Assessment Study About The Water Quality Criteria and Heavy Metals Concentrations in Different Fish Ponds of Four Districts of Balochistan Province, Pakistan

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Abstract: The present study includes the analysis of different physiochemical properties of water samples from fish ponds located in the four different districts of Balochistan province; district Sibi (City Sibi, Pond Location Circuit House), district Bolan (Village Mithrri), district Jaffarabad (Village Hajji Yaqoob Khan Pandrani) and district Nasirabad (Village Jumma Khan Umrani) during the period from June to December, 2014. All these districts were included in Kachhi plains of Balochistan except the district Sibi, which was the northern area of province Balochistan. During this study, all selected parameters such as, temperature, conductivity and pH of all selected water ponds were found in recommended levelsthat required for fish growth. The concentration of dissolve Oxygen (DO) was almost sufficient for all ponds. Thoughsome heavy metals i.e., manganese and iron were also found in these pond water samples, however, their concentration was not so high, therefore, they were not found to be lethal for growth of fishes. Thus, our present work will provides useful assistance to the fish culturiststo improve the ecological setup necessary for the growth of fish species in their ponds. Furthermore, such information could also be valuable for determining the growth rate and productivity of fishes.

Key words: Balochistan Districts · Kachhi Plain · Water Quality Parameters · Fish Ponds

INTRODUCTION

Balochistan is the largest province of Pakistan, located in semi-arid to arid zone. Rangel level of Balochistan is 46% and its population is just 8% of Islamic republic of Pakistan [1]. Kachhi Plain of Balochistanis northern extension of Indus Plain and islocated at western Pakistan. These plain revealed the proof of human settlement over 10, 000 years ago [2]. Four different districts of Balochistan province were selected for this study from whichthree districts are part of Kachhi plains of Balochistan these are, Jaffarabad, Bolan and Nasirabad and the fourth district is Sibi District, it is not a part of Kachhiplain as it is located innorthern area of Balochistan [3]. Water is the spring and source of all natural life and also has a deep impact on human wellbeing; it is the only element that occurs naturally on Globe in three physical positions of matter solid, gas and also in liquid frame. The water quality parameters of aquatic habitats have a great influence on growth rate and development of fishes along with other aquatic life.

A pond stands for a natural or man-made water reservoir having an area between2 ha and 1 m^2 (20, 000 m^2 or ~5 acres) that can grips water for some months of the year (mainly for four months or may be more) [4]. They are created for strengthen the aquatic life mainly of fishes, native human consumption wherever huge regular water bodies are inappropriate for use and upgrading of water transportation [5]. A water quality calculation usually consists of study of physicochemical, microbiological and biological parameters to convey biotic and abiotic prominence of the ecosystem [6].

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The physicochemical features of water are essential factors as they may directly or indirectly distress its quality and subsequently its suitability for the production, distribution and growth of fish and other aquatic animals, therefore, the parameters like temperature, pH and salinitystated to have a great impact on the activities of organisms [7]. Amongst the wide diversity of impurities affecting aquatic environment, metals deserve detailed considerations because of their high dredging toxicity even if they are present at low concentrations [8].

As temperature is characterizes as the degree ofcoldness or hotness in the body of an organism either live on land or in water [9]. Temperature of any water body should be recorded at the time of collection of samples, because it has great impact on the reproductive activities of fishes [10, 11]. The word "pH" is a mathematical alteration of the hydrogen ion concentration as it suitably expresses basicity or the acidity of water [12]. Conductivity of an electrolyte solution is a measure of degree of its capacity to conduct the electricity. Therefore, the measurements of conductivity are mostly used in many environmental and industrial applications as an inexpensive and fast way of evaluating the ionic content of a solution [13]. Dissolved oxygenis essential for aquatic lifecycle, as it is required to keep organisms flourish [14]. The depletion of dissolved oxygen could be the reason of death of fish, reduce feeding, suppress respiration, or distress early growth and hatching success because of starvation of oxygen [15]. The biochemical oxygen demand (BOD) check is a widely used manner to compute the consumption of oxygen in water by the decay and disintegration of organic matter [16]. BOD range of 2- 4 does not illustrate pollution and a level beyond of 5 mg/L is revealing of serious pollution [17]. Water bodies having BOD levels in ranged between 1.0 and 2.0 mg/L will be consider as clean; but at 3.0 mg/Las fairly clean, withdoubtful at 5.0 mg/L; and if this level reached at 10.0 mg/L than it will be consider as absolutely polluted [18, 19].

As the pollutants are the key sources of water quality degradation throughout the world, therefore, excess of heavy metal concentrations found in any water body beyond the tolerance range of aquatic life will be consider as vital ecological pollutants because their toxicities can cause distressing impact on the ecological balances of any ecosystem andalso on the biodiversity of aquatic organisms [20, 21]. Subsequently, our current study was designed toexamine the different physiochemical parameters of various pond water bodies in order to evaluate their impact on the fish production in a water pond and to analyze the significance of these parameters in pond construction for viable fishery managing policies. Such a study will be valuable to guarantee the safety ofthe aquatic ecosystem, environment for good and healthy production of fish for consumption in the future [22].

MATERIALS AND METHODS

Study Zones: Our present research was conducted from the four different districts of Balochistan province of Pakistan, which is the largest province by area forming around 44% of the Pakistan's over-all land mass and is smallest in position of population. The districts selected for the collection of water samples from fish ponds in this study weredivided into four stations such as, Station 1 include district Sibi (Pond located in Circuit House), Station 2 includedistrict Bolan (pond located in village Mithrri), Station 3 include district Jaffarabad (pond located in village Hajji Yaqoob Khan Pandrani) and Station 4 include district Nasirabad (pond located in village Jumma Khan Umrani).

All the three ponds were built especially according to economic considerations except the pond of district Sibi (Circuit House) which is an ornamental pond.

Pond Water Sampling: From the four sampling stations, water samples were assembled fortnightly at day time within the study period from June to December, 2014. In the present study, two locations were selected for the collection of water samples monthly from each fish pond i.e., pond surfaceand ground. At least six liters of water sample was collected from the each selected site in plastic containers were compiled. Before the sampling, the containerswere cleaned, washed, dried out, labeled, corked and stored in laboratory settings to avoid contamination. The samples were treated carefully in the field and then transported to the laboratory for further analysis.All the parameters of study were measured separately from surface and ground water of each station and then mean and standard deviation for each parameter was measured.

Analysis of Physiochemical Characteristics of Pond Water Samples: Diverse number of physical and chemical parameters of pond water bodies.Water temperature, dissolve oxygen (DO), hydrogen ion concentration (pH) and electrical conductivity were explored during this study using standard methods of water analysis.

Temperature: The temperature of water was measure following APHA method [23]. The water temperature was determined in the area with the help of mercury in glass thermometer (0-110°C), graduated with 0.1°C interims. Thermometer was dipped directly in the water andtemperature values were recorded when the mercury become constant at a point. Three readings were taken and the mean of the readings was calculated and recorded. This process was repeated for all the four sampling collection stations.

Hydrogen Ion Concentration (pH): The water hydrogen ion concentration (pH) was measured in the laboratory using a standardized JENWAY portable electronic pH meter model 3020 followed by Torimiro *et al.* [24]. First the pH meter was calibrated by using standard above pH 7.0 (basic) and below pH 7.0 (acidic) as followed by Javed *et al.* [25]. The readings were recorded by dipping the probe of pH meter in the water sample. The mean water pH of three such readings was calculated and recorded for the samples of all stations.

Electrical Conductivity: Electrical conductivity of the assembled water samples from four stations was measured under the laboratory conditions using JENWAY portable Conductivity meter model No.4520 [21]. For all stations small volume of water enough to create contact with the electrode of meter was poured in a clean beaker. The reading was noted by lowering the electrode (probe) in the beaker having water sample and left for almost three to four minutes to standardize the meter. After taking three readings the mean was recorded.

Dissolved Oxygen: Dissolved Oxygen was measured with the help of 9500 DO_2 meter JENWAY [26].

Heavy Metal Contents: Heavy metals in water samples were determined with the help of the atomic absorption spectroscopy [27].

RESULTS AND DISCUSSIONS

In the present study, physiochemical properties of the different pond water samples collected from the four districts of Balochistan such as, Jaffarabad, Bolan and Nasirabad were analyzed. Table 1 presents the significance of some parameters of pond water like temperature, conductivity, dissolve oxygen and pH in the growth of fish found in fish pond [28]. In the present study, results on physiochemical parameters and metals concentrations of pond water bodies were presented in the Tables 2-8, respectively.

Temperature: In the present study, temperature ranged measure for Station1 at surface 28.3 and ground water was measured as 29.8°C, Station 2 with temperature 27.3 and 27.5°C, Station 3 27.3 and 28.8°C and Station 4 was 25.3-25.9°C, at surface and bottom watersrespectively, as shown in Table 2, respectively. The result of the present study in all stations revealed that the temperature measurements was sufficient as the optimum temperature required for fish growth that is 26 to 32°C, as shown in Table 1. The results also correlates with temperature 26-30°C, as recorded by Anonymous [29]. Temperature basically means the gradation of coldness or hotness of a body. As Fish is an exothermic organisms acquire heat from their outside environment, therefore, if temperature of its external environment changes than the temperature of fish body will also be change accordingly. Each species need their optimum temperature range for survival growth and reproduction and because of such necessity the fish are divided in to three classes that are, semi cold water fishes such as, *Tor putitora*etc. can bear a temperature of 15 to 20°C. Cold water fishes e.g., trout can tolerate a temperature of7 to 15°C. Warm water fishes for example carps can tolerate a temperature from 20 to 35°C. So its mean every species have their optimum of temperature in which they can grow, survive and reproduce [21]. Thus, the result of the present studyin all stations revealed that the temperature measurement was sufficient as the optimum temperature required for fish growth that is 26 to 32°C.

pH: pH basically is measure of the degree of the alkalinity or acidity of a solution and is measured on a (pH scale) from 0 - 14. The pH has great effect on growth of fish. The pH values of the all ponds water were measured to be in the alkaline range (pH > 7.0) as given in Table 3. While station 2 having pH 7.41 (surface) and7.91(bottom) of pond water was somewhat similar in range with pH 7.4-7.9as calculated by Mane *et al.* [30]. Whilein present study station 1 having pH value 7.86 and 7.96, with mean value of 7.96 similar with mean value recorded by Boyd *et al.* [31]. Station 3 having pH value at surface 7.1 and bottom of pond was7.6 found to be similar as values noted by Sharma and Jain [32]. Hence, in our present study, the pH values of all stations falls in recommended regions needed for fish growth as given in Table 1 that is 6.5 to 9.5.

Table 1: The significance of some physiochemical parameters for water of fish ponds [28]

Parameter	Importance in production of Fish	Recommended range	What happened when the range is below from recommendation	What happened when the range is above from recommendation
Temperature	The rate of metabolism of fishes is directly related with temperature, as fishes are cold blooded animals.	26-32°C	If temperature is below15-26°C than fishes get a stressed environment therefore become susceptible to different type of diseases.	If recommended range increases death can occur at extreme temperature.
Dissolved Oxygen (DO)	Oxygen is used during breathing for metabolic purposes. Dissolved oxygen oxidized the toxic metabolic wastes into potentially less toxic forms.	From 4.0 mg/l to above (e.g., For catfish)	If DO decreases below 1.4 to 5.0 mg/l than though fishes survive but slow growth rate; toxic wastes build up because they are not broken down.	When the water is supersaturated Gas bubbles trauma occurs.
pH	Effects the chemical forms and solubility of different compounds	6.5-9.5	Fishes become stressed.	Death is almost certain.

Table 2: Temperature values of pond water from the four selected stations

Pond location	Temperature measured from the surface of pond water (°C)	Temperature measured from the bottom of pond water (°C)	Mean±S.D
Station 1	28.3	29.8	0.242±0.03
Station 2	27.3	27.5	0.91±0.83
Station 3	27.3	28.8	0.83±0.10
Station 4	29.5	30.5	0.46±0.02

*S.D=Standard deviation.

Table 3: The measured pH levels of pond water of four selected stations

Pond location	pH at the surface of fish pond	pH at the bottom of fish pond	Mean±S.D
Station 1	7.81	7.96	7.96±0.0
Station 2	7.41	7.91	7.64±0.2
Station 3	7.11	7.61	7.44±0.2
Station 4	7.52	7.58	7.62±0.1

Table 4: Conductivity values of pond water samples from the four selected stations

Pond location	Conductivity at surface of fish pond (μScm^{-1})	Conductivity from bottom of fish pond (μScm^{-1})	Mean±S.D
Station 1	211	213	213±1.0
Station 2	87.1	87.2	87.2±0.0
Station 3	79.1	89.2	85.8±5.8
Station 4	212	215	214±1.73

Table 5: Dissolved Oxygen levels of pond water samples of the four selected stations

Pond location	Dissolved Oxygen from surface water of pond water (mg/l)	Dissolved Oxygen from bottom water of fish pond (mg/l)	Mean±S.D
Station 1	1.3	1.70	1.6±0.0
Station 2	1.1	1.20	1.1±0.1
Station 3	1.55	2.61	2.25±0.6
Station 4	1.45	1.70	3.7±0.1

Table 6: Manganese concentration atsurface and bottom of pond water samples of four selectedstations

Pond location	Manganese concentration from Surface water (mg/l)	Manganese concentration from bottom water (mg/l)	Mean±S.D
Station 1	0.022	0.042	0.032 ± 0.01
Station 2	0.005	0.023	0.018±0.01
Station 3	0.038	0.115	0.076± 0.05
Station 4	0.005	0.072	0.03± 0.04

Table 7: Iron concentration at surface and bottom pond water samples from four selected stations

Pond location	Iron (Fe) concentration from surface of pond water samples (mg/l)	Iron (Fe) concentration from ground water samples (mg/l)	Mean±S.D
Station 1	0.268	0.217	0.242±0.03
Station 2	0.321	1.506	0.91± 0.83
Station 3	0.912	0.767	0.83± 0.10
Station 4	0.481	0.451	0.46± 0.02

Table 8: Chromium concentration at surface and bottom of pond water samples of four selectedstations.

Pond location	Chromium concentration at the surface of pond water samples (mg/l)	Chromium concentration at the bottom of pond water samples (mg/l)	Mean±S.D
Station 1	0.783	0.525	0.654± 0.018
Station 2	0.75	0.797	0.775± 0.033
Station 3	0.774	0.009	0.391± 0.54
Station 4	0.298	0.745	0.521± 0.316

Water Conductivity: Water Conductivity is an extent of the capacity of water to allow the electrical current pass through it. This conductivity of water is because of inorganic dissolved solids in it. Conductivity has not as much of effect on the fish growth. Thus, if any change in conductivity in the form of increase or decrease from standard value occur so it will be tolerable for fish and will not affect the fish severely. The conductivity values recorded for station 1, 2, 3 and 4 at surface and bottom of fish ponds as were correlates more or less with the values of conductance measured by Torimiro *et al*. [24] as shown in Table 4, respectively.

Dissolve Oxygen: Dissolve Oxygen is the quantity of Oxygen dissolved in water. Oxygen is necessary and critical for the survival of aquatic animals and plants and a shortage of dissolved oxygen is not only harmful to fish but also a sign of pollution. The dissolved oxygen level atstation 1 with measure value of dissolved oxygen 1.30-1.70 mg/l, Station 2 was found to be 1.0 and 1.2 mg/l, station 3having dissolved oxygen value 1.55 and 2-61mg/l and station 4 with the value of 1.45 and 1.70mg/l at surface and bottom water as shown in Table 5, respectively. These recorded values were very much less as compared to Table 1. But as minimum concentration of 1.0 mg/l of dissolved oxygen is needed to sustain fish for long period of time [24], therefore, itwas concluded that the measured values of dissolved oxygen for all stations in this study were minimum for fish growth.

Metal Concentrations: The requirement for fish farming is virtuous water quality and absence of pollutants. Some heavy metals such asIron, Calcium, Magnesium and Zinc could become toxins above the required concentrations.

Others metals likesilver (Ag), mercury (Hg), cadmium (Cd) and arsenic (As) are not needed by the organisms even at low concentrations [34]. The potentially lethal metal elements are recognized to cause health threats to aquatic bionetwork. Therefore, it is needed to identify the heavy metal concentration in aquatic ecosystem. In the present study, manganese concentration was recorded in following trend in mg per liter (mg/l). Surface and bottom water concentrations were measured separately and recorded in the Tables 6-8, respectively. Although somemetals such as manganese and iron if found in a high concentration can cause death of fish found in fish pond but the concentration of both of these metals in each selected stations of our present study was not as much high that could havehazardous impact on fish life.

CONCLUSION

The current study was conducted to recognize the water quality parameter and heavy metal concentrations in the different fish ponds from four different districts of Balochistan province including Sibi, Nasirabad, Jafarabad and Bolan. From the obtained results of this study, it remained concluded that heavy metals and other tested parameterswere found in normal range, hence, proved to be suitable for fish growth, survival and reproduction rate andalso have no adversarial effect on the life of fish. The leading reason for such result was that at four selected stations, there were no nearby industries and factories that are the major causes of pollution for any water reservoirs. But as the selected areasof our present study have no such factories and industries, therefore, the water of all these areas is of good quality.

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