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Faisal Junaid
Department of Zoology, GPGC, Karak, KP, Pakistan

Hameed Ur Rehman
Department of Chemistry, Kohat University of Science & Technology, KUST, Kohat, KP, Pakistan

Naqeeb Ullah
Directorate of Post-Harvest and Food Technology Agriculture Research Institute ARI, Sariab Road Quetta

Muhammad Tariq
Directorate of Special Crops Agriculture Research Institute ARI, Sariab Road Quetta

Muhammad Ayub
Directorate of Oil Seed Crops Agriculture Research Institute ARI, Sariab Road Quetta

Muhammad Naseem
Research Officer Directorate of Agriculture Research Potato Seed Production Pashin Quetta

Abdul Majid
Department of Chemistry, Kohat University of Science & Technology, KUST, Kohat, KP, Pakistan

Jalil Khan
Department of Chemistry, Kohat University of Science & Technology, KUST, Kohat, KP, Pakistan

Maqsood Ali
Department of Chemistry, Kohat University of Science & Technology, KUST, Kohat, KP, Pakistan

Parsa Shaffait
Department of Chemistry, University of Kotli, AJK, Pakistan

Muhammad Ibrahim
Department of Chemistry, University of Kotli, AJK, Pakistan

Correspondence
Hameed Ur Rehman
Department of Chemistry, Kohat University of Science & Technology, KUST, Kohat, KP, Pakistan

Physiochemical parameter of water and soil of Nashpa district Karak KPK Pakistan

Faisal Junaid, Hameed Ur Rehman, Naqeeb Ullah, Muhammad Tariq, Muhammad Ayub, Muhammad Naseem, Abdul Majid, Jalil Khan, Maqsood Ali, Parsa Shaffait and Muhammad Ibrahim

Abstract
The present research was conducted to study and analyze the physiochemical parameters of water and soil of Nashpa dam of district Karak, KP, Pakistan. The physiochemical properties like color, taste, odor, TS, electrical conductivity, pH, temperature and, TDS of water and soil samples collected from different sites (start, mid, and end) of the dams were analyzed. For this purpose, three samples (n= 3) for each water and soil were collected from the different sites of the dam. These samples were further analyzed for physiochemical parameters. From results it was concluded that physicochemical parameter of both soil and water are within the giving range according to (WHO) and are also well suitable for growing fish and more productivity.

Keywords: Physiochemical, water, Nashpa dam, ecosystem, soil

Introduction
Karak is one of the richest southern district of the Khyber Pakhtunkhwa province of Pakistan Located at the south of the district Kohat and on the north side of Bannu and Lakki Marwat districts. Plenty no small dams had been constructed in the Karak district to accommodate the large amount of rain water which is used for domestic or household and agriculture purposes. Nashpa Dam is laying not more, about 10 km from the North of the Karak development Authority (KDA) of district Karak. This dam is completely enclosed by moderate High Mountain from Southern, East and Western sides and presenting a best scenic location. Nashpa dam was completed in 2003 by the cooperation of local government and villager's contribution. This dam was firstly explored and also reported their fish fauna by [1]. The total Catchment area of Nashpa dam is about 300 canals, solely dependent on rain water so called as a Barany dam relatively when the annual rainfall ratio is more which results to store more and more water in dam. If the water exceeds from their normal accommodation level due to intense rains, then it has an outlet flow way by which overflow of extra water is accomplished toward the nearest fields and give more and more advantage to the farmers by enhancing the crops growth and results in to more production. The aquatic life is the most complicated and comprehensive ecology which is so Troublesome to understand, rather the water is the most valuable essential source for the life in both land and the life inside the water such as fishes, other invertebrates, etc. We know that water is the key aspect of the life for all living organism while the contaminated water couldn't be used for that purpose so for this purpose the Physiochemical analysis of water is of much importance for the survival and proper growth and development. Therefore, the analysis shows the condition of water for aqua-farming such as fish production, agricultural purposes and for other uses [2]. Quality of water is necessary concern for humankind because it directly connected with human health [2]. At recent few years, the menace of water borne diseases and epidemics still looms large on the horizons of well developed and developing countries of the world [3]. From very past or over hundreds of years ago humans consume their water from rivers, lakes, ponds, dams and majority of reservoir etc. for various purposes for their life needs or requirements [3]. Physicochemical properties of water also have an important role in the maintenance of healthy aquatic ecosystem [4] these reservoirs are formed for special purposes like to store large amount of rainwater for the production of energy, to controlling floor and also to make efficient water supply possible for aims of irrigation [5].

Fishes are the cheapest, essayist and important source of proteins around the world and they require water as the most fundamental physical sustain for their life survival i.e. for breeding, feeding, swimming etc. [3]. A lot of studies have been conducted on the physiochemical parameter analysis of water with respect to their effect on fish survival some of them are, Marshall and Elliot [6] observed important relation between fish species and the effect of water, temperature, salinity (salt concentration), dissolved oxygen (DO) to their life survival. The properties of water quality are dependent on amount of dissolved oxygen (DO), biochemical oxygen demand (BOD), organic content, chemical oxygen demand (COD), pH value temperature, infectious agents, toxic substances and mineral matter [7]. In the growing aquaculture industry, it is believed to be taught that good water quality is preferred to retain viable aquaculture production [8]. Poor water quality can result in minor production rate and gives less profit. Production level is reduced when the water contains contaminants or pollutants that can effects production, rate of growth, development, or even results in death to the cultured species [9]. To handle this great problem, it is essential to make planning, management and water quality assessment [10] the improper management of water systems may revel on serious problems in quality and availability of water [11]. The physical possessions or allocation of mostly pond soil are contingent on the dye, quality, absorbency, arrangement consistence, penetrability (amount to be penetrate) and inorganic component in them [12]. The soil properties of a place have a vigorous role in survival and growth of marine organisms. The soil serves as a biological filter through absorbing fish excretions, organic residues of feed and algal metabolites and also controls the salinity not to increase, solidity or rigidness and pH of aquaculture systems [13]. The Quality of soil increases to the proportional amount of gravel, deposit and clay in soil. It is an important soil parameter subsequently which controls the suitability of a site for fish development in aquaculture [14] Ecological balance sustainability of an aquaculture system is also dependent on its soil properties. Therefore, it is necessary to determine physiochemical parameter analysis to analyze the quality of water and soil of an ecosystem, which give adequate and proper information about favorable and unfavorable Conditions happening inside an ecosystem and their effects on aquatic organisms living in such type of ecosystem [15]. The Physical and chemical properties of water had been introduced and used by Djukic *et al*. [16] to estimate the water quality of rivers, lakes. Thus, the present research was conducted in order to study the physiochemical parameter of water, soil of the giving Nashpa dam as to estimate their effect on fishes and to analyze or revels the importance of these parameters in fishery management policies used in these area. Such, great study will also be helpful in future to confer the safety of the aquatic ecosystem and environment for healthy production of fishes [17].

Fig#01 map of Nashpa dam.

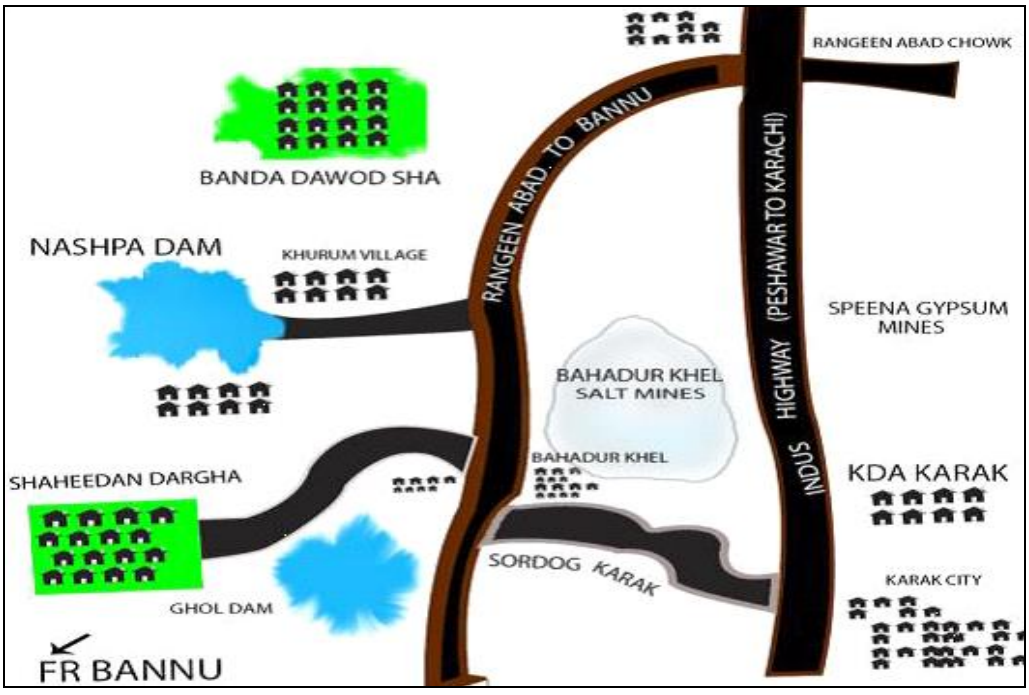

Fig 1

Materials and Methods

Sampling Procedure and Laboratory Analysis

The total of six samples of soil and water were collected from each of the three points (start, mid and final) of the dam. The collection of water samples was carried out in properly washed plastics containers, while soil collection was carried out from nearer the bottom of dam and then packed in an air tight polyethylene bags until analysis. The analysis was carried out by techniques and methodology as followed by Masood *et al*. [18].

Sample Analysis

Physical parameters comprising color, odor, taste, elasticity and temperature of both soil and water samples of the Nashpa Dam were determined at sampling site while chemical parameters including pH, conductivity and TDS of water and soil were measured in laboratory by the aid specific laboratory instruments and apparatus. Temperature of soil and water was measured by using thermometer. PH of soil and water was measured using pH meter (Model 3505) calibration each and every soil and water sample was subjected to pH

meter for pH measurement. For the measurement of conductivity of soil and water a specific modern digital conductivity meter was used (Model 103 Jencose). Conductivity meter was calibrated by using 0.1 M solution of KCl. After calibration each soil and water sample were investigated for conductivity one by one respectively.

Physiochemical Characteristics

The physiochemical parameters such as TDS (Total dissolved solids), EC (Electrical conductivity), color, odor, hydrogen ion concentration (ph), temperature, and elasticity of water and soil samples collected from (Nashpa dam) was analyzed (Fig. 1, 2). Physiochemical parameters of water which includes temperature, taste, color, odor, conductivity and pH were measured by the help of analytical procedures as followed by Afshan *et al*. [19], while the characteristic of soil were also measured including temperature, elasticity, color, and total dissolved solids (TDS) with the help of methods and procedure used by Naila *et al*. [20], in order to determine the effect of some physical and chemical properties of aquatic environment that play a significance role in distribution, diversity, species richness and growth of various aquatic fauna which may include fish fauna and other small aquatic invertebrates.

Electrical conductivity & Total dissolved solids

Electrical conductivity and TDS of both (water and soil) samples were measured by means of Jenway conductivity meter, 0.1 M solution of Potassium chloride was used for its calibration. The electrodes were well washed properly before and after dipping it into water and soil samples.

Temperature and Hydrogen ion concentration

Temperature as well as pH is amongst those factors which seriously affect the ecology of an ecosystem. Therefore, it is convenient to determine the temperature of the dam as it helps in understanding the behavior of life under water. For the temperature measurement a special APHA method was followed [21, 22]. For the PH measurement of the soil and water Electrical Jenway PH meter was used [23]

The determination of pH was conducted according to method followed by Torimiro *et al*. [24].

Fig 2: An overview of Nashpa dam

Results and Discussion

The physiochemical parameters such as temperature, pH, conductivity, total dissolve solids (TDS), color, odor, elasticity, taste of water and soil of the different region of Nashpa dam, was presented in the table 01 and 02 respectively.

PH

PH is one of the most essential water quality factors. It was observed that pH of the water normally remains higher in summer and in rainy seasons due incoming different water. It depends on photosynthetic activity. The lower values of pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment, deposition and difficulties in chlorination for disinfections of water [25]. Extreme pH negatively distresses fish reproduction and growth [16]. The optimum pH of water and soil which habitually favors the growth of fishes ranged from 6.5-9.5 and 6.5 to 8.4 congruently [26, 27]. The pH of soil is one of the most important physicochemical parameters. Its affect the mineral nutrient soil quality and much microorganism activity [28]. The PH of the Nashpa dam water taken from the three different points which are following start point, midpoint, and end point were (8.7, 8.4, and 8.6) and the PH of soil from start point, midpoint, and end point were 9.1, 9.3, and 8.5 respectively.

Temperature

The temperature of water controls the rate of all chemical processes, reproduction and immunity and effectively affects fish growth. Drastic and sudden temperature alterations can be fatal to fish [29]. The ideal temperature which required for proper growth of fishes lies between 26-32 °C [30]. Fish are exothermic (cold blooded), gain heat from their external environment, so when the temperature of external environment fluctuates than the alterations or change in fish body temperature may occurs accordingly [31]. All fish species has an ideal temperature (optimal) range in which they grow quickly and efficiently. It can be concluded that change in temperature seriously affect the overall biota present. If the temperature become high from the normal growth of microorganism, then cause color change in water and other destructive issues are accomplished [32]. The Temperature of the Nashpa dam water taken from the three different points which are following start point, midpoint, and end point are (32 °C, 31 °C, 33 °C) respectively and the soil taken from start point, midpoint, and end point are (26 °C, 25 °C, 27 °C) respectively.

Total Dissolve Solids

Total dissolved solids (TDS) relates mainly to the various kinds of minerals present in the water "Dissolved Solids" refers to any mineral salts, metals, cat ions or anions dissolved in water. A tremendous or extreme alteration in TDS could lead to killing of aquatic life [33, 34]. Normally, TDS ranged from 5 to 1000 mg/L is considering as more suitable range for fish growth [35]. The quantity of TDS was proportional to the degree of pollution [36, 37]. In more polluted place the DTS value as for water and soil will be high and the water become notable for the aquatic purpose. The permitted limits of TDS in water are shown in given mentioned Tables. All of the values ranges within permissible limits suggested by WHO (i.e. 500-1000mg/l) [38]. The TDS value of the Nashpa dam water and soil of the start point, midpoint, and end point are (0.01mg/100ml, 0.01mg/100ml, and 0.02mg/100ml) and (12mg/100ml, 12mg/100ml, 13mg/100ml) respectively. TDS analysis has large implications in the control of physical and biological waste water treatment processes [39].

Total solid (TS)
The TS value of the Nashpa dam water and soil of the different sites start point, midpoint, and end point are (0.02, 0.01, and 0.03) and (09.3, 10.1, 10.2) respectively.

Electrical Conductivity (EC)
Electrical conductivity is the capability of an aqueous solution to carry or pass electric current. As fishes are very sensitive to electrical conductivity, therefore, conductivity is directly related to the amount of osmotic pressure exerted or falling on their cellular membranes. Conductivity of freshwater mostly ranges between 50 to 1500 µs/ml [40]. It is a useful important tool to check and analyze the purity of water. According to WHO (World health organization) normal range of electrical conductivity (EC) for water lies between 400-600µS/cm [41]. The EC value of the Nashpa dam water and soil of the different sample taken start point, midpoint, and endpoint are (0.29us/ml, 0.28us/ml, 0.29us/ml) and (0.17us/ml, 0.18us/ml, 0.17us/ml).

Color and Odor
Although color of water changes from place to place, these colors shows that whether the water is suitable for the growth and survival of organisms beneath it or not, for example greenish and light greenish colored water is suitable for survival because it is more productive, while dark green and brown colored water is deadly for growth and survival due to more decomposition and very low productivity [42]. Likewise, the presence of plankton was also confirmed with the help of water color [43]. The Color pattern of soil might be the due to both chemical and biological processes. Yellow or red soil indicates the presences of iron oxides, while dark brown or black color reveals that the soil contain high organic matter content. The occurrence of some specific minerals can also effect on the soil color. Furthermore, manganese oxide (Mno) results in a black color, glauconitic makes the soil green, while calcite accomplished the soil appearance as white [44]. The odor of the water is due to various reasons such as, sewage, decomposing vegetation and microbial activity. Odor affects the aesthetics of recreational water and also the taste of fish [42]. The Nashpa dam water was Odorless, light blue and soil was also Odorless and light blue.

Elasticity
The water and soil of the Nashpa dam on analysis shows that they are non-elastic.

Table 1: shows the Physiochemical parameter of water of Naspa dam

S. No	Parameter	Start point	Midpoint	End point
01	Temperature	32 °C	31	33
02	PH	8.7	8.4	8.6
03	TDS	0.01mg/100ml	0.01 mg/100 ml	0.02mg/100 ml
04	TS	0.02 mg/100ml	0.01mg/100 ml	0.03mg/100 ml
05	Conductivity	0.29µs/ml	0.28µs/ml	0.29µs/ml
06	Taste	Slightly saline	Slightly saline	Slightly saline
07	Odor	Odorless	Odorless	Odorless
08	Elasticity	Non-elastic	Non-elastic	Non-elastic
09	Color	Dark blue	Light blue	Dark blue

Table 2: Represents the parameter of soil of Nashpa dam

S. No	Parameter	Start point	Midpoint	End point
01	Temperature	26 °C	25	27
02	PH	9.1	9.3	8.5
03	TDS	12mg/100ml	12 mg/100 ml	13mg/100 ml
04	TS	9.3 mg/100ml	10.1mg/100 ml	10.2mg/100 ml
05	Conductivity	0.17µs/ml	0.18µs/ml	0.17µs/ml
06	Taste	Slightly saline	Slightly saline	Slightly saline
07	Odor	Odorless	Odorless	odorless
08	Elasticity	Non-elastic	Non-elastic	Non-elastic
09	Color	Dark blue	Light blue	Dark blue

The different values of physiochemical parameter of water and soil can be represented apparent in graph as given bellow.

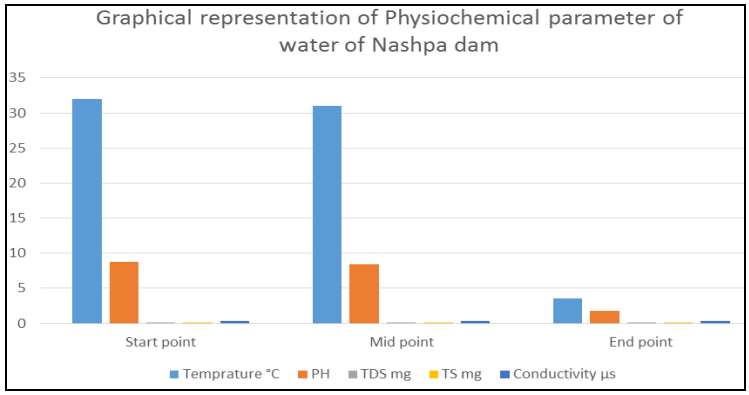

Fig 3

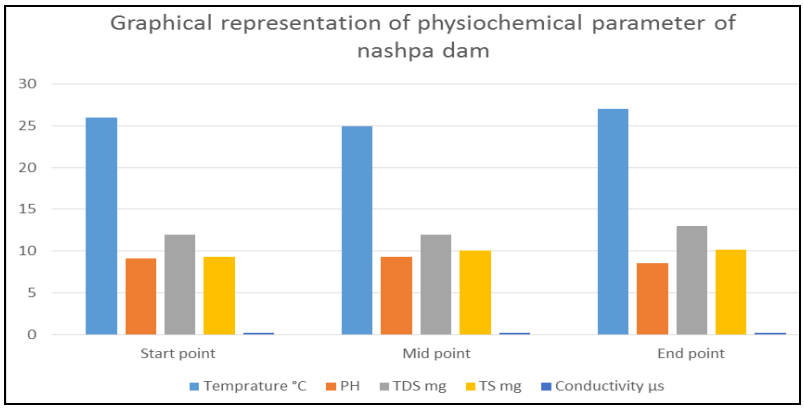

Fig 4

Conclusion

All the studied physiochemical parameters were laying in normal range and have no such adverse effect on survival, reproduction, and growth of aquatic flora (plants) and fauna (animals). Physical and chemical analysis of water shows a good range of properties for all these samples, suitable for fish growth, soil was also found to be of good quality. Hence, the current research work would provide useful information to fish culturists and fisheries managers for promoting the fish culturing in the local area to raise the economic and social benefits for the local population of Karak district. There should be proper management and Government should take action in the management of these fresh water sources, if proper management strategies fail to develop than aquaculture cannot successfully developed.

References

1. Faisal J, Hameed UR. Fish fauna of Nashpa dam (Bahadur Khel) district Karak Khyber Pakhtunkhwa, Pakistan, Journal of Entomology and Zoology Studies. 2017; 5(5):525-528.
2. Rehman HU, Bibi M, Masood Z, Jamil N, Masood H, Mengal F *et al*. Physicochemical Analysis of Water and Soil of Barganat dam in North Waziristan Agency of FATA, Pakistan, With Special Reference to Their Influence on Fish Growth. Global Veterinaria. 2015; 14(5):738.
3. Furhan I, Ali M, Salam A, Khan BA, Ahmad MS, Qamar *et al*. Seasonal Variations of Physicochemical Characteristics of River Soan Water at Dhoak Pathan Bridge (Chakwal), Pakistan. International Journal of Agriculture and Biology. 2004, 6(1).
4. Venkatesharaju K, Ravikumar P, Somashekarand RK, Prakash KL. Physicochemical and bacteriological investigation on the river Cauvery of Kollegal stretch in Karnataka. Kathmandu University Journal of Science, Engineering and Technology. 2010; 6(1):50-59.
5. Bronmark C, Hansson LA. The biology of lakes and ponds, Oxford University Press, Oxford, 2005, 285.
6. Wetzel RG. Fresh water ecology: changes, requirements and future demands. Limnology, requirements and future demands. Limnology, 1995.
7. Marshall S, Elliott M. Environmental influences on the fish assemblage of the Humberestuary UK. Estuarine, Coastal and Shelf Science. 1998; 46:175-184.
8. Oluyemi EA, Adekunle AS, Adenugaand AA, Makinde WO. Physico-chemical properties and heavy metal content of water sources in IfeNorth Local Government Area of Osun State, Nigeria, African Journal of Environmental Science and Technology. 2010; 4(10):691-697.
9. King RP. Physicochemical indices of the fisheries potential of Nigerian rainforest pond. Journal of Aqua. Sciences. 1998; 13:49-54.
10. Stone NM, Thormforde HK. Understanding your fish pond water analysis report. University of Arkansas Co-operative Extension Printing services. 2003, 1-4.
11. Seker DZ, Goksel C, Kabdasli S, Musaoglu N, Kaya S. Investigation of coastal morphological changes due to river basin characteristics by means of remote sensing and GIS techniques. Water Science Technology, 2003, 142.
12. Radha Krishnan R, Dharmaraj K, Ranjitha Kumari BD. A comparative study on the physicochemical and bacterial analysis of drinking borewell and sewage water in the
13. Three different places of Sivakasi, Journal of Environmental Biology. 2007; 28(1):105-108.
14. Federal Department of Fisheries (FDF), Federal Statistics of Nigeria. Published by Federal Department of Fisheries Nigeria. Fourth Edition. 2008, 48.
15. Hubert WAJ, Lavoic Debray LD. Densities and substrate association sofmacro invertebrates in riffles of a small high plains stream. Journal of Freshwater Ecology. 1996; 11:21-26.
16. Gupta SK, Gupta PC. General and Applied Technology (Fish and Fisheries) S. Chand and Company, New Delhi, 2006, 1130.
17. Shinde SE, Pathan TS, Raut KS, Sonawane DL. Studies on the physicochemical parameters and correlation coefficient of Harsool-Savangi Dam, District Aurangabad. Journal of Scientific Research. 2011, 8(3).
18. Djukic N, Maletin S, Pujin V, Ivanc A, Milajonovic B. Ecological assessment ofwater quality of Tisze by physicochemical and biological parameters. Tisca Szeged, 1994, 28(1).
19. Keremah RI, Davies OA, Abezi ID. Physicochemical Analysis of Fish Pond Water in Freshwater Areas of Bayelsa State, Nigeria, Greener Journal of Biological Sciences, 2014, 4(2).
20. Masood Z, Rehman HU, Rafique N, Jamil N. Physicochemical Analysis of Water and Soilof Fresh Water Damai Stream of Tehsil Domel of Bannu District with Special Reference To Their Impact on Survival of Fishes. Global Veterinaria, 2015, 14(5).
21. Afshan M, Benazeer MM, Zubia M, Rehman HU, Asim-Ullah, Gul N. Assessment Study about the Water Quality

Criteria and Heavy Metals Concentrations in Different Fish Ponds of Four Districts of Balochistan Province, Pakistan. Global Veterinaria. 2015; 14(3):361-367.
22. Naila G, Mussaa B, Masood Z, Rehman HU, Asim-Ullah Majeed A. Study of Some Physiochemical Properties of Soil in Fish Pondat Circuit House, District Sibi of Province Balochistan, Pakistan. Global Veterinaria. 2015; 14(3):362-365.
23. Public Health Association (APHA), Standard methods for the examination of water and wastewater, 1999.
24. American Public Health Association (APHA), Standard methods for the examination of water and wastewater, 18 ed. American Public Health Association, Washington D.C, 1992.
25. Priyanka T, Amita Bajpai, Sukarma Thareja. Nature and Science. 2009; 1(6):91.
26. Torimiro N, Bebe PT, Ogundipe FE, Esan DM, Aduwo AI. The Bacteriology and Physicochemical Analysis of Fresh water Fish Ponds. International Research Journal of Microbiology, 2014, 5(3).
27. Priyanka T, Bajpai A, Thareja S. Evaluation of Water Quality: Physicochemical Characteristics of Ganga River at Kanpur by using Correlation Study, Nature and Science, 2009, 1(6).
28. Singh SP, Deepa P, Rashmi S. Hydrobiological studies of two ponds of Satna (M.P.), India. International Journal of Environmental Research. 2002; 8(3):289.
29. Borkar AD. Studies on Some Physicochemical Parameters of Soil Samples in Katol Taluka District
30. Nagpur (MS), India, Research Journal of Agriculture and Forestry Sciences. 2015; 3(1):16-18.
31. Patil PN, Sawant DV, Deshmukh RN. Physico-chemical parameters for testing of water: A review, International Journal of Environmental Sciences. 2012; 3(3):6-13.
32. Khan A, Yousafzai AM, Latif M, Rehman AU, Khan Q, Zaib A *et al*. Analysis of selected water quality parameters and heavy metals of Indus River at Beka Swabi, Khyber Pakhtunkhwa, Pakistan. International Journal of Biosciences. 2014; 4(2):28-38.
33. WHO (World Health Organization), Guidelines for drinking water quality. Geneva, Netherlands. 2006; 1:491.
34. Nelly A, Isyagi LK, Veverica R, Asiimwe Daniels DWH. Manual for the Commercial Pond Production of the African Catfish in Uganda, USAID, USA and Cooperative Agreement, 2014.
617-A-00- 0500003-00,222.
35. Shivakumar R, Mohanraj R, Azee PA. Physico-Chemical analysis of water sources of Ooty, South India, Poll. Res. 2000; 19(1):143-146.
36. Gaikwad LB. Hydrobiological study of Nandrabad dam. Ph.D. thesis. Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, 2003.
37. Brady NC, Weil RR. The Nature and Properties of Soils, (13 Ed.) Singapore: Pearson Education. Prentice-Hall, Englewood Cliffs, NJ, 2002.
38. Rain FH, Thatcher LL. Methods for Collection and Analysis of Water Samples', U.S. Govt. Office Washington, USA, 1990.
39. Nasrullah, Rafia Naz, Hamida Bibi, Mudassar Iqbal, Ilyas Durrani M. Journal of Agricultural and Biological Science. 2006; 1(3):18.
40. WHO. Guidelines for drinking water quality, recommendations, Geneva WHO. 1984; 1:130.
41. Medudhula Thirupathaiah, Samatha CH, Chintha Sammaiah. Analysis of water quality using physicochemical parameters in lower manair reservoir of Karimnagar district, Andhra Pradesh, International Journal of Environmental sciences. 2012; 3(1):369-378.
42. Boyd CE. Water quality in warm water fish ponds.n Alabama Agriculture Experiment Station, Auburn University, Auburn, AL, 1979, 482.
43. Zaigham Hasan, Zubair Anwar, Khalid Usman Khattak, Mazhar Islam, Rizwan Ullah Khan, Jabar Zaman Khan. Khattak Civic Pollution and Its Effect on Water Quality of River Toi at District Kohat, NWFP, Research Journal of Environmental and Earth Sciences, 2012, 334-339.
44. Bhatnagar SNA, Jana SK, Garg BC, Patra G, Singh UK Barman. Water quality management in aquaculture. In: Course Manual of summer school on development of sustainable aquaculture technology in fresh and saline waters, CCS Haryana Agricultural, Hisar (India), 2003, 2004.
45. Delince G. The ecology of the fish pond ecosystem. With special reference to Africa, In: Series: Developments in Hydrobiology, 72, Springer Science plus Business Media, Dordrecht, 1992, 230.
46. Brady NC, Ray RW. Elements of the Nature and Properties of Soils, New Jersey: Prentice Hall, 2006, 95.
47. Lin SD. Tastes and Odors in Water Supplies-A Review. linois state water survey, Urbana, 1977, 50.