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Original Article

# Inventory of major wetlands of Brahmanbaria District, Bangladesh, with special reference to sediment characteristics

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**ABSTRACT**

The present study was carried out on the inventory of wetlands and its sediment characteristics for preparing a database toward an effective management and monitoring of wetlands in the Brahmanbaria district, Bangladesh. All the wetlands are perennial in nature and have multifarious uses. They are classified into two categories such as small category (40–100 ha) belongs to 11 wetlands and large category (100–200 ha) goes to nine wetlands. The average value of organic matter was measured as 5.7 ± 5.19%. The maximum organic matter was recorded at Shapla Beel (22.13%), while the minimum was at Gyail Beel (0.94%). The average value of organic carbon was measured to be 3.30 ± 3.00%. The highest amount of organic carbon was found at Shapla Beel (12.84%) while the lowest amount of organic carbon was observed at Gyail Beel (0.55%). The average concentration of sand, silt, and clay was recorded as 53.31 ± 15.3, 17.61±9.56, and 29.08 ± 12.87%, respectively. Maximum concentration of sand was recorded at Gagotia Beel (85.00%) and minimum was recorded at Shapla Beel (27.00%). Furthermore, the highest amount of silt was recorded at Beel Kajolia (39.28%) and the lowest at Balklongon Beel (4.00%). Likewise, highest value of clay was recorded at Shapla Beel (54.70%) and least was found at Baliajoori Beel (5.28%). The results of the present study indicate that the sediment quality of these wetlands is favorable for fish culture. Considering the results obtained in the present study and other technological facilities, it may be concluded that sustainable development may be possible in this area, but it needs to take proper management by the authority.

**Keywords:** Geographic information system, Inventory, Organic carbon, Organic matter, Wetlands

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## INTRODUCTION

Wetlands, areas that are saturated with moisture and as a consequence, contain unique land cover classes, are some of the most diverse ecosystems in the world. Wetlands provide a wide range of ecosystem services such as groundwater recharge, attenuated nutrient runoff, habitat generation, and contaminant stabilization.[1] An inclusive explanation for wetlands, established for the period of a 1971 resolution in Iran, statuses that wetland included in petlands, marshes, and fens are artificial, natural, permanent, or temporary with fresh, brackish, or salt water that is motionless or flowing. Ramsar convention of Iran in 2017 reported that wetlands are area as a transitional land from terrestrial to aquatic systems where water limits are commonly around surface or it may be land enclosed by surface water. It is leads to the rich biodiversity and wide range of ecosystem services such as water storage, water purification, flood mitigation, and erosion control. Wetland rebuilding and making have been extensively tried as a way to compensate for wetland losses and to improve wetland function. The soil, sand, and clay in restored wetland recovered faster than in created wetland.[2] Although, the soil carbon in restored organic flat and created wetlands recovered more rapidly than hydrologically restored and created open wetlands. Soil texture exerts an important control over mineralization by (i) influencing aeration/moisture status, (ii) affecting the physical distribution of organic materials and hence their potential for degradation, and (iii) conferring

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some degree of "protection" through an association of organic materials with clay particles.[3] The soil texture influences the soils ability to store water and nutrients. Organic soil is often black when wet, porous, and lightweight when dried, while mineral soil consists of diverse types and sizes of mineral particles making them variable in color and texture.[4] Soil provides structure for plants roots, retains water to ensure plants have access long after rains, and holds nutrients so they are available to organisms over time.[5] Sandy soils are more susceptible to leaching. Clay soil has a large moisture holding capacity, whereas sandy soil has good drainage. Soil textures are commonly gravelly or very gravelly (sometimes extremely gravelly) loam, clay loam or silt loam on summits, risers, and treads. Mean clay percentages are about 20% for all caliche soil horizons, while that are 45% and total sands 35%.[6] Wetland areas of Brahmanbaria present the opportunity to support a range of livelihood activities: Agriculture, livestock rearing, fishing, gathering of wild products, craft and are characterized with some distinct features and mostly serve as agriculture and livelihood earnings.[7] However, unfortunately, there was no previous record of scientific research on Brahmanbaria wetlands. This necessity, therefore, compelled us to conduct such types of research with the aims to identify and locate the major wetlands of Brahmanbaria districts and to measure the sediment characteristics of the selected wetlands.

## MATERIALS AND METHODS

### Study Area

The present study was conducted in Brahmanbaria district situated between 90°07′00″E and 23° 57′10″N longitude. Brahmanbaria is located at the east-central region of Bangladesh. It has a total area of 1927.11 km². Soil samples were collected from 20 selected stations such as: Beel Neel and Loyska, Beel Koleyar khal Megna, Beel Kajolia, Beel Shakla, Beel Dogangi, Beel Shapla, Beel Horol, Beel Gyail, Beel Balinga, Beel Gorian, Beel Baklongon, Beel Gagotia, Beel Baliajoore, Khorati river, Beel cachoa madir haor, Beel villaborii, Beel haora, Badoyr khal, Bogdhor Beel, and Titas river [Figure 1].

### Sampling Design

Of the several water bodies observed during the field survey in various parts of the Brahmanbaria district, in total, 20 were identified as wetlands, each having an area exceeding 50 ha. In this work, an inventory of wetlands in Brahmanbaria district has been prepared in a way so to constitute a basic information system by giving a precise account of its location (latitude and longitude, nearest village or town, Block/police station, etc.). The information collecting formula used in this context was designed more or less by adopting the ones used,[8] while studying the Greek wetlands in which their data gathering sheets included such aspects as location, area and the uses, the pressures threatening the wetland, the legal status, and the positive actions. Soil samples were collected from the study area using transect method along with stratified random technique. Excellent discussion was provided in the literature to justify the use of transects when sampling along environmental gradients and the use of stratified techniques.[9] A preliminary survey of the study area was made to identify the sampling sites.

### Sample Collection and Processing

For the assessment of sediment quality, surface sediments are more commonly collected. A large range of devices is available for the collection and review of their uses and suitability for different collection conditions.[10] In general, 2 kg of sediment from each site was collected for analyses of sediment texture (analysis of particle size) using Grab Sampler. Geographical coordinates were taken using GPS. Water depth was taken by the help of meter scale (made of wood). Soil organic carbon (SOC) was measured by Walkley and Black wet oxidation method modified by Haq and Alam[11] and organic matter by Storer.[12] Soil texture (% of sand, silt, and clay) in the study area was analyzed using the hydrometer method described by Bouyoucos[12] and modified from Bouyoucos.[13]

### Statistical Analysis

The study map was constructed using Arc Geographic information system (GIS) (v.10.1) software and PRIMER (v.6) was used to show the similarity[14] among the wetlands. One-way analysis of variance (SPSS v.22) was used to determine the difference among the wetlands. MS Excel software was used to draw different graphs during the study.

## RESULTS

A total number of 20 wetlands had been recorded from the six Upazilas of the Brahmanbaria district throughout the study. The area of the wetlands that were selected for the present study was >100 acres and were classified into two categories such as small category (40–100 ha) and large category (100–200 ha). The small category included 11 wetlands, whereas the large category included nine wetlands. In total, 20 wetlands were recorded from Brahmanbaria in the present study. Characterization of 20 wetlands in Brahmanbaria district reveals variation of 20 wetlands under four basic categories. With the application of these characters, a cluster diagram was prepared [Figure 2], considering the similarities of their characteristics. From this diagram, it is evident that nine wetlands, i.e., Khorati, Haora, Dogangi, Gorian, Bogdhor, Baliajoore, Badoyrkhal, Gagotia, Balinga, and Villaborii show the same characteristics. Among them 20 wetlands, only Koleyar sustains a single representative cluster.

GIS in combination with remote sensing data was used for the identification 20 wetlands among six Upazilas of Brahmanbaria district, which would help for the conservation

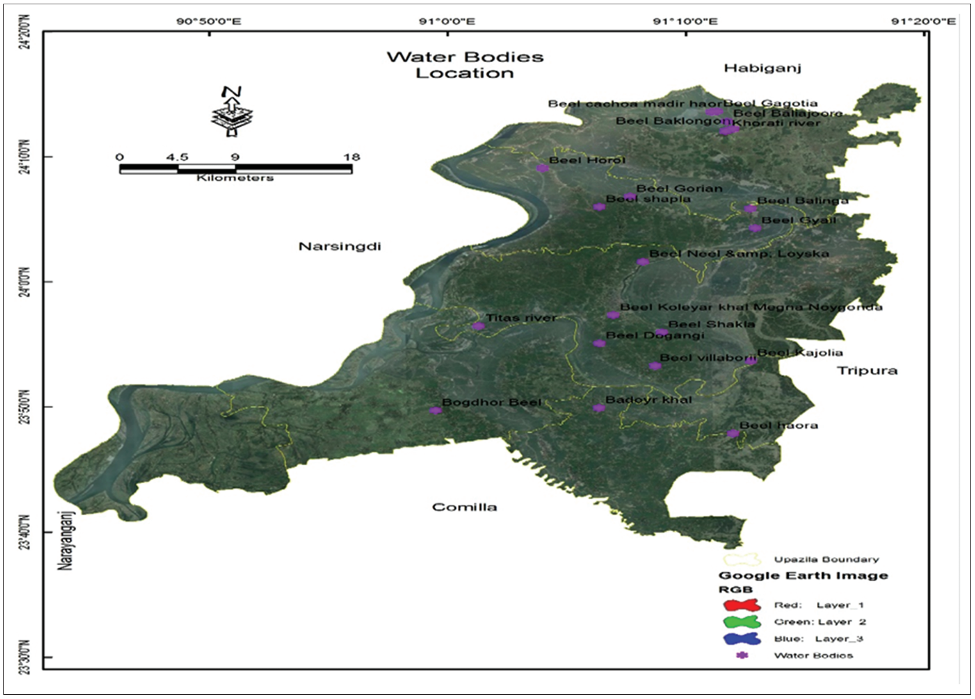


**Figure 1:** GIS map showing the sampling sites of Brahmanbaria district, Bangladesh

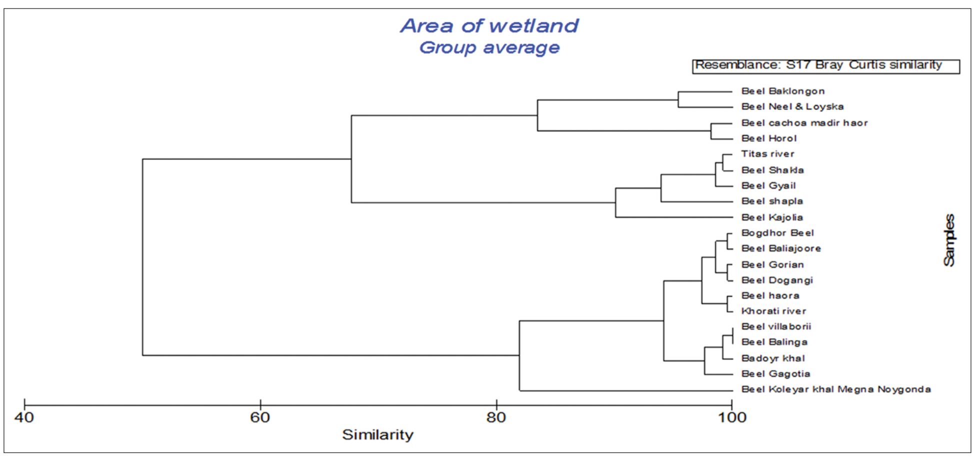


**Figure 2:** Similarity of 20 wetlands studied from Brahmanbaria district, Bangladesh

and management of wetland in the region. GIS provides the convenient method for documentation and analysis of data for the wetland inventory. Similarly, GIS system encompasses water resource assessment and monitoring of the environmental impacts of water, water body mapping, and monitoring as well as identifying wetland boundaries [Figure 1]. The detailed soil texture profiles of different wetlands in Brahmanbaria District are summarized in Table 1.

The average value of organic matter was measured as 5.7 ± 5.19%. The maximum organic matter was recorded at Shapla Beel (22.13%), while the minimum was at Gyail Beel (0.94%) [Figure 4]. The average value of organic carbon was measured to be 3.30 ± 3.00%. The highest amount of organic carbon was found at Shapla Beel (12.84%) while the lowest amount of organic carbon was observed at Gyail Beel (0.55%). The average concentration of sand, silt, and clay was recorded as 53.31 ± 15.3, 17.61 ± 9.56, and 29.08 ± 12.87%, respectively. Maximum concentration of sand was recorded at Gagotia Beel (85.00%) and minimum was recorded at Shapla Beel (27.00%). Furthermore, the highest amount of silt was recorded at Beel Kajolia (39.28%) and the lowest at Balklongon Beel (4.00%). Likewise, highest value of clay was recorded at Shapla Beel (54.70%) and least was found at Baliajoori Beel (5.28%) [Figure 3]. In the present research, soils of 2, 5, and 10 wetlands were found to be sandy loam, clay, and sandy clay loam, respectively, which indicate the suitability of the soil for fish culture.

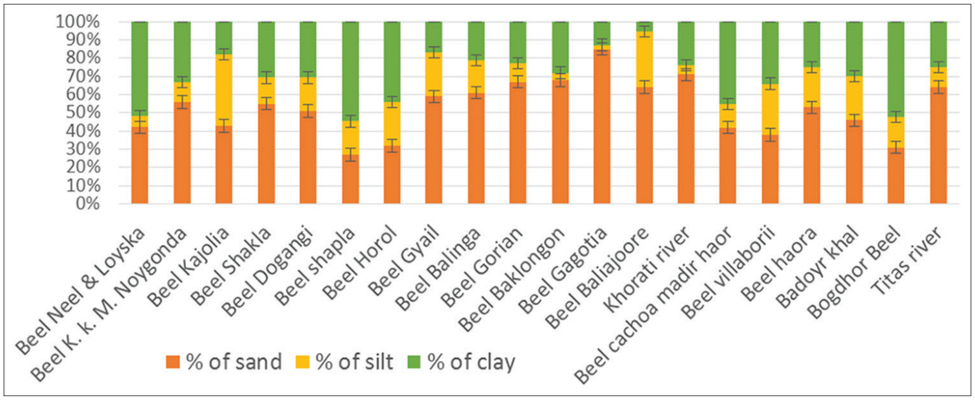


**Figure 3:** Percentage of sand, silt, and clay in different wetlands of Brahmanbaria district

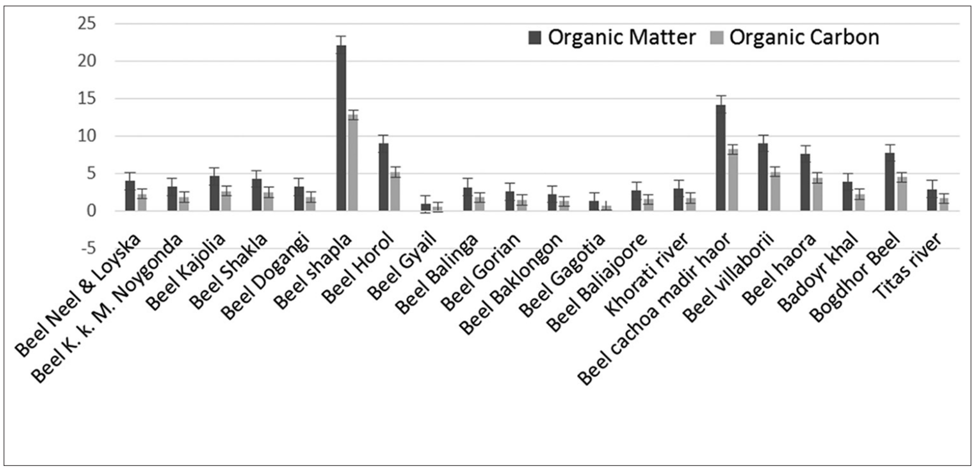


**Figure 4:** Percentage of organic matter and organic carbon in different wetlands of Brahmanbaria district

## DISCUSSION

A total number of 20 wetlands had been recorded from the six Upzillas (Akhura, Bancharampur, Brahmanbaria sadar, Kasba, Nabinagar, Nasirnagar, and Sarail) of the Brahmanbaria district throughout the present study. According to Zalidis *et al.,*[15] choice of classification system is the main consideration when an inventory effort begins, and it comprises the infrastructure for distinction of different wetland units and types of data collected. As many as 11 parameters are used to classify the concerned wetlands. The district is occupied by 20 wetlands whose individual area is >100 acre. The wetland occurs in all the seven Upzillas of the district. Among the 20 wetlands in six Upzillas, a maximum number[6] of wetland represent in Brahmanbaria sadar upzilla. It followed successively by Neel and Loyska,[1] Beel Koleyar khal Megna Noygonda,[2] Beel Shakla,[4] Beel Dogangi,[5] Beel villaborii,[16] and Titas river.[17] Zalidis and Mantzavelas[18] mentioned that wetlands are important productive resources. Organic matter and organic carbon remain within the optimum level for satisfactory growth of culture species, especially fish culture. Wetlands play an important role in the balance of a cultural system and consequently on the growth and survival of aquatic organisms. The soil texture along with the standard textural fraction triplet sand-silt-clay is commonly used to estimate soil properties.[19] The sediment can act as a buffer and provides the water with nutrients and also serves as a biological filter. A synthesis of soil carbon and nitrogen recovery after wetland restoration and creation was found in various regions.[2] Sandy clay loam to sandy loam is favorite for the semi-intensive and intensive culture, where artificial food is used as the main source of food. In the present research, soils of two wetlands were found to be sandy loam, which indicate the suitability of the soil for culture. In addition, organic matter was found in Beel cachoa madir (14.22%) and the amount was obtained from Beel villaborii (9.05%). These results were similar to optimum level (9–15%)[16] and it is well known that low organic matter of wetlands water is suitable.[20] The rapid diminution of wetland biodiversity in relation to scarcity of water and pollution of water body, degradation, and devastation of soil, is essentially a crisis for the fish culture.[21] Wetlands being important for ecosystem, it is urgent to conserve immediately and for this it is needed to disseminate the application of performance prediction models to siting, design, and assessment of wetland

**Table 1: Soil texture profiles of different wetlands in Brahmanbaria district, Bangladesh**

| Name of the Beel | Organic matter | Organic carbon | Soil type | % of sand | % of silt | % of clay |
|---|---|---|---|---|---|---|
| Beel Neel and Loyska | 3.99 | 2.32 | Clay | 42.00 | 6.40 | 51.52 |
| Beel K. k. M. Noygonda | 3.25 | 1.89 | Sandy Clay Loam | 56.00 | 11.00 | 33.00 |
| Beel Kajolia | 4.65 | 2.70 | Loam | 43.00 | 39.20 | 18.00 |
| Beel Shakla | 4.31 | 2.50 | Sandy Clay Loam | 55.00 | 14.30 | 30.70 |
| Beel Dogangi | 3.25 | 1.89 | Sandy Clay Loam | 51.00 | 18.30 | 30.70 |
| Beel shapla | 22.13 | 12.84 | Clay | 27.00 | 18.30 | 54.70 |
| Beel Horol | 8.98 | 5.21 | Clay | 32.00 | 24.00 | 44.00 |
| Beel Gyail | 0.94 | 0.55 | Sandy Loam | 59.00 | 24.30 | 16.70 |
| Beel Balinga | 3.18 | 1.85 | Sandy Clay Loam | 61.00 | 18.00 | 21.00 |
| Beel Gorian | 2.58 | 1.50 | Sandy Clay Loam | 67.00 | 10.28 | 22.72 |
| Beel Baklongon | 2.24 | 1.30 | Sandy Clay Loam | 68.00 | 4.00 | 28.00 |
| Beel Gagotia | 1.31 | 0.75 | Loamy Fine Sand | 85.00 | 2.27 | 12.72 |
| Beel Baliajoore | 2.75 | 1.60 | Sandy Loam | 64.00 | 30.72 | 5.28 |
| Khorati river | 3.01 | 1.75 | Sandy Clay Loam | 71.00 | 5.00 | 24.00 |
| Beel cachoa madir haor | 14.22 | 8.25 | Clay | 42.00 | 13.00 | 45.00 |
| Beel villaborii | 9.05 | 5.25 | Clay Loam | 38.00 | 28.00 | 34.00 |
| Beel haora | 7.63 | 4.43 | Sandy Clay Loam | 53.00 | 22.00 | 25.00 |
| Badoyr khal | 3.91 | 2.27 | Sandy Clay Loam | 46.00 | 24.00 | 30.00 |
| Bogdhor Beel | 7.75 | 4.50 | Clay | 31.00 | 17.00 | 52.00 |
| Titas river | 2.93 | 1.70 | Sandy Clay Loam | 64.00 | 11.00 | 25.00 |
| Mean | 5.7%±5.19 | 3.30%±3.00 | | 53.31%±15.32 | 17.61±9.56 | 29.08±12.87 |

restorations.[18,17,22] The amounts of organic matter found from the different wetlands in the present study are much related to the optimum level of organic matter (%) for the aquaculture development. The most widely accepted model was proposed by Pearson and Rosenberg,[23] who suggested that, as the content of organic matter increases, the species diversity decreases, and the number of individual increases.[23] Organic content, mud content, and water content of the sediments were found to influence the abundance of wetland biotic communities as were also reported by Groenewald.[24] In this study, SOC and organic matter also influenced various species of the wetlands.

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