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Physico-chemical characteristics of sediment samples from three selected wetlands Adra Sahebbundh, joypur Ranibundh and Nibaran Sayar in Purulia District, West Bengal, India.

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ABSTRACT

In the present communication, three important wetlands, located in different Blocks of Purulia District, West Bengal viz. Adra Sahebbundh, Joypur Ranibundh and Nibaran Sayar have been selected and investigated. Sediment samples collected from these three wetlands during the post monsoon period (2014-2015) were analysed for studying as many as eight important parameters. The study revealed physico-chemical characteristics of sediments of Adra Sahebbundh, joypur Ranibundh and Nibaran Sayar in Purulia District, West Bengal.

Keywords: Physico-chemical characteristics, sediments, Purulia District.

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INTRODUCTION

Wetlands are usually categories according to their characteristics vegetation, their location (coastal or inland), the salinity of the water they carry or other biological, chemical, hydrological and geographical features. They sustain highly productive ecosystems, with the potential for supplying nutrients to adjacent areas.

In agriculture, soil test is primarily done to identify growth potential of the soil by determining physical as well as chemical properties like nutrient and contaminant content, composition and other features like acidity or pH level in particular.

The inland sedimentary soils of Purulia have been classified on the basis of Rapid Reconnaissance Soil Survey into three broad groups namely, Gneissic soil, Gondwana soil and Transition soil. The major area of the district has soil of the first category and these soils have been formed from the parent Gneissic rocks.

The wetlands considered in this work need rational utilization, periodic monitoring, management and protection for conservation before it is too late, since they collectively constitute a natural resource of great importance. This documentary work may prove its worth in laying the foundation of a wetland based multidimensional programme for health, economy and environment in Purulia District, West Bengal.

MATERIALS AND METHODS

The present study was conducted in Purulia District, situated between 23° 19' 50.23 " North latitudes and 86° 21' 46.91 "East longitudes. It extends over an area of 6259.00 sq Km. The soil is of lateritic type and the temperature ranges from 26-44°C during summer and from 11-24°C during winter. Maximum rainfall for the district as far recorded is in the month of July 413 mm [**10]**.

STUDY SITES

Three important wetlands were selected for physico-chemical analysis of sediments from Purulia District. Sediment samples collected from these three wetlands during post monsoon period (2014-2015) were analysed for studying pH, conductance, Acidity, Alkalinity, Organic Carbon, Total Nitrogen, Available Phosphorus and Available Potassium. Brief information and distinctive physiographic features of sampling sites are as follows **(Table 1).**

Table 1: Details of sampling sites.

Sites	Name of wetlands	Block	Longitude	Latitude	Area in acres
1.	Adra Sahebbundh	Kashipur	86° 42' 35" E	23° 28' 57" N	11
2.	Joypur Ranibundh	Joypur	86° 08' 00" E	23° 26' 00" N	120
3.	Nibaran Sayar	Purulia I	86° 21' 32 " E	23° 20' 17 " N	70

RESULTS

For studying physico-chemical characteristics of wetland sediments three sampling sites were selected (**Table 1**) and only eight important parameters of the samples collected there from were studied, a brief account of which is given in the following (**Table 2**).

i.pH: The values of pH were found to be 5.75, 5.85 and 6.03 for sediment samples collected from Joypur Ranibundh, Adra Sahebbundh and Nibaran Sayar respectively.

ii.Conductance: In cases of both Adra Sahebbundh and Joypur Ranibundh values of specific conductance of soil samples were found to be the same i.e. 2.11 µmho/cm. It was 2.95 µmho/cm for sediment samples procured from Nibaran Sayar.

iii.Acidity: Acidity of soil samples was found to be 38.33 mg/litre in case of Adra Sahebbundh which got lowered to 31.66 mg/litre in case of Joypur Ranibundh and to 28.33 mg/litre in Nibaran Sayar.

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iv.Alkalinity: Alkalinity of soil samples was determined to be 28.33 mg/litre both for Joypur Ranibundh and Adra Sahebbundh which got reduced to 21.66 mg/litre in samples from Nibaran Sayar.

v.Organic Carbon (%): In case of Adra Sahebbundh the organic carbon content of soil samples thus determined was 2.19 % of which in case of the Joypur Ranibundh was 3.27 % and in case of Nibaran Sayar 2.77 % of soil sample.

vi.Total Nitrogen (%): The values of total nitrogen was somewhat similar in case of the three wetlands. However, the mean values of total nitrogen ranged from 0.325% (Joypur Ranibundh) to 0.37% of sediment (Nibaran Sayar). The value was 0.345% in case of Adra Sahebbundh.

Available nitrogen: The mean values of available nitrogen ranged from 24.18 mg/l00g (Joypur Ranibundh) to 28.30 mg/100 g of sediment (Nibaran Sayar). The value was 26.68 mg/l00g in case of Adra Sahebbundh.

vii.Available Phosphorus (PO_4): The mean value of this parameter ranged from 12.63 mg/100g (Nibaran Sayar) to 19.08 mg/100g. (Joypur Ranibundh). For Adra sahebbundh, the PO_4 concentration was 13.72 mg/100g of sediment.

viii.Available Potassium: The value of this parameter was highest in case of Adra Sahebbundh (17.76 mg/100g) and lowest in case of Joypur Ranibundh (12.16 mg/100g). In case of Nibaran Sayar the concentration of available potassium was 14.59 mg/100g of the wetland sediment.

Table 2: Physico-chemical characteristics of sediment samples collected from three selected wetlands

Parameter	Name of the wetland								
	Adra Sahebbundh			Joypur Ranibundh			Nibaran Sayar		
	Mini.	Maxi.	Mean	Mini.	Maxi.	Mean	Mini.	Maxi.	Mean
pH	5.721	5.998	5.85	5.752	5.763	5.75	6.033	6.035	6.034
Conductance(µmho/cm	2.11	2.12	2.11	2.10	2.13	2.11	2.89	2.98	2.95
Acidity (mg/l)	30	45	38.33	25	40	31.66	25	35	28.33
Alkalinity (mg/l)	25	35	28.33	20	45	28.33	20	25	21.66
Organic Carbon (%)	2.18	2.20	2.19	3.00	3.80	3.27	2.72	2.80	2.77
Total Nitrogen(%)	0.34	0.35	0.345	0.32	0.33	0.325	0.36	0.38	0.37
Mean C/N ratio	6.35			10.06			7.49		
Available Nitrogen(mg/100g)	26.32	27.04	26.68	23.48	24.88	24.18	28.16	28.44	28.30
Available Phosphorus(mg/100g)	13.66	13.78	13.72	18.72	19.44	19.08	12.50	12.76	12.63
Available Potassium (mg/100g)	16.89	18.72	17.76	11.66	12.66	12.16	14.48	14.70	14.59

DISCUSSION

Wetland sediments form the basis of wetland metabolism in general and productivity in particular by releasing nutrients to water –phase and providing shelter to benthic flora and fauna. The sediment dynamics is the key factor in sustenance of biodiversity of a wetland. The important parameters of soil which either act singly or synergistically culminating into the productivity include soil pH, organic matter content C/N ratio, available nutrients etc **[3].**That the waterbodies having more organic carbonate are more productive **[11, 2]** may not be true in case of wetlands with heavy infestation of macrophytes. This might be due to locking up of available nutrients in the huge biomass of macrophytes **[5].**These shallow, nutritionally enriched water bodies get pushed further to the dying situation silently **[14].** So, a holistic and concerted management approach is the immediate need to revitalize the potentialities of such ecosystem in order to sustain and conserve the rich pool of biodiversity thriving there in. The management approach must periodically monitor atleast the important physicochemical characteristics of water as well as sediments so that necessary amendments can be suggested if necessary for restoration. In view of this the present work has dealt with the physicochemical characteristics of sediments which are discussed in the following.

Soil reaction (pH) is one of the most important characteristics regulating not only life processes but also the availability of nutrients in water phase in optimum quantity for the survival of organisms. The pH values were found to be minimum (5.721) in Adra Sahebbundh and maximum (6.035) in Nibaran Sayar. However the mean value (**Fig. 1)** ranged from 5.758 (Joypur Ranibundh)) to 6.034 (Nibaran Sayar)**.** The ideal range of soil pH for proper productivity is from 6.5 to 7.5 and pH below 4.0 or above 9.0 has detrimental effect on overall productivity. The pH values thus determined are in no case detrimental; rather they remain in the proximity of the ideal range of pH.

Soil Specific conductance (µ mho/cm) indicates the presence of free ions (electrolytes) in the soil i.e. dissolved minerals which is essential for production. Specific conductance values of sediment samples (**Fig. 2)** were found to be minimum (2.10µmho/cm) in case of Joypur Ranibundh and maximum (2.98 µmho/cm) in Nibaran Sayar with the mean value ranging from 2.11 µmho/cm (joypur Ranibundh) to 2.95 µmho/cm Nibaran Sayar**.**

Values of acidity **(Fig. 3)** were detected to be minimum (25mg/l) in case of sediment of Joypur Ranibundh and Nibaran Sayar and maximum (45mg/l) in Adra Sahebbundh with the mean value ranging from 28.33mg/l (Nibaran Sayar) to 38.33mg/l(Adra Sahebbundh).

Values of alkalinity **(Fig. 4)** were found to be maximum (45mg/l) in sediment samples from Joypur Ranibundh and minimum(20mg/l) in case of Joypur Ranibundh and Nibaran Sayar with the mean values ranging from 21.66 mg/l (Nibaran Sayar) to 28.33mg/l (Adra Sahebbundh and Joypur Ranibundh).

The organic matter has predominant role in the process of biological production. It not only serves as source of food for benthic feeding fishes and invertebrate but also forms the substrate for bacterial growth and other microorganisms at the soil-water interface so as to control the overall dynamics of nutrient recycling. The breakdown is carried out by facultative and obligate anaerobes with slower decomposition rate releasing organically bound nutrients. In this context, dissolved oxygen in water is being utilized as an important factor and its diminution is certain to affect biological production adversely. Maximum mean value of organic carbon in the wetland sediment was determined in case of Joypur Ranibundh (3.27%) and minimum in Adra Sahebbundh (2.19%). In case of Nibaran Sayar the mean value of organic carbon was 2.77 % of soil sample **(Fig. 5)**. The values of total nitrogen of sediments of the three wetlands were found to be very close to one another ranging from 0.325 % (Joypur Ranibundh) to 0.37% (Nibaran Sayar). The value was 0.345% in case of Adra Sahebbundh (**Fig. 6a)**. Attention must be given duly to the C/N ratio – the prime predictor of mineralization or immobilization controlling availability of inorganic nitrogen in water phase from sediment, especially in shallow weed infested wetlands. Sediment C/N ratio should lie in the range of 10 to 17. The values of the C/N ratio of sediments were calculated to be marginally within this range only in case of Joypur Ranibundh. In all others values were within 6 to 8 i.e. below the suitable range to sustain optimum productivity. Available-N in sediment is greatly influenced by the organic-C content in soil **[15**]. Available-N **(Fig. 6b)** was found to be maximum in case of sediment samples from Nibaran Sayar (28.30 mg/100g) and minimum in case of Joypur Ranibundh (24.18 mg/100g). The value was 26.68 mg/l00g in case of Adra Sahebbundh**.** Availability of N in wetlands can also be attributed to fluctuation in water level, climatic factors, soil reaction (pH) and type of vegetation, catchment ecology and characteristics of run-off water entering into wetlands.

Available phosphorus of wetland soil should be in the range 4.7 to 6.2 mg/100g for sustaining aquatic productivity **[4].** The values determined for the sediment samples were much higher than this optimum range. Available phosphorus was found to be highest in Joypur Ranibundh (19.08 mg/100g) followed successively by Adra Sahebbundhl (13.72mg/100g) and Nibaran Sayar (12.63 mg/100g) **[Fig.7]**. Excess of available phosphorus in wetland ecosystem is a an alarming factor for deterioration of production primarily because it is likely to encourage formation of algal bloom by Cyanophytes leading to hypoxic and acidic conditions in water, thus impoverishing plant and animal diversity and encouraging anaerobic micro organisms. Input of sewage carrying detergents and leaching of phosphate fertilizers from the nearby agricultural fields are likely to increase the phosphorus load.

The optimum range of potassium in sediments is 4.7 to 6.2 mg/100g for aquatic production. Available potassium was found to be above this range in all cases. It was found to be maximum in Adra Sahebbundh

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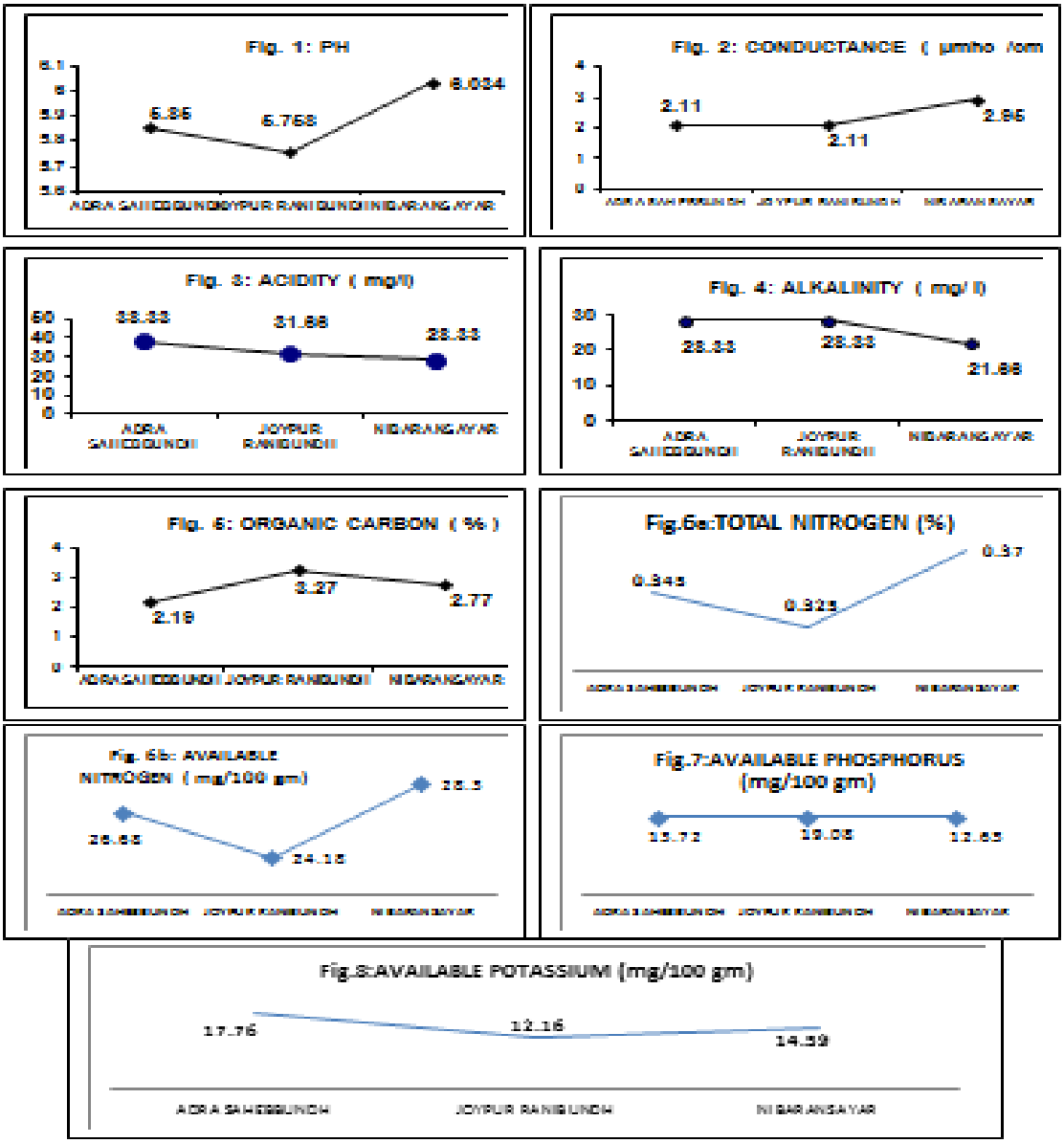
(17.76 mg/100g in each case) and minimum in Joypur Ranibundh (12.16 mg/100g). Sediment samples of Nibaran Sayar registered a value of 14.59 mg/100g (**Fig. 8**).



CONCLUSION

The highest mean values of pH, specific conductance, total-N, available-N of sediment samples could be recorded in case of Nibaran Sayar and those of organic carbon, C:N ratio and available phosphorous were scored in case of samples from Joypur Ranibundh. Adra Sahebbundh showed highest values of acidity, alkalinity, and available potassium concentration. The lowest values of organic-C, C: N ratio, and conductance were detected in case of Adra Sahebbundh and those of pH, total and available nitrogen, and available-K were minimum in case of Adra Sahebbundh. Values of available-P, acidity and alkalinity were lowest in case of samples from Nibaran Sayar. The unevenness especially in NPK and organic carbon contents of the three wetlands speaks of constrained metabolic activities linked with production.

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