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# Water quality assessment of the lower Badri stream, district Swabi, Khyber Pakhtunkhwa, Pakistan

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**Abstract**
The present study was conducted to find out the selected water quality parameters of lower Badri stream located in PunjPeer village, district Swabi, Khyber Pakhtunkhwa, Pakistan. The main purpose of this study was to know that the water of the lower Badri stream is suitable for fish survival or not. The duration of the study was four months from May 2019 to August 2019. One sample was collected in each month and then analyzed in the laboratory. The mean value calculated for each parameter were pH (7.11), electrical conductivity (568.32mg/L), total dissolved solids (359.56 mg/L), total hardness (211.54 mg/L), chloride as Cl (44.82 mg/L), sulphate (50.75 mg/L), sodium (34.79 mg/L), nitrite (1.24), total alkalinity (240.89 mg/L), calcium as CaCO3(140.17 mg/L), magnesium (70.84mg/L), potassium (7.92 mg/L). Therefore it was concluded that the concentration of all the parameters were in the normal range and have no adverse effect on the fish growth and survival.

**Keywords:** water quality, Badi stream, physical, chemical, parameters, water, concentration and conductivity etc

## Introduction

Water is a major constituent of all living things and plays an important role in the life of human beings and other organisms (Saana, 2016).[1]. Water is used for different activities of life. It is used for drinking, cleaning, domestic and agricultural purposes (Grzywna and Sender, 2021) [2]. Water as a universal solvent with the ability to dissolve many substances including organic and inorganic compounds (Vijay and Kale, 2016) [3]. The quality of water generally refers to the components of water present at the optimum level for the suitable growth of plants and animals (Agbaire PO and Obi CG, 2009) [4]. Aquatic organisms need an adequate nutrients and healthy environment for their growth and productivity (Verma *et al*., 2012) [5]. The release of domestic, industrial, and agricultural pollutants into rivers without adequate filtering and their accumulation lead to water pollution. Such events obviously indicate the necessity of water quality analysis (Daud *et al*., 2017)v[6]. Parameters such as temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen, etc. are some of the important factors that determines the growth of living organisms in the water body (Smitha, 2013) [7]. In the last few decades, there has been a huge increase in the demand for freshwater due to increase in population number and the accelerated step toward industrialization (Ramakrishnaiah *et al*., 2009) [8]. Throughout the history people have preferred the sites around the sources, where it has been easy to access water and the river sides as a residential areas (Prabu *et al*., 2011) [9]. The recent documentary by W.H.O showing houses, public offices, schools not provided with latrines causing individuals to excrete anyhow in the bushes, rivers and open spaces is a matter of serious concern (Egereonu *et al*., 2004) [10]. All of the organisms depend on this limited source of water for all of their water related necessities (Tuzen and Soylak, 2006) [11]. Water pollution by effluents has become a question of considerable public and scientific concern due to their extreme toxicity to both human health and biological ecosystem. Worldwide water bodies are primary means for disposal of waste, especially the effluents from industrial, municipal sewage, agricultural practices that are near them and these effluents can alter the physical, chemical and biological nature of receiving water bodies (Smitha, 2013) [7].

The W.H.O reports that approximately 36% of urban and 65% of rural Indian were without access to safe drinking water (Vinita, 2006) [12]. It is necessary to check the quality of drinking water at regular time interval because human population suffers from variety of water borne diseases such as typhoid and diarrhea etc. (Uduma, 2014) [13]. Human health is threatened by most of the agricultural development activities especially in relation to excessive application of fertilizers and unsanitary conditions (Okeke and Igboanua, 2003) [14]. Water quality parameters are the chemical, physical and biological characteristics of water (Diersing., 2009) [15]. The Study of water quality parameters is necessary in the field of aquaculture because it has great importance to increase fish production. Fish makes a vital contribution to the survival and health of a significant portion of world's population e.g. Bangladesh and Cambodia people fulfill as much as 75% of their daily protein from fish (Gouic *et al*., 2018) [16].

Fish provides essential nourishment especially quality proteins and fats, vitamins and minerals, people as well as governments should take interest in the quality analysis of water in order to fulfill both protein deficiency and balanced diet for all human beings. It is very essential and important to test the water before

it is used for drinking, domestic, agricultural or industrial purpose (Benjamin *et al*., 1996) [17].

In the present chemical analysis for water quality was carried at Badri stream in district Swabi, various parameters like Total hardness, pH, Electrical conductivity, Total alkalinity, Total dissolved solids, Chloride, Sulphate, Sodium, Nitrite and Potassium were checked and their values were determined from May, 2019 to August, 2019.

## Materials and Methods

### Study area

The study area is located near the Panj Peer Swabi which is commonly known as Badri stream. Badri stream comes from the southern part of Buner, which is 1760 $km^2$ southeast of the Swat district at 34'08 and 34'41 N latitude and 72'14 and 72'40E longitude. From Buner it passes through Chinglay as the upper part of the Badri stream valley, while its lower part is known as the Totali valley, which covers 78 $km^2$. The Badri stream flows to south and leaving mountains just downstream of Totali valley it crosses northwest corner of Swabi and finally get discharge into Indus River. It has been indicated that land along Badristream in vicinity of Totali has a high economic potential under the irrigation (Ahsan *et al*., 2014) [18]. This Badri then passes from Shah Mansoor, Zaida, Bala,Haryan villages. These areas from which this stream is passed must depend on this stream as source of water. As this stream is passing through these areas it must be means of drainage of sewage water that contain materials of different kinds to affect water quality differently and hence affect life of aquatic biota especially fishes. Almost nearly or in the Hund this stream which in Pashto language called Badri stream falls into the Indus river.

### Samples collection

Water analysis was carried out for exactly four months from May 2019 to August 2019 and one sample was collected each month in order to observe the fluctuation of the selected parameters. Samples were carefully collected in the morning time so as to prevent any envirmental uncertainties. 1.5 litters of bottles were used to collect water; the bottles were first washed with distilled water and then washed with water from the sampling area. To collect water in bottle, bottle was dipped in water 1.52 cm below the water surface and all samples were sent to the laboratory within 24 hours for examination. During each sampling every affecting aspect was kept in consideration, so extremely careful manner was adopted during entire period of this study. The collected water samples were analyzed for certain selected parameters like pH, Electrical conductivity, Total hardness, Total dissolved solids, Chloride as Cl, Sulphate as $SO_4$, Sodium as Na, Nitrite as no, Total alkalinity as $CaCO_3$ and Potassium as K.

## Results

The present study was performed from May, 2019 to August, 2019 at lower Badri stream located in district Swabi, Khyber Pakhtunkhwa, Pakistan. Different water quality parameters including pH, Electrical conductivity, Total hardness, Total dissolved solids, Chloride as Cl, Sulphate, Sodium, Nitrite, Total alkalinity, Calcium, Magnesium and Potassium were analyzed. All the analyzed parameters along with their recorded values for each month are mentioned in the table 3.1 while the standard values by PSQCA, 2010 are shown in Table 3.2.

Total hardness of water in Badri Streem in May was 222.63 mg/L, in June was 220.4 mg/L, during July was 204.19 mg/L and in August was 198.92. The total dissolved solids value in May was 286.00 mg/L, in June was 404.6 mg/L, in July was 371.00 mg/L and in August was 376.67 mg/L. the Chloride value in May 25.51, in June was 41.94, in July was 80.31 mg/L, and in August was 31.54 mg/L. The Sulphate value in May was 50.61 mg/L, in June 67.14 mg/L, in July was 47.28 mg/L and in August was 38.45 mg/L. Similarly the pH value in May was 6.83 mg/L, in June was 6.88, in July was 6.88 and in August was 7.85 with a mean value of 7.11. Human health is not directly affected by the pH of water but it has some indirect effects, which produces changes in water quality parameters such as solubility of metal ions and survival of aquatic life. High value of pH attributes bitter taste to drinking water. Sodium concentration in May was 34.27 mg/L, in June was 38.40 mg/L, in July was 37.17 mg/L and in August was 29.33 mg/L.

The value of nitrite in May June, July was zero and in August 1.24 was recorded. Total alkalinity value in May was 208.16 mg/L, in June was 249.67 mg/L, in July was 228.98 mg/L and in August was 276.67 mg/L. the calcium concentration was 140.95 in May, in June was 153.12 mg/L, in July was 121.85 mg/L and in August was 146.88 mg/L. The Magnesium value in May was 81.68 mg/L, in June was 67.32 mg/L, in July was 82.34 mg/L and in August was 52.04 mg/L. The Potassium value in May was 8.87 mg/L, in June was 8.60 mg/L, in July was 8.37 mg/L and in August was 5.87 mg/L. The conductivity in May was 513.33 µS/cm, in June was 583.3 µS/cm, in July was 576.67 µS/cm and in August was 600.00 µS/cm. The mean value of each parameter were, Total hardness 211.54 mg/L, Total dissolved solid 359.56 mg/L, Chloride 44.82 mg/L, Sulphate 50.75 mg/L, Ph 7.11, Sodium 34.79 mg/L, Total alkalinity 240.89 mg/L, Calcium 140.17 mg/L, Magnesium 70.84 mg/L, Potassium 7.92 mg/L, conductivity 568.32 mg/L. The physical parameters for water quality analysis are shown in Fig. 3.1 while chemical parameters are shown in Fig. 3.2. The results show that total dissolved solids and conductivity, total hardness and pH of water samples were observed within the approved recommendations of WHO,2004 [24].

**Table 1:** Showing water quality parameters values from May, 2019 to August, 2019.

| Water quality parameters | May | June | July | August | Mean |
|---|---|---|---|---|---|
| Total hardness | 222.63 mg/L | 220.44 mg/L | 204.19 mg/L | 198.92 mg/L | 211.54 mg/L |
| Total dissolved solids | 286.00 mg/L | 404.6 mg/L | 371.00 mg/L | 376.67 mg/L | 359.56 mg/L |
| Chloride | 25.51 mg/L | 41.94 mg/L | 80.31 mg/L | 31.54 mg/L | 44.82 mg/L |
| Sulphate as as $SO_2$ | 50.16 mg/L | 67.14 mg/L | 47.28 mg/L | 38.45 mg/L | 50.75 mg/L |
| pH | 6.83 | 6.88 | 6.88 | 7.85 | 7.11 |
| Sodium as Na+ | 34.27 mg/L | 38.40 mg/L | 37.17 mg/L | 29.33 mg/L | 34.79 mg/L |
| Nitrite | — | — | — | 1.24 mg/L | — |
| Total alkalinity as $CaCO_3$ | 208.16 mg/L | 249.67 mg/L | 228.98 mg/L | 276.77 mg/L | 240.89 mg/L |

| | | | | | |
|---|---|---|---|---|---|
| Calcium as $CaCO_3$ | 140.95 mg/L | 153.12 mg/L | 121.85 mg/L | 146.88 mg/L | 140.17 mg/L |
| Magnesium as $CaCO_3$ | 81.68 mg/L | 67.32 mg/L | 82.34 mg/L | 52.04 mg/L | 70.84 mg/L |
| Potassium K+ | 8.87 mg/L | 8.60 mg/L | 8.37 mg/L | 5.87 mg/l | 7.92 mg/L |
| Conductivity | 513.33 µS/cm | 583.3 µS/cm | 576.67 µS/cm | 600.00 µS/cm | 568.32 µS/cm |

**Table 2:** Showing Standard values by PSQCA, 2010

| Parameters | Standard values by PSQCA, 2010 | Maximum range of measurement |
|---|---|---|
| Total Hardness | Max:500.00 | 1–1000 ppm |
| Total Dissolved solids | Max:1000.00 | 5–5000.00 ppm |
| Chloride as Cl- | Max:500.00 | 1-1000 ppm |
| Sulphate as $SO_2$ | Max:400 | — |
| pH | 6.5-8.5 | 1–14 |
| Sodium as Na+ | Max:200.00 | 0–40 |
| Nitrite as $NO_2$ | Max:50.00 | — |
| Total Alkalinity as $CaCO_3$ | Max:600 | 1–1000 ppm |
| Calcium as $CaCO_3$ | Max:250.00 | 1–1000 ppm |
| Magnesium as $CaCO_3$ | Max:150 | 1–500 ppm |
| Potassium as K+ | Max:75 | 0–20 |
| Conductivity | Max:200-800 | 60–1000 µS/cm |

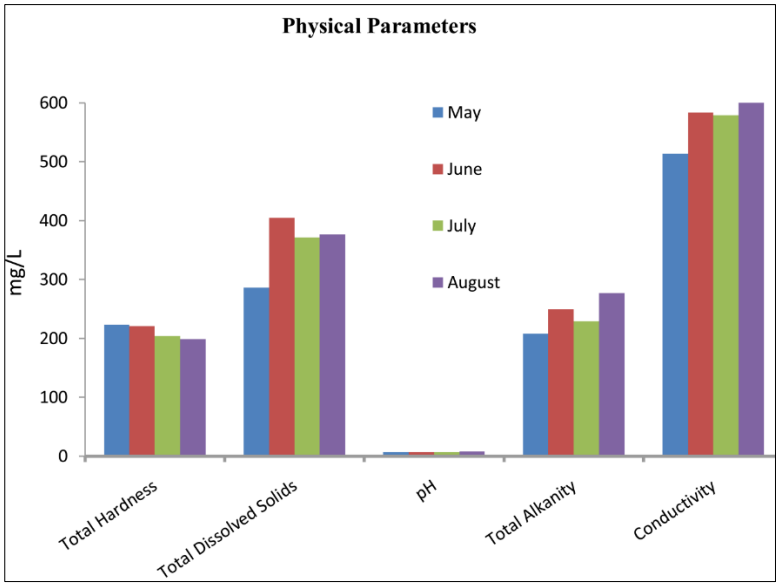


**Fig 1:** Physical Parameters for water quality analysis.

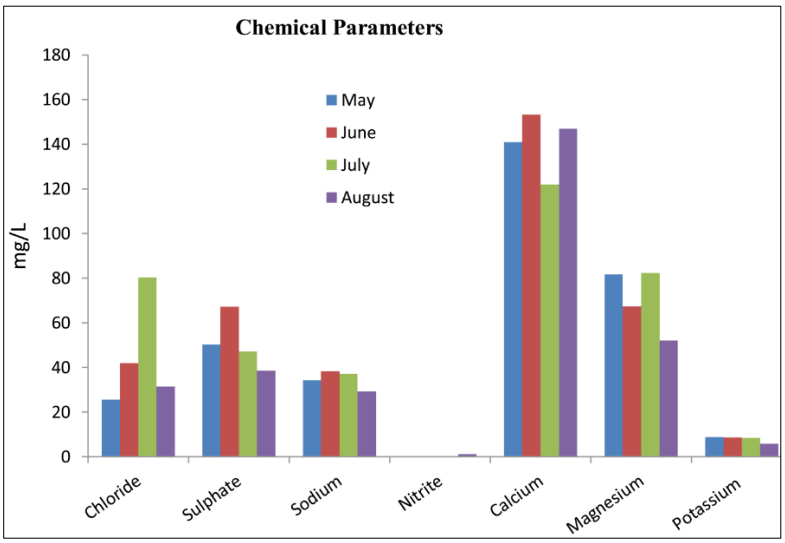


**Fig 2:** Chemical Parameters for water quality analysis.

## Discussion

Water for human consumption must be free from organisms and chemical substances which may affect human health. Water is very important component of life without which life cannot be exist on the earth, all organisms depend on water for their survival (Smitha *et al*., 2007) [19]. Water is an essential requirement of human and industrial developments and it is one of the most important components of the environment (Das and Acharya, 2003) [20]. Water can be used for, drinking, industry, recreation, agriculture, or fisheries. Water is one of the most important compounds of the ecosystem. Better quality of water described by its physical, chemical and biological characteristics, but some correlation was possible among these parameters and the significant one would be useful to indicate quality of water (Pandey *et al*., 2003) [21]. The earth is the only planet having about 70% of water. But due to increased human population, industrialization, the use of fertilizers in the agriculture and man-made activity, it is highly polluted with different harmful contaminants (Sagar *et al*., 2015) [22]. Each of these specified purposes has various biological, chemical and physical properties to accomplish the desired goals. There are various standards for drinking water which are different from the water being used in industry, agriculture and swimming. Various scientific procedures and apparatuses were developed to examine the water pollutants (Dissmeyer, 2000) [23].

These procedures comprise the analysis of numerous parameters e.g. total suspended solids (TSS), turbidity, pH, total hardness, heavy metals, conductivity, and total dissolved solids (TDS). These parameters can affect the quality of drinking water, if their concentrations are higher than the standard limits given by the World Health Organization (WHO, 2011) [24]. Therefore, the analysis of the quality of drinking water by the government departments and researchers has been accomplished frequently throughout the world (Jia *et al*. (2010), Katsoyiannis, and Zouboulis (2013) and (Tuzen and Soylak (2006) [25, 26, 11].

The present study was conducted to evaluate the selected water quality parameters of the lower Badri stream. From the present study it has been observed that the mean value of pH was 7.11. pH ranged from 6.5 to 9.0 is suitable for the growth of the aquatic organisms (Ali, 1999) [27]. Standard water quality for aquaculture has a pH of 6.5 to 8.0 (Meade., 1989) [*et al*28]. The mean pH value for selected four months was 7.11 which is obviously reasonable that it has no adverse effects on fish growth, reproduction and survival. The electrical conductivity is (568.32 us/cm), the conductivity of water shows high fertility of water while low Water conductivity indicates low fertility of water. Conductivity of most freshwater varies but it may not increase from1000 µS/cm if the water is contaminated with industrial or agricultural wastes then conductivity would be affected (Chapman, 1997) [29]. The electrical conductivity has less effect on fish growth, reproduction and survival. So if it increase or decrease from the standard value then it would be also suitable for fish growth. The total dissolved solids are 359.56mg/L which is in normal range. High concentrations of dissolved solids have severe effects on aquatic organisms e.g. cell damage; reduce photosynthesis process as well increase water temperature (Mitchell and Stapp, 1992) [30]. Total hardness is 211.54 mg/L; hardness of water is also a significant parameter of water due to its terrific effect on the life of aquatic organisms (Boyd, 1984) [31]. In Pakistan the total value of hardness of water is 500 mg/L (DIL., 2010) [32] so, it means the hardness has no serious effect on aquatic life. Calcium plays an important role in maintaining bone structure and functions while magnesium helps in regulating various biochemical reactions in the body. Calcium hardness is 140.17 mg/L while magnesium hardness is 70.84 mg/L. The total alkanity of water is due to the presence of bicarbonate ions, it helps in neutralizing water to be suitable for fish growth and survival. In the absence of alkanity the water would become more acidic which is harmful for aquatic life. The total alkalinity is 240.89 mg/L which is in normal range and would not affect fish life. Chloride is 44.82 mg/L, potassium is 7.92 mg/L, sodium is 34.79 mg/L. High concentration of sulphate reduces both growth and hatching rates in fish. In our study sulphate is 50.75 mg/L, which is in normal range. Nitrite is naturally occurring compound found in river and stream water and its high concentration can cause death of aquatic life. Nitrite in our observation is less than the normal rage of W.H.O and PSQCA (Pakistan Standards & Quality Control Authority). According to the result all the parameters are within the normal range except nitrite which is less than the normal range and have no adverse effect on fish survival. The current study would be useful for future research on water quality analysis in district Swabi and its surroundings areas.

## Conclusion

Analysis of water quality is important to examine the acceptability of water sources for various uses. Water quality parameters are evaluated to identify the suitability of water to be used for various purposes. The assessment of the water has been standardized through various procedures and research. In this study various parameters are used which may be helpful to get proper understandings of water quality procedures and standards. All the parameters are within the normal range and no parameters in any way can cause any lethal effect to fish and other aquatic organism. Recorded values for different parameters show the suitability of stream water for culturing of warm and semi coldwater species.

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## Author contribution

MA and FA conceived and designed the project and experiments. MA and JK performed the experiments and FA analyzed the data. FA wrote the paper.

## Conflict of interest

The authors declare no conflict of interest.

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