Physiochemical Analysis of Water and Soil from Gomal Zam Dam of Khajuri Kach in South Waziristan Agency of Pakistan, with Special Reference to Their Impact on Fish Growth and Survival

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Abstract: A study on physicochemical parameters of water and soil was carried out on Gomal Zam Dam situated in Khajuri Kach of South Waziristan Agency in Federally Administered Tribal Areas (FATA) of Pakistan, with special reference to its impact on fish growth and survival. The physicochemical characteristics of both water and soil analyzed in the present study includes i.e., color, odor, elasticity, temperature, pH, conductivity (EC) and total dissolved solids (TDS). The results of present analysis revealed that the temperature of dam water and soil was above the tolerable range of fishes, hence not suitable for fish survival and growth, whereas the remaining other parameters like color, odor, elasticity, pH, EC, TDS were found in suitable range, which indicates the better quality of water and soil of Gomal Zam dam. Therefore, from the result of the present study, it was concluded that Gomal Zam dam is good to support the survival and production of aquatic life, especially fish fauna. Furthermore, this dam was also found safe to be used for irrigation purpose, domestic water supply and other related water usage.

Key words: Gomal Zam dam · Physicochemical characteristics · Water · Soil

INTRODUCTION

Gomal Zam Dam is a multi-usagedam, situated at Khajuri Kach in South Waziristan Agency of Federally Administered Tribal Areas (FATA) from about 100 kilometers from Tank in Tank district of Khyber Pakhtunkwah province, Pakistan. The dam impounds the Gomal River, a branch of the Indus River, where the Gomal River passes through a deep gorge ravine as shown in Figure 1. The purpose of the dam is irrigation, flood control, fish cultivation and hydroelectric power generation [1].

Fish is a cheap source of protein and an important cash crop in many parts of world. Water is the fundamental physical sustain in which fish can perform their each life functions i.e., feeding, swimming, breeding, absorption and emission [2]. Water is a vital natural resource, a fundamental require of all living beings and its importance in daily life makes it crucial that physicochemical examinations can be conducted on water [3]. Quality of water is determined by various physicochemical and biological factors, as they may directly or indirectly affect the water quality and therefore its suitability for the production and distribution of fish and other aquatic animals [4].

The equilibrium of an aquaculture system is also dependent on its soil properties. Soil properties have a dynamic role in endurance and growth of marine organisms. The soil serves as a biological filter through absorbing fish excretions, organic residues of feed and also controls the salinity, maintains pH of aquaculture systems [5]. All living organisms have tolerable limits of
Fig. 1: Map showing Gomal Zam dam located in South Waziristan Agency of Federally Administered Tribal Areas, Pakistan
https://www.google.com/maps/place/Gomal+Zam+Dam,+Pakistan/@32.0987218,69.8818118,17z/data=!3m1!4b1!4m2!3m1!1s0x3928f7731ba5f791:0x349985bc0d641744.

water and soil quality parameters in which they perform their function. An increase or decrease within these limits has unfavorable effects on their body functions [6, 7]. So, good water and soil quality is very essential for survival and growth of fish. Hence, the main purpose of present study about the physicochemical parameters of water and soil of Gomal Zam Dam was to further explore the assembly potential, because both physical and chemical factors can affect the efficiency, diversity and species composition of any lentic or lotic environments.

MATERIALS AND METHODS

Study Area: The study was performed on Gomal Zam dam, situated in South Waziristan Agency of Federally Administered Tribal Areas (FATA), Pakistan.

Sample Collection: Physicochemical analysis of water and soil samples were collected from Gomal Zam Dam situated at Khajuri Kach in South Waziristan Agency at FATA, Pakistan (Figure 1). Sampling was done in the month of June 2015. Both water and soil samples were collected randomly from three different areas of the dam. For water collection, acid sterilized plastics containers were utilized. While soils were put in tight polyethylene bags and shifted in the laboratory of the chemistry department of Kohat University of Science and Technology (KUST) of Kohat district, Pakistan for further analysis.

MATERIALS AND METHODS

Physicochemical parameters of water were measured with the help of analytical procedures followed by Afshan et al. [8], while soil parameters were measured by following the method of Naila et al. [9]. Temperature was measured with the help of thermometer and pH was measured with pH meter JENWAY model no.3505 calibrated with Buffer solution of 4 and 10 pH, while conductivity was analyzed by Conductivity Meter Jenco Model 103.Conductivity meter calibrated by 0.1 KCl (potassium chloride) solutions.

RESULTS AND DISCUSSION

The physiochemical parameters including color, odor, elasticity, temperature, pH, conductivity and total dissolve solids (TDS), of water and soil samples of Gomal Zam Dam are shown in Tables 1, respectively.

Color: The wavelength of visible light reflected by an object shows the color of that object. The water samples are generally colored due to the presence of inorganic impurity, colloidal substance, aquatic growth and disintegration of vegetation. In the present investigation, the water color was found to be pale white, which is found to be suitable for fish growth and survival [10]. Color of soil shows one quality of carbon concentration. Soil colour of the Gomal Zam dam
Table 1: Physicochemical properties of water and soil samples of Gomal Zam dam

<table>
<thead>
<tr>
<th>Samples</th>
<th>color</th>
<th>odor</th>
<th>elasticity</th>
<th>Temperature (°C)</th>
<th>pH</th>
<th>Conductance (µs/ml)</th>
<th>TDS (mg/100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Pale white</td>
<td>odorless</td>
<td>Non-elastic</td>
<td>49.5</td>
<td>7.47</td>
<td>114</td>
<td>300</td>
</tr>
<tr>
<td>Soil</td>
<td>Black</td>
<td>odorless</td>
<td>Non-elastic</td>
<td>48.0</td>
<td>7.43</td>
<td>228</td>
<td>150</td>
</tr>
</tbody>
</table>

was black in color and the black color indicates that soil is high in organic matter which is good for growth of many fishes.

**Odor and Elasticity:** An odor in water is due to variety of conditions, sources and substances. Algae and decaying vegetation are the primary substances related to natural sources. Other sources can be domestic and industrial wastes. In the present investigation, the odor of water and soil sample of Gomal Zam dam was odorless and non-elastic in nature.

**Temperature:** The degree of hotness or coldness in the body of a living organism (either in water or on land) is termed as temperature [11]. Fish is a cold blooded animal, its body temperature changes according to its atmosphere affecting its physiology and metabolism and eventually affecting the production. High temperature results in increase rate of bio-chemical activity of the micro biota. According to Delince [12], 30-35°C is tolerable range to fish. In the present investigation, the water temperature recorded for Gomal Zam dam is 49.5°C, which is above the desirable range of fish growth. High water temperature enhances the growth of microorganisms and may increase taste, odor, color and corrosion problems [13]. The soil temperature of Gomal Zam Dam was also 48°C. Thus, the result of present study revealed that such high temperature of dam was not suitable for fish growth and survival, because high temperature can produce death in fish.

**pH:** pH is a general term used to express the strength of the acid or alkaline condition of a solution. Acidity and alkalinity can be determined by the production of hydrogen and hydroxyl ions. The pH of a marine environment is closely related to biological productivity and hence, pH can be caused by extreme primary production [14]. The suitable pH range for fish survival is between 6.7 and 9.5, while ideal pH level is between 7.5 and 8.5, however the level above and below this pH is stressful for the fishes [15]. In the present investigation, the pH value of the water sample was 7.47, hence, lies in the suitable pH range for fish growth. The pH value of soil sample was 7.43. As, the optimum range required pH of soil for fish production is lies in between 6.5 to 7.3, therefore, from the above observations, it was concluded that the pH of water and soil are suitable for fish growth and survival.

**Conductivity:** Conductivity is affected by the presence of dissolved solids and it is the ability of water to pass an electrical current and the ability depends on the presence of ions, their total concentration, valence, mobility, relative concentrations and temperature of measurement [16]. Conductivity is the most important sign of fish production. Conductivity of water depends on its ionic concentration, temperature and on variations of dissolved solids. Conductivity of freshwater is mostly ranged from 50 to 1500 µs/ml [17]. In the present investigation, the conductance of water and soil samples were 114µs/ml and 228µs/ml, hence, all these values lies within the desirable range for fish survival.

**Total Dissolved Solids (TDS):** Total dissolved solids (TDS) can be defined as the quantity of all dissolved material in water. TDS signifies the amount of total dissolved salts. Salinity affects the quality of water which has critical influence on aquatic biota and every kind of organism has a typical salinity range that it can tolerate. Salinity of soil is essential for the fish strength and it increases the vital slim coat of fishes. Normally TDS ranges from 5 to 1000 mg/L [18]. In the present study, the TDS values of water and soil sample were 300 and 150 mg/100 ml, which were in the desirable range for fish growth and survival.

**CONCLUSION**

From the obtained results of the present investigation, it was concluded that except temperature, parameters like pH, electric conductivity, Total Dissolved Solids were considered to be in safe and in suitable limits, thence, good to support the survival and production of most aquatic life, especially fish fauna. Therefore, this dam can support only those fish species that can tolerate the wide range of temperature for their growth and survival. In addition, it was also observed that some aquatic and terrestrial fungi might be introduced into the Gomal Zam Dam to make it more productive.
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