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Inventory of Major Wetlands with Special Reference to Hydropedological Factors of Narsingdi District, Bangladesh

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Abstract: *The study was carried out on the inventory of wetlands in Narsingdi district, which includes the gathering of information on geo-morphological and pedological features along with status of these resources that are prerequisites for preparing a database for effective management and monitoring of wetlands. The present study was conducted in Narsingdi district situated between 23°30'and 23°45′N and 90°10' and 90°43' E. Among the 120 wetlands, 9 wetlands were selected for the present study those were greater than 10 acre. These wetlands namely Dhargar Beel, Deshwary Beel, Borodoar Beel, Guptopara pukur, Dohatiar Beel, Nolbayed Beel, Ibrahimpur Boro Beel, Nali Beel, Mohespur kur. These wetlands are located in four Upazilla namely Raipura (3), Belabo (3), Shibpur (2) and Monohordi (1). Out of 9 wetlands, the largest Deshwary Beel (99.73 acre) is situated between 24° 06' 03" N and 90° 67' 30" E whereas the smallest Nali Beel (10.2 acre) is situated between 23° 98' 66" N and 90° 73' 90" E. Mean depth of the wetland surveyed in the present study was 3.83±0.90. There are only 3 wetlands each of which ranging from (4.00m-5.21m). The maximum depth (5.21 m) was recorded from Dohatiar Beel during rainy season and the minimum depth (2.42 m) was recorded from Guptopara Pukur during dry season. The average soil organic carbon of different wetlands was 3.23%±0.85. The maximum value (4.3%) of soil organic carbon was recorded from Mohespur Kur during rainy season where as the minimum value (2.1%) was recorded from Ibrahimpur Boro Beel during dry season. The average soil organic matter of different wetlands was 5.40%±1.63 throughout the study. The maximum value (7.96%) of soil organic matter recorded from Deshwary Beel during rainy season and the minimum value (3.7%) was found from Ibrahimpur boro Beel during dry season. The average value of sand was recorded 54.45%±13.63. Highest value (72%) was recorded from Dohatiar Beel and the lowest value (32%) from Ibrahimpur Boro Beel. The average value of silt was recorded 18.28%±7.89. Highest value (30.3%) was found from Guptopara Beel and the lowest value (6.7%) from Nolbayed Beel. The average value of clay was recorded 27.24%±14.46. Highest value (50%) was recorded from Ibrahimpur Boro Beel and the lowest value (4.96%) from Guptopara Beel. Similarity among the wetlands shown by Dendogram (PRIMER v.6) and sampling station presented by GIS (ArcMap v.10.1). There was significant difference among different wetlands in case of organic carbon, organic matter, sand, silt, clay and it was analyzed by One Way ANOVA (SPSS v.22). Among the 9 wetlands, selected in present study 6 were found as perennial wetlands where water is available throughout the year. The uses pattern of wetlands are concerned as many as 9 wetlands have multifarious uses, e.g., in pisciculture, irrigation, jute retting etc. As many as 5 wetlands are used for traditional pisciculture. On the whole as many as 9 out of 9 are used in irrigation. For better environment it is obvious to conserve these wetland through meaningful way.*

Keywords: *Inventory, Wetland, Hydropedological factors, ANOVA, GIS, Environment*

I. Introduction

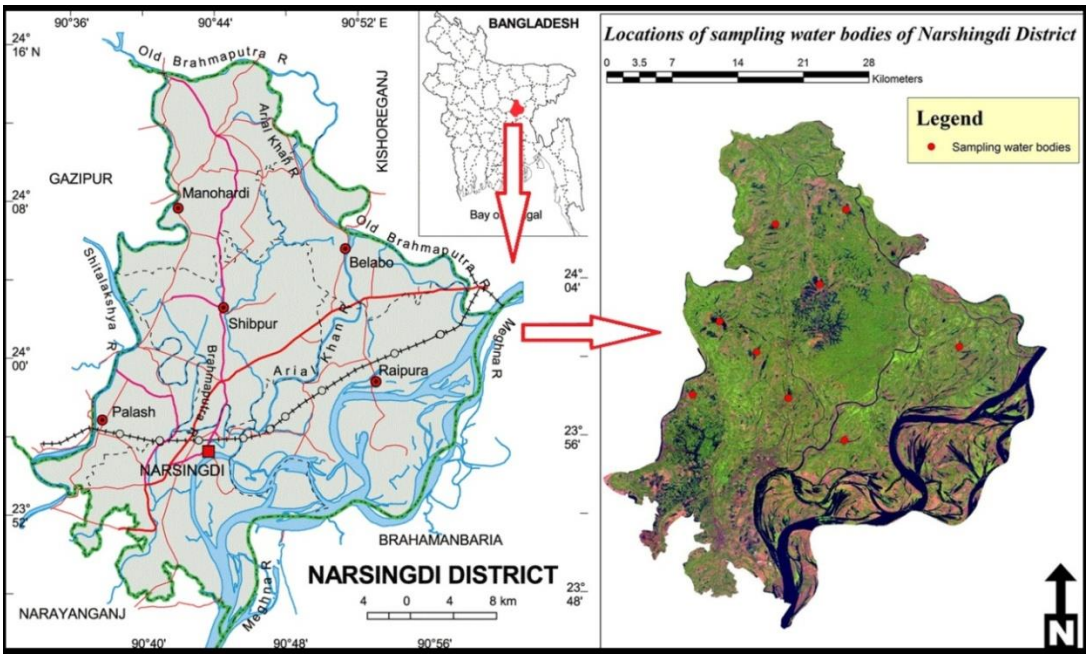
According to RAMSAR convention, 1971, wetlands are "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres". Thus the term wetlands groups together a wide range of inland, coastal & marine habitats which share a number of common features (Dugan, 1990). Wetlands are a valuable renewable natural resource (Day et al., 1990) and indispensable element for biodiversity and human that play role in the coastal protection, flood reduction, sediment accumulation, fish and crustacean nurseries (Finlayson and Davidson, 2012) and provides a wide range of ecosystem services such as groundwater recharge, attenuated nutrient runoff, habitat generation, and contaminant stabilization (Mitsch et al., 1993). The wide range of species wetlands support are important for fisheries, fuel wood, timber, medicines and the local and global biodiversity (Dugan, 1993), ecological processes (Acreman, 2003) and hydrological cycle (Bullock and

Acreman, 2003) as the hydrology of wetlands is the most important element that distinguishes wet from terrestrial habitats (Mistch and Gosselink, 2000). Wetlands serve as potential sinks for excess nutrients in agricultural and urban runoff (Neely and Baker, 1989; Bingham 1994; also see Crumpton et al., 1995). According to one assessment of natural ecosystems, the dollar value of wetlands worldwide was estimated to be $14.9 trillion (Costanza et al., 1997). Many factors exert an influence on wetland stability or degradation by using land and land cover (Steffen et al., 2004) that have been drained and altered to accommodate human needs which ultimately brought changes in the migratory patterns of birds, local climate, and the makeup of plant and animal populations (Kentula, 2002). Most of them are anthropogenic sources such as overuse of resources, lack of property rights, human encroachment, and conversion to other 3 uses and also absence of effective enforcement of laws are some of the most important factors for the decline in wetland biodiversity of the country (Islam, 2011). The loss and degradation of freshwater resources are a result of both the acceleration of human-caused changes and the sensitivity of freshwater ecosystems to such change (Abramovitz, 1996). These changes represent a strategic threat to the quality of human life, the sustainability of the biosphere, and, in fact, the long-term survival of human society (Neiman et al., 1995). The wetlands of the country are diverse and each has some distinctive features in terms of physiography, seasonality and use patterns (Government of Bangladesh, 1990) and water hyacinth found in wetland used as fodder in many areas (Karim, 1989) mostly important for rural areas for their livelihood (Sarker, 1993). But there is no research about the wetland of Narsingdi and this shortage of information led us to conduct research for the better and meaningful management of wetlands with an aim to characterize the hydro-pedological factors of different wetlands selected in the present study.

II. Materials and Methods

2.1 Sampling location:

The present study was conducted in Narsingdi District lies between 23°29' and 23°45' north latitudes and 90°10' and 90°43' east longitudes. The total area of the district is 1150.13 sq.km. (District Statistics, 2011). There are 120 wetlands in Narsingdi district. Among them Raipura-40, Belabo-24, Narsingdi Sadar-15, Shibpur-27, Palash-01 and Monohordi-11.Among them (9) wetlands namely Dargar Beel (24°06′06″N and 90°67′30″E), Deshwary Beel (24°16′75″N and 90°79′40′E), Borodoar Beel (24°09′58″N and 90°76′92″), Dohatiar Beel (24°15′35″N and 90°72′66″E), Nolbayed Beel (24°03′10″N and 90°70′85″E), Ibrahimpur Boro Beel (23°98′99″N and 90°64′72″E), Nali Beel (23°98′66″N and 90°73′90″E), Guptopara Beel (23°94′63″N and 90°79′28″E), Moheshpur Kur (24°03′60″N and 90°90′32″E). Samples were collected for two seasons, namely dry season (October-March) and rainy season (April-September) from each station.



2.2 Sampling Design:

Of the several water body observed during field survey conducted in different parts of the districts as many as 9 were identified as wetlands, each having an area exceeding 10 acres. In this work an inventory of wetlands in Narsingdi District has been prepared in a way so to constitute a basic information system giving a precise account of its location (Geographical coordinate, water depth, sediment texture, use pattern etc.). The information

collecting sheet used in this context was designed more or less adopting the ones used by (Zalidis and Mantzavelas, 1996) while studying the Greek wetlands. Soil samples were collected from the study area by 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 (e.g., the elevation gradient; Neckles and Dionne, 2000). A preliminary survey of the study area was made to identify the sampling station. A plot of measuring 50 x 350 m^2 size was drawn in the study area**.**

2.3 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 reviews of their uses and suitability for different collection conditions are available (Mudroch and Azcue, 1995). Generally 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 were taken by the help of meter scale (made of wood). Uses pattern information were collected by Check-list method. Soil organic carbon (SOC) was measured by Walkey and Black wet oxidation method modified by Haq and Alam (2005) and organic matter by Storer (1984). Soil texture (% of sand, silt and clay) in the study area was analyzed by the hydrometer method described by (Haq and Alam, 2005), modified from (Bouyoucos, 1936).

2.4 Statistical analysis

Map was drawn by arc GIS (v.10.1) software. Statistical analyses were done using the PRIMER (v.6) software. Association of different wetlands was shown in a Dendogram produced by Cluster analysis. One Way Analysis of Variance (SPSS v.22) was used to determine the difference among the wetlands. To draw different graphs MS Excel software was used.

III. Results

A total number of 9 wetlands had been recorded from the 4 Upazilla (Raipura, Belabo, Shibpur, Monohordi) of the Narsingdi district throughout the present study period. Wetlands greater than 10 acres were studied during the research. Among the 4 Upazilla, 9 wetlands represents namely Dargar Beel, Deshwary Beel, Borodoar Beel, Dohatiar Beel, Nolbayed Beel, Ibrahimpur Boro Beel, Nali Beel, Guptopara Beel, Moheshpur Kur. The area of wetlands ranging between 10 to 100 acres. Among the 9 wetland Dargar Beel and Deshwary Beel at Raipura was found as the largest wetland. Almost all this wetlands are being used for cultivation, especially fishery, paddy and during dry season it is hardly possible for anyone to different and identify them as wetlands. 9 wetlands are located in rural areas and the value are accordingly linked with the cultural status and the socio-economic needs of the rural people who use them. Mean depth of most of the water bodies does not exceed 4.5 m. There are only one wetland, Dohatiar Beel is deeper than 4.5 m.

Table 1: General characteristics of wetlands in Narsingdi District

Name of the wetlands	Parameter											
	Latitude N	Longitude E	Average depth (m)	Average area (acre)	Average Organic Matter (%)	Average Organic Carbon (%)	water regime	Source of water	Use Pattern	% of sand	% of silt	% of clay
Dargar Beel	24°06′	90°67′	3.04	30.6	4.71	2.53	N	R	I, P, J,	63	12	25
Deshwary Beel	24°16′	90°79′	4.2	99.7	7.96	3.98	P	R	I, P, D	52	21.	26
Borodoar Beel	24°09′	90°76′	3.2	29.0	6.72	3.51	P	R	I, D	38.3	27.	34
Dohatiar Beel	24°15′	90°72′	2.48	30.0	7.6	3.87	N	R,	I, P, J,	64.7	30.	4.9
Nolbayed Beel	24°03′	90°70′	4.57	11.4	3.72	2.05	N	R,	I, J, D	72	11	17
Ibrahimpur Boro	23°98′	90°64′	1.99	16.9	4.70	3.1	N	R,	I, P, J	46	6.7	47.
Nali Beel	23°98′	90°73′	2.93	11.4	3.7	2.01	P	R,	I, J	32	18	50
Guptopara Beel	23°94′	90°79′	3.52	10.2	4.2	3.7	P	R,	I, P, J,	55	22	23
Moheshpur Kur	24°03′	90°90′	4.5	27.0	5.3	4.3	N	R,	I, P, J	67	15	18

Abbreviations used; For (1) Water regime: p – perennial; NP = Nonperennial; (2) Origin: Mm = Man made; Na = Natural; (3) Source of Water: R=River water; RW = Rain Water: (4) Use pattern: Irrigation; Pisciculture; D=Domestic Use; J=Jute retting; Es–Aesthetic use: (5) Source of pollution : Ar = Agriculture run off: Ds =

Domestic sewage; Ns = Nonspecific; H = Biomedical sewage; JR = Jute Retting; O = Others; (6) Plant diversity: PMR=Moderate: PP=Poor.

Among the wetlands Deshwary Beel is largest (99.73 acre) and Nali Beel is the smallest (10.2 acre). Details information are shown in (Figure 1 and 2).

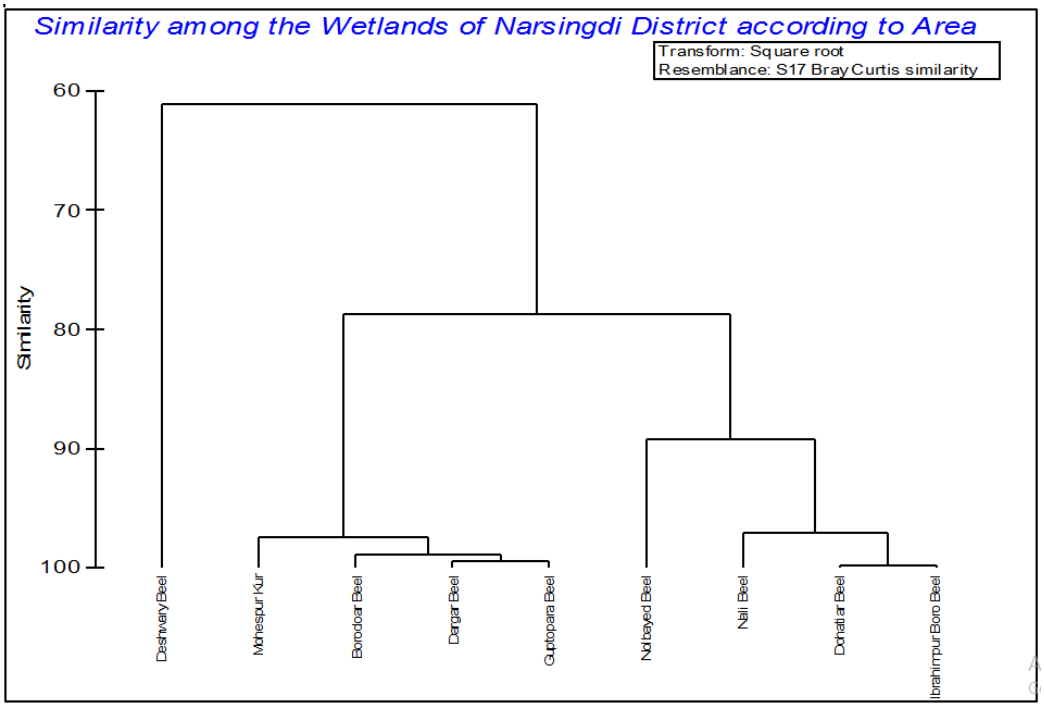


Figure 1: Dendrogram showing the percentage of similarity among different wetlands of Narsingdi district that was prepared on the basis of area

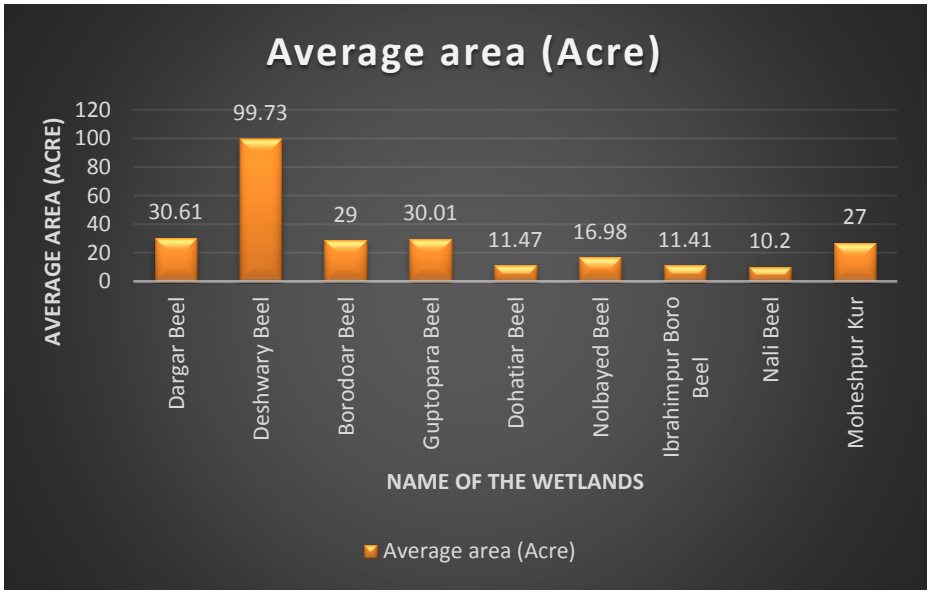


Figure 2: Average area of wetlants of Narsingdi District

Highest depth (m) was recoded from Moheshpur Kur (5.31m) during the rainy season whereas the lowest depth was found from Guptopra Beel (1.25m) during the dry season. Further more details about the depth of the wetlands shown in (Figure 3 and 4).

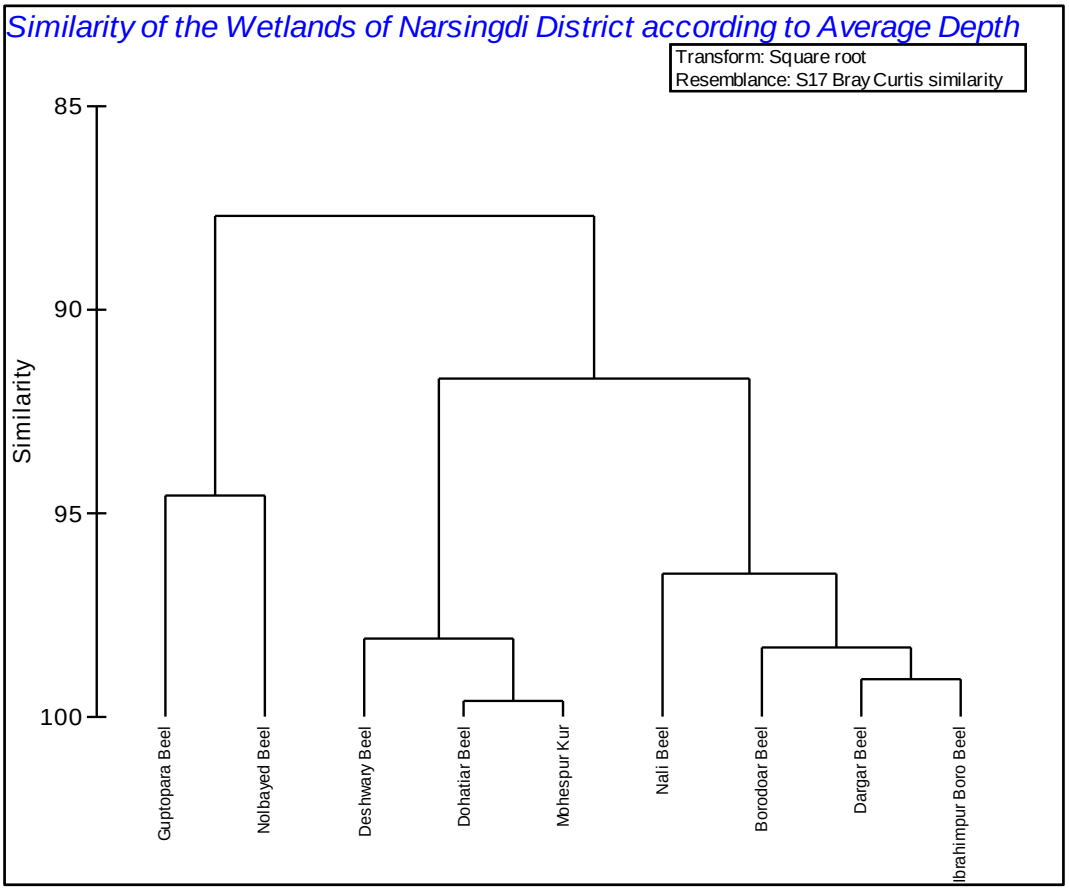


Figure 3: Dendrogram showing the percentage of similarity among different wetlands of Narsingdi district that was prepared on the basis of depth

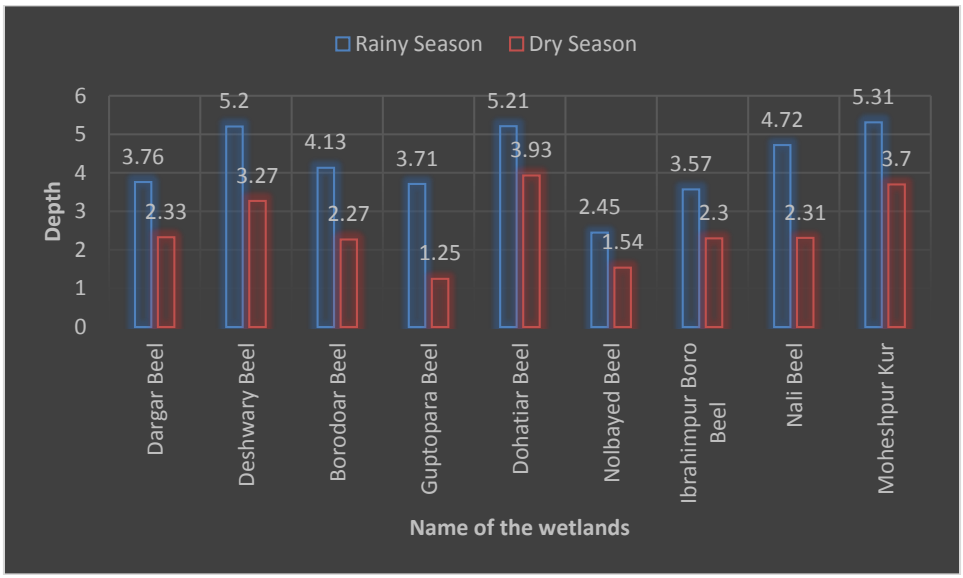


Figure 4: Depth (m) of different wetlands of Narsingdi district

The average soil organic carbon of different wetlands was 3.23%±0.85. The maximum value (4.3%) of soil organic carbon was recorded from Mohespur kur during rainy season where as the minimum value (2.1%) was recorded from Ibrahimpur Boro Beel during dry season. Amount of organic carbon of different wetlands shown in (Figure 5).

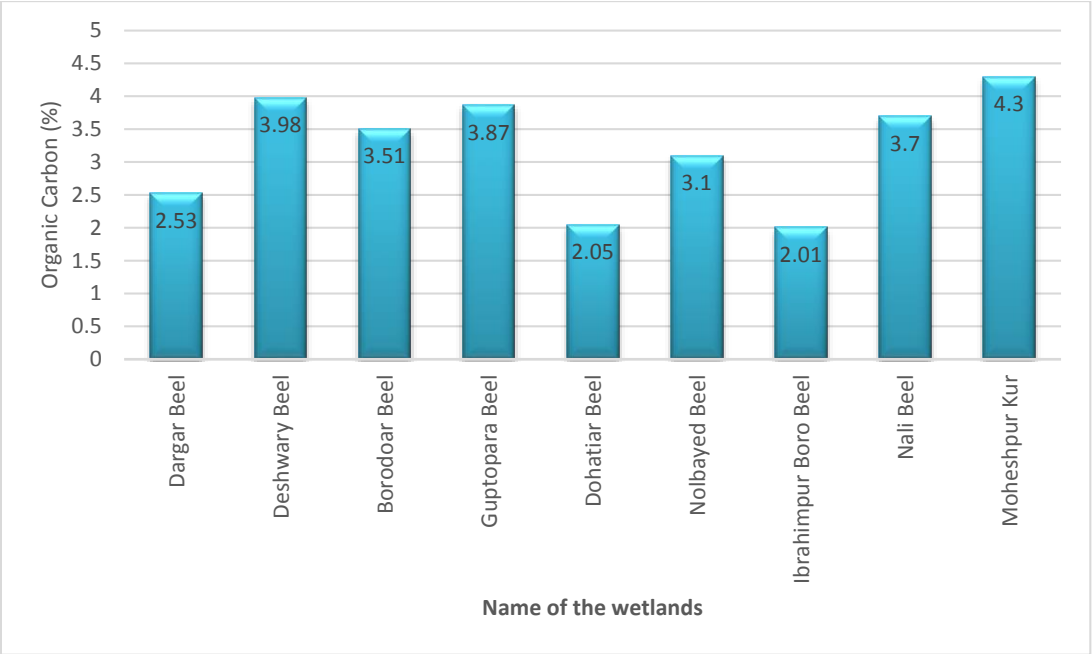


Figure 5: Organic carbon of different wetlands of Narsingdi district

The average soil organic matter of different wetlands was 5.40%±1.63 throughout the study. The maximum value (7.96%) of soil organic matter recorded from Deshwary Beel during rainy season and the minimum value (3.7%) was found from Ibrahimpur Boro Beel during dry season. Overall details shown in (Figure 6).

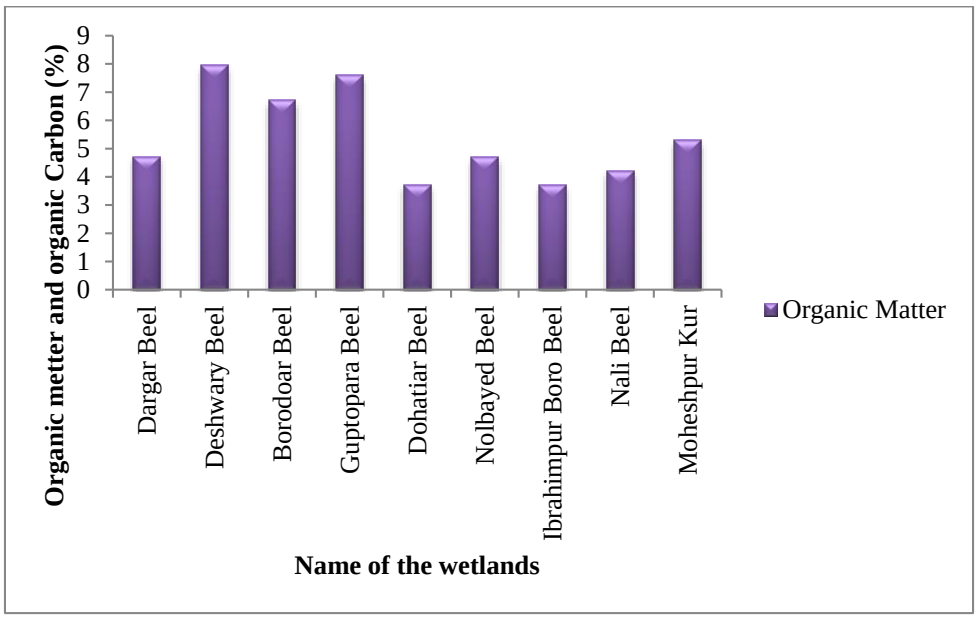


Figure 6: Organic matter of different wetlands of Narsingdi district

The average value of sand was recorded 54.45%±13.63. Highest value (72%) was recorded from Dohatiar Beel and the lowest value (32%) from Ibrahimpur Boro Beel. The average value of silt was recorded 18.28%±7.89. Highest value (30.3%) was found from Guptopara Beel and the lowest value (6.7%) from Nolbayed Beel. The average value of clay was recorded 27.24%±14.46. Highest value (50%) was recorded from Ibrahimpur Boro Beel and the lowest value (4.96%) from Guptopara Beel (Shown in Figure 7, 8 &9 respectively).

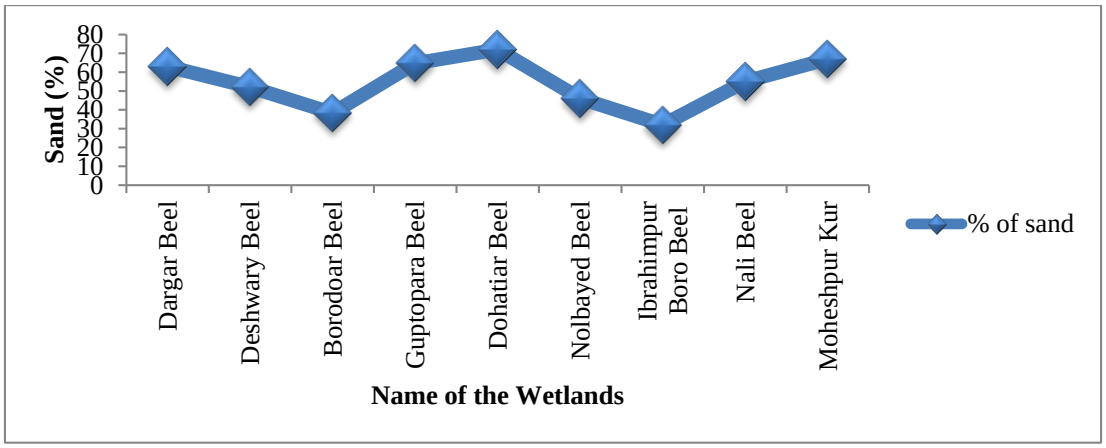


Figure 7: Sand texture of different wetlands of the Narsingdi District

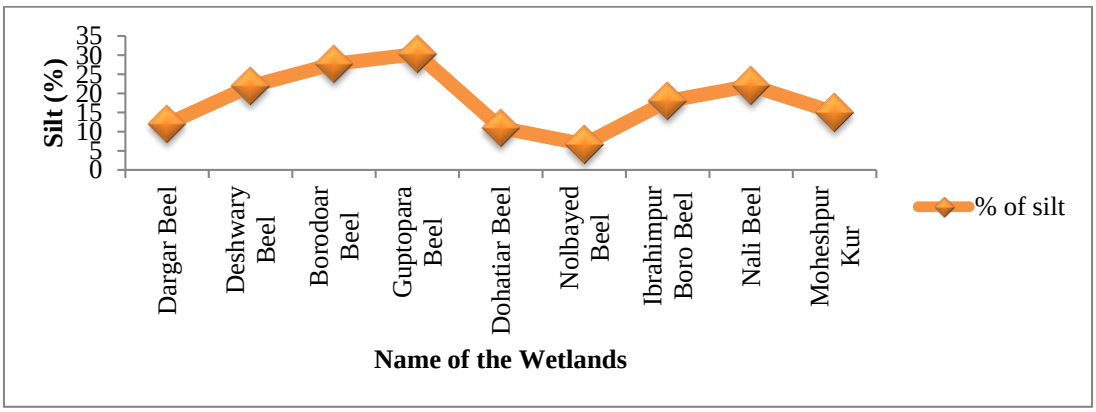


Figure 8: Silt texture of different wetlands of the Narsingdi District

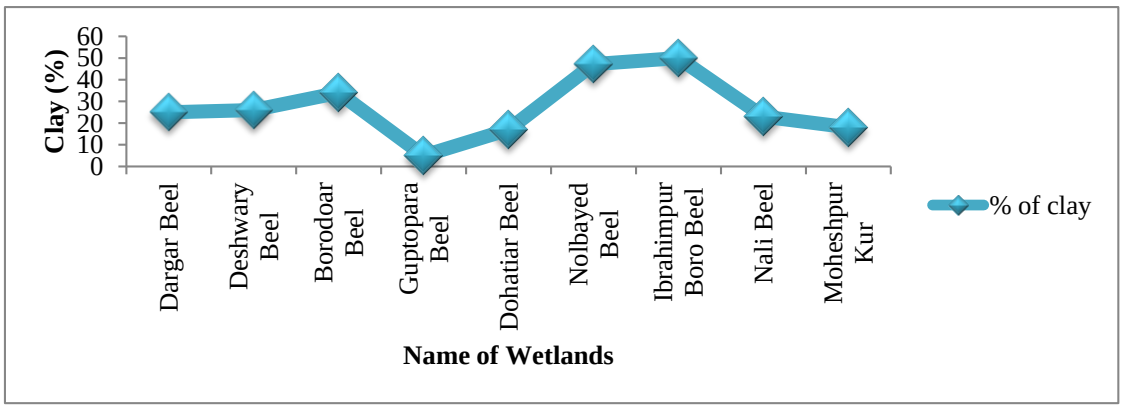
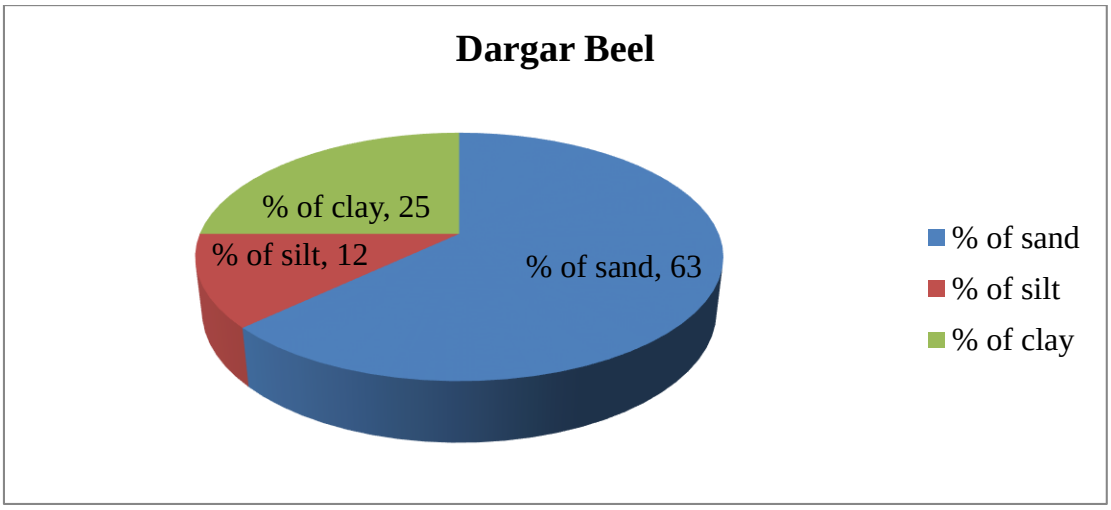
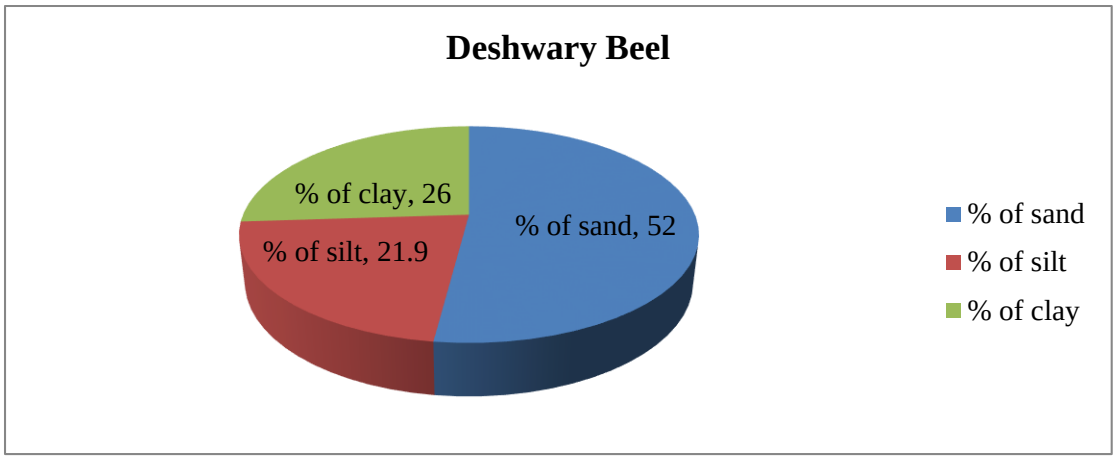


Figure 9: Clay texture of different wetlands of the Narsingdi District

Graphical representation (Pie Chart) of percentage of sand, silt, clay of different wetlands give an overview of easily understanding (Shown in Figure 10, 11 and 12).





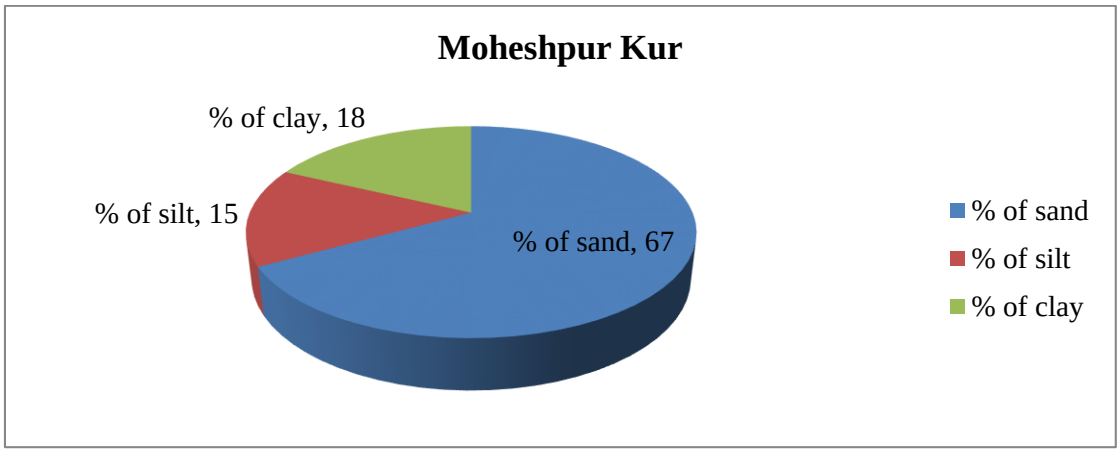


Figure 10: Soil texture of different wetlands of the Narsingdi District

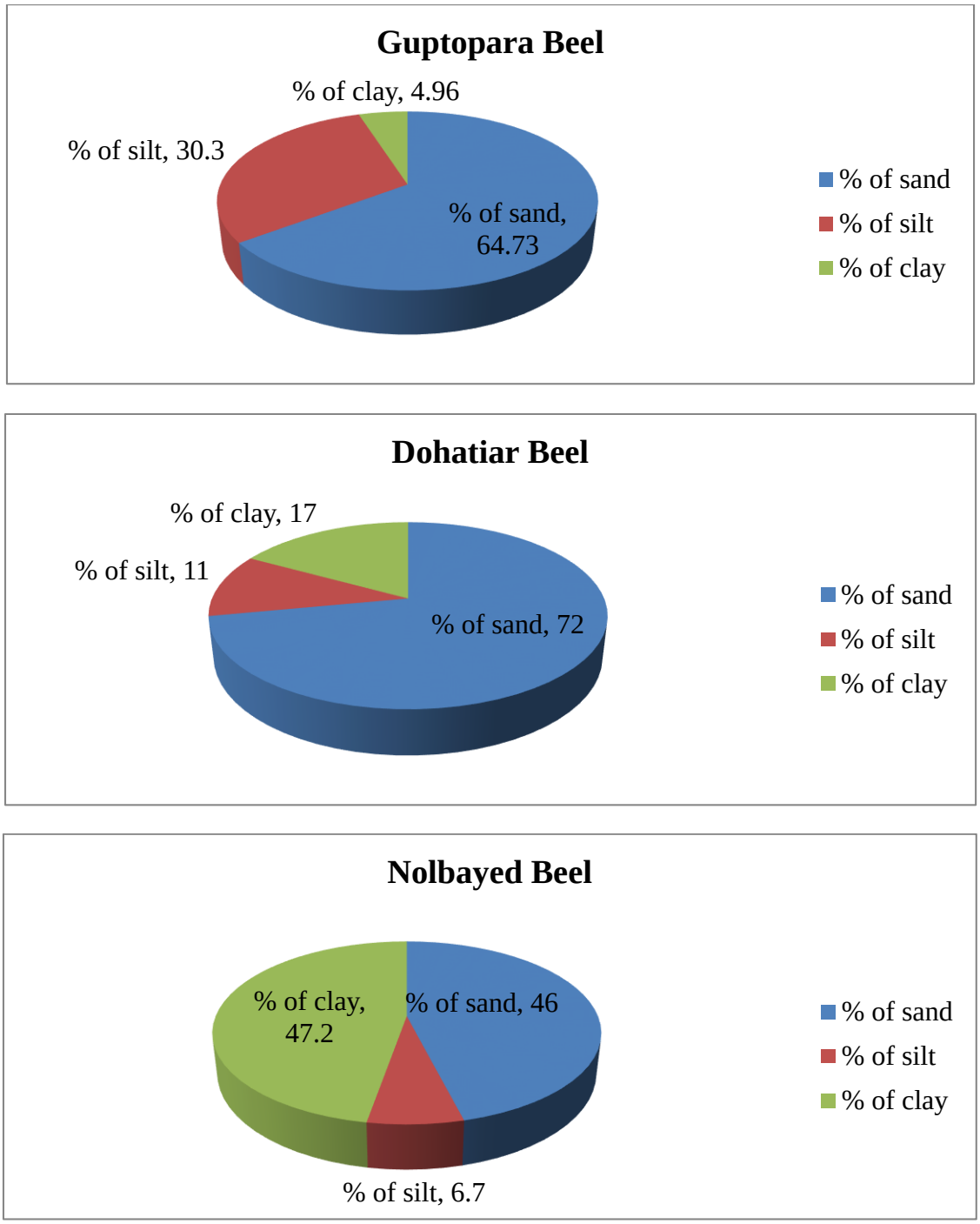


Figure 11: Soil texture of different wetlands of the Narsingdi District

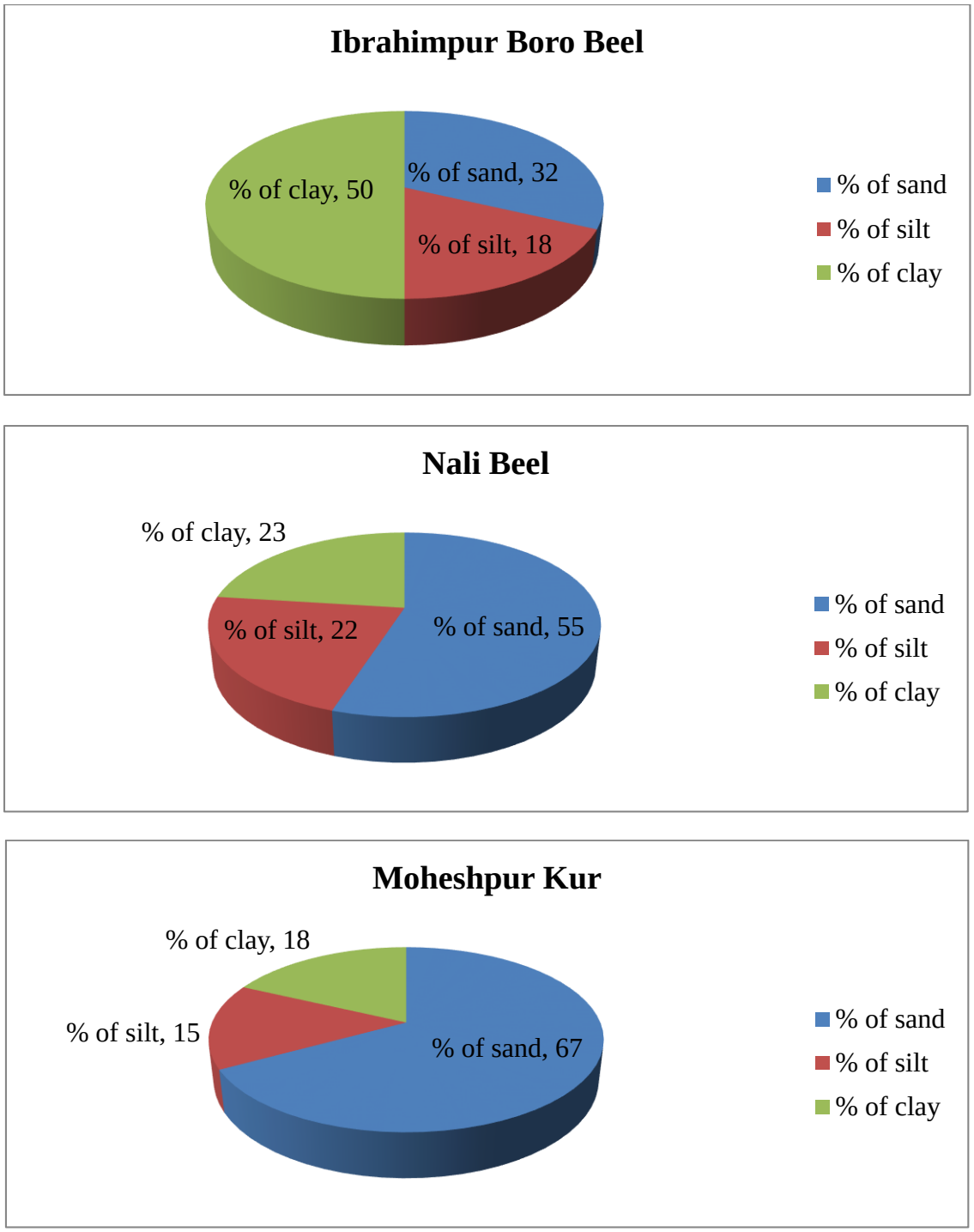


Figure 12: Soil texture of different wetlands of the Narsingdi District

IV. Discussion

Wetlands are important resources required judicious planning for sustainable development and prosperity (Zalidis and Mantzavelas, 1996). Wetlands are valuable as we found these are very productive. In our finding we found that there was a significant difference among the wetlands in terms of organic carbon, organic matter, sand, silt and clay as the alpha level ($p<0.05$) though some relationship prevail as the significance level ($p>0.05$). That means all the wetlands are equally productive. An inventory should constitute an information system that provides a geographically comprehensive picture of acquired information and should give insights into the wetland's temporal dynamics (Zalidis et al., 1997). To achieve this, a proper classification system and characterization are needed.According to (Zalidis et al., 1997) a total number of 9 wetlands had been recorded from the 4 Upazilla (Raipura, Belabo, Shibpur, Monohordi) of the Narsingdi district throughout the present study. The district is occupied by 120 wetlands whose individual area is greater than 10 acre. The wetlands occur in all the 6 Upazilla

of the district. Among the 6 Upazilla represents in 120 wetlands Maximum number (40) of wetland represent in Raipura, (24) Belabo, (15) Narsingdi Sadar, (27) Shibpur, (2) Palash, (11) Monohordi. Almost all this wetlands are being used for cultivation, especially fishery, paddy and during dry season it is hardly possible for anyone to different and identify them as wetlands and some of the wetlands were remain unexploited (Kilkus, 1986) and surrounded by water reservoirs, fish ponds, etc. (Basalykas, 1965). So far location is concerned, 9 wetlands are located in rural areas and the values are accordingly linked with the cultural status and the socio-economic needs of the rural people who use them. The abundance of water and wetlands has always been the geographically and historical destiny of Bangladesh. More than two third of Bangladesh may be classified as wetland according to the definition enunciated in the Ramsar Convention. About 6.7 percent of Bangladesh is always under water, 21 is deeply flooded (more than 90 cm) and 35 percent experiences shallow inundation (FAO, 1988). Mean depth of most of the water bodies does not exceed 4.5 m. There are only one wetland, Dohatiya Beel is depper than 4.5 m. The Sylhet basin is subdivided into the Surma-Kusiayara floodplain and Titas floodplain because of its lower elevation receives run-off from the Tripura hills, neighboring piedmont apron and adjoining Old Meghna estuarine floodplain as well as spilling from the Meghna River. In the rainy season, it becomes an enormous lake more than 12 feet deep. Sound scientific information identifying and quantifying the societal values of these' wetland functions is necessary before the public and governments will regard and therefore protect wetlands as a vital component of a sustainable healthy environment (Leitch and Fridgen, 1998; Scarth, 1998). Close interaction among researchers, user groups (e.g., agriculture, developers), and private and public agencies with various policy or management mandates is vital to the development of progressive conservation policy and management programs. Although the important of wetlands as a natural resource is much greater in district like Narsingdi than those in most of the districts of Bangladesh, Government schemes and project for management are operative different wetland. Characteristics of 9 wetlands in Narsingdi district reveal variation of different characters under different categories. With the application of these characters, a cluster diagram was prepared considering the similarities of their characteristics. It has been suggested that wetlands may contribute to the generation of rainfall locally and on a regional basis in drier areas of the continent (Smith, 1997). Removal or alteration of wetlands in these regions may therefore affect rainfall inputs and related hydrologic functions such as groundwater recharge. The role of wetlands in regional hydrological cycles requires investigation especially as overall climate change draws increasing attention (Robarts and Waiser, 1998). There was no remarkable variation of organic carbon in different wetlands of the study area. The organic matter content of the study area remind almost similar over the different wetlands. The amount of organic matter found from the different wetlands which are related to the optimum level of organic matter (%) for the aquaculture development. The most widely accepted model was proposed by (Pearson and Rosenberg, 1978), who suggested that, as the organic matter content increases, the species diversity decreases, the of individual increases. Organic content, mud content and water content of the sediments of the sediments were found to influence the abundance wetland biotic communities that were reported by (Groenewald, 2010). In this study soil organic carbon and organic matter also influenced various species of the wetlands.

V. Conclusion

From the foregoing it appears that various interesting and important characters are available in the investigated wetlands. These characters are valuable and significant in the preparation of an inventory so as to reflect the present status of wetlands. All data collected and analyzed during this Upazilawise survey (including all characteristics of important wetlands in each Upazila of Narsingdi District, sediment texture, land use and conservation measures, maps of all levels) were compiled in a special publication, which will serve as important tool for wetlands management and protection. Systematic study on the use of wetlands resources and their environmental and economic value has been carried out in Narsingdi District. A detailed inventory of wetlands resources should be carried out covering different eco-regions of the country. It is also better to do the study before destruction of the resources base.

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