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Analysis of selected water quality parameters and heavy metals of Indus River at Beka Swabi, Khyber Pakhtunkhwa, Pakistan

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Abstract

Present study deals with analysis of selected Water Quality Parameters and Heavy Metals of Indus River at Beka Swabi. Present study was conducted for four months that was from November 2012 to February 2013. During each study month, the mean value recorded for water quality parameters were: Velocity Of Water 0.94 m/s, Depth Of River 26.2 inches, pH 7.5, Water Temperature 15.75 ℃, Total Hardness 204.9 mg/L, Calcium Hardness 129.9 mg/L, Magnesium Hardness 75 mg/L, Water Conductivity 169.25 µS/cm, Dissolved Oxygen (D.O) 6.5 ppm, Total Solids (TS) 192 mg/L, Total Dissolved Solids (TDS) 117 mg/L, Total Suspended Solids (TSS) 75 mg/L, Total Alkalinity 188.4 mg/L, Chloride 27.4 mg/L, Sulphate 31.2 mg/L. During each study month, mean value recorded for Heavy Metals were: Lead (Pb) 0.2 mg/L, Zinc (Zn) 0.22 mg/L, Iron (Fe) 0.45 mg/L, Chromium (Cr) 0.00 mg/L, Copper (Cu) 0.01 mg/L, Manganese (Mn) 0.62 mg/L. The main aim of this study was to know whether this water is good for fish growth, survival and reproduction. So from this study it was concluded that this part of Indus River at Beka Swabi having values of water quality parameters and heavy metals were in the normal range and have no adverse effect on fish growth, survival and reproduction.

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Introduction

The word Indus is derived from the Sanskrit word "Sindhu" Greek "Sinthos" and Latin "Sindus" which means divider, keeper of defender. (Gulhati, 1968). In Urdu, the official language of Pakistan, the Indus is known as "Darya-e-Sindh" . The Indus river is ranked 23rd biggest river of the world on the basis of annual discharge which is 5.6*1000 m^3 sec^{-1} and 31st on the basis of length which is 11,65,500 km^2 (Wellcome, 1985).The river rises in the southwestern Tibet Autonomous Region of China at an elevation of about 18,000 feet (5,500 meters). For about 200 miles (320 km) it flows northwest, crossing the southeastern boundary of the disputed Kashmir region at about 15,000 feet (4,600 meters). A short way beyond Leh, in Ladakh (in the Indian-administered state of Jammu and Kashmir), it is joined on its left by its first major tributary, the Zaskar River. Continuing for 150 miles (240 km) in the same direction into the Pakistani-administered Northern Areas of the Kashmir region, the Indus is joined by its notable tributary the Shyok River on the right bank. Below its confluence with the Shyok, as far as the Kohistan region, it is fed by mighty glaciers on the slopes of the Karakoram Range, the Nanga Parbat massif, and the Kohistan highlands. The Shyok, Shigar, Gilgit, and other streams carry the glacial melt water into the Indus. The Shigar River joins the Indus on the right bank near Skardu in Baltistan. Farther downstream the Gilgit River is another right-bank tributary, joining it at Bunji. A short distance downstream the Astor River, running off the eastern slope of Nanga Parbat, joins as a left-bank tributary. The Indus then flows west and turns south and southwest to enter the Khyber Pakhtunkhwa Province of Pakistan, in the process skirting around the northern and western sides of the Nanga Parbat massif (26,660 feet [8,126 meters]) in gorges that reach depths of 15,000 to 17,000 feet (4,600 to 5,200 meters) and widths of 12 to 16 miles (19 to 26 km). Trails cling grimly to precipitous slopes overlooking the river from elevations of 4,000 to 5,000 feet (1,200 to 1,500 meters). After emerging from this highland region, the Indus flows as a rapid mountain stream between the Swat and Hazara areas in Khyber Pakhtunkhwa Province until it reaches the reservoir of Tarbela Dam. On its eastern bank it receive several other Himalayan rivers viz, Sutlej, Ravi, Chenab, Jhelum, Poonch and Soan.On the western bank the significant river is the Kabul receive from Afghanistan and beside this various rivers recieves like Swat, Panjkora, Khiyali, Chitral and number of small streams in KPK. The other rivers draining the mountains west of the Indus plain are the Kurram, Gomal, Zhob, Tochi, Nari, Bolan, Mula, Gaj and Chakar.Near Tatta the Indus branches into distributaries that form a delta and join the Arabian sea at various points south-southeast of Karachi. The delta covers an area of 3,000 square miles (7,800 square km) or more (and extends along the coast for about 130 miles (210 km). The uneven surface of the delta contains a network of existing and abandoned channels. The coastal strip, from about 05 to 20 miles (08 to 32 km) inland, is flooded by high tides. The Indus delta has elongated protruding distributaries and low sandy beaches. The flowing of Indus River through Pakistan is shown in Fig.1.

The above descriptions of the Indus are found in surveys of the corresponding regions, such as (Lambrick 1975; Peter 1995; Kureshy 1977; Fairley 1975; Michel 1967; Ahmad and Chaudhry 1988).

Water quality parameters are the physical, chemical and biological characteristics of water. (Diersing and Nancy, 2009). It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose (Johnson *et al,* 1997).

Heavy Metal is a member of a loosely-defined subset of elements that exhibit metallic properties. It mainly includes the transition metals, some metalloids , lanthanides , and actinides. Some of them are dangerous to health or to the environment (e.g. mercury, cadmium, lead, chromium). (Hogan. 2010) . Some may cause corrosion (e.g., lead), some are harmful in other ways (e.g. arsenic may pollute catalysts).(Abdul-Wahab *et al*, 2011). Many different definitions have been proposed, some based on

Density, some on Atomic weight, and some on Chemical properties or Toxicity (John H. Duffus, 2002).

(Bjerrum's, 1936), definition of "heavy metals" is based upon the density of the elemental form of the metal, and he classifies "heavy metals" as those metals with elemental densities above 7 g/cm^3. In 1964, the editors of Van Nostrand, International Encyclopedia of Chemical Science and in 1987, the editors of Grant and Hackh's Chemical Dictionary included metals with a density greater than 4 g/cm^3. A little later (Parker, 1989), (Lozet, 1991), and (Mathieu and Morris, 1992), choose a defining density "greater than 5 g/cm^3. However, (Streit, 1994), used a density of 4.5 g/cm^3 as this reference point, and (Thornton, 1995), chose 6 g/cm^3. The Roemp Chemical Dictionary (1996), gives 3.5 g/cm^3 as a possible defining density. Other definitions included like "Heavy metals" is the name of a range of very dense alloys used for radiation screening or balancing purpose.

(Bennet, 1986), and (Lewis, 1993), opt for Atomic weight greater than that of sodium (i.e., greater than 23), thus starting with magnesium, while (Rand *et al*,1995), prefer metals of Atomic weight greater than 40, thus starting with scandium.

On basis of Chemical properties, Intermetallic compound of iron and tin ($FeSn_2$) formed in tinning pots which have become badly contaminated with iron. The compound tends to settle to the bottom of the pot as solid crystals and can be removed with a perforated ladle. Lead, zinc, and alkaline earth metals that react with fatty acids to form soaps. "Heavy metal soaps" are used in lubricating greases, paint dryers, and fungicides.

So it's concluded that Heavy metals are poising serious threat to natural water bodies and its biota. The natural aquatic system may extensively be contaminated with heavy metals released from domestics, industries and other man-made activities. Heavy metals contamination may have devastating effect on the ecological balances of the recipient environment and on the diversity of aquatic organism. Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, mutagenic and carcinogenic effects in animals.

Swabi lies between the Indus River and Kabul River, in Khyber Pakhtunkhwa (KPK) Province of Pakistan. Its residents are referred to as Swabiwaals. Swabi is the fourth most populous district of the KPK. The Yousafzai clan of Pakhtoons is the district's predominant clan.

Beka is a town and Union Council of Swabi District in the Khyber Pakhtunkhwa of Pakistan. It is part of Lahor Tehsil. (SMEDA 2009). The present-day Beka was founded approximately 300 years ago as a result of the diversion a river, the Indus, which flows through the town.

The present study deals with study of selected water quality parameters and heavy metals of Indus River at Beka Swabi. The main aim of this study was to know whether the water of Indus River at this area is of good quality for fish fauna, for survival, growth and reproduction of fish or not. At this site of Indus River previously no such work has been reported. It was the first time to report the selected water quality parameters and heavy metals of Indus River at this site, so that's why it was the need to know that whether this area of Indus river have good quality of water or of bad quality, so to know this such study was carried out.

Materials and methods

Water sample collection

The water sample was collected in clean plastic bottles. First of all the bottle was washed with the sampling site water. Then sample of water was taken from the depth of about 1.5 to 2 cm below the surface of water from different site of the river and then bring to laboratory for further analysis of water quality parameters. Sample was collected twice in a month

and then founded the mean of two samples and then presented the result month wise.

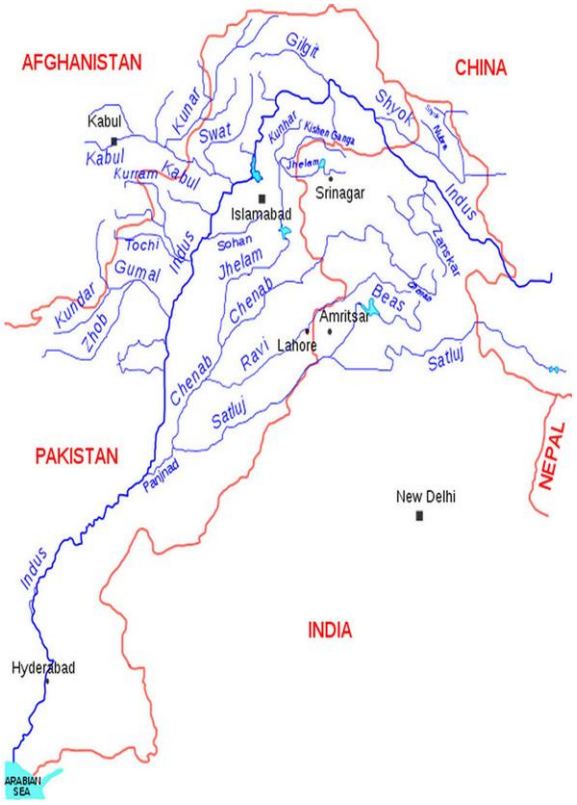

Fig. 1. Showing flow of Indus River through Pakistan.

Water quality parameters checking methods

The Velocity of water was checked by using ordinary ball and a measured area in river between two points which was marked by ordinary sticks. The ordinary ball was allow to move between two points with the flow of water, and the time of movement of ball between two marked area was noted with the help of stop watch which gave us velocity of water in river. The depth of river was checked by mean of Graduated stick. Water temperature was checked by Ordinary Centrifuge Thermometer. pH was calculated by pH meter whose model is **(**Mettler Delta 320. Halstead, C09 2dx, England. Model 320. Made In Uk). Dissolve Oxygen (D.O) was measured by D.O meter (WPA, ox20, UK). Water Conductivity and Total Dissolved Solid (TDS) was measured by Conductivity meter and Total Dissolved Solid meter (Model 4520, jenway, UK). For Water Conductivity, the water temperature was fixed at 25 ℃ . Total Suspended Solid was measured by evaporating 50ml sample of water on water bath, and the remainder were dried in oven (Mammert 854, West Germany), and weighted through digital balance (Sartorious Germany, ME 414s, 0.0001g). Total Solids (TS) can be calculated by using formula (Total Solid = Total Dissolved Solid + Total Suspended solid). EDTA Titrimetric method was used for the estimation of Total Hardness and Calcium Hardness as $CaCo_3$. Difference between the Total hardness and Calcium hardness directly determine the extent of Magnesium hardness. (Magnesium hardness as $CaCO_3$= Total Hardness – Calcium Hardness). Titrimetric method was used for the estimation of the Total Alkalinity. Argenometric method was used to determine the Chloride in the sample of water. EDTA Titrimetric method was used for the estimation of Sulphate.

Heavy metals detection procedure

The heavy metals in the sample should be detected by Atomic Absorption (Model aa-660X V142). For the estimation of the heavy metals in the sample first of all we have to do acid digestion of the sample. The main purpose of the acid digestion is to remove the turbidity of sample water. So for acid digestion, take well mixed 100 ml water sample in 250 ml volumetric flask. Then add 5 ml concentrated HNO_3 (55%).After that put it on the hot plate and evaporate it, and stop evaporation when it reach to 20 ml. After that again add 5ml concentrated HNO_3 (55%) and again place it on the hot plate and start evaporation. When it again reach to 20 ml so stop evaporation and cool it to room temperature and then dilute it to 100 ml with distilled water in 100 ml volumetric flask. So the acid digestion is done and now the sample is ready to run on Atomic Absorption Spectrophotometer. In Atomic Absorption Spectrophotometer the flame used was air acetylene and for every heavy metal analysis, its characteristic lamp was set in flame Atomic Absorption Spectrophotometer. Characteristic standard solutions for each heavy metal were aspirated first into flame atomic absorption spectrophotometer to prepare the standard curve for each heavy metal and then finally samples were aspirated and the concentration of selected heavy metals was observed. The concentration of each heavy metal was reported in mg/L.

Statistical method

Mean of data

It is the representative part of the whole data, denoted by $\overline{X}$. To know about the representative value for all months, mean can be calculated by the following formula.

$\overline{X}$ (Mean) = Σxi/n

In Above formula

Σxi = sum of observation, and

n= number of observation.

Results

Velocity of water in river during November was 0.85 m/s, during December was 0.96m/s, during January was 1.05m/s, and during February was 0.93 m/s. Depth of river during November was 26.3 inches, during December was 25 inches, during January was 24 inches, and during February was 29.6 inches. The pH value in November was 7.15, in December was 7.45, in January was 7.55 and in February was 8.2. The temperature value in November was 22℃, in December was 16℃, in January was 18℃ and in February was 25℃. The Total Hardness value in November was 146 mg/l, in December was 196.6 mg/l, in January was 257.3mg/L and in February was 220 mg/l. The Calcium Hardness value in November was 100 mg/l, in December was 118.6 mg/l, in January 174.6 mg/l and in February was 126.6 mg/l. The Magnesium Hardness value in November was 46 mg/l, in December was 78 mg/l, in January was 82.7 mg/l and in February was 93.6mg/l. The Water Conductivity value in November was 170 µS/cm, in December was 165 µS/cm, in January was 62 µS/cm and in February was 180µS/cm. The Dissolved Oxygen value in November was 6.2 ppm, in December was 6.6 ppm, in January was 6.8 ppm and in was 6.4 ppm. The Total Solids value in November was 200 mg/l, in December was 187 mg/l, in January was 178 mg/l and in February was 203 mg/l. The Total Dissolved Solids value in November was 120 mg/l, in December was 115 mg/l, in January was 108 mg/l and in February was 125 mg/l. The Total Suspended Solids value in November was 80 mg/l, in December was 72 mg/l, in January was 70 mg/l and in February was 78 mg/l. The Alkalinity value in November was 124 mg/l, in December was 190.6 mg/l, in January was 270 mg/l and in February was 169.3 mg/l. The Chloride value in November was 23.9 mg/l, in December was 20.4 mg/l, in January was 32.8 mg/l and in February was 32.8 mg/l. The Sulphate value in November was 13.44 mg/l, in December was 19.2 mg/l, in January was 69.12 mg/l and in February was 23.04 mg/l. Mean values of each parameter were, Velocity Of Water 0.94 m/s, Depth Of River 26.2 inches, pH 7.5, Water Temp 20.25 ℃, Total Hardness 204.9 mg/l, Calcium Hardness 129.9 mg/l, Magnesium Hardness 75 mg/l, Water Conductivity 169.25 µS/cm, Dissolved Oxygen (D.O) 6.5 ppm, Total Solids (TS) 192 mg/l, Total Dissolved Solids (TDS) 117 mg/l, Total Suspended Solids (TSS) 75 mg/l, Total Alkalinity 188.4 mg/l, Chloride 27.4 mg/l, Sulphate 31.2 mg/l. The Lead value in November was 0.26 mg/l, in December was 0.22 mg/l, in January 0.18 mg/l and in February was 0.14 mg/l. The Zinc value in November was 0.2 mg/l, in December was 0.25 mg/l, in January was 0.28 mg/l and in February was 0.18 mg/l. The Chromium value in November was 0.00 mg/l, in December was 0.00 mg/l, in January was 0.00 mg/l and in February was 0.00 mg/l. The Iron value in November was 0.72 mg/l, in December was 0.18 mg/l, in January was 0.37 mg/l and in February was 0.54 mg/l. The Copper value in November was 0.01 mg/l, in December was 0.01 mg/l, in January was 0.02 mg/l and in February was 0.01 mg/l. The Manganese value in November was 0.6 mg/l, in December was 0.65 mg/l, in January was 0.62 mg/l and in February was 0.64 mg/l. The mean values for each Heavy metals were, Lead (Pb) 0.2 mg/l, Zinc (Zn) 0.22 mg/l, Iron (Fe) 0.45 mg/l, Chromium (Cr) 0.00 mg/l, Copper (Cu) 0.01 mg/l, Manganese (Mn) 0.62 mg/l. The results are shown in tabulated from in Table 1 and 2.

So from this study it was concluded that this part of Indus River at Beka Swabi having values of water quality parameters and heavy metals were in the normal range and have no adverse effect on fish fauna, fish growth, fish survival and fish reproduction.

Table 1. Showing results of heavy metals.

Heavy Metals	November	December	January	February	Mean
Lead (Pb)	0.26 mg/L	0.22 mg/L	0.18 mg/L	0.14 mg/L	0.2 mg/L
Zinc (Zn)	0.2 mg/L	0.25 mg/L	0.28 mg/L	0.18 mg/L	0.22 mg/L
Iron (Fe)	0.72 mg/L	0.18 mg/L	0.37 mg/L	0.54 mg/L	0.45 mg/L
Chromium (Cr)	0.00 mg/L	0.00 mg/L	0.00 mg/L	0.00 mg/L	0.00 mg/L
Copper (Cu)	0.01 mg/L	0.01 mg/L	0.02 mg/L	0.01 mg/L	0.01 mg/L
Manganese (Mn)	0.6 mg/L	0.65 mg/L	0.62 mg/L	0.64 mg/L	0.62 mg/L

Table 2. Showing results of water quality parameters.

Water Quality Parameters	November	December	January	February	Mean
Velocity Of Water	0.85 m/s	0.96 m/s	1.05 m/s	0.93 m/s	0.94 m/s
Depth Of River	26 inches	25 inches	24 inches	29.6 inches	26.2 inches
pH	7.15	7.45	7.55	8.2	7.5
Water Temperature	22℃	16 ℃	18 ℃	15 ℃	20.25 ℃
Total Hardness	146 mg/l	196.6 mg/l	257.3 mg/l	220 mg/l	204.9 mg/l
Calcium Hardness	100 mg/l	118.6 mg/l	174.6 mg/l	126.6 mg/l	129.9 mg/l
Magnesium Hardness	46 mg/l	78 mg/l	82.7 mg/l	93.6 mg/l	75 mg/l
Water Conductivity	170 µS/cm	165 µS/cm	162 µS/cm	180 µS/cm	169.25 µS/cm
Dissolved Oxygen (DO)	6.2 ppm	6.6 ppm	6.8 ppm	6.4 ppm	6.5 ppm
Total Solids (TS)	200 mg/l	187 mg/l	178 mg/l	203 mg/l	192 mg/l
Total Dissolved Solids (TDS)	120 mg/l	115 mg/l	108 mg/l	125 mg/l	117 mg/l
Total Suspended Solids(TSS)	78 mg/l	80 mg/l	72 mg/l	70 mg/l	75 mg/l
Total Alkalinity	124 mg/l	190.6 mg/l	270 mg/	169.3 mg/	188.4 mg/l
Chloride	23.8 mg/l	20.4 mg/l	32.8 mg/l	32.8 mg/l	27.4 mg/l
Sulphate	13.44 mg/l	19.2 mg/	69.12 mg/l	23.04 mg/l	31.2 mg/l

Discussion

The water quality of Indus River at Beka Swabi is good and productive for fishes. The water plays an important role in the growth, survival and reproduction of the fish but here one question arise that which type of water? So the answer of this question is that, water of good quality. Here the second question arise that which type of water have good quality? So the answer of this question is, that water is consider as of good quality whose all parameter values are in the standard values ranges, and specially those water quality parameters which play an important role in the growth, survival and reproduction of the fish.

pH simply means measure of the degree of the acidity or the alkalinity of a solution as measured on a scale (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. Ex. 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 effect 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). The mean value of pH for selected four month was = 7.5, which is clearly understandable that it was in normal range and have no adverse effect on fish growth, survival and reproduction.

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 on 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 dividing in to three classes that are, Cold water fish like *Trout* etc, tolerate in a temperature range of 07 to 15℃. Semi cold water fish like *Tor putitora* etc, tolerate in a temperature range of 15 to 20℃. Warm water fish like *Carps* etc, tolerate in a 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, Likens, 1979). According to (Ali, 1999) the suitable temperature for fish's lies between (16℃ to 40℃). So the present study show that this part of Indus River have mostly warm water species at present time, because temperature mean was 20.25℃.

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). These calcium and magnesium ions play important role in the survival of the fish like calcium ions play important role in the bone formation and also in blood clotting factor, While magnesium ions play a key role in the muscle's contraction and nerve impulsion. Hardness of water effect fish tolerance to toxic metals, toxicity of mercury, copper, lead, ammonia, phenols increases with lower alkalinity. The hardness of water is also important parameter of water because it has also great effect on the flora and fauna of water. (Boyd and Claude, 1984). Calcium and magnesium ions can sometimes be removed by water softeners.(Christian Nitsch *et al,* 2005). The total hardness of water in Pakistan will be less than 500 mg\l and it's a standard value for hardness of water. (Dil, 2008). So mean value of Total Hardness for four month was = 204.9 mg/l and mean value of Calcium Hardness was= 129.9 mg/l and mean value of Magnesium Hardness was = 75 mg/l, which clearly show that total hardness have no adverse effect on fish life.

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 effected by temperature. The warmer the water, the higher the conductivity. For this reason, Water conductivity is reported as conductivity at 25 degrees Celsius (25℃) (Environmental Protection Agency (EPA)). High Water conductivity value show high fertility of water and similarly low Water conductivity reflect low fertility of water. The Water conductivity of water is directly proportional to the total dissolved solids. More total dissolved solids so more will be the Electric conductivity and vice versa. The Water conductivity has less effect on the fish growth, survival, and reproduction. So if it increase or decrease from there standard value so it will be acceptable for fish and will not affect the fish badly. The conductivity of rivers in the United States generally ranges from 50 to 1500 µS/cm. (Environmental Protection Agency (EPA)). Conductivity of most freshwater ranges from 10 to 1000 µS/cm, but may exceed this if the water is polluted or receive large quantities of land runoff. (Chapman, 1997). So mean value of Water Conductivity for four month was = 169.25 µS/cm, which clearly show that it will have no adverse effect on fish.

Dissolve Oxygen (D.O) 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 D.O can be obtained from the surrounding environment. D.O is inversely proportional to the

temperature and directly proportional to the partial pressure across the water surface. The D.O participates in many important chemical and biological reactions and has become the most widely studied chemical in the aquatic environment. The D.O 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). The favorable dissolved oxygen level is 05 to 07 mg/l. it is desirable range for fish cultivable. (Boyd and Claude, 1979). So the mean value of Dissolved Oxygen for four month was = 6.5 ppm, which were in normal range and have no adverse effect on fish life.

Total solids (T.S) of water include the dissolved solids plus suspended solids in water. Dissolved solids consist of calcium, chlorides, nitrate, phosphorus, iron, sulfur, and other ions particles. Suspended solids include silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. So it is clear that total solid is equal to total dissolved solids and total suspended solids in water. These 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. The large amount of total suspended solids can reduced the water transparency, reduced the precipitation of sunlight and increases the water turbidity. This turbidity effect the photosynthesis activity of plants, also reduced the dissolved oxygen, increase the level of Co_2, and increase the water temperature. Sources of total solids include industrial discharges, sewage, fertilizers, road runoff, and soil erosion. The normal range according to environmental protection agency for total dissolved solid is, 100 – 250 mg/l while Standard value for total suspended solid is <80. (Meade, 1989). So now if we calculate total solid of study duration so, mean value of total dissolved solid was 117mg/l and mean value for total suspended solid was 75 mg/l , from which it is clearly noticed that total dissolved solid values and total suspended solid values were in normal range and have no adverse effect on fish life.

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 mill equivalents per liter. Alkalinity consists of the sum of titratable carbonate and noncarbonated chemical species in a filtered water sample. The total alkalinity of 20_200mg/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). So mean value of Alkalinity for four month was = 188. 4mg/l which shows clearly that value of total alkalinity were in normal range and have no adverse effect on fish life.

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 thee 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). So mean value of chlorine for four month was = 27.4 mg/l, which shows clearly that value of chlorine, were in normal range and have no adverse effect on fish life.

Sulphur is a non-metallic element that occurs naturally in numerous minerals, including barite

($BaSO_4$), epsomite ($MgSO_4 \cdot 7H_2O$), and gypsum ($CaSO_4 \cdot 2H_2O$). Sulphate is discharged into the aquatic environment in wastes from industries such as mining and smelting operations, kraft pulp and paper mills, textile mills and tanneries. Fish kills are the most obvious effect of acid sulfate soils; the chronic, less visible effects such as reduced hatching and decline in growth rates are more common and wide spread. Copper sulfate can be toxic to fish and other organisms. Over time the use of copper sulfate can actually increase the frequency and severity of algae blooms. According to (The Pennsylvania lake management society) usually sulphate in natural water is about 5-50 mg\l and for normal functioning of the aquatic organism it must not exceed from 250mg\l.). So mean value of sulphate for four month was = 31.2 mg/l, which shows clearly that value of sulphate, were in normal range and have no adverse effect on fish life.

Heavy metals are poising serious threat to natural water bodies and its biota. The natural aquatic system may extensively be contaminated with heavy metals released from domestics, industries and other man-made activities. Heavy metals contamination may have devastating effect on the ecological balances of the recipient environment and on the diversity of aquatic organism. Among animal's species, fishes are the inhabitant that cannot escape from the determinable effects of these pollutants. Fishes are widely used to evaluate the health of aquatic ecosystem because pollutants build up in the food chain and are responsible for adverse effects and death in the aquatic system. Chemicals derived from agriculture operations and industrial effluents, such as metals, ultimately find their way into a variety of different water bodies and can produced a range of toxic effects in aquatic organisms, and ranging from alterations to a single cell, up to change in whole population. Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, mutagenic and carcinogenic effects in animals. Aquatic organisms have the ability to accumulate heavy metals from various sources including sediments, soil erosions and runoff, air deposition of dust and aerosol, and discharge of waste water. (Rauf *et al*, 2009).Beside all this, although they have toxic effect on the aquatic organisms, but when they are in high concentration, but they are inorganic elements and are essential for plants growth in traces or very minute quantities, and these plants then provide the food for the aquatic organisms.

Heavy metals adversely affect the growth rate in major carp. Fish are often at the top of aquatic food chain and may concentrate large amounts of some metals from the water. Multiple factors including season, physical, and chemical properties of water can play a significant role in metals accumulation in different fish tissues. The gills are directly in contact with water. Therefore the concentration of metals in gills reflect their concentration in water where the fish lives, where as the concentration in liver represent storage of metals in the water.(Rauf *et al*, 2009).

Toxic level of metals may effect growth impaired movement, behavioral imbalances, physiological and reproductive abnormalities in fishes. Fish intake heavy metals through different organs (gills and digestive tract), Which are transported by blood to various body parts where metals ions bind with different proteins. Heavy metals exhibit different accumulation pattern in organs of fish gills, liver and kidneys accumulate heavy metals in higher concentration in comparison to muscles, which exhibit lowest levels of metals accumulation. Among different organs, liver accumulates higher concentration of metals comparatively and has used widely to investigate the process of bioaccumulation. Kidneys also play a vital role in excretion of trace metals ions. The general principle for accumulation of metals ex higher in liver, followed by gills, kidneys and muscles. Liver and gills generally accumulated higher concentration of metals compared to other organs. Beside all this the metals content in muscles are most important because people consume the muscular part of the fish as food after removing liver, gills, kidneys.

Conclusion

The present study was conducted to know about water quality parameter and heavy metals of Indus River at Beka Swabi , and after results it were concluded that parameters and heavy metals which were checked, all were in normal range and were good for fish survival, reproduction, and growth and have no adverse effect on fish life, and the main reason for such result was that, at this part of Indus river, there in no nearby Industries, Factories, Agricultural fields, and population, which is the main sources of water body pollution due to which water quality can be damaged and effect the fish life, but this area have no such things, that's why, the water of this area is of good quality and and all the checked parameters were in normal range and good for fish life.

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