, and a shortage of dissolved oxygen is not only a sign of pollution, it is harmful to fish. This DO can be obtained from the surrounding environment. DO is inversely proportional to the temperature and directly proportional to the partial pressure across the water surface. The DO participates in many important chemical and biological reactions and has become the most widely studied chemical in the aquatic environment. The DO is necessary for the respiration of living organisms of both animals and plants and is produced by plant photosynthesis only when sufficient light and nutrient is available (Goldman, 1983).

DO requirements of aquatic organisms are difficult to determine at it is influenced by its physical state, water temperature, level and state of pollution and species, e.g., trout utilizes 50 to 60 mg of DO per hour at 5^0 C (41^0 F), but at 25^0 C (77^0 F) the requirement increases by five to six times of that amount. Being cold-blooded animals fish use

more oxygen with increase in temperatures. Reduction in oxygen due to increase in temperature may influence egg development of many species which in turn may change the species, age structure, dominancy and guild abundance. More over this may also favor increase in the population of invasive species which are better adapted to warmer temperature than native species might result in larger difference to reference communities and disappearance of key guilds (Dubling and Blank, 2005).

In the present study period the recorded values of dissolved oxygen fluctuates between 5.8 to 6 ppm with a mean value of 5.91 ppm. Dissolved Oxygen value of River Swat (5.91 ppm) was compared with that of River Indus (6.5 ppm) (khan *et al.*, 2014). River Swat value was slightly less than the dissolved oxygen value of River Indus. It may be due to climatic changes and geological changes in the area as well as in the study period because it was conducted in different months of different year.

Total dissolved solids, when high in concentration have bad effect on aquatic life. According to Mitchell and Stapp (1992), high concentration of dissolved ions can damage the organism's cells. High concentration of total dissolved solids also reduced the photosynthesis activity and increases the water turbidity and water temperature. TDS up to 2000 mg/L would not harm fish and other aquatic life. The normal range according to environmental protection agency for total dissolved solid is, 100 – 250 mg/L.

In current study period values of total dissolved solid ranged between 0.051-1 ppm with a mean value of 0.49 ppm. Mean TDS value of River Swat (0.49 ppm) was compared with that of River Indus (117 ppm) (Khan *et al.*, 2014). The comparison of both values shows a great difference. The mean TDS value of River Indus was much higher than the TDS value of River Swat. The difference may be due to high pollution in River Indus and study area. Water of River Swat was much clear, transparent and they are almost neutral as compared to water of river Indus.

Water Conductivity is a measure of the ability of water to pass an electrical current. This conductivity of water is due to the inorganic dissolved solids. Conductivity is also affected by temperature. The warmer the water, higher will be the conductivity. For this reason, water conductivity is reported as conductivity at 25 degrees Celsius 25^0C (Environmental Protection Agency). Electrical Conductivity is a measure of concentration of total dissolved solids and major ions. The unit of measurement is microsiemens per centimeter (µs/cm). Conductivity is a non-specific parameter which can be measured to establish pollution zone. The conductivity of most fresh water ranges from 10-1000 µs/cm but may exceed 1000µs/cm particularly in polluted waters (Chapman, and Kimstach, 1992). The values of electrical conductivity during the study period ranged between of 97 and 120 µS/cm with a mean value of 104 µS/cm.

The mean observed value of electrical conductivity of River Swat (104 µS/cm) was compared with the mean electrical conductivity value of River Indus (169.5 µS/cm) (Khan *et al.*, 2014). The electrical conductivity values of River Indus were high because the electrical conductivity value increased with total dissolved solids and addition of pollutants. May be the river Indus water was more polluted and high amount of dissolved solids as compared to River Swat that's why the electrical conductivity value of River Indus was high.

CONCLUSION

All the physico-chemical parameters were in normal range and have no adverse effect on survival, reproduction, and growth of aquatic flora and fauna. Water quality shows suitability for varieties of fishes such as *Notopterous chitala* (Papellate), *Tor putitora* (Mahseer), *Mastacembelus armatus* (Marmahi), etc. The data generated in this study will definitely help the concerned quarters to take necessary steps to control pollution and the fish biodiversity of River Swat.

To maintain the diversity of flora and fauna of River Swat the following recommendations are recommended.

- Government should taken strict steps for the survival of fish species.
- Excessive hunting of fish should be avoided.
- Industrial areas should not be developed near water bodies.
- Organic and deposable wastes should not be added to water bodies.
- People should be aware of water pollution and their threats.
- The diversity of fishes found should be preserved by making hatcheries along the rivers.

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