

DISTRIBUTION OF ORGANIC CARBON IN MANGROVE SOIL OF SUNDARBANS

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Abstract

Organic Carbon (OC) levels were monitored in four stations of Indian Sundarbans during June 2017. The level of organic carbon in soil differs significantly with stations. The order is Diamond harbour > Kachuberia > Banstala > Sagar South. This variation may be attributed to a large extent by mangrove biomass and diversity, forest age, the degree of tidal exchange and sedimentation of suspended matter. Also anthropogenic activities like fish landing, tourism and shrimp farms contribute appreciable amount of organic load in the selected stations.

Keywords – Organic carbon, Indian Sundarbans, spatial variation

INTRODUCTION

Climate change is caused directly or indirectly by human activity that alters the composition of the global atmosphere and which is observed over comparable time periods in addition to natural climate variability [1]. Atmospheric concentration of carbon dioxide has increased from a pre-industrial value of 280 parts per million (ppm) to current levels of 387 ppm. This is the highest level in 650,000 years and is expected to double pre-industrial levels during this century, which could raise global temperatures 2 to 5°C over the next hundred years. Despite efforts to stabilize greenhouse gas concentrations by some countries, global warming will continue as a result of climate system inertia [2]. The impacts of climate change are readily apparent around the planet. Retreating glaciers and extreme precipitation events cause flooding in some areas while elsewhere water bodies are evaporating from the heat. Tropical diseases are spreading as hurricanes become stronger and more destructive. Since last few decades atmospheric concentrations of carbon dioxide have increased in a sustained way [3]. This has led to study the capacity of carbon sequestration in forests and other terrestrial and wetland ecosystems. Most of the studies are related to forest ecosystems and crops, and there is not enough information on carbon sequestration potential of wetland soil. Wetlands provide several important ecosystem services, among which carbon sequestration is most crucial. The reservoirs of soil organic carbon can act as sources or sinks of atmospheric carbon dioxide, depending on land use practices, climate, texture and topography [4-7]. Wetlands cover about 5% of the terrestrial surface and are important carbon sinks containing 40% of soil organic carbon at global level [8]. Estuarine wetlands have a capacity of carbon sequestration per unit area of approximately one order of magnitude greater than other systems of wetlands [9] and store carbon with a minimum emission of greenhouse gases due to inhibition of methanogenesis because of sulfate [10]. On this background it is extremely important to assess the organic carbon pool of intertidal mudflats of the famous mangrove ecosystem of Indian Sundarbans, which together with Bangladesh Sundarbans constitutes the world's largest brackish water wetland.

II. MATERIALS AND METHODS

a) Study area

The Sundarban mangrove ecosystem covering about one million ha in the deltaic complex of the Rivers Ganga, Brahmaputra and Meghna is shared between Bangladesh (62%) and India (38%) and is the world's largest coastal wetland. Enormous load of sediments carried by the rivers contribute to its expansion and dynamics. Some 34 species of true mangroves thrive in this deltaic lobe [11]. We conducted survey at Kachuberia (station 1), Diamond Harbour (station 2), Banstala (station 3) and Sagar South (station 4) in the Indian Sundarbans region during June, 2017 and station selection was primarily based on anthropogenic activities and mangrove richness (Table 1).

b) Sampling of soil

Sampling areas of 10 m × 5 m were considered for each station. Care was taken to collect the surface samples within the same distance from the estuarine edge, tidal creeks and the same micro-topography. Under such conditions, spatial variability of external parameters such as tidal amplitude and frequency of inundation [12], inputs of material from the adjacent Bay/estuary and soil granulometry and salinity [13-14] are minimal.

Soil samples from surface zone were collected. The uppermost 0.01m, which frequently includes debris and freshly fallen litter, was not used in this study. In the laboratory, the collected samples were carefully sieved and homogenized to remove roots and other plant and animal debris prior to oven-drying to constant weight at 60°C.

c) Analysis of Soil Organic Carbon (SOC)

Total organic carbon was analyzed following a modified version of Walkley and Black method. Sediment samples were collected (during 5th to 7th June, 2017) at the surface (0-5 cm) and air-dried. Organic carbon in air-dried sediment samples is oxidized by dichromate-sulfuric acid and the amount of remaining dichromate is determined by titration with a standard ferrous solution. One-gram sample was taken into a clean, dry 500 ml conical flask. Exactly 10 ml 1 N K₂Cr₂O₇ and 20 ml conc. H₂SO₄ was added and mixed by gentle swirling at first and then vigorously for a total time of 1 minute. The flask was kept for the mixture to react for about 30 min.

After the reaction was over the content was diluted with 200 ml distilled water and then 10 ml conc. H₃PO₄ added, mixed and let cool. 1 ml of Diphenylamine as oxidation-reduction indicator was added and titrated with 0.4N Ferrous ammonium sulfate solution. At the end point colour changes from dull green through turbid blue to a brilliant green. A blank was run with same quantity of the chemicals but without sediment. Calculation was done by the following expression:

$$\frac{3.951}{g} \left(1 - \frac{T}{S} \right)$$

Where, g = weight of sample in g

S = ml ferrous solution with blank titration

T = ml ferrous solution with sample titration

III. RESULT

TABLE 1: Sampling stations with Soil Organic Carbon (SOC) values

Stn.	Geographical Location		SOC (%)
	Longitude	Latitude	
1 (Kachuberia)	88°11'35.05"E	22°11'07.84"N	1.06
2 (Diamond harbour)	88°07'57.32"E	21°52'27.99"N	1.10
3 (Banstala)	88°10'44.55"E	21°43'05.58"N	1.04
4 (Sagar South)	88°03'06.17"E	21°38'54.37"N	0.92

IV. DISCUSSION

The % of organic carbon in soil differs significantly with stations. The order is Diamond harbour > Kachuberia > Banstala > Sagar South. This variation may be attributed to a large extent by mangrove biomass and diversity, forest age, the degree of tidal exchange and sedimentation of suspended matter. Also anthropogenic activities like fish landing, tourism and shrimp farms contribute appreciable amount of organic load in selected stations. In Sundarbans some pockets are known for fish landing, passenger jetties and intense tourism activities (as seen in Diamond harbor). Organic carbon in deltaic zone originates from mangrove litter/ detritus, anthropogenic activities, deposition of silt/clay etc.

Mangrove forests are usually characterized by sediment accretion [15]. This fact, combined with the high productivity and low ratio of sediment respiration to net primary production, gives mangrove sediments the potential for long-term sequestration of organic carbon. Thus, these systems play an important role in global carbon cycle [16] and may be a possible solution to rising trend of carbon dioxide due to rapid industrialization and urbanization in the present *era*. However, erosion of Sagar South (station 4) is the basic reason behind low SOC in the intertidal mudflat of the station. Hence erosion control through mangrove plantation is an effective approach to eco-restore the situation, which may be carried out as a part of CSR activities by various corporate houses.

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