A COMPARATIVE STUDY ON THE NATURE AND PROPERTIES OF SOME BRACKISHWATER AND NEARBY FRESHWATER FISH POND SOILS

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A COMPARATIVE STUDY ON THE NATURE AND PROPERTIES OF SOME BRACKISHWATER AND NEARBY FRESHWATER FISH POND SOILS

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ABSTRACT

Nature and properties of six brackishwater and six nearby freshwater fish pond soils representing different areas in coastal West Bengal were studied in order to understand how the characters of brackishwater pond soils differ from those of freshwater ponds. The study revealed brackishwater and freshwater pond soils to have almost similar pH ranges with average values of 7.70 and 7.50 respectively. Highly saline conditions in brackishwater ponds (water salinity 6.10 to 23.80 ppt) resulted in higher electrical conductivity values of the soils (average 6.90 mmhos/cm) over those of freshwater ponds (average 3.50 mmhos/cm). Organic carbon content were relatively lower (average 0.27%) and calcium carbonate values were slightly higher (average 2.90%) in brackishwater pond soils than in freshwater ponds (average 0.42% and 2.30% respectively). Freshwater pond soils contained comparatively higher amount of available nitrogen (average 13.60 mg/100g soil) and lower amount of available phosphorus (average 1.60 mg/100 g soil) than brackishwater pond soils with corresponding average values of 10.40 and 2.60 mg/100 g soil.

INTRODUCTION

THE PRODUCTIVITY of the ponds was directly related to the nutrient status of the bottom mud (Pillay *et al.*, 1962). Hickling (1971) also emphasized the importance of bottom soil in maintaining the fertility of brackishwater fish ponds since benthic algae, which form the main fish food organisms in such ponds, grow on the pond soil base. Importance of the nature and properties of brackishwater fish pond soils on productivity of the ponds has also been described by workers like Tang and Chen (1967), Djajadiredja and Poernomo (1972) and others.

The physico-chemical properties of the soils of brackishwater fish ponds differ widely from those of freshwater ponds mostly due to remaining submerged under highly saline tidal water. Mandal (1962) characterised such soils texturally by high clay content, chemically by high percentage of exchangeable sodium and alkaline reaction and physically by extremely low permeability. Although some work has been done to identify the nature and properties of brackishwater fish pond soils in India (Chattopadhyay, 1978), information showing how the properties of such soils differ from those of freshwater ponds in the same region are still very meagre. Therefore, in the present investigation, it was decided to make a comparative study on the nature and properties of some brackishwater and nearby freshwater fish pond soils in coastal areas of West Bengal, with the objective of knowing whether there is need for any differential management practice for improving the fertility of brackishwater pond soils.

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Material and Methods

Soil samples were collected from six different locations covering the main areas of concentration of brackishwater fish farms in coastal West Bengal (Fig. 1). In each location, samples were collected from one brackishwater and one nearby freshwater fish pond where no tidal water is allowed to enter. The distance between the two types of ponds, however, did not exceed 0.5 km in any instance. After collection the soils were air dried, ground, passed initially through a 2 mm and then through a 80 mesh sieve and used for subsequent analyses.

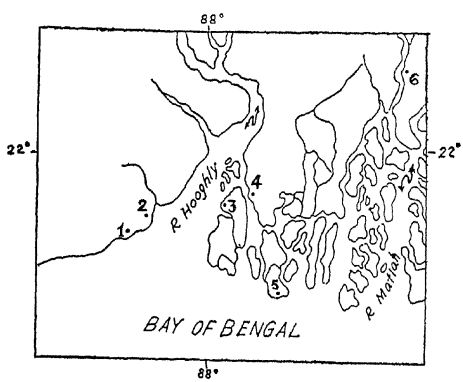

Fig. 1—Map showing the location of sampling stations.

Values of pH and E.C. were determined by using 1 : 2.5 soil : water ratio. Organic carbon content of the soil was determined by the rapid digestion method of Walkley and Black (1934) after necessary modification (Jackson, 1967) to overcome the interference of chloride ions in saline soils. Free calcium carbonate was determined by the method described by Piper (1966), available nitrogen content of the soil by using alkaline permanganate method of Subbiah and Asija (1956) and available phosphorus content by the method of Olsen *et al.* (1954).

Results and Discussion

Results of different analyses have been presented in Table 1. As evidenced from the Table, pH values of the studied soils did not vary very much between the two types of ponds with average values of 7.7 and 7.5 for brackishwater and freshwater pond soils respectively. Slightly alkaline pH values for brackishwater pond soils were as expected, since the soils of such ponds remain submerged under highly saline tidal water. As indicated from the E.C. values, the soils of freshwater ponds were also rich in soluble salts due to being situated in low lying coastal areas and this resulted in slightly alkaline pH values of the soils also. Importance of neutral to slightly alkaline pH values on productivity of fish ponds has been discussed by Ohle (1938), Alikunhi (1957) and many others. Hence the obtained pH values for all the studied brackishwater and freshwater pond soils may be considered to be favourable for aquaculture.

E.C. values of the soils of brackishwater ponds were higher than those of freshwater ponds with average values of 6.9 and 3.5 mm hos/cm respectively, obviously due to the former remaining submerged under highly saline tidal water. Freshwater pond soils although showed lower E.C. values than brackishwater ponds, it was rather higher in comparison to the values generally obtained in case of freshwater pond soils. These freshwater ponds are situated in low lying coastal areas, soils of which are highly saline in nature. This resulted in comparatively higher E.C. values of the soils although no tidal water was allowed to enter in such ponds. Paliwal (1972) has described

TABLE 1. *Some important characteristics of the brackishwater and nearby freshwater pond soils*

Location Name	Type	pH	E.C. (mmhos/cm)	$CaCO_3$ (%)	Available N_2 (mg/100g soil)	Available P (mg/100g soil)	Organic carbon (%)
Digha	B	7.5	7.4	2.0	12.6	1.7	0.13
	F	7.4	3.2	2.0	10.2	1.6	0.11
Junput	B	8.0	7.8	2.5	8.4	3.1	0.10
	F	7.7	4.1	2.0	7.8	3.2	0.10
Sagar	B	8.3	6.1	4.0	10.8	3.1	0.33
	F	7.4	3.2	2.5	19.6	1.4	0.78
Kakdwip	B	7.7	8.2	2.7	8.8	1.6	0.33
	F	8.2	5.0	2.2	14.0	1.2	0.35
Bakkhali	B	7.0	6.1	3.0	11.2	3.7	0.41
	F	7.1	2.4	2.5	15.0	0.8	0.78
Canning	B	7.6	6.1	3.1	10.6	2.4	0.30
	F	7.5	3.4	2.4	14.8	1.5	0.24
Average	B	7.7	6.9	2.9	10.4	2.6	0.27
	F	7.5	3.5	2.3	13.6	1.6	0.24

B — Brackishwater F — Freshwater

decomposition of organic matter to be lower under high E.C. values. The results of the present study, therefore, indicate that decomposition of organic manures in brackishwater fish ponds may be adversely affected by the highly saline condition of the ponds and hence use of previously decomposed organic manures may be beneficial for improving productivity of such ponds.

Free $CaCO_3$ content of the soils ranged between 2.0 to 4.0 per cent for brackishwater ponds and between 2.0 to 2.7 per cent for freshwater ponds with average values of 2.9 and 2.3 per cent respectively.

Available nitrogen levels were rather low in both the two types of pond soils with average values of 10.4 mg/100 g soil in case of brackishwater ponds and 13.6 mg/100 g soil in case of freshwater ponds while Banerjea (1967) indicated the critical value of available nitrogen in freshwater fish ponds as 25 mg/100 g soil. Presence of organic matter is known to influence the amount of available nitrogen content of the soils to a large extent. In the present study also the freshwater pond soil of location 3, Sagar island, showing the highest amount of organic carbon among all the studied soils recorded the highest value of nitrogen in available form. On the other hand, both the freshwater and brackishwater ponds of location 2, Junput, recording the minimum value of organic carbon, also showed lowest amounts of available nitrogen in the soils. Pillay *et al.* (1962) observed productivity of brackishwater ponds to depend largely on the amount of available nitrogen in the bottom soils and hence the low values obtained in the present study

emphasize the need for application of comparatively higher amount of nitrogen in brackishwater ponds in the form of organic manures or inorganic fertilizers than what is generally used for freshwater ponds.

Amount of available phosphorus in brackishwater pond soils assumed comparatively higher values over freshwater ponds with corresponding average values of 2.6 and 1.6 mg/100 g soil. Higher amount of available phosphorus in brackishwater pond soils has been reported by Chattopadhyay (1978) and may be considered favourable for brackishwater fish culture not only due to the fact that phosphorus is one of the essential nutrient elements for pond productivity and which often occurs in very meagre amount in nature but also due to its importance in the growth and multiplication of blue green algae which form the major fish food organisms in brackishwater ponds.

Organic carbon content of the soils of brackishwater ponds were comparatively lower than that of the freshwater ponds with respective average values of 0.27 per cent and 0.42 per cent. Banerjea (1967), while describing productivity of freshwater fish ponds in relation to chemical condition of pond soil and water, reported pond soils having less than 0.5 per cent organic carbon to be low in productivity. Assessing from his criterion, the studied freshwater pond soils of the coastal West Bengal may, in general, be considered to be low in productivity even with the comparatively higher organic carbon value of freshwater pond soils over the brackishwater pond soils. Occurrence of lower amount of organic carbon in brackishwater fish pond soils of West Bengal is in agreement with the observations of Chattopadhyay (1978). Accumulation of organic carbon in fish pond soils has been attributed largely to the production of planktonic and bacterial mass by Hepher (1965). Hence lack of presence of sufficient fish food organisms in brackishwater ponds (Bhimachar and Tripathi, 1966) may be the reason of this lower amount of organic carbon in such soils. Tang and Chen (1967) showed that the productivity of brackishwater fish ponds increases with the organic matter content of the bottom soils. Hence the low values of the studied brackishwater pond soils indicate that application of organic manures in comparatively higher doses may be beneficial to increase the productivity of such ponds.

The present study, therefore, indicates that the soils of brackishwater fish ponds of West Bengal have comparatively higher amount of available phosphorus but lesser amount of available nitrogen and organic carbon than those of nearby freshwater ponds. Hence use of organic manures and nitrogenous fertilizers in comparatively higher doses may be beneficial for obtaining higher production in such ponds.

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