

Studies on Seasonal Variations of Physico-Chemical Parameters of Fish Farm at Govt. Nursery Unit, Muzaffargarh, Punjab, Pakistan

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Abstract—The present study was designed to demonstrate the seasonal variations in physico-chemical parameters of fish farm at Govt. Nursery Unit, Muzaffargarh, Department of Fisheries Govt. of Punjab, Pakistan for a period of eight months from January to August 2008. Water samples were collected on fifteen days basis and have been analyzed for estimation of Air temperature, Water temperature, Light penetration, pH, Total dissolved oxygen, Clouds, Carbonates, Bicarbonates, Total carbonates, Total dissolved solids, Chlorides, Calcium and Hardness. Seasonal fluctuations were observed in all the physico-chemical parameters of fish farm. The overall physico-chemical parameters of fish pond water remained within the tolerable range throughout the study period.

Keywords—Freshwater, Fish farm, Water quality, Seasonal variation, Chemical factor

I. INTRODUCTION

THE physical and chemical properties of water immensely influenced its uses, the distribution and richness of the biota [1]. The important physical and chemical parameters

influencing the aquatic environment are temperature, rainfall, pH, salinity, dissolved oxygen and carbon dioxide and these parameters are the limiting factors for the survival of aquatic organisms [2].

Freshwater systems are variable in space and time. Many changes occur faster in freshwater systems than in terrestrial ones [3], [4]. The water in which a fish lives is the principal environmental component that influences its health. Some of the most critical water quality conditions that are readily influenced by biological activity, and thus of primary concern in intensive aquaculture, include dissolved oxygen, unionized ammonia, nitrite, carbon dioxide and pH. Maximum and minimum tolerable and lethal concentrations for many of these metabolites and constituents have been established for numerous fish species [5]. Other water quality characteristics which are not influenced by biological activity such as alkalinity, hardness, salinity and temperature, and turbidity also may affect the health of fish, especially if they are not within normal tolerable limits. Different fish species may vary considerably in terms of specific tolerance limits for various water quality characteristics [6]. The term aquaculture is defined as "the art of increasing and rearing aquatic organisms and plants". It covers the activities whose main object is the production of freshwater, brackish and marine species by man under controlled or semi controlled conditions. The production of living number from the aquatic medium is fundamental to all aquaculture activities; aquaculture is based on the manipulation of the natural or artificial aquatic environment for the production of species which are useful to man. It therefore involves all aspects of production of living matter in water [7]. Interest in water analysis is due to the enormous importance of water to all categories of living things. It is necessary for the healthy development of man, animals and plants [8].

The aim of the present study was to determine seasonal variations of physico-chemical parameters of fish farm at Govt. Nursery Unit, Muzaffargarh, Punjab, Pakistan.

II. MATERIALS AND METHODS

Present study conducted at Govt. Nursery Unit Muzaffargarh, Department of Fisheries Govt. of Punjab,

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Pakistan nearly 2 Km away from Muzaffargarh city on Thermal Power Station Road. The sampling started from 30th January, 2008 and continued up to 4th August, 2008. The study period consisted of 8 months. The samples were taken from the surface and subsurface in plastic bottles of 1.5 litre capacity on fifteen days basis. The bottles were labeled with date, time and name of sample with the help of permanent marker. The depth of the pond was 6 feet and depth of water remained in the range of 4 to 5 feet during the entire study period. The source of water for pond is diesel tube well. Artificial feed and fertilizers were added to fish pond and life dependent on artificial feed. The pond was stocked by four types of fishes i.e. Rohu, Mori Thaila and Silver carp. At the time of sampling the air and water temperatures were recorded by using alcoholic thermometer, light penetration was recorded with the help of Secchi's disk. Dissolved oxygen was determined by using an oxygen meter (Jenway Model 9071). pH was determined by using digital pH meter (Model WTW-pH 90). While all other parameters were determined by the methods as described by Boyd [9].

III. RESULTS

The mean values (\pm SD) ranges of different physico-chemical parameters for Govt. Nursery Unit, Muzaffargarh, Department of Fisheries Govt. of Punjab are given in Table I and variation in the data during the entire study period is described in Table II and III.

The lowest air temperature 23°C was recorded in January while highest 39°C was in July. The lowest water temperature 19°C was recorded in January while highest 34°C in July. The air and water temperature showed variation with season. Air temperature gradually increased since January and reached its peak value in June. There was gradual decline in subsequent months (Fig. 1 and 2, Tab II). The overall range of light penetration was observed between 5.33" to 26.03" during March and January respectively. Light penetration showed 7 alternative variations with the seasonal variation during the entire study period (Fig.3, Table II). Clouds were 50% in the month of March, less than 30% in January while the clouds were totally absent in other months during the sampling dates (Table II). The maximum dissolved oxygen (9.2 mg/l) was observed in January and the minimum value (4.6mg/l) in June. It showed 4 alternative variations with the seasonal variation during the entire study period (Fig. 4, Table II). pH value ranged 6.8-8.0. The maximum value (8.0) was observed in January and June while the minimum value (6.8) in March and July. pH showed 6 alternative variations with the seasonal variation during the entire study period (Fig. 5, Table II). The maximum value of total dissolved solids 1983 mg/l was observed in August and minimum value 1596 mg/l in January. The total dissolved solids showed gradual variation during the entire study period (Fig. 6, Table III). The minimum carbonates 23.68 were recorded in February while the maximum 32.56 mg/l in June. Carbonates showed 9 alternative variations with the seasonal variation

TABLE I
THE MEAN VALUES (\pm SD) AND RANGES OF DIFFERENT PHYSICO-CHEMICAL PARAMETERS OF FISH POND AT GOVT. NURSERY UNIT, MUZAFFARGARH, PAKISTAN.

Parameter	Mean \pm S.D	Range
Air Temperature	31.62 \pm 5.71	23-39
Water Temperature	25.85 \pm 4.37	19-34
Light Penetration	9.26 \pm 5.77	5.33-26.03
Dissolved Oxygen	6.3 \pm 1.34	5.50-9.86
pH	7.52 \pm 0.42	6.8-8.0
Carbonates	28.35 \pm 2.89	23.68-32.56
Bicarbonates	94.43 \pm 27.74	58.46-141.34
Total Alkalinity	122.95 \pm 27.11	91.02-167.98
Total Dissolved Solids	1877.18 \pm 131.55	1596-1983
Chlorides	19.52 \pm 4.17	11.52-27.2
Calcium	454.23 \pm 71.74	306-570
Hardness	1796.92 \pm 182.8	1485-2018

SD = Standard Deviation

during the entire study period (Fig. 7, Table III). The maximum bicarbonates 141.34 mg/l was observed in June and minimum value 58.46 mg/l in July. Bicarbonates increases from January and it reached its peak value in June and then showed decline (Fig. 8, Table III). The over all range of total carbonates fluctuated between 91.02 to 167.98 mg/l in July and June respectively. Total carbonates increases from January and it reached its peak value in June and then showed decline (Fig. 9, Table III). The maximum chloride (27.2 mg/l) was observed in July and minimum value 11.52mg/l in the months of June. Chlorides showed fluctuations in all the months of observations (Fig. 10, Table III). The maximum calcium (570mg/l) was observed in May and minimum value 306mg/l in March. Calcium reached at peak in May and then show gradual decline (Fig. 11, Table III). The maximum hardness 2018 mg/l was observed in February and minimum value 1485 mg/l in March. It showed 6 alternative variations with the seasonal variation during the entire study period (Fig. 12, Table III).

IV. DISCUSSION

This study comprises of one pond having a depth 6 feet. Temperature fluctuations, both diurnal and seasonal are more evident in the freshwater habitat. Temperature is one of the most important among the external factors which influence fish production [10]. Air and water temperature showed increasing trend reaching maximum in July and then both had a decreasing trend. Similar results were reported by Tassaduque et al. [11]. Light penetration determines the extent of euphotic zone and is determined by the turbidity of water [12]. Light penetration showed decreasing trend from February till June then increasing trend in subsequent months. Similar results were reported by Salam and Perveen [13]. The pH of water is important because many biological activities can occur only within a narrow range. Thus any variation beyond acceptable range could be fatal to a particular organism [12]. The favorable range of pH is 6.5-9.0 at daybreak, are most suitable for fish production [14]. pH

TABLE II
SEASONAL VARIATIONS IN PHYSICO-CHEMICAL PARAMETERS OF FISH POND AT GOVT. NURSERY UNIT, MUZAFFARGARH, PAKISTAN

Month	Date	Air Temperature (°C)	Water Temperature (°C)	Light Penetration (Inch)	Dissolved Oxygen (mg/l)	pH	Clouds %
January	30-01-08	23	19	26.03	9.2	8.0	5
February	18-02-08	25	20	16.10	8.2	7.5	0
March	04-03-08	28	22	5.33	7.4	6.8	2-3
March	16-03-08	26	24	6.23	7.2	7.0	50
March	31-03-08	24	21	8.36	6.4	7.7	30
April	18-04-08	36	27	10.03	5.5	7.8	0
April	30-04-08	38	28	9.00	6.2	7.8	0
May	14-05-08	37	26	5.90	5.8	7.7	0
June	01-06-08	33	29	7.33	4.6	7.8	0
June	17-06-08	32	28	6.86	5.1	8	0
July	02-07-08	34	29	6.16	5.2	7.5	0
July	18-07-08	39	34	6.70	5.4	6.8	0
August	04-08-08	36	29	6.33	5.9	7.4	0
Minimum		23	19	5.33	4.6	6.8	2
Maximum		39	34	26.03	9.2	8.0	50
Average		31.6	25.8	9.26	6.3	7.5	6.76

TABLE III
SEASONAL VARIATIONS IN CHEMICAL PARAMETERS OF FISH POND AT GOVT. NURSERY UNIT, MUZAFFARGARH, PAKISTAN.

Month	Date	Total Dissolved Solids	Carbonate	Bicarbonate	Total Carbonate	Chloride	Calcium	Hardness
January	30-01-08	1596	28.12	95.46	123.58	18.24	425	2010
February	18-02-08	1630	23.68	74.00	97.68	21.76	460	2018
March	04-03-08	1775	26.64	75.48	102.12	17.92	306	1686
March	16-03-08	1841	31.08	96.2	127.28	17.28	386	1485
March	31-03-08	1930	23.68	92.5	116.18	18.24	473	1968
April	18-04-08	1966	31.08	113.96	145.04	18.56	521	1986
April	30-04-08	1971	28.12	126.54	154.66	19.52	545	1741
May	14-05-08	1965	26.64	133.2	159.84	16.32	570	1656
June	01-06-08	1961	26.64	141.34	167.98	17.92	496	1551
June	17-06-08	1948	31.08	95.46	126.54	11.52	481	1703
July	02-07-08	1883	28.12	64.38	92.5	27.20	406	1975
July	18-07-08	1950	32.56	58.46	91.02	25.92	418	1851
August	04-08-08	1983	31.08	60.68	93.98	23.36	413	1725
Minimum		1596	23.68	58.46	91.02	11.52	306	1485
Maximum		1983	32.56	141.34	167.98	27.2	570	2018
Average		1876.846	28.34769	94.43538	122.9538	19.52	453.8462	1796.538

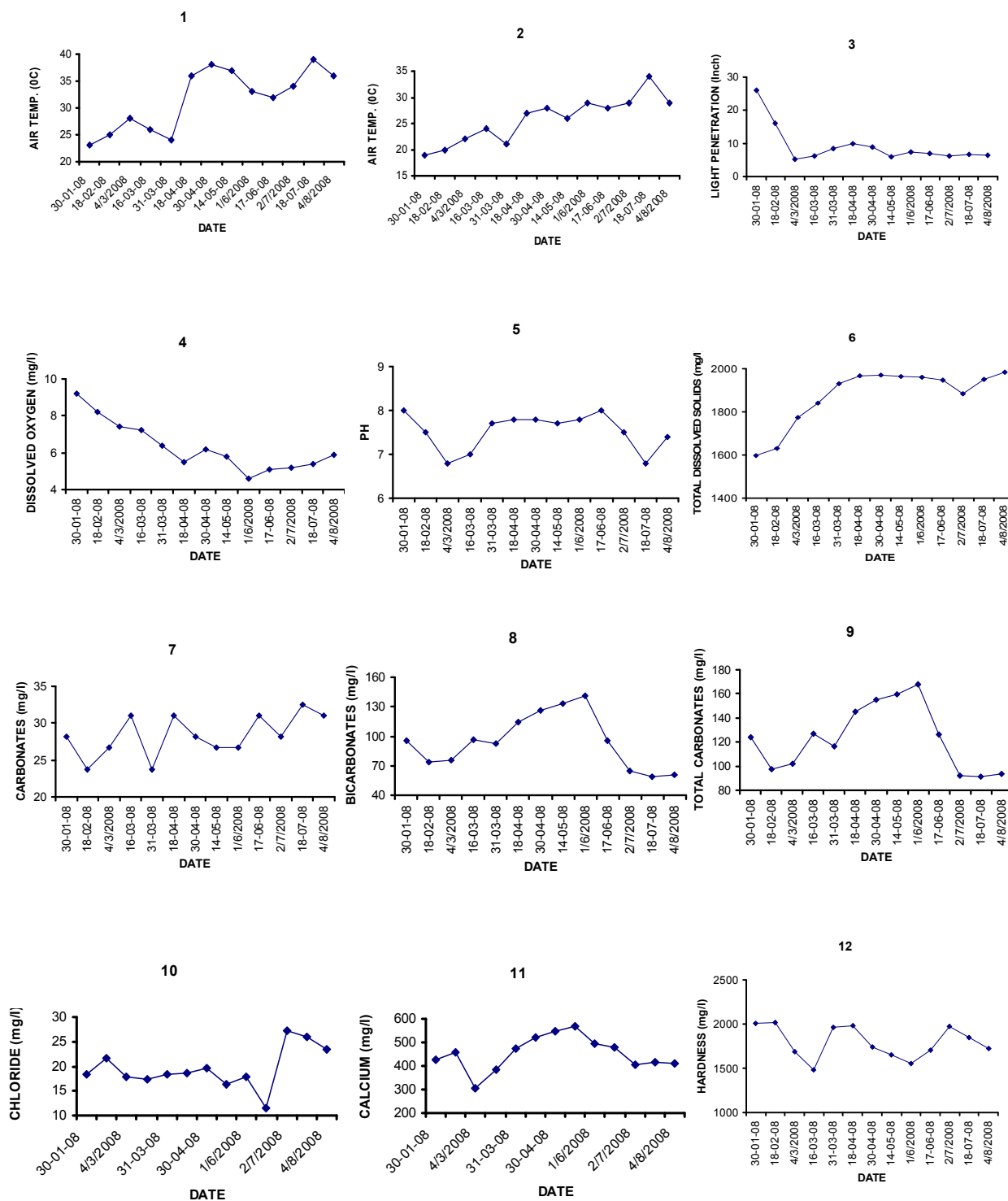


Fig. (1-12). Seasonal variations in Physico-chemical parameters of fish pond at Govt. Nursery Unit, Muzaffargarh, Pakistan

range in the present study was 6.8-8.0, which indicates that water is suitable for fish production. Dissolved oxygen is the most important chemical parameter in aquaculture. Low dissolved oxygen levels are responsible for more fish kills,

either directly or indirectly, and then all other problems combined. Like human, fish require oxygen for respiration [15]. DO showed negative relationship with water temperature throughout the study period. Similar results were found by

- [16] S. N. Islam, "Physicochemical Condition and Occurrence of Some Zooplankton in a Pond of Rajshahi University", Bangladesh J. Fish. Hydrobiol., vol. 2, 2007, pp. 21-25.
- [17] R. Rajakumar, M. Panagal, R.A. Kumar, T.M.M.J. Bastin, "Studies on the physicochemical parameters and the microbial Investigation of the freshwater exotic carp *Ctenopharyngodon Idella* (Cuvier & Valenciennes 1844) in Tamil Nadu, India", Int. J. Univ. Pharm. Life Sci., vol. 1, 2011, pp. 1-16.
- [18] H. Campos, W. Steffen, G. Agnuero, O. Parra, and L. Zuniga, "Limnological studies of Lake Rupanco (Chile); morphometry physics, chemistry, plankton & primary productivity", Arch. Hydrobiol./Suppl. 90, vol. 1, 1992, pp. 85-113.
- [19] R. K. Rath, "Fresh water aquaculture", Scientific Publishers, Jodhpur, 1993.

- [1] A.E. Unanam and A.W. Akpan, "Analysis of physicochemical characteristics of some freshwater bodies in Essien Udum Local Government area of Akwa Ibom State, Nigeria", In: Proceeding of the 21st Annual Conference of the Fisheries Society of Nigeria (FISON) Calabar, 13th -17th November, 2006.
- [2] E.O. Lawson, "Physico-Chemical Parameters and Heavy Metal Contents of Water from the Mangrove Swamps of Lagos Lagoon, Lagos, Nigeria," Adv. Biol. Res., vol. 5, 2011, pp. 08-21.
- [3] O. E. Sala, F. S. Chapin III, J. J. Armesto, E., Berlow, J. Bloomfield, R. Dirzo, E. Huber-Sanwald, L. F. Hueneke, R. B. Jackson, A. Kinzig, R. Leemans, D. M. Lodge, H. A. Mooney, M. Oesterheld, N. LeRoy Poff, M. T. Sykes, B. H. Walker, M. Walker and D. H. Wall, 2000, "Global biodiversity scenarios for the year 2100", Science, vol. 287, pp. 1170-1174.
- [4] D. Dudgeon, A. H. Arthington, M. O. Gessner, Z. Kawabata, D. Knowler, C. Lévêque, R. J. Naiman, A-H. Prieur-Richard, D. Soto, M. L. J. Stiassny and C. A. Sullivan, "Freshwater biodiversity: importance, threats, status and conservation challenges", Biological Reviews vol. 81, 2006, pp. 163 – 338.
- [5] R. R. Stickney, "Principals of aquaculture", John Willey and Sons, NewYork, 1994.
- [6] E. I. Adeyeye and F. O. Abulude, "Analytical assessments of some surface and ground water resources in Ile-Ife, Nigeria", J. Chem. Soc. Nig., vol. 29, 2004, pp. 98 -103.
- [7] D. H. Evans, "The physiology of fishes", CRC. Press, Boca Raton, FL, 1993.
- [8] G., Barnabe, "Aquaculture Biology and Ecology of Cultured Species," Ellis Harwood, New York, 1994.
- [9] C.E. Boyd, "Water quality in warm water fishponds", Craft master Printers Inc Opelika, Alabama, 1981.
- [10] M., Huet, "Textbook of fish culture", 2nd Ed. Fishing News Book Ltd., England, 1986.
- [11] K. Tassaduqe, M. Ali, A. Salam, M. Latif ans T. Zahra, "Study of the seasonal variations in the physico chemical and biological aspects of Indus River Pakistan", Pak. J. Biol. Sci., vol. 6, 2003, pp. 1795-1801.
- [12] D. Slingsby and C. Cook, "Practical Ecology", Macmillan Edition Ltd. London, 1986.
- [13] A. Salam and S. Perveen, "Seasonal changes in the physico-chemical parameters of Dhand Gazanfargarh, Muzaffargarh, Pakistan", Acta Sci., vol. 6, 1996, pp. 45-56.
- [14] R. Lloyd, "Pollution and Freshwater Fish", Fishing News Books, 1992.
- [15] T. L. Meade, "The technology of Closed Culture of Salmonids", University of Rhode Island Marine Technical Report No.30, 1974.