Suitability of Ground Water Quality in Kala Khatae District Sheikhupura for Fish Farming

Muhammad Arfan Hadyait[*1], Sana Salim[1], Asif Ali[1], Muhammad Zafar Ullah[1],

Ayisha Asghar[2] & Ehsan Mahmood Bhatti[1]

[1]Fish Quality Control Labs, Fisheries Research & Training Institute Manawan Lahore, Pakistan.

[2]Department of Chemistry, Govt. Postgraduate Islamia College for Women Cooper Road, Lahore, Pakistan

*Corresponding Author: marfan39@gmail.com

Abstract

The efficient profitable production of fish and other aquatic organism in aquaculture depends on a suitable environment in which they can reproduce and grow. Because these organism live in water the major environmental concern within the culture system is water quality. The physio-chemical and biological characteristic in the fish pond offers the most favorable conditions for the existence of fish as well as other biota which constitute essential components of the food chain. The survival and optimum growth of cultural fish is largely depend upon the good water quality. The aim of the study to provide overview of suitability for fish farm by analysis of ground water. Water samples from twelve sites in triplicate were collected randomly from different villages of Kala Khatai District Sheikhupura in March-April 2016. The collected samples were tested for temperature, odour, colour, electrical conductivity, phenol, turbidity, hardness, carbon dioxide, sulfite, alkalinity, pH, iron and chloride. The mean value and standard deviation of the temperature, conductivity, phenol, turbidity, hardness, carbon dioxide, sulfite, alkalinity pH and chloride were found (24.39±3.69 ºC, 622.33±218.78uS/cm, 0.01±0.00 mg/L, 1.43±1.03 NTU, 221.36±99.49 mg/L, 56.25±18.16 mg/L, 41.89±50.30 mg/L, 273.39±92.30 mg/L, 7.02±0.35 and 66.94±12.38 mg/L) respectively. The values of temperature, conductivity, phenol, turbidity, hardness, carbon dioxide, sulfite, alkalinity pH, chloride, colour, odour and iron are almost within suitable range when compared with standards. Thus the ground water of Kala Khatae can be profitably used for fish culture.

Key Words: Water quality; Kala Khatae; Fish Farming; Ground Water; FQCL

1. Introduction

The suitable environment is essential for the reproduction and growth of fish and other aquatic organisms. Water quality is the key factor for the profitable production of aquatic organisms including fish.

The efficient profitable production of fish and other aquatic organism in aquaculture depends on a suitable environment in which they can reproduce and grow. Because these organism live in water the major environmental concern within the culture system is water quality.

The physical, chemical and biological characteristics of water are of great concern for its beneficial use (Boyd & Tucker, 2009). Water quality characteristics can effect growth, productions, reproduction, survival of fish & aquaculture species, influence the management decision, cause environment impacts or reduce product quality.

The physio-chemical and biological characteristic in the fish pond offers the most favorable conditions for the existence of fish as well as other biota which constitute essential components of the food chain (Soladoye & Ajibade, 2014). The survival and optimum growth of cultural fish is largely depend upon the good water quality.

Ground and Surface water are two main categories of water supply for aquaculture. Now a days, ground water is emerging as most needed resource that cannot be neglected in any region of the world (Llamas & Martinez-Santos, 2005). Earlier to this development all the focus was on surface water due to its direct participation in hydrological cycle. In developing countries like Pakistan, ground water was considered only as a means of rural water supply. Ground water has unique natural features which makes it suitable for aquaculture/fish culture. However, not all available water is good enough for fish farming .Water quality standards vary significantly due to different environmental conditions, ecosystem and intended human uses (Alsalah, Al-Jassim, Timraz, & Hong, 2015)

The growth and development of fishes are mainly dependent on water temperature, DO, pH, alkalinity, free CO_2 and other salts. Any change in these parameters effect the growth of fish (Olopade, 2013).

The present study gives an over view of groundwater for fish farming in the area of Kala Khatae District Sheikhupura. The fish farmers of the region can improve their fish production by knowing the water quality of that area and also can produce a good farm management. The main objective of the study was to assess physio chemical parameters to check the suitability for fish stocking. Therefore, the present research is providing an overview of suitability for fish farm by analysis of ground water.

2. Material and Methods

Water samples from twelve sites in triplicate were collected randomly from different villages (Kot Abdullah, Ratte Gujaran, Jandiala Kalsan, Khukher, Kala Khatai, Sidhan Wali, Awan Muslim, Ghazi Kakka, Laban Wala, Fateh Rehan, Latheypur and Goal) of Kala Khatai District Sheikhupura in March-April 2016. Figure (1) shows the sampling points, from where the water samples were collected. The parameters which are considered to be important for fish farming were selected for the study. These include temperature, odour, colour, electrical conductivity, phenol, turbidity, hardness, carbon dioxide, sulfite, alkalinity, pH, iron and chloride. For the temperature, pH and electrical conductivity in situ measurements were taken. These were checked by liquid in glass thermometer (Model: Zeal, England), pH meter (Model: pH 100 YSI, USA) and conductivity meter (Model: CM 35+, Crison Spain) respectively.

Groundwater samples were collected in one (1) liter hygienic plastic bottle with screw caps, placed in ice container and transported to Fish Quality Control Labs Lahore (Chemistry Section), Fisheries Research and Training Institute Manawan for further tests. Turbidity, phenol, hardness, carbon dioxide, sulfite, alkalinity iron and chloride were

checked by turbidity meter (Model: 2100AN HACH, USA) and Hanna water testing kit (HI 3864, 3812, 3818, 3822, 3811, 3834, 3815) respectively.

The collected data of physicochemical parameters of water samples. The data was statistically analyzed for mean, standard deviation, minimum and maximum by using SPSS 22 (Statistical Pakage for Social Sciences). The results were also compared with standards set by different regulatory bodies.
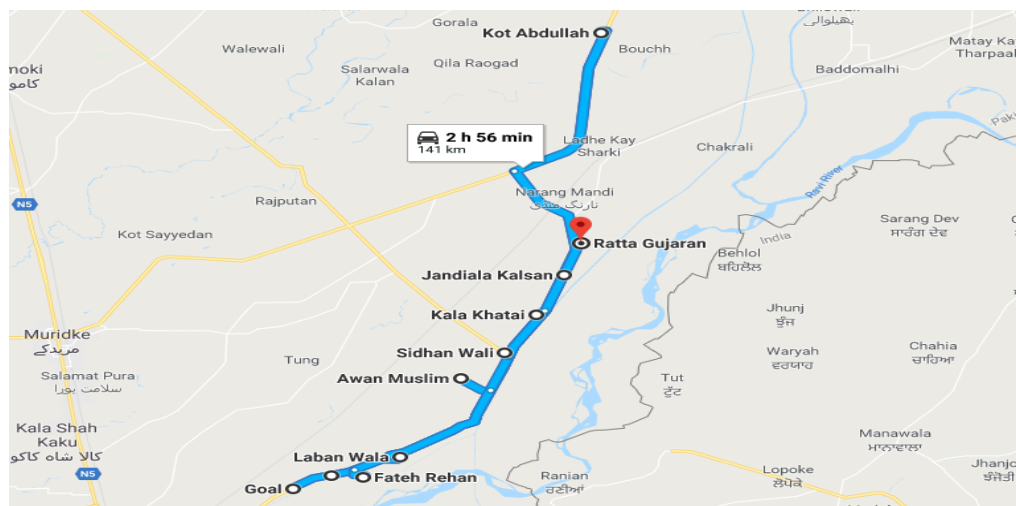

Figure 1: Sampling Point Description

3. Results and Discussion

10 parameters were analyzed to check the water quality of ground water collected from Kala Khatae. The main purpose of this study is to evaluate, whether ground water of this area is suitable for fish farming or not. Water samples were collected from different locations of this site with different depths (Table 1). All the collected water samples were colorless and odourless. Iron is found in all samples less than 1 mg/L.

Location	n	Depth (Feet)	Type of Water
Kot Abdullah	3	125	Ground Water
Ratte Gujaran	3	200	Ground Water
Jandiala Kalsan	3	250	Ground Water
Khukher	3	30	Ground Water
Kala Khatai	3	300	Ground Water
Sidhan Wali	3	40	Ground Water
Awan Muslim	3	135	Ground Water
Ghazi Kakka	3	300	Ground Water
Laban Wala	3	150	Ground Water
Fateh Rehan	3	140	Ground Water
Latheypur	3	180	Ground Water
Goal	3	250	Ground Water

Table 1: List of water samples collection points

The highest mean temperature of 27.9±0.1ºC was observed in Ghazi Kakka, Labban Wala, Latheypur and Goal while the lowest temperature of 18.1±0.6 ºC was found in Kala Khatae. In the current study, highest mean pH value is 7.55±0.01 in Kot Abdullah and lowest value of 6.51±0.07 was recorded in Khukhar. Electrical Conductivity was measured highest 985±4uS/cm in Goal and lowest 329±1uS/cm in Fateh Rehan. Phenol was detected highest 0.02±0.00mg/L in Ghazi Kakka, Latheypur and Goal while all in other places it was just 0.01±0.00mg/L. Turbidity was ranged from 3.50±0.8NTU in Latheypur to 0.34±0.06NTU in Awan Muslim. The highest mean Hardness value of 402±2mg/L was observed in Ghazi Kakka and lowest value of 74±2mg/L in Kot Abdullah. CO_2 level was range from 85±4mg/L in Sidhan Wali to 27±4mg/L in Kala Khatae. Laban Wala was found with highest Sulfite value 143±6mg/L while Khukhar was found with lowest Sulfite value 3±1mg/L. Value of Alkalinity was detected highest in Goal i.e., 450±4mg/L and lowest in Kala Khatae 162±8mg/L. Awan Muslim was observed with highest value of Chloride i.e. 97±6 while Laban Wala and Fateh Rehan were observed with lowest value of 53±6mg/L

Area	Temp. (ºC)	Cond. (uS/cm)	Phenol (mg/L)	Turbidity (NTU)	Hardness (mg/L)	CO2 (mg/L)	Sulfite (mg/L)	Alkalinity (mg/L)	pH	Chloride (mg/L)
Kot Abdullah	25.8±0.1	939±3	0.01±0.00	1.40±0.07	74±2	45±2	12±2	343±7	7.55±0.01	73±12
Ratte Gujaran	25.9±0.3	716±1	0.01±0.00	2.39±0.33	223±15	61±1	13±2	275±16	7.28±0.02	63±6
Jandiala Kalsan	19.2±0.3	499±1	0.01±0.00	3.00±0.19	235±5	74±2	5±1	214±6	6.57±0.05	63±6
Khukher	20.7±0.2	513±1	0.01±0.00	0.40±0.05	149±8	75±2	3±1	176±14	6.51±0.07	63±6
Kala Khatai	18.1±0.6	352±2	0.01±0.00	0.38±0.07	181±9	27±4	7±1	162±8	6.99±0.28	63±6
Sidhan Wali	19.9±0.3	690±1	0.01±0.00	0.45±0.07	205±9	85±4	4±0	243±11	6.55±0.06	77±6
Awan Muslim	25.7±0.1	516±3	0.01±0.00	0.34±0.06	185±9	48±1	13±1	204±10	7.16±0.10	97±6
Ghazi Kakka	27.9±0.1	908±4	0.02±0.00	1.72±0.01	402±2	55±4	117±1	434±3	7.23±0.03	63±6
Laban Wala	27.9±0.1	444±5	0.01±0.00	1.26±0.09	364±5	66±1	143±6	279±4	6.71±0.02	53±6
Fateh Rehan	25.8±0.1	329±1	0.01±0.00	0.99±0.03	75±3	23±2	11±1	201±3	7.23±0.02	53±6
Latheypur	27.9±0.1	577±3	0.02±0.00	3.50±0.08	320±5	62±1	93±6	299±3	7.09±0.03	67±6
Goal	27.9±0.1	985±4	0.02±0.00	1.31±0.19	241±5	53±1	83±6	450±4	7.34±0.03	67±6

Table 2: Details of results village wise

Parameters	N	Min	Max	Mean	Std. Deviation
Temperature (ºC)	36	17.60	28.00	24.39	3.69
Conductivity (uS/cm)	36	328.00	989.00	622.33	218.78
Phenol (mg/L)	36	0.01	0.02	0.01	0.00
Turbidity (NTU)	36	0.29	3.59	1.43	1.03
Hardness (mg/L)	36	72.00	405.00	221.36	99.49

International Journal of Research

Available at https://edupediapublications.org/journals

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 12
April 2018

CO2 (mg/L)	36	22.00	89.00	56.25	18.16
Sulfite (mg/L)	36	2.00	150.00	41.89	50.30
Alkalinity (mg/L)	36	156.00	454.00	273.39	92.30
pH	36	6.43	7.55	7.02	0.35
Chloride (mg/L)	36	50.00	100.00	66.94	12.38

Table 3: Descriptive Statistics of Water Parameters in Kala Khatai

Thirty six samples from different sites were analyzed during all the research work. The result of the descriptive data analysis are shown in table (3). Temperature was found is range from 17.6 to 28.0°C with a mean value of 24.4± 3.7 °C. Electrical conductivity was varied from 328 to 989 µS/cm with the mean of 622±218.8 µS/cm, which is very high. Five locations were observed above the mean value namely Kot Abdullah, Ratte Gujaran, Sidhan Wali, Ghazi Kakka and Goal. Phenol level were observed very minimal in all the water samples i.e. 0.01 and 0.02 mg/L with the mean value of 0.12±0.004 mg/L. Turbidity ranged from 0.29 to 3.59NTU and the mean value is 1.43±1.03 NTU. There values are acceptable as the samples are ground water. Hardness was analyzed from 72 to 405mg/L with the mean value of 221±99.seven sites were observed below the mean value. Level of CO_2 ranged from 22 to 89 mg/L and its mean value is 56± 18mg/L. Seven sites were observed below the mean value. The concentration of sulfite in this study was found from 2.0 to 150mg/L with the mean value of 41± 50mg/L. Hardness from samples of eight sites were observed less than 15mg/L and the remaining four sites were observed higher then 80mg/L. This standard deviation of 50 is fairly high indicating the dispersion of the observation. Alkalinity level was analyzed from 156 to 454mg/L with the mean value of 273± 92mg/L. six sites were found with higher concentration of alkalinity then mean value. pH was found with minimal value of 6.43 and maximum value of 7.55. Mean of all the observations was 7.01with standard deviation 0.34. The concentration of chloride ions varied from 50 to 100 mg/L. its mean value was observed 66±12 mg/L.

Parameters	Mean	Std. Deviation	WHO	FEPA	Desirable range
Temperature °C	24.39	3.69	<35	27	20-30
Conductivity (uS/cm)	622.33	218.78	300	200	20-1500
Phenol (mg/L)	0.01	0.00	-	-	-
Turbidity NTU	1.43	1.03	10	<7	10-1000
Total Hardness mg/L	221.36	99.49	600	-	50-400
CO2 (mg/L)	56.25	18.16	-	-	-
Sulfite (mg/L)	41.89	50.30	-	-	-
Total Alkalinity mg/L	273.39	92.30	600	-	50-400
pH	7.02	0.35	6.5-8.5	6-9	6.5-9
Chloride (mg/L)	66.94	12.38	-	-	-

Table 4: Comparison of Results with other standards, WHO (Gorchev & Ozolins, 2011), FEPA (Agency, 1991) and desirable range (Boyd & Tucker, 2009)

Temperature is the most important physical parameter that directly or indirectly effect all other water quality variables. Effect of temperature varies in different fish species according to Gorchev & Ozolins (2011), the water temperature should be less than 35℃. As per finding of Delince (1992) 30 ℃ to 35 ℃ is tolerable to fish and for carp culture suitable water temperature is between 24 ℃ to 30 ℃. In present study, temperature range is 18-28 ℃. Most of the sites temperature is > 24 ℃ that is suitable for fish culture.

Extremes of pH can be harmful or lethal for aquatic animal. Optimum pH range for efficient growth and health of aquatic animal is 6.5-9.0 (Boyd & Tucker, 2009). According to the Gorchev & Ozolins (2011) it should be within the 6.5-8.5, similarity Agency (1991) proposed it should be between 6-9. All the samples of current study lies within suitable range.

Alkalinity does not have direct effect on fish culture. Alkalinity is an important variable as it interacts with other variables that effect the growth of aquatic animals. According to Singh & Ngachan (2007) the ideal value for fish culture is 50-300mg/L, while Gorchev & Ozolins (2011) proposed that it should be 600mg/L. Most of the samples of the present study lies within the range except that of Ghazi Kakka (434mg/L) and Goal (450mg/L).

A wide range of total hardness may be acceptable for most freshwater aquatic animals to grow. Stone & Thomforde (2004) in their study find that the desirable range is 50-150mg/L, while according to Gorchev & Ozolins (2011) it should be 600mg/L. in the current study, total hardness range is 74-402mg/L, that is low according to (Gorchev & Ozolins, 2011). A few samples have the range between 50-150mg/L, while all other water samples have total hardness >

150mg/L. our findings match with the study of Boyd & Tucker (2009) who concluded that ground water usually ranges from 20-400mg/L.

Carbon dioxide is biologically active gas and have tendency to dissolve in water. Dissolved CO_2 level in aquaculture pond s should lie between 0-10mg/L (Boyd & Tucker, 2009). According to Ezeanya *et.al*. (2015) tropical fishes can bear over 100mg/L CO_2 level but less than 10mg/L of CO_2 level is an ideal concentration for fish ponds. In present study, all water samples range above 10mg/L which is not ideal for aquaculture pond .this problem may be the result of high bacterial load and less photosynthetic activity.

Turbidity is caused by suspended material helps to scatter the light rather to be transmitted in a straight line. (Boyd & Tucker, 2009) suggested that turbidity level should be in range of 25-80mg/L. Bhatnagar & Devi (2013) also mentioned the same finding. Level of turbidity in recent study is less than 25 NTU, range from 0.34- 3.50 NTU that is very low for pond ecosystem low level of turbidity indicates that there is less amount of suspended particles (such as soil particles, plankton and other organic detritus).

The amount of phenol should be less because its high concentration causes toxicity. In this work, phenol concentration is 0.01-0.03mg/L which is tolerable and suitable for fish farming.

Optimum conductivity for fish production varies from on species to another. Stone & Thomforde (2004) recommended the desirable range 100-2000 µS/cm and acceptable range 30-5000 µS/cm for aquaculture pond. All water samples of current study meet the required level of conductivity for fish farming.

Stone & Thomforde (2004)suggested that the chloride level for fish farming should be more than 60mg/L. Only two samples from Laban Wala (53mg/L) and Fatch Rehan (53mg/L) have low level of chloride ions than required**.**

4. Conclusion

From the current study it is concluded that the ground water of Kala Khatae District Sheikhupura is suitable for fish culture and by using the ground water quality data the fish farming can be promoted in this area.

5. Acknowledgment

The authors are

The authors are acknowledge the fish farmers of Kala Khatae area for their cooperation and provision of water samples.

References

Agency, F. E. P. (1991). *Guidelines and Standard for Environmental Pollution Control* (Vol. 27).

Alsalah, D., Al-Jassim, N., Timraz, K., & Hong, P. (2015). Assessing the groundwater quality at a Saudi Arabian agricultural site and the occurrence of opportunistic pathogens on irrigated food produce. *International Journal of Environmental Research and Public Health*, *12*(10), 12391–12411. https://doi.org/10.3390/ijerph12101239 1

Bhatnagar, A., & Devi, P. (2013). Water quality guidelines for the management of pond fish culture. *International Journal of Environmental Sciences*, *3*(6), 1980–2009. https://doi.org/10.6088/ijes.201303060 0019

Boyd, C. E., & Tucker, C. S. (2009). *Pond Aquaculture Water Quality Management*.

Delince, G. (1992). *Development in Hydrobiology*.

Ezeanya, N. C., Chukwuma, G. O., Nwaigwe, K. N., & Egwuonwu, C. . (2015). Standard Water Quality Requirements and Management Strategies for Fish Farming (a Case Study of Otamiri River). *International Journal of Research in Engineering and Technology*, *4*(3), 1–5. Retrieved from http://esatjournals.net/ijret/2015v04/i03 /IJRET20150403001.pdf

Gorchev, H. G., & Ozolins, G. (2011). *WHO guidelines for drinking-water quality. World Health Organization* (Vol. 38). https://doi.org/10.1016/S1462-0758(00)00006-6

Llamas, M. R., & Martinez-Santos, P. (2005). INTENSIVE GROUNDWATER USE: A SILENT REVOLUTION THAT CANNOT BE IGNORED. *Water Science and Technology Series*, *51*(8), 167–174.

Olopade, O. (2013). Assessment of Water Quality Characteristics for Aquaculture Uses in Abeokuta North Local Government Area, Ogun State, Nigeria. *Lakes, Reservoirs and Ponds*, *7*(1), 9–19.

Singh, N. P., & Ngachan, S. V. (2007). Guidelines for water quality management for Fish culture in tripura.

ICAR Research Complex for NEH Region Tripura Centre, Lembucherra, 29.

Soladoye, O., & Ajibade, L. T. (2014). A Groundwater Quality Study of Lagos State , Nigeria. *International Journal of Science and Technology*, *4*(4), 271–281.

Stone, N. M., & Thomforde, H. K. (2004). Understanding Your Fish Pond Water Analysis Report. *Aquaculture/Fisheries*, (January).