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Fish diversity, physicochemical Parameters of soil and water, length-Weight relationships and condition factor of fishes of Urbashi Dam Karak, KPK, Pakistan

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Abstract
Biodiversity is the difference between life forms that highlights the abundance and significance of living organisms in the ecosystem. Physiochemical parameters of water and soil have utmost importance in the dispersion of aquatic life and also in the breeding of aquatic organisms. Studies on the length-weight relationship are very important to fishing biology and stock assessment of fisheries resources. This research was carried out to elaborate on fish diversity, physicochemical parameters of water and soil, length-weight relationships (LWR) and condition factor (K) of fishes of the Urbashi dam in Karak, Khyber Pakhtunkawa, Pakistan. Fish samples were obtained by the help of local fisherman through nets, gill nets, drag nets, and cast nets from October 2020 to July 2021. The specimens were preserved in a 10% formalin solution. The length and weight of fish samples were determined with the help of a measuring tape and a digital balance. The physiochemical parameters like conductivity, PH, temperature, color, taste, TS, and TDS of water and soil were examined by collecting (n=3) samples from different sites of the Urbashi dam, i.e., the start, mid, and end.
During the current research study, 7 species belonging to family *Cyprinidae* were known at species level. The obtained values of each parameter such as conductivity, PH, temperature, color, taste, TS and TDS of water and soil were compared with the standared values set by the World Health Organization (WHO). According to the findings of this study, all physiochemical parameters were found to be within permissible ranges and non-harmful for culturing and growing fishes, as recommended by the (WHO). *Labeo rohita* and *Tor khudree* had positive allometric growth in the length-weight relationship (LWR), while *Catla catla*, *Cirrhinus mrigala*, *Hypopthalmichthys molitrix*, and *Cyprinus carpio* had negative allometric growth and *Carassius auratus* had isometric growth.The highest value of condition factor (K) was recorded in *Carassius auratus*, while the lowest was in *Catla catla.*
Hence,the study explore useful information of ichthyofauna of Urbashi dam, which is beneficial for fisheries management as well as for further research. After analysis, it was concluded from the results that the physiochemical parameters of the water and soil of Urbashi dam lie within a suitable range which is suggested by WHO for fish growth, survival, and reproduction. Hence, the study aimed to enhance some more information in the aquaculture department of the country to narrate the population conditions of the fish species in the Urbashi dam.

Keywords: Biodiversity, Urbashi dam, cyprinidae, physiochemical parameter of water and soil, length- weight, isometric and allometric and World Health Organization (WHO).

1. Introduction
The study of fish biodiversity is known as "ichthyodiversity." Biodiversity is a significant scientific field because it emphasises the importance, abundance, and critical role of living organisms in the ecosystem. Biodiversity is a broad field concerned with the abundant availability of living beings in water, many of which are related to humans, such as fish. The huge quantity of fish in the targeted area determines the bio - diversity of fish fauna [1].
Homeothermic fishes belong to chordates with fin-like appendages, gills as their primary respiratory organs, and scales covering their bodies [2]. Fish are most diverse bunch of vertebrates, occupying nearly every niche in the hydrosphere. The superclass Pisces contains 21,723 species out of the 40,000 vertebrate species [3]. Early work in Pakistan was done by, who described the fish diversity of West Pakistan [4]. Many scientists have been studying the variety of fish found around the world. Moreover, several of their work has contributed to the understanding of fishery resources found in Pakistan's freshwater resources. In Pakistan, more than 186 freshwater fishes has been reported [5].
Contamination of household and drinking water resources Heavy components, metal complexes, and microbial pathogens are essential to humans for a variety of activities, including severe health problems [6]. To address this issue, planning, management, and moisture quality assessment are required [7]. Inadequate water system management can lead to serious issues with water quality and availability [8]. Contaminants in water can have an impact on water quality and, as a result, on operations and water treatment facilities. Microbes, organics, inorganics, radionuclides, and disinfectants are the different types of contaminants [9].
Quality of water is determined by all physical and chemical characteristics of water that influence its beneficial use in irrigation, drinking, fish production, recreation, and other applications [10]. Physicochemical analysing mehtod is the primary consideration for assessing water quality for optimal utilisation such as irrigation, drinking,fisheries, and industrial uses, and it aids in understanding the various interrelations between climatological and biological processes in water [11]. Water's physicochemical parameters, as well as the reliance of all living systems on these parameters, start making it desirable to use as an environment. The water quality must therefore be checked on a regular basis, because the humanity suffers from a wide range of water-borne diseases as a result of the use of contamination of drinking water. It is difficult to fully comprehend the biological phenomenon because water

chemistry reveals much about ecosystem metabolism and explains the overall hydro-biological relationship [12].

The analysis of various variables such as turbidity, pH, conductivity, total suspended solids (TSS), total organic carbon (TOC), total dissolved solids (TDS), and heavy metals is included in these procedures. These parameters can have an impact on quality of drinking water if their concentrations exceed the safe limits established by the WHOand other regulatory authorities [13].

Temperature is the main factor that implies direct impact on aquatic life. The temperature is regarded as the most important parameter of all metabolic activeness of the organism within the water, as well as a significant biological cause [14]. There is a closed relationship between the the water temperature and atmospheric temperature. Air temperature is the primary ecological factors which controls the physiological behaviour of the aquatic system and the distribution of microorganisms [15].

Water temperature is a major parameter governing the majority of the physical, chemical, and biological features of aquatic habitats. Water temperature affects liability, fish growth, abundance, and distribution. Freshwater fishes grow quickly at temperatures ranging from 25 to 30 degrees Celsius. The maximum bearing level of temperature for the most aquatic life is commonly thought to be around 35°C [16].

Water PH is also important for the bio-diversity of fishes in the aquatic environment. The ideal pH for fish production is between 6.5 and 9.0. Water has an acidic death position of pH 4.0, a reproduction point of pH 4.0-5.0, a slow growth point of pH 4.6-6.5, and an alkaline death point of pH 11. All physical, chemical,and biological processes in natural water, like streams, lakes, and rivers, may be affected by changes in PH value. In natural water, for example, the surface energy of colloids and the ability to coagulate ions are entirely dependent on the solubilization of the electrolytes and the PH of the water [17]. Dissolved solids are indeed the salts and minerals that are dissolved in water. These really are inorganic salts dissolved in water, like NaCl, calcium, magnesium, potassium, and trace amounts of organic matter. TDS levels greater than 500mg/L are not fit for consumption or irrigation. As a result, the proper salt concentration is critical for aquatic biota. Salinity above its normal value lessens fish fertilisation rates, productivity, algae growth, and causes death of aquatic life [18]. Dissolved oxygen is necessary for the biodegradation of planorganic component, which breaks down of organic detritus required for respiration and allows biochemical pathways to be completed. The minimal status of dissolved oxygen is 5mg/L for reproduction of fish. From 0.3-1.0 mg/L DO is hazardous for fish survival, and 3.5mg/L is incurable for most fish species within 20 hours. Water hardness is caused by alkaline earth metals such as Mg++ and Ca++ ions, as well as CaCO3 and MgCO3 [19].

Electrical - conductivityis a measure of a water solution's capacity to carry an electrical current. Electrical conductivity is an important factor in an aquatic ecosystem. Because the fresh - water eco - system supports a diverse array of aquatic life [20]. High conductivity may reduce the esthetical value of water by imparting a mineral taste. Water conductivity is essential to monitor for agricultural and industrial and activities. High conductivity water can corrode the metal surfaces of equipment like boilers. It also applies to household appliances like water faucets and heaters. Excessive conductivity also eliminates food-plant as well as habitat-forming plant species [21].

2. Materials and Methods

2.1 Study area

Karak is an area facing scarcity of drinking water occurring in Northern Districts of Khyber Pakhtunkhawa, Pakistan, approximately 150 km away from the capital Peshawar on the Indus highway (N-55), i.e., from Karachi to Peshawar. Geographically, Karak is located at 37°7’12 North latitude and 71°5’41 East latitude. Actually, Karak is comprised of a hilly area which ranges from 600-1400 metres above sea level. The current study is concerned with the Urbashi dam in Tehsil Banda Daud Shah. This dam was constructed at the end of 2018 by the Khyber Pakhtunkhawa government as a small water reservoir project. Geographically, it is located at 33°16’14.0 North latitude and 70°46’35.5 East latitude. The venue of the dam is Gurguri Karak, KPK, Pakistan, about 27 km away from the Banda Daud Shah main chowk, which links to the highway (N-55). The area occupied by this dam is about 550 m in length, while its width ranges from 80-110 m, which has a high range of storing capacity. The depth of the dam is from 60 to 110 feet. It is a rainy dam (Barani) which is plentiful with water in the summer season but deficient in the spring.

2.2 Collection of Sampling

The sample of fishes were taken from the various points of the Urbashi dam by the avail of native fisher using different variety of catching nets such as gill nets, hand nets, drag nets, cast nets, and different size of hooks with regular interval of time. A total of 118 fish sample were collected from Urbashi dam Karak, Khyber Pakhtunkhawa, Pakistan. The purpose of fishes collection was to find the length and weight relationship. Three samples of soil and water respectively were collected from start, mid and end point of the dam to analyze the physiochemical parameter of soil and water for finding out PH, total dissolved solids, temperature, color, order and electrical conductivity.These all collections were made in the duration from October, 2020 to July, 2021.

2.3 Preservation of Samples

Collected fish were photographed soon after being taken out of the water. The specimens were preserved in 10% formalin soon after giving an abdominal incised brought to the Laboratory of Zoology at the Government Post Graduate College Karak. To avoid microbial attack, they were preserved for a long time for further study. Collections of water and soil samples were carried in plastic containers and polyethylene bags, respectively.

2.4 Identification

In the concerned laboratory, each specie was carefully examined on the basis of colour pattern, shape of the body, specific spots, structure, position, and number of fins by using systematic and basic identification keys [22]. The aim was to determine WLR. These samples were carried into the laboratory, weighted by digital balance, and lengthened with the help of a measuring tape.

2.5 Procedure of Sample Analysis

The collected fishes were dissected with the help of a surgical knife at the specific position of the body to estimate length and weight with the aid of a measuring tape and digital balance, respectively. Three collected samples of soil and water from Urbashi dam were presented for further study. The samples of water were brought in properly washed and dried plastic containers, while the samples of soil were taken from the bottom and sealed in air-free polyethylene bags till analysis. The analytical study was done on the method of [23]. Examination of physical parameters like taste, odor, color,

temperature, and elasticity of both soil and water samples was done easily on this occasion, as it does not need any laboratory assistance. On the other hand chemical parameters that include conductivity, PH, and TDS of the collected sample are brought to the laboratory and examined with the application of proper instruments and apparatus. PH, temperature, and conductivity were analyzed with the aid of a PH metre (Electrical JENWAY), a thermometer, and a conductivity metre (JENWAY model no.4520) respectively.

2.6 Physio-chemical Parameters

Total Dissolved Solids (TDS), Electrical Conductivity(EC), temperature, colour, odour, elasticity of soil, hydrogen ion concentration, and water samples collected from Urbashi Dam were meticulously studied. Temperature, colour, odour, and H+ concentration were all measured using an analytical procedure that was then followed by [23]. The method was used to study the effects of certain physical and chemical characteristics of the aquatic environment on the distribution, species richness, diversity, and growth regulators of different oorganisms, including ichthyo - fauna as well as small water dwelling invertebrates [24].

2.6.1 Electrical Conductivity

Fishes are perceptive to the conductivity of water and have massively effected the osmotic pressure which applied on their cellular membranes. Conductivity of fresh water ranging between 50- 1500 µs/ml . Conductivity higher than this suitable limit of water and soil could be lethal for the survival of certain species of fishes and invertebrates [25] . It plays a vital role to estimated the purity of water. According to WHO optimum range of electrical conductivity is varies from 400-600 µS/cm . The Electrical conductivity of soil and water sample of Urbashi dam were measured by the aid of Conductivity meter JENWAY model no.4520.Conductivity meter was marked by 0.1M KCL (potassium chloride) solution and cleaned with distilled water and dried before dipped into each sample of water and soil to prevent the miscalculation. The EC value of the Urbashi Dam water and soil of the different sample taken from start point,mid point and end point are (0.25 µs/ml, 0.27µs/ml, 0.25µs/ml) and (0.22µs/ml, 0.24µs/ml, 0.21µs/ml) respectively.

2.6.2 Total Solubalizable Solids

Total dissolved solids(TDS) is basically concerned with the different types of minerals found in water and soil. Such minerals may be salt, metal, cations or anions dissolved in water. The TDS values of the Urbashi Dam water and soil at the start points, mid point, and end points (17 mg/100ml, 19 mg/100ml, and 16 mg/100ml) (0.05 mg/100milliliter, 0.04 mg/100ml, and 0.02 mg/100ml) and correspondingly.

2.6.3 Total solids

The TS value of Urbashi Dam soil and water of the start point, mid point, and end point are (0.04, 0.06, and 0.03) and (10.4, 9.8, and 9.6) respectively.

2.6.4 Temperature

The temperature was calculated with the aid of a thermometer following the APHA procedure [27]. The temperature of the Urbashi Dam water collected from the 3 major points, which are starting point, mid point, and ending point, are (28 ºC, 27 ºC, and 31 ºC) and the soil taken from the start point, mid point, and end point are (22 oC, 20 ºC, and 24 ºC) respectively.

2.6.5 H+ Ions concentration (PH)

PH is the negative logarithm of H+ions concentration. The measurement of PH was determined according to the procedure followed by [28]. The PH of the Urbashi dam water taken from the three different points, which are the following: start point, mid point, and end point were (7.8, 7.9, and 7.3) & the PH of soil from the starting point, mid point, and ending point were (8.9, 8.4, and 8.8) respectively.

2.6.6 Color, Odor and Elasticity

The color is the wavelengths of ocular light that reflects from object. The water color like pale, greenish and light greenish is best for the fishes growth [29]. Urbashi dam Karak water and soil is slightly rotten and non-elastic, while the water and soil color was light green and brown yellowish respectively.

2.7 Length-Weight relationship (LWR)

Length-weight relationship (LWR) was separately evaluated for all individuals and grouped by sex (females and males). This relationship was computed to determine the growth patterns of fishes according to species by the application of the equation of Ricker [30] as follows: W = aLb

Where
W = weight of fish expressed in gram (g),
L = Total length of fish in centimeter (cm),
a = the intercept and
b = the slope or the growth constant and represents the growth pattern of fish.

2.7.1 Condition Factor

The condition factor measures all the variations associated with physical conditions, season, food availability and maturity stages (E. D. Le Cren, 1951). The condition factor (K) was determined by using the expression by (William Edwin Ricker, 1975).
K= 100 W/L3
Where,
K= Condition factor
W= Weight of fish in gram
L= Length of fish in centimeter

3. Results

During the present study seven species of family *Cyprinidae* were identified upto species level such as *Labeo rohita, Catla catla, Carassius auratus, Cirrhinus mrigala, Hypopthalmichthys molitrix, Cyprinus carpio* and *Tor khudree.* The obtained values of each parameter such as conductivity, PH, temperature, color, taste, TS and TDS of water and soil were compared with the standared values set by the World Health Organization (WHO). The result of the present study makes clear that all the Physiochemical parameters were found to be in permissible range and non- harmful for culturing and growing fishes as recommended by the (WHO). In Lenght-weight relationship (LWR) the *Labeo rohita* and *Tor khudree* showed positive allometric growth, *Catla catla*, *Cirrhinus mrigala*, *Hypopthalmichthys molitrix* and *Cyprinus carpio* showed negative allometric growth and *Carassius auratus* showed isometric growth. The highest value of condition factor (K) was recorded in *Carassius auratus*, while lowest in *Catla catla.*

3.1 Diversity of Fishes

Table 1: Systematic position of Urbashi Dam Fishes

S/N	Fish Name	Phylum	Class	Order	Family	Genus	Species
01	Rohu	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Labeo	*L.rohita*
02	Thalla	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Catla	*C.catla*
03	Gold Fish	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Carassius	*C.auratus*
04	Mori	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Cirrhinus	*C.mrigala*
05	Silver Carp	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Hypopthal michthys	*H.molitrix*
06	Gulfam	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Cyprinus	*C.carpio*
07	Mahaseer	Chordata	Actinopterygii	Cypriniformes	Cyprinidae	Tor	*T.khudree*

3.1. Physio-chemical Parameter of Soil and Water

Table 2: Parameters of Soil of Urbashi dam

S/N	Parameter	Start Point	Mid Point	End Point
01	Odor	Slightly rotten	Slightly rotten	Slightly rotten
02	Elasticity	Non-elastic	Non-elastic	Non-elastic
03	Color	Yellowish	Yellowish	Yellowish
04	Conductivity	0.22 µs/ml	0.24 µs/ml	0.21 µs/ml
05	TDS	17 mg/100ml	19mg/100ml	16mg/100ml
06	Temperature	22°C	20°C	24°C
07	PH	8.9	8.4	8.8
08	TS	10.4	9.8	9.6
09	Taste	Slightly saline	Slightly saline	Slightly saline

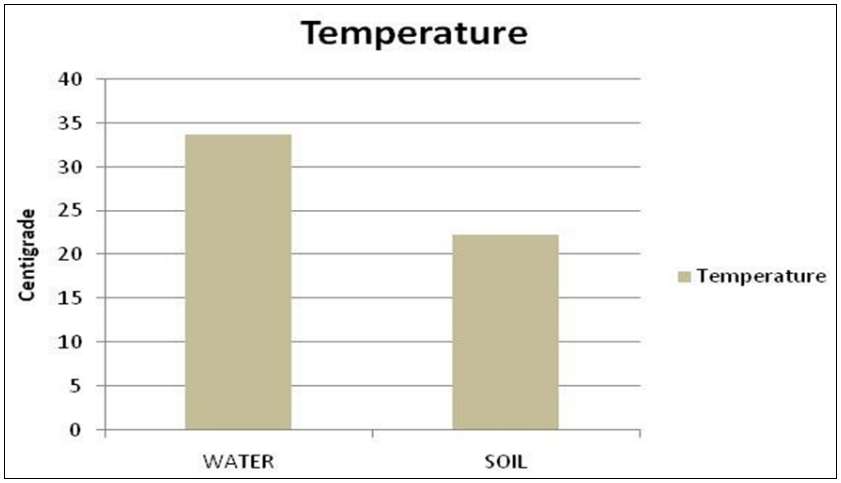
Table 3: Parameters of water of Urbashi dam

S/N	Parameter	Starting Point	Mid-Point	Ending Point
01	Conductivity	0.25 µs/ml	0.27 µs/ml	0.25 µs/ml
02	TDS	0.03 mg/100ml	0.04 mg/100milliliter	0.05 mg/100milliliter
03	Temperature	28°C	27°C	31°C
04	Elasticity	Non-elastic	Non-elastic	Non-elastic
05	TS	0.04	0.06	0.03
06	PH	7.8	7.9	7.3
07	Odor	Slightly rotten	Slightly rotten	Slightly rotten
08	Taste	Slightly saline	Slightly saline	Slightly saline
09	Color	Light green	Light green	Light green

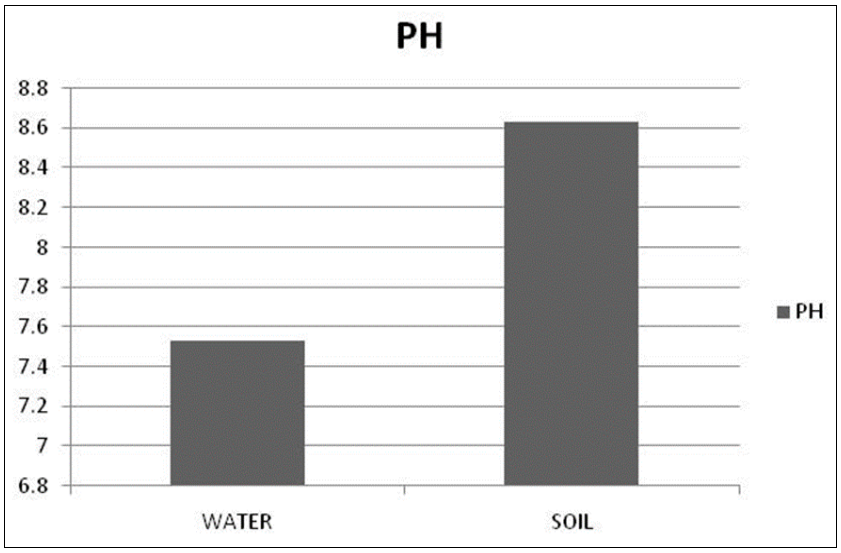
Table 4: Length and Weight relationship (LWR)

Species	Weight Range (gram)	Length Range (cm)	N	a	b	r2	K	G.T
L. rohita	4-400	7.5-30	23	-2.045	3.13	0.99	1.48	A+
C. catla	2-24	7.3-16.9	10	-2.086	2.94	0.97	0.49	A-
C. auratus	7-190	5.6-22	22	-1.181	2.69	0.88	1.78	I
C. mrigala	27-312	13-28.8	17	-1.89	3.00	0.99	1.30	A-
H. molitrix	15-235	8.9-23.9	20	-1.31	2.80	0.90	1.72	A-
C. carpio	2-25	4.6-12.8	15	-1.11	2.46	0.89	1.19	A-
T. khudree	3-282	6.5-30.6	11	-2.098	3.10	0.99	0.98	A+

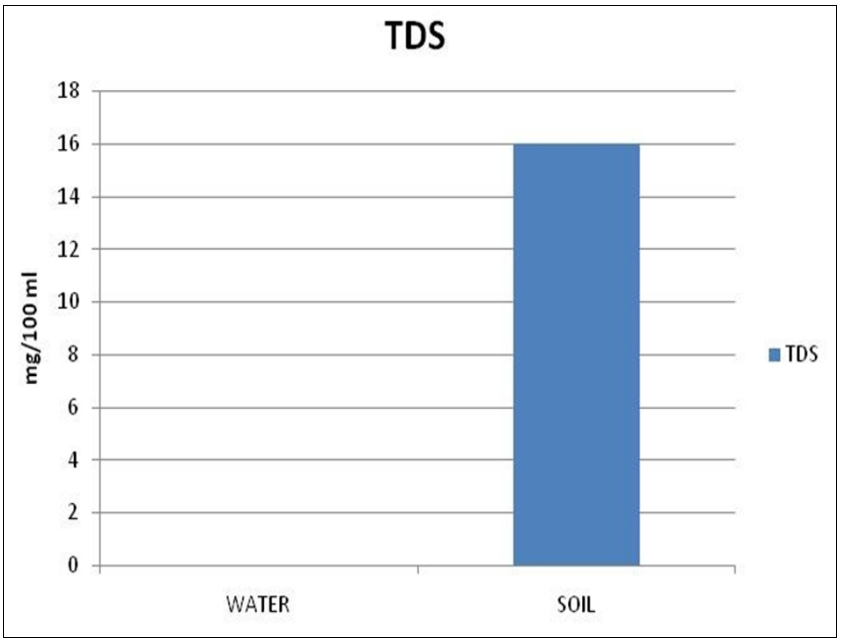
N: Number of specimens, a: intercept, b: slope, r^2: coefficient of determination, k: condition factor, G.T: growth types, I: positive allometric growth isometric growth, A+: and A-: negative allometric growth.



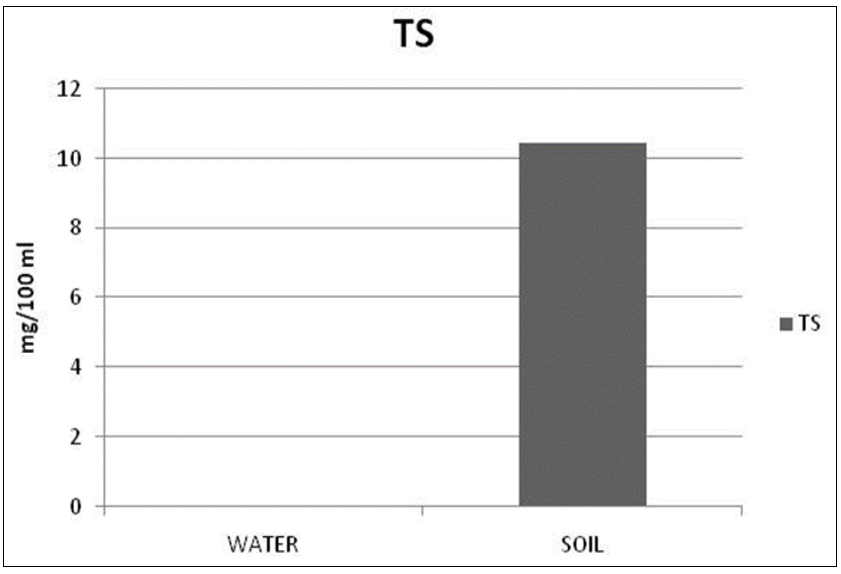
Graph 1: Temprature of water and soil taken from Urbashi dam



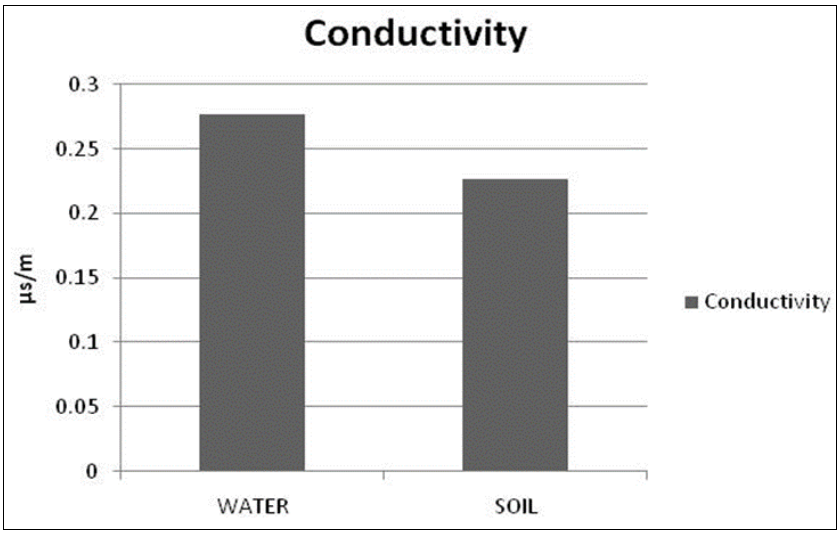
Graph 2: PH of water and soil taken from Urbashi dam Karak



Graph 3: TDS of water and soil taken from Urbashi dam



Graph 4: TS of water and soil taken from Urbashi dam



Graph 5: Conductivity of water and soil of Urbashi dam

Discussions

The results of the ichthyofauna of Urbashi dam in the District of Karak Khyber Pakhtunkhawa, with common and scientific names and their taxonomic rank up to species level, are given in table no.1. During the present survey, a total of 118 fish species were collected from Urbashi Dam in Karak, Pakistan. The classification of fishes represented the existence of seven species.

The seven reported species belong to a single phylum, *Chordata*, class *Actinopterygii*, order *Cypriniformes*, family *Cyprinidae, n/* with seven different genra and species. These seven species are *Labeo rohita, Catla catla, Carassius auratus, Cirrhinus mrigala, Hypopthalmichthys molitrix, Cyprinus carpio* and *Tor khudree*. Exploring the fish fauna of any area is very essential to provide basic knowledge about the species utilised for human consumption. This type of study also provides knowledge about the availability, abundance, population dynamics, and conservation status of fish species in an area. Our results show similarity to those of the attempt by Haseeb (2015). (Zaigham Hasan *et al*., 2014) who examined that a large number of species of the family *Cyprinidae* are dispersed throughout the freshwater reservoirs in different districts of KPK, Pakistan. IIyas reported the *Cyprinidae* with the following species at Zebi dam in District Karak: *Labeo rohita, Catla catla, Carassius auratus, Cirrhinus mrigala, Hypopthalmichthys molitrix, Cyprinus carpio, Barilius vagra, Ctenopharyngodon idella, Puntitus ticto,* and *Puntius sophore*. Butt explains 94 species of fish from the whole province of K.P. (Butt, 1986). Similarly, research conducted by Mirza *et al*. describes 13 species of the river Khuram [30]. Fish fauna of Dandy Dam in North Waziristan Ageny of FATA, KPK, Pakistan and identified five species such as *Hypopthalmichthys molitrix, Cyprinus carpio, Cyprinus carpio, Ctenopharyngodon idella, Cirrhinus cirrhosus,* and *Tor tor*. Nasir attempted research on the fishes of Tanda dam kohat and identified 23 species, among which 7 species are *Barilius vagra, Hypopthalmichthys molitrix, Cyprinus carpio, Labeo rohita, Barilius pakistanicus, Mastacembelus armatus,* and *Crossocheilus latius* [31, 32]. (Rehman *et al*., 2015) identified 6 species from Ghandiali dam, District Kohat in 2015, which comprised of two orders, two families, five genera, and six species. Among them, five species come from the family *Cyprinidae* and only one species belongs to the *Hypopthalmidae*. The result of the current study revealed that the large number of species in Urbashi dam belong to a single family, *the Cyprinidae.* So habitats and environmental condition of Urbashi dam is more favourable for the growth of Cyprinid species.

Present study was conducted in order to analyze the physiochemical parameters such as temperature, PH, conductivity, total dissolve solids (TDS), color, elasticity, taste of water and soil samples collected from Ubashi dam Karak, KPK, Pakistan. Three samples of soil and water were collected from Urbashi dam for physiochemical analysis. The results of physiochemical parameter of soil and water of Urbashi dam are given in the table no.2 and table no.3 respectively.

Conclusions

It can be concluded from the present research study that Urbashi Dam Karak kept peaceful and favourable environmental conditions for the family Cyprinidae. The most common populated fish found in this study was Labeo rohita. All the physio-chemical parameters existed at their optimum limit, which had no detrimental effect on the survival, reproduction, and growth of both aquatic flora and fauna. Examining the physical and chemical properties of water, which were good for fish growth, soil was also found to be of the best quality. In length-weight relationships (LWR), all the *b* values were within the expected range from 2.46 to 3.13 for most of the species, and the K value of most species was greater than 1, which meant that the well-being of fish was best. Hence, from the current research study, we concluded that the ichthyofauna, physiochemical parameters, and length-weight relationship (LWR) of Urbashi dam fishes supply helpful knowledge to fish culturists and fisheries managers to enhance fish farming in the native region and to increase the economic and social benefits for the local population of district Karak. The government needs to take action and provide proper management to establish a well- developed aquaculture system, otherwise the aquaculture will lead towards destruction.

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