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Physico-Chemical Parameters Of Water And Soil Of A Few Fish Yielding Ponds In Birbhum District Of West Bengal, India

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ABSTRACT

The aim of this study was to assess physico-chemical characteristics of water and soil of few fish yielding ponds located in six blocks, two blocks from each three sub-Divisions of Birbhum district of West Bengal. The study was made on seasonal survey basis during the period from February, 2019 to March, 2020. Analysis of water & soil samples revealed that almost all physico-chemical parameters were within normal range which was conducive for fish production.

Key words: Pond, water quality, physico-chemical parameters, soil quality, plankton cell.

INTRODUCTION

Assessment of quality of water and soil depend on its physical, chemical and biological characteristics. Water and soil properties of fish yielding ponds play a crucial role towards productivity as well, as profit from pisciculture. Deciding quality of water resources an adequate knowledge of existing nature of physico-chemical parameters magnitude and source of any pollution load must be known, for which monitoring of physico-chemical parameters and pollutants is essential (Reddy *et.al.* 1994). Water quality assessment from any region is an important aspect for the development activities of the region, because the rivers, lakes etc. are used for water supply to domestic, industrial, agriculture and fish culture use (Jain and Senapati, 1996). The Productivity of any fish pond depends on availability of phytoplankton and zooplankton which in turn based on the quality of bottom mud i.e. store house of nutrients. Various chemical and biochemical changes continuously take place in the underwater pond mud resulting in release of nutrients to the overlying water (Mandal and Chattopadhyay, 1990). Increasing anthropogenic activities in and around aquatic systems and their catchment areas have contributed to a large extent to be deterioration of water quality and dwindling number of water bodies, leading to their accelerated eutrophication (Gaval *et.al*, 2011). Fresh water has become a scarce commodity because of over exploitation and pollution of water. The present work was undertaken to study water and soil quality of a few fish yielding ponds located in six blocks, two blocks from each three sub-Divisions of Birbhum district.

MATERIALS AND METHODS

Fish yielding rural ponds situated in six blocks, two blocks each from three Sub Divisions namely, Suri-I & Suri-II from Suri Sub Division, Bolpur-Sriniketan & Illambazar from Bolpur Sub Division and Mayureswar-I & Mayureswar-II from Rampurhat Sub Division respectively were undertaken for the present study. Water and soil samples were collected on seasonal survey basis during summer (March to May), Monsoon (June to September), post-monsoon (October to November) and winter (December to February) period from February 2019 to March, 2020. Water samples were collected in clean and sterilized BOD glass bottles from three different sites of each pond using composite sampling method. Sampling was done in early hours of the day and stored at 4 ^{0}C. Some physical and chemical parameters such as water temperature, transparency, P^H and dissolved oxygen were determined in the field during the visits. For the certain parameters such as free carbon-di oxide, total alkalinity, plankton cell, total hardness, phosphate phosphorus, nitrate nitrogen and dissolved organic matter were analyzed in the laboratory without lapse of much time. The estimation of physico-chemical parameters was carried out by following standard method as described by APHA (1995). Soil samples were collected from different spots of the bottom of ponds in plastic bags and taken to the laboratory. Then the soil samples were air dried completely powdered and mixed together thoroughly for chemical analysis**.** Nitrogen estimation was made by alkaline permanganates method (A.O.A.C., 1998), available phosphorus by Bray and Kurtz (1945), exchangeable potassium by Jackson (1958) and soil organic carbon by Walkey and Black (1943).

RESULTS AND DISCUSSIONS

The mean values of the analysis of various water parameters, has been shown in Table 1. Variation of ponds water temperature in different blocks was depending upon the hydro biological environment. Most of these ponds water are mainly used for domestic and irrigation purpose. In the present investigation, pond water temperature was almost similar in all blocks is ranging in between 20.20 to 24.72 ^{0}c and observed seasonal change in it. The mean lowest water temperature was found in block 2 as 20.20 ^{0}c and maximum at block 3 as 24.72^{0}c. Similar observation of water temperature was also reported by Roy (2000). Water transparency is highly variable parameter and helps in determining productivity zone of water body. The minimum and maximum average values of transparency were found in block 3 (13.65 cm) & block 1 (15.90cm) respectively. Similar results of transparency were reported by Khabade *et. al.* (2002).

Table 1 Physico-chemical parameters of fish pond water.

Parameters	Unit	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
Temperature	(^{0}c)	23.42	20.20	24.72	20.92	24.32	23.42
Transparency	Cm	15.90	15.47	13.65	15.05	15.00	13.97
Plankton cell	No's	104.50	82.50	122.50	102.50	88.75	108.25
P^H		6.75	7.70	7.40	6.70	7.40	7.00
D.O.	mg/l	3.80	3.00	4.80	3.80	4.90	3.40
Free CO_2	mg/l	7.22	6.40	9.02	11.75	9.30	9.20
Total alkalinity	mg/l	80.50	69.30	100.00	92.00	82.50	83.60
Total hardness	mg/l	92.30	96.80	95.50	88.88	81.30	70.00
Phosphate phosphorus	mg/l	0.50	0.80	1.90	0.80	0.75	0.70
Nitrate nitrogen	mg/l	0.038	0.053	0.049	0.065	0.048	0.040
Dissolved organic matter	mg/l	8.97	9.07	7.60	8.77	9.12	10.85

Suri-I (block 1), Suri-II (block 2) Bolpur-Sriniketan) (block 3), Illambazar (block 4), Mayureswar-I (Block 5) and Mayureswar-II (block 6) .

The density of plankton cells were varied in accordance with change of season and the lowest population was found in pre-monsoon and the highest in winter. The lowest mean value of plankton cell was recorded in water samples of block 2 (82.50 No's) and the highest in block 3 (122.50 No's). The study revealed that P^H of almost all water samples was slightly acidic in nature which was ranged between 6.75 and 7.70. Comparatively highest mean value was observed in monsoon and lowest in summer. Oxygen is an index of the physical and biological processes interacting in water. Dissolved oxygen (DO) concentration of all water samples varied from 3.00 (block 2) to 4.90 mg/l (block 5). It decreases with increases in temperature especially in summer season. Dissolved oxygen shows seasonal variation and it increased during winter season. Similar observations carried out by Bhosale *et.al*. (1994) and Khabade *et.al*. (2002). Carbon-di oxide is produced as a result of breathing of living organisms of aquatic environment. The lowest value (6.40 mg/l) of free carbon-di oxide was recorded in block 2 and highest value (11.75 mg/l) in block 4 respectively. The observed value of free carbon-di oxide was lower than the value reported by Rawat and Jakher (2002). During study period the alkalinity of water samples was varied from 69.30 to 100.00 mg/l, in block 2 and block 3 respectively. Similar results have also been obtained by Bhavimani and Puttaiah (2011). Total alkalinity was varied seasonally and it increases in winter season. The highest value of total hardness was observed in block 2 (96.80 mg/l) and lowest in block 2 (70.00 mg/l). According to Swingle (1967), water body containing hardness above 15 ppm is necessary for satisfactory fish growth. Hardness was comparatively higher in summer and lower in monsoon due to fluctuation of water level. Higher value of hardness content of all pond water samples were normal and corroborated with the results of Bhosale *et.al*. (1994) and Khabade *et.al*. (2002). In the present investigation phosphate phosphorus and nitrate nitrogen content in all water samples were varied from 0.50 to 1.90 mg/l and 0.038 to 0.065 mg/l respectively which were below range indicating oligotrophic nature of fish pond water. Similar observation has also been made by Pandey *et.al*.(1999). According to Ramachandran *et.al*. (2002) Inorganic phosphorus plays a dynamic role in aquatic ecosystems and it is one of the most important nutrients when present in low concentrations but in excess along with nitrate and potassium cause algal blooms. The highest dissolved organic matter was observed in block 6 as 10.85 mg/l and minimum was in block 3 as 7.60 mg/l. The dissolved organic matter

varied seasonally and it increased in rainy season due to mixing of domestic sewage and runoff from various sources into the ponds.

The mean values of the analysis of various fish pond soils, has been shown in Table 2. Pond bottom soils play a pivotal role for the production of various primary food organisms. Different nutrients are supplied by soils which lead to the productivity of ponds. Hickling (1971) described bottom soils to be the chemical laboratory of fish ponds. Soil texture depends upon the parent material forming the soil. Loam soils found in block 3 were considered desirable compared to sandy clay and clay loam. The mean values of P^H of all soil samples were slightly acidic with the exception of block 3, block 4, block 5 and block 6 which were slightly alkaline in nature. According to Chakrabarti (2003) slightly acidic to slightly alkaline reaction is considered desirable for both soil and water in fish ponds and P^H less than 5.5 or above 8.5 are unproductive.

Table 2 Physico-chemical parameters of fish pond soil.

Parameters	Unit	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
Texture		Sandy clay	Clay loam	Loam	Clay loam	Clay loam	Sandy loam
P^H		6.77	6.35	7.42	7.70	7.05	7.15
Exch. potassium	mg/100 g	8.07	8.00	7.70	8.52	8.77	9.65
Av. phosphorus	mg/100 g	1.37	1.97	1.61	1.70	1.80	2.35
Av. Nitrogen	mg/100 g	30.70	35.57	35.90	34.62	32.97	27.65
Organic carbon	(%)	0.45	0.46	0.87	0.65	0.63	0.51

Suri-I (block 1), Suri-II (block 2) Bolpur-Sriniketan (block 3), Illambazar (block 4 Mayureswar-I (Block 5),and Mayureswar-II (block 6).

Potassium plays an important role in agriculture but in fish culture its importance is rather obscured because this element is within normal range in most of the pond soils. Maximum and minimum mean values of exchangeable of potassium were found in block 6 (9.65 mg/100 g) and block 3 (7.70 mg/100 g) respectively. Exchangeable potassium in all soil samples were within congenial range. According to Chakrabarti (2003) the available phosphorus content of most of the soils samples remain even less than 3.0 mg/100 g and seldom exceeds more than 6.0 mg/100 g soil. Maximum available phosphorus was found in block 6 (2 .35 mg/100 g) and minimum in block 1 (1.37 mg/100 g) which were conducive for fish production. Similar results of available phosphorus were reported by Sharma (2007). The lowest mean value of available nitrogen was observed at block 6 (27.65 mg/100 g) and maximum (35.90 mg/100 g) at block 3. Available nitrogen content in all soil samples were within normal level. Organic carbon influences various physico-chemical properties of pond bottom soils and release different nutrient elements that enhance pond productivity. The results showed that mean values of organic carbon was varied from 0.45 to 0.87 %. Organic carbon content in fish pond soils were in moderate range. Both the results of available nitrogen and organic carbon corroborated the findings Sharma (2007).

CONCLUSION

On the basis of above mentioned physico-chemical parameters of fish yielding pond water and soil it may be concluded that temperature, transparency, dissolved oxygen, free carbon dioxide, alkalinity and Plankton cells were varied seasonally. Hardness, phosphate phosphorus and nitrate nitrogen and dissolved organic matter content of water were in moderate range. The nutrient status of pond bottom soils indicated a moderate productive nature of soil. Majority of soils were slightly acidic to alkaline in nature, whereas, exchangeable potassium, available phosphorus, nitrogen and organic carbon were in moderate range. The nutrient profile of both water and soil of ponds were congenial for fish production.

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