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Water Quality Profiles of Fish Farms from the District Attock, Pakistan

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Abstract:
The survival and optimum growth of cultured fish largely depend upon the good water quality. The study aimed to provide an overview of fish farms in the Attock District for suitability and development of fish farming. Water samples from five sites (Garyala, Fatehjang, Hattian, Hazro, and Hassan Abdal) in triplicates were collected randomly in July 2017. The mean value and standard deviation of all the selected water quality parameters were as turbidity (96.12 ± 24.57 NTU), cadmium (0.001 ± 0.001 mg/L), chromium (0.003 ± 0.002 mg/L), lead (0.060 ± 0.012 mg/L), pH (7.78 ± 0.21), conductivity (366.66 ± 66.41 µS/cm), salinity (210.60 ± 66.86 mg/L), TDS (259.60 ± 87.33 mg/L), total alkalinity (82.16 ± 26.36 mg/L), total hardness (66.32 ± 29.16 mg/L), chloride (31.72 ± 4.28 mg/L), sulfite (19.60 ± 4.78 mg/L) and carbon dioxide (8.44 ± 2.42 mg/L)) were found to be almost within the suitable range for fish culture. Hence, this study revealed that the water quality of the Attock District can profitably be used for fish culture.
Keywords: Water quality; Attock District; Fish farms; Physico-chemical parameters.

INTRODUCTION

In this world, water is vital for all life forms. From all freshwater resources of the earth, only a very minute quantity is available to human beings, due to unplanned urbanization, use of chemicals, rapid industrialization, which causes varying levels of heavy pollution in aquatic organisms and deterioration of water quality of aquatic fauna including fish (Kiran, 2010).

The life quality of any population is directly related to water quality and availability. In recent years, the increased population growth and industrial activities have contributed to the worsening of the environmental problems mainly related to surface waters (Blume *et al.*, 2010; Iqbal and Ashraf, 2018).

The water contamination is a consequence of anthropogenic inputs and become a major problem in urbanized areas (Bezgodov *et al.*, 2015). Other human activities such as burning or cutting of forests with inappropriate procedures and techniques lead to soil erosion and expansion of cities without planning and construction of roads also contributed to increased residue levels in rivers (Ahmad and Afzal, 2011). These residues in the river change the quality of water and these may produce harmful effects for organisms inhabiting them (Blume *et al.,*, 2010).

Aside anthropogenic activities, which affect the quality of freshwater resources (including rivers and lakes), seasonal variations are driven by precipitation (mainly rainfall), surface runoff, groundwater flow, and abstraction, also have a significant effect on the concentration and accumulation of pollutants and as a result, affecting the surface water quality (Mohseni-Bandpei *et al.*, 2018).

Water quality is the major concern of all experts now in the world. WHO emphasizes water delivered to a customer must be free from toxic substances and pathogenic organisms. The quality of water mainly depends upon the location of the source and environmental protection. Therefore the quality of water is determined by the chemical and physical analysis (Ling *et al.*, 2018).

Any characteristic of water which affects growth, reproduction, survival, production of aquaculture species are considered as water quality variable (Shamsan *et al.*, 2019; Steffens *et al.*, 2015). The water quality gives knowledge about the use and suitability in every field including fishing. Fast declining accessibility of useable water and unequal distribution of water on the surface of the planet are the key issues in terms of water amount and quality (Yunas *et al.*, 2015).

Surface water reservoirs are the freshwater resources, used for irrigation and domestic purposes. They also provide an ecosystem for aquatic life and allow fish culture practices. Water pollution nowadays is an important concern not in terms of public health, but also in terms of its aesthetics, conservation, preservation of normal beauty of natural resources (Saha and Paul, 2018).

Many researchers view that the quality of water largely depends on physicochemical parameters and biological characteristics (Irda Sari *et al.*, 2018). These characteristics are therefore used to ascertain the conservation and utilization of freshwater resources, as well as, the general management of them for fishing, irrigation, and drinking or other domestic and commercial uses (Kolawole *et al.*, 2011). On the other hand, the growth and development of fishes are mainly dependent on water temperature, DO, pH, alkalinity, free CO2, and other salts. Any change in these parameters affects the growth of fish (Iqbal *et al.*, 2009b).

The present study gives an overview of the water quality of fish farms in the Attock District of Pakistan. The fish farmers of the region can improve their fish production by knowing the water quality of that area and also can produce good farm management. Hence, the aim of the study to provide an overview of

fish farms in the Attock District for suitability and the development of fish farming.

MATERIALS AND METHODS

Triplicate surface water samples from five sites (Garyala, Fatehjang, Hattian, Hazro, and Hassan Abdal) from the Attock District of Pakistan were collected randomly in July 2017. The parameters considered to be important for fish farming were selected for the evaluation of water quality. These parameters include turbidity, cadmium, chromium, lead, pH, conductivity, salinity, TDS, total alkalinity, total hardness, chloride, sulfite, and carbon dioxide. pH and electrical conductivity were measured in situ by using pH meter (Model: pH 100 YSI, USA) and conductivity meter (Model: CM 35+, Crison Spain) respectively. For the remaining water quality parameters, water samples were collected in 1 L hygienic plastic bottles with screw caps, which are placed in iceboxes and transported to Fish Quality Control Labs Lahore (Chemistry Section), Fisheries Research and Training Institute Manawan for further tests. Turbidity, hardness, carbon dioxide, sulfite, alkalinity, and chloride were checked by turbidity meter (Model: 2100AN HACH, USA) and Hanna water testing kit (HI 3864, 3818, 3822, 3811, 3815), respectively. Salinity and TDS were checked by a conductivity meter (Model: CM 35+, Crison Spain). Lead, cadmium, and chromium were checked by ICP-OES (DV 7000). The mean, standard deviation, minimum and maximum values of the measured water quality parameters were calculated by using SPSS version 22.

RESULTS AND DISCUSSION

The main objective of our study was to assess the water quality parameters for the suitability of fish farming development in district Attock. The results showed that the level of turbidity in the present study is 96.12 NTU, range from 55-133 NTU that indicates that there is the proper amount of suspended particles (such as soil particles, plankton, and other organic detritus). Light penetration and turbidity showed an inverse relationship. Turbidity is caused by suspended material helps to scatter the light rather be transmitted in a straight line. Hema *et al.* (2014), suggested that the turbidity level should be in the range of 25-80 mg/L. Iqbal *et al.* (2009a) also mentioned the same finding.

The pH of water is very important as many biological actions happen within a fine range. Particular organisms could face a fatal situation due to variation in pH beyond range. Extremes of pH can be harmful or lethal for aquatic animals. The optimum pH range for efficient growth and health of the aquatic animal is 6.5-9.0. According to Iqbal *et al.,* (2009a), it should be between 6.5-8.5. Similarly, Irda Sari *et al.,* (2018) proposed it should be in between 6-9. The pH of all water samples in the current study lies within a suitable range.

The ability of a solution to pass electric current is described as conductivity. Several factors including ionic mobility, temperature, and ionic balances influence the conductivity. Conductivity gives a rapid idea of knowledge of TDS concentration and salinity of water (Hadyait *et al.*, 2018). Optimum conductivity for fish production varies from one species to another. Khuhawar *et al.* (2018) recommended the desirable range of being 100-2000 µS/cm and acceptable range as 30-5000 µS/cm for aquaculture ponds. All water samples in the current study meet the required level of conductivity for fish farming.

The total dissolved solids (TDS) and salinity are very important variables of water quality. The mean TDS values in the present study were 259 mg/L and salinity was 210 mg/L. These values confirm the findings of Ghaderpoori *et al.* (2018) that excess amount of TDS and salinity in water disturb the ecological balance and cause suffocation of aquatic fauna. TDS and salinity levels of all water samples in

the current study were in an acceptable range for fish farming.

Table 1. Water quality parameters results (Mean) site-wise.

Sampling Site	Garyala	Fatehjang	Hattian	Hazro	Hassan Abdal
Turbidity (NTU)	90	131	58	95	107
Cadmium (mg/L)	0.001	0.001	0.001	0.003	0.001
Chromium (mg/L)	0.003	0.002	0.002	0.000	0.005
Lead (mg/L)	0.062	0.048	0.051	0.068	0.069
pH	7.56	7.76	7.60	7.98	8.02
Conductivity (uS/cm)	426	395	388	379	245
Salinity (mg/L)	211	260	190	291	101
TDS (mg/L)	272	323	240	308	115
Total Alkalinity (mg/L)	114	99	89	65	43
Total Hardness (mg/L)	111	79	68	41	34
Chloride (mg/L)	33	35	32	31	27
Sulfite (mg/L)	21	13	19	21	24
Carbon Dioxide (mg/L)	9	8	8	7	11

Table 2. Descriptive statistics of Water quality parameters of fish farms district Attock

Parameters	Mean	SD	Min	Max	Range
Turbidity (NTU)	96.12	24.57	55.00	133.00	78.00
Cadmium (mg/L)	0.001	0.001	0.000	0.004	0.004
Chromium (mg/L)	0.003	0.002	0.000	0.008	0.008
Lead (mg/L)	0.060	0.012	0.042	0.089	0.047
pH	7.78	0.21	7.48	8.12	0.64
Conductivity (µS/cm)	366.56	66.41	234.00	432.00	198.00
Salinity (mg/L)	210.60	66.86	98.00	298.00	200.00
TDS (mg/L)	259.60	84.33	112.00	362.00	250.00
Total Alkalinity (mg/L)	82.16	26.36	39.00	125.00	86.00
Total Hardness (mg/L)	66.32	29.16	32.00	128.00	96.00
Chloride (mg/L)	31.72	4.28	25.00	40.00	15.00
Sulfite (mg/L)	19.60	4.78	11.00	28.00	17.00
Carbon Dioxide (mg/L)	8.44	2.42	4.00	14.00	10.00

Bicarbonates, carbonates, and hydroxides of Mg, Ca, K, Na, Fe, and NH_4 are the major components of alkalinity in freshwater. Alkalinity does not have a direct effect on fish culture. Together with, it is an important variable, because it interacts with the other variables that affect the growth of aquatic animals. According to Pati *et al.* (2014), the ideal value for fish

culture is 50-300mg/L, while Radfard *et al.* (2018) proposed that it should be as high as 600mg/L. The total alkalinity in our study was between 39-125 mg/L, which made the fish ponds as nutrient-rich and highly productive water bodies.

Based on total hardness, Hadyait *et al.,* (2018) classified water into three categories; soft (0-75 mg/L), moderately hard (75-150 mg/L), and hard (151-300 mg/L). A wide range of total hardness values may be acceptable for the growth of most freshwater fauna. In their study, Singh *et al.* (2015) found that the desirable range was 50-150mg/L, but Soleimani *et al.* (2018) suggested it should be as high as 600mg/L. In the current study, the total hardness range was 32-128 mg/L and was suitable for fish farming. Steffens *et al.,* (2015) suggested that the chloride level for fish farming should be more than 60mg/L. In the present study, all samples have a low level of chloride ions than this.

Respiration and organic matter decay liberated free carbon dioxide. The free carbon dioxide content of freshwater mainly depends on the temperature of the water, respiration rate, depth, and organic matter decomposition (Yunas *et al.,*, 2015). In this study, the mean value of carbon dioxide in water was found as 8 mg/L. These results are similar to the findings of (Gatica *et al.*, 2012). Carbon dioxide is a biologically active gas and tends to dissolve in water. The dissolved CO_2 level in aquaculture ponds should lie in between 0-10mg/L (Acharya *et al.*, 2018). According to Edokpayi *et al.* (2018), tropical fishes can bear over 100mg/L free CO_2 level, but less than 10 mg/L CO_2 level was considered as an ideal concentration for fish ponds. In the present study, the CO_2 level in all water samples was below 10mg/L, which was ideal for aquaculture. Heavy metals (lead, cadmium, and chromium) results were also in safe limits.

CONCLUSION

From the current study, it was concluded that water quality parameters of the fish culture ponds in the District Attock were suitable for fish culture, and by using the water quality data the fish farming can be promoted in this area. All the water quality parameters were fully life-supporting and helpful for the growth and nourishment of healthy fish. It was further suggested that these types of studies should be conducted in all over Punjab in more details for the promotion of fish culture. As fisheries production increase in the province then fisheries meet the protein needs of people.

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CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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