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Physiochemical parameters of water and soil of three Dams of district Karak, KP, Pakistan

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Abstract

The present research was conducted to study the physiochemical parameters of water and soil of three dams namely Khurum dam, Muhabbat Khel dam and Khasari dam of district Karak, KP, Pakistan. The physiochemical properties like color, taste, odor, TS, electrical conductivity, pH, temperature and, TDS of water and soil samples collected from various sites (start, mid, and end) of the three dams were analysed. For this purpose three samples (n= 3) of water and soil were collected from the different sites of the each dam. These samples were analyzed for physiochemical parameters. From results it was concluded that physicochemical parameter of both soil and water are within the giving range given by (WHO) and are also suitable for growing fish and productivity

Keywords: Physiochemical, water, Muhabbat Khel dam, ecosystem

Introduction

Quality of water is vital concern for mankind because it directly linked with human health [1]. Now a day, the menace of water borne diseases and epidemics still looms large on the horizons of developed and developing countries [1]. Over centuries humans consume water from rivers, lakes, ponds, dams etc for various purposes [1]. These reservoirs are built for special reasons like to store rainwater for the production of energy, for controlling flood and to make water supply possible for irrigation purpose [2]. Fishes are the cheapest and important source of proteins worldwide and they need water as the most fundamental physical sustain for their survival i.e. for breeding, feeding, swimming etc. [3]. Physicochemical properties of water also play an important role in the maintenance of healthy aquatic ecosystem [4]. Several studies have been conducted on the physiochemical analysis of water with respect to their effect on fish survival few are as follows. Marshall and Elliot [5] observed important relation between fish species and the effect of water temperature, salinity, dissolved oxygen on their survival. The properties of water quality are comprised of amount of dissolved oxygen (DO), biochemical oxygen demand (BOD), organic content, chemical oxygen demand (COD), pH value temperature, infectious agents, toxic substances and mineral matter [6]. In the growing aquaculture industry, it is believed that good water quality is preferred to retain viable aquaculture production [7]. Poor water quality can result in minor production and less profit. Production is decreased when the water contain contaminants that can effecter production, growth, development, or even results in death to the cultured species [8]. To handle this problem, it is necessary to make planning, management and water quality assessment [9]. An inappropriate management of water systems may cause serious problems in quality and availability of water [10]. The physical possessions of pond soil are contingent on the dye, quality, absorbency, arrangement consistence, penetrability and inorganic component [11]. Quality of soil rises to the proportional amount of gravel, deposit and clay in soil. It is an important soil parameter subsequently it controls the suitability of a site for fish development [12]. Ecological balance of an aquaculture system is also dependent on its soil properties. The soil properties have a vigorous role in survival and growth of marine organisms. The soil serves as a biological filter through absorbing fish excretions, organic residues of feed and algal metabolites and also controls the salinity, solidity and pH of aquaculture systems [13]. Therefore it is necessary to carry out physiochemical analysis to analyze the quality of water and soil of an ecosystem, which give adequate information about favorable and unfavorable conditions happening in an ecosystem and their effects on aquatic organisms living in an

ecosystem [14]. The Physical and chemical properties of water had been used by Djukic *et al.* [15] to estimate the water quality of rivers, lakes. Thus, the present research was planned to study the physiochemical characters of water, soil of the giving three dames in order to estimate their effect on fishes and to analyze the importance of these parameters in fishery management policies. Such study will also be helpful in future to assure the safety of the aquatic ecosystem and environment for healthy production of fishes [16].

Materials and Methods

Sampling Procedure and Laboratory Analysis

Six samples of soil and water were collected from each of these dames (Khurumdam, muhabbat khel dam and khasari stream). The collection of water samples was carried out in properly washed plastics containers, while soil collection were carried out from nearer the bottom of dam and then packed in an air tight polyethylene bags until analysis. The analysis was carried out by using the methodology as followed by Masood *et al* [17].

Sample Analysis

Physical parameters comprising color, odor, taste, elasticity and temperature of both soil and water samples of the (Khurumdam, muhabbatkhel dam and khasari stream) were investigated at sampling site while chemical parameters including pH, conductivity and TDS of water and soil were measured in laboratory by using specific laboratory instruments and apparatus. Temperature of soil and water was measured by using thermometer. PH of soil and water was measured using pH meter ((Model 3505) calibration each soil and water sample was subjected to pH meter for pH measurement. For the measurement of conductivity of soil and water a specific conductivity meter used (Model 103 Jencose). Conductivity meter was calibrated by using 0.1 M solution of KCl. After calibration each soil and water sample was investigated for conductivity.

Physiochemical Characteristics

The physiochemical parameters such as TDS (Total dissolved solids), EC (Electrical conductivity), temperature, color, odor, hydrogen ion concentration and elasticity of water and soil samples collected from (Khurum dam, muhabbatkhel dam and khasari stream) was analyzed (Fig. 1, 2). Physiochemical parameters of water including temperature, taste, color, odor, conductivity and pH were measured by the help of analytical procedures followed by Afshan *et al.* [18], while the properties of soil were also measured including temperature, elasticity, color, and total dissolved solids with the help of method used by Naila *et al.* [19], in order to determine the impact of some physical and chemical properties of aquatic environment that play a significance role in distribution, diversity, species richness and growth of various aquatic organisms including fish fauna and other small aquatic invertebrates.

Electrical conductivity & Total dissolved solids

Electrical conductivity and TDS of both (water and soil) samples were analyzed by means of Jenway conductivity meter, 0.1 M solution of Potassium chloride was used for its calibration. The electrodes were washed properly before and after dipping it into water and soil samples.

Temperature and Hydrogen ion concentration

Temperature as well as pH is amongst those factors which seriously affect the ecology. Thus it is convenient to

determine the temperature of the dam as it helps in understanding the behavior of life under water. For temperature measurement APHA method was followed [20, 21]. The investigation of pH was conducted according to method followed by Torimiro *et al.* [22]. For the PH measurement of the soil and water Electrical Jenway PH meter was used [23].

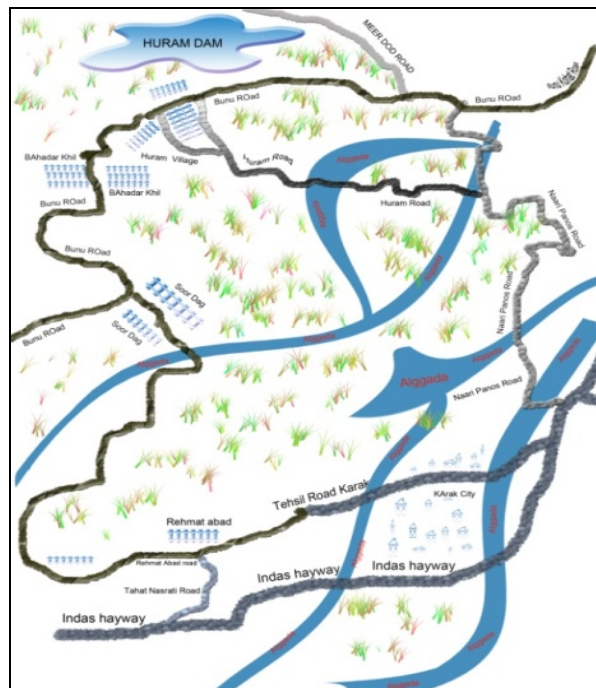


Fig 1: Map Showing Khuram dam.

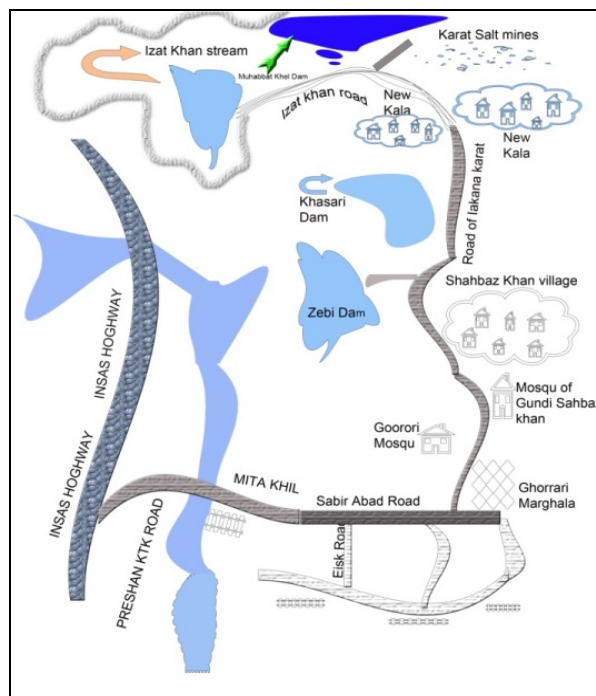


Fig 2: Map Showing Khasari dam and MuhabbatKhel dam.

Results and Discussion

The physiochemical parameters such as temperature, pH, conductivity, total dissolve solids (TDS), color, odor, elasticity, taste of water, soil of the Khurum dam, Muhabbatkhel dam, and Khasari dam was presented in the Tables1-6.

PH

pH is one of the most essential water quality factors. It was observed that pH of the water normally remains higher in summer and in rainy seasons. It depends on photosynthetic activity. The lower values of pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment, deposition and difficulties in chlorination for disinfections of water [25]. Extreme pH negatively distress fish reproduction and growth [17]. The optimum pH of water and soil which habitually favors the growth of fishes ranged from 6.5-9.5 and 6.5 to 8.4 congruently [25, 26]. The pH of soil is one of the most important physicochemical parameters. It affects the mineral nutrient soil quality and much microorganism activity [27]. The PH of the Khurum dam water taken from the three different points which are following start point, midpoint, and end point were (8.3, 8.3, and 8.1) and the PH of soil from start point, midpoint, and end point were 9.0, 9.1, and 8.9. Similarly the PH of Khasari dam water and soil of the start point, midpoint, and end point are respectively are (6.3, 6.7, 6.4) and (6.3, 6.4, 6.1). The observed PH of the three different sites of the Muhabbatkhel dam water and soil were 7.3, 7.4, 7.1 and 6.1, 6.3, 6.3.

Temperature

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 [28]. Fish are exothermic, gain heat from their external environment, so when the temperature of external environment fluctuates than the alterations in fish body temperature also occur accordingly [29]. All fish species has an ideal temperature range in which they grow quickly. It can be concluded that change in temperature seriously affect the overall biota. The ideal temperature which required for proper growth of fishes lies between 26-32 °C [30]. If the temperature become high from the normal growth of microorganism then cause color change in water and other destructive issues [31]. The Temperature of the Khurum dam water taken from the three different points which are following start point, midpoint, and end point are respectively (30 °C, 33 °C, 31°C) and the soil taken from start point, midpoint, and end point are respectively (27°C, 25°C, 27°C). And the temperature of three sites of Muhabbatkhel dam water and soil of the start point, midpoint, and end point are respectively (32 °C, 33 °C, 30 °C) and (24 °C, 20 °C, 23 °C). Temperature of three sites of Khasari dam water and soil of the start point, midpoint, and end point are respectively and (30 °C, 34 °C, 31°C) and (20 °C, 22 °C, 22 °C).

Total Dissolve Solids

Total dissolved solids denotes mainly the various kinds of minerals present in the water "Dissolved Solids" refers to any mineral salts, metals, cations or anions dissolved in water. A sudden or extreme change in TDS it could be killed aquatic life [32, 33]. Normally, TDS ranged from 5 to 1000 mg/L is considering as suitable range for fish growth [34]. The quantity of TDS was proportional to the degree of pollution [35, 36]. In more polluted place the TDS value of the water and soil will be high and the water become notable for the aquatic purpose. The permitted limits of TDS in water are shown in given Tables. All values lies within permissible limits suggested by WHO (i.e. 500-1000mg/l) [37]. The TDS value of the Khurumdam water and soil of the start point, midpoint, and end point are respectively are (0.02mg/100ml, 0.02mg/100ml, and 0.01mg/100ml) and (14mg/100ml, 13mg/100ml, 13mg/100ml). Similarly the TDS value of the Muhabbatkhel dam water and soil of the start point, midpoint, and end point

are respectively are (0.01, 0.02, 0.01) and (16mg/100ml, 14mg/100ml, 12mg/100ml). Similarly the TDS value of the Khasaridam water and soil of the start point, midpoint, and end point are respectively are (0.01 mg/100ml, 0.01 mg/100ml, 0.02 mg/100ml) and (13mg/100ml, 14mg/100ml, 13mg/100ml). TDS analysis has great implications in the control of physical and biological waste water treatment processes [38].

TS

The TS value of the Khurumdam water and soil of the start point, midpoint, and end point are respectively (0.03, 0.02, and 0.03) and (09.1, 10.3, 10.1): The TS value by the Muhabbatkheldam water and soil of the start point, midpoint, and end point are calculated respectively (0.04, 0.01, 0.03) and (10.4, 11.2, 09.4). The TS value of the Khasaridam water and soil of the start point, midpoint, and end point are respectively (0.03, 0.02, 0.03) and (10.3, 11.2, 10.0).

Electrical Conductivity (EC)

Electrical conductivity is the ability of an aqueous solution to carry electric current. Fish are very sensitive to conductivity, since conductivity is strictly related to the amount of osmotic pressure exerted on their cellular membranes. Conductivity of freshwater mostly lies between 50 to 1500µs/ml [39]. It is a useful tool to assess the purity of water. According to WHO normal range of electrical conductivity for water is 400-600µS/cm [40]. The EC value of the Khurumdam water and soil of the start point, midpoint, and end point are (0.27us/ml, 0.29us/ml, 0.27us/ml) and (0.19us/ml, 0.19us/ml, 0.18us/ml). The EC value of the Muhabbatkheldam water and soil of the start point, midpoint, and end point are respectively (0.24us/ml, 0.24us/ml, 0.25us/ml) and (0.22us/ml, 0.24us/ml, 0.21us/ml). In Khasaridam the TS value of the water and soil from the start point, midpoint, and end point are respectively (0.20us/ml, 0.24us/ml, 0.21us/ml) and (0.19us/ml, 0.18us/ml, 0.18us/ml).

Color and Odor

Although color of water varies place to place, these colors lay down whether the water is suitable for the growth and survival of organisms beneath it or not, for example greenish and light greenish colored water is suitable for survival, while dark green and brown colored water is deadly for growth and survival [41]. Likewise the presence of plankton was also confirmed with the help of water color [42]. The Color pattern of soil might be the results from both chemical and biological processes. Yellow or red soil shows the occurrence of iron oxides, while dark brown or black color reveals that the soil contain high organic matter content. The presence of some specific minerals can also effect on the soil color. Furthermore, manganese oxide causes a black color, glauconitic makes the soil green, while calcite can make soil appearance white [43]. The odor of the water is due to various sources such as, sewage, decomposing vegetation and microbial activity. Odor affects the aesthetics of recreational water and the taste of fish [43]. The Khurum dam water was Odorless, dark blue and soil was also Odorless and Dark blue. The Muhabbatkhel dam water was whitish blue, odorless and the soil was odorless, and yellowish. And the water of the Khasari dam was bluish, slightly rotten and the soil was blackish, slightly rotten.

Elasticity

The water and soil of the Khurum dam, Muhabbatkhel dam, and Khasari dam are non-elastic.

Table 1: Parameter of Khurum dam water.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	30 °C	33 °C	31 °C
2	PH	8.3	8.3	8.1
3	TDS	0.02mg/100ml	0.02mg/100ml	0.01mg/100ml
4	TS	0.03 mg/100ml	0.02 mg/100ml	0.03 mg/100ml
5	Conductivity	0.27µs/ml	0.29µs/ml	0.27µs/ml
6	Taste	Slightly saline	Slightly saline	Slightly saline
7	Odor	odorless	Odorless	Odorless
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	Dark blue	Dark blue	Dark blue

Table 2: Parameter of Khurum dam soil.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	27 °C	25 °C	27 °C
2	PH	9.0	9.1	8.9
3	TDS	14mg/100ml	13mg/100ml	13mg/100ml
4	TS	09.1 mg/100ml	10.3 mg/100ml	10.1 mg/100ml
5	Conductivity	0.19µs/ml	0.19µs/ml	0.18µs/ml
6	Taste	Slightly saline	Slightly saline	Slightly saline
7	Odor	Odorless	Odorless	Odorless
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	Dark blue	Dark blue	Dark blue

Table 3: Studied parameters of Muhabatkhel dam water.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	32 °C	33 °C	30 °C
2	PH	7.3	7.4	7.1
3	TDS	0.01 mg/100ml	0.02 mg/100ml	0.01 mg/100ml
4	TS	0.04 mg/100ml	0.01 mg/100ml	0.03 mg/100ml
5	Conductivity	0.24µs/ml	0.24µs/ml	0.25µs/ml
6	Taste	Slightly saline	Slightly saline	Slightly saline
7	Odor	Odorless	Odorless	Odorless
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	whitish blue	whitish blue	whitish blue

Table 4: Studied parameters of Muhabatkhel dam soil.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	24 °C	20 °C	23 °C
2	PH	6.3	6.3	6.1
3	TDS	16mg/100ml	14mg/100ml	12mg/100ml
4	TS	10.4 mg/100ml	11.2 mg/100ml	09.4 mg/100ml
5	Conductivity	0.22µs/ml	0.24µs/ml	0.21µs/ml
6	Taste	Slightly saline	Slightly saline	Slightly saline
7	Odor	Odorless	Odorless	Odorless
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	yellowish	Yellowish	Yellowish

Table 5: Studied parameters of khasari dam water.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	30 °C	34 °C	31 °C
2	PH	6.3	6.4	6.7
3	TDS	0.01 mg/100ml	0.01 mg/100ml	0.02 mg/100ml
4	TS	0.01 mg/100ml	0.02 mg/100ml	0.03 mg/100ml
5	Conductivity	0.20µs/ml	0.24µs/ml	0.21µs/ml
6	Taste	Tasteless	Tasteless	Tasteless
7	Odor	Slightly rotten	Slightly rotten	Slightly rotten
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	Bluish	Bluish	Bluish

Table 6: Studied parameters of Khasari dam soil.

S. No.	Parameter	Start point	Midpoint	End point
1	Temperature	20 °C	22 °C	22 °C
2	PH	6.3	6.4	6.1
3	TDS	13mg/100ml	14mg/100ml	13mg/100ml
4	TS	10.3 mg/100ml	11.2 mg/100ml	10.0 mg/100ml
5	Conductivity	0.19 μ s/ml	0.18 μ s/ml	0.18 μ s/ml
6	Taste	Tasteless	Tasteless	tasteless
7	Odor	Slightly rotten	Slightly rotten	Slightly rotten
8	Elasticity	Non-elastic	Non-elastic	Non-elastic
9	Color	Blackish	Blackish	blackish

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. Physical and chemical analysis of water shows a good range of properties for all these dams, suitable for fish growth, soil was also found to be of good quality. Hence, the current study would provide useful information to fish culturists and fisheries managers for promoting the fish culturing in the local area to raise the economic and social benefits for the local population of Karak district. There should be proper management and Government should take action in the management of these fresh water sources, if proper management strategies do not developed than aquaculture cannot successfully developed.

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