EFFECT OF WATER QUALITY PARAMETER ON FISH CULTURE IN LAKE WITH REFERENCE TO STATISTICAL APPROACH

BY

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Abstract. Water samples were collected from different locations around Lakha Banzara Lake. These water samples from 9 sampling points during three seasons were analyzed for their physicochemical characteristics, viz. pH, Colour, Odour, Hardness, Chloride, Alkalinity, TDS, COD, Metal ion content etc. to investigate the effect of physico-chemical parameters on fish production. A Systematic study of correlation between water quality parameters has been done with the objective of minimizing the complexity and dimensionality of large set of data. An attempt has been made to find the seasonal quality of water in Lakha Banzara Lake, in order to establish relationship between physico-chemical characteristics and fish production of the lake and generate a statistical model for examine water quality.

Key words: water quality; fish culture; statistical model.

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1. Introduction

Water is the elixir for life. Whole of the aquatic life in any water body is governed by the interaction of a number of physical and chemical conditions (Awadullah, 1990). The quality of water may be described according to their physico-chemical characteristics. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality. Parameters is essential for survival, growth, reproduction and distribution of fishes (Dagaonkar & Saxena, 1992). Any adverse environmental condition threatens the life of fishes. A number of investigations attempted before to check the physico-chemical characteristics of water resources have been reported by several workers (Pathak, 2011; Pathak & Limaye, 2011a; Pathak & Limaye, 2011b; Pathak & Limaye, 2011c; Pathak & Limaye, 2011d; Pathak, 2012a; Pathak, 2012b; Pathak, 2012c; Kabil Hussain et al., 2008; Boyd, 1979).

Lake habitats can easily be manipulated by controlling the water characteristics for an optimum environment yielding high level fish production (Jhingran et al., 1988). This study therefore focuses on:

1. Assessment of water quality parameters.
2. Suitability of lake water for fish production.

Statistical techniques help in the interpretation of complex data matrices to better understand the water quality and ecological status of the studied systems and allows for Identification of the possible factors that are responsible for the variations in water quality and offer valuable tool for developing appropriate strategies for effective management of the water resources in respect of fish production (Shukla, 1995).

2. Experimental

The objective of the study was to analyse the 14 parameters of water along 9 locations of Sagar city for 3 seasons (pre-monsoon, monsoon and post-monsoon during June 2009 - June 2012). The obtained water quality data was subjected to multivariate statistical techniques to evaluate homogeneity and heterogeneity between sampling stations and to differentiate water quality variables in respect to fish production.

The determinations of the major ions, physical and other chemical properties of the water samples were determined on the same sampling day. Each sample was analysed using procedures outlined in the standard methods for the examination of water and wastewater as suggested in APHA USA (APHA, 2005).

Table 1

List of Chemical Parameters and their Test Methods

SN.	Parameters	Unit	Test Methods
1	pH	−	pH meter
2	Dissolved Oxygen (DO)	mg/L	Winkler method
3	Biochemical Oxygen Demand (BOD)	mg/L	5 days incubation at 20°C and titration of initial and final DO.
4	Chemical Oxygen Demand	mg/L	Open Reflux Method
5	Chloride	ms/cm	Titration
6	Alkalinity	mg/L	Titration
7	Total dissolved Solids	mg/L	Digital conductivity meter (LT-51)
8	Chloride	mg/L	Argentometric titration
9	Orthophosphate ($PO_4^{3-} - P$)	mg/L	Ammonium molybdate ascorbic acid reduction method
10	Nitrate -Nitrogen ($NO_3 - N$)	mg/L	Spectrophotometric method
11	Ammonia-Nitrogen ($NH_3 - N$)	mg/L	Spectrophotometric (Phenate method)
12	Total Hardness as $CaCO_3$	mg/L	EDTA titration
13	Calcium content	mg/L	Titration Method
14	Iron	mg/L	Colorimetric Method

Results obtained were subjected to multivariate statistical analysis using SPSS.11, Winks SDA 6.0.5, multivariate statistical analysis has been performed using standard methods. Test results compare to IS: 10500 Standards.

3. Results and Discussions

The various water quality parameters recorded for Sagar Lake were suitable for fish culture and were within the standard range. Average surface water temperature recorded was 15.5 – 31.7°C agreed with the ranges suggested and documented earlier by some authors for freshwaters. The average pH values recorded was between 7.34 and 9.4. This is slightly basic in nature, range was nearer the pH range of 6.5 – 9.0 is suitable for maximum fish production. Tolerable pH range for most fish is 05-09. Dissolved Oxygen (DO) recorded with higher ranges of 4.8 – 7.4 mg/L fell within the ranges mentioned by APHA for good water quality on fish culture. This is because oxidation coverts poisonous compounds to useful material. It also encourages good feeding, food utilization and high stocking density of fish eggs, larvae and adults.

BOD values ranged between 2.3 and 7.4 mg/L, COD values ranged between 4.6 and 11.4 mg/L and found higher values provide by BIS hence, polluted body. The total alkalinity ranges was 110 – 319 mg/L which is suitable for fish production. TDS value of the Lake water varied between 220 and 452 mg/L. A maximum value of 400 mg/L of TDS is permissible for a diverse fish

population. TDS concentration below 200 mg/L promoted even healthier spawning conditions. Hence, it can be concluded that water of Sagar Lake provides favourable condition for fish production.

The Calcium contents vary between 14.0 and 39.1 mg/L to be rich as the average calcium contents of the water are more than 25 mg/L.

Total hardness of Lake ranged from 123 to 242 mg/L. Water is slightly harder which is favourable for good flora and fauna of the lake including fish.

Chloride contents of the reservoir ranged between 14 and 32 mg/L. Fresh water normally contains 8.3 mg of Chloride per liter. The higher concentration indicates that the water is slightly polluted and is not favourable for fish in general. Lack of Phosphate is often the chief cause of poor productivity of water Phosphate values ranged between 0.19 and 2.40 mg/L. Recommended value of phosphate for rivers and streams is 0.1 mg/L.

The nitrate values of the reservoir water ranged between 0.19 mg/L and 1.01 mg/L, nitrate contents are beyond the standard permissible limits of WHO and IS (10500). Nitrate-nitrogen levels below 90 mg/L seem to have no effect on warm-water fish, indicate its polluted quality status for fish production. The relationship between fish yield and water parameters showed that no parameter can be singled out in relation to fish growth and health. However, five of these parameters (*i.e.* temperature, DO, pH alkalinity and TDS) must be kept at optimal level to guarantee high fish yield. The high temperature recorded might have resulted in better feeding and food conversion for the fish allow tropical fish to eat more and grow faster.
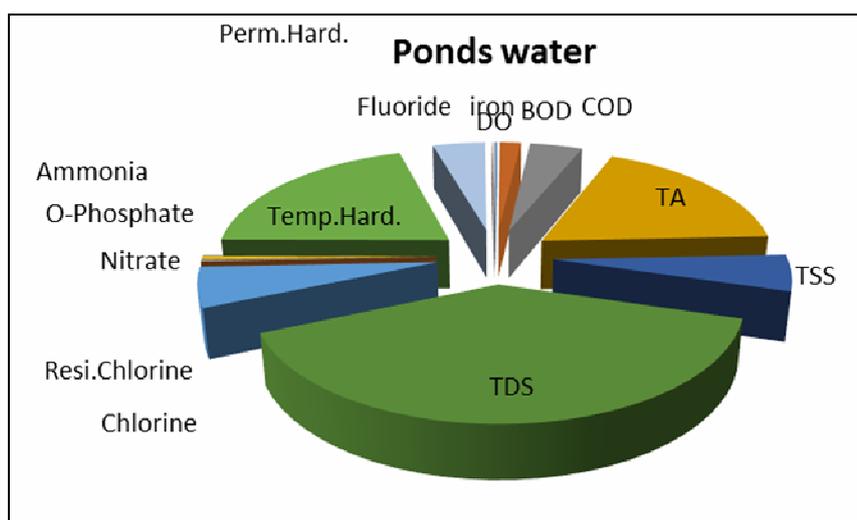

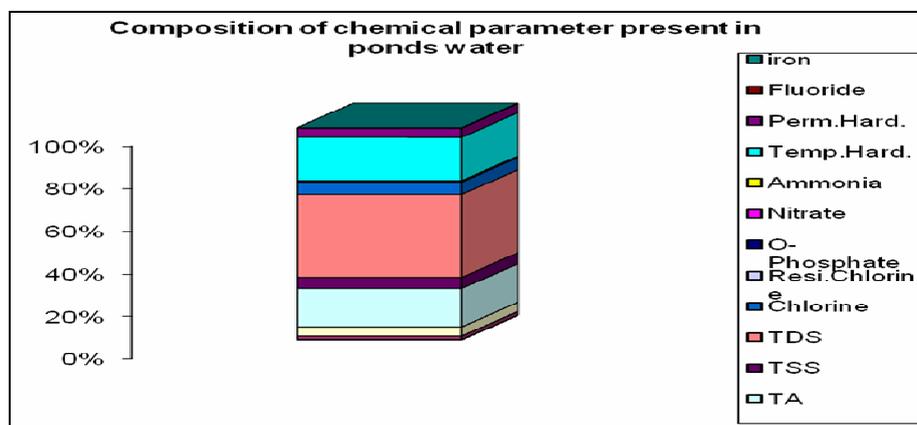Fig. 1 – Physico-chemical Parameters of Sagar pond.

Fig. 2 – Percentage physico-chemical composition of Sagar pond.

4. Conclusions

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From the above discussion it can be concluded that the most of the water quality parameters of Sagar Lake only provide favourable conditions for existence of fish but gave few opportunities for growth, survival and production of fish at commercial level.

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ABORDAREA STATISTICĂ A EFECTULUI PARAMETRILOR DE CALITATE AI APEI DIN LAKHA BANZARA ASUPRA CULTURII DE PEŞTE

(Rezumat)

Probe de apă au fost colectate din diferite locaţii în jurul Lakha Banzara Lake. Au fost analizate zilnic probe de apă colectate de la 9 puncte de prelevare timp de trei sezoane, vizând caracteristicile lor fizico-chimice, adică pH, culoare, miros, duritate, cloruri, alcalinitate, TDS, COD, conţinut de ioni metalici, etc., pentru a investiga efectul parametrilor fizico-chimici asupra producţiei de peşte. Un studiu sistematic de corelare între parametrii de calitate ai apei a fost făcut cu scopul de a minimiza complexitatea şi dimensionalitatea setului mare de date. Această încercare a fost făcută pentru a evalua calitatea sezonieră a apei în Lakha Banzara Lake, cu scopul de a stabili relaţii între caracteristicile fizico-chimice ale apei şi producţia de peşte a lacului şi a genera un model statistic pentru a examina calitatea apei.