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PEAT SOILS OF BANGLADESH, THEIR CHARACTERISTICS AND MANAGEMENT

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Abstract : Peat soil of Bangladesh is seasonally flooded, poorly to very poorly drained, very dark greyish brown to black organic soil. These soils include alternate layer of peat and muck, sometimes peat and mineral layer at the top of the profile. Two popular management techniques are practised in these areas namely, '*Sharjan*' and '*Gher*' procedure. In peat soils organic matter content is very high. Due to the presence of highly decomposed and partially decomposed orgnic matter, there is a possibility of root injury by H_2S gas. The main landuse patterns are: fallow-broadcast *aman*, fallow-mixed *aus* and broadcast *aman*, *Boro*-shrimp and *Boro*-mixed shrimp and T. *aman*. There are some possibilities to improve these soils having mineral layer at the top of the profile and by allowing the sediments settling on full organic soils.

Keywords: Peat soil, *Harta* soil, *Satla* soil

Introduction

In Bangladesh, peat soil covers an area of about 0.22 million hectares, which is 1.6% of the total area of the country. Peat soil occupies a number of basin areas lying between the Ganges river floodplains and the Ganges tidal floodplains of Gopalganj, Bagerhat and adjoining parts of Khulna, Barisal and Jessore districts. Peat soil is also found in the Sylhet basin. The main limitations of peat soil are deep flooding, perennially wetness, low bearing capacity and difficult to manage for crop production. Above all, this soil is generally low in agricultural production. Considering the above facts, a project was undertaken:

(a) to study physical and chemical properties of peat soil;
(b) to identify the constraints and
(c) to find out the development possibilities of the soil.

Materials and Methods

Ten soil samples were collected from different horizons of *Harta* and *Satla* soil series at Terokhada thana and *Beel* Dakatia of Fultala thana. The samples were air dried, ground and passed through a 2 mm sieve and bottled for chemical analysis. *In situ* soil physical properties were identified and described in Appendix-1 and 2. Soil pH was determined with a Pye pH meter using a glass electrode at a water suspension ratio 1: 2.5. Total carbon in soils was determined by the dry

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combustion method. Total nitrogen was estimated by Kjeldahl digestion method (Black, 1965). Ca, Mg and K were determined with neutral 1N NH_4OAC displacement method of Jackson (1973). Zn, Cu, Fe and Mn were extracted with DTPA and were determined by Atomic Absorption Spectrophotometer. Boron was determined by hot water extraction method.

Results and Discussions

Chemical Properties

Chemical properties of *Harta* soil series in Terokhada and *Satla* soil series in *Beel* Dakatia peat basins are shown in Tables 1 to 3. The soil reaction is generally slightly acidic (pH 5.9 - 6.4) throughout the profile in *Satla* and almost neutral in *Harta* soils (pH 6.3-6.9). Soil salinity ranges from non saline to slightly saline (ECe: 0.9 ds/m - 5.5 ds/m). From Table 1 it is revealed that organic matter content is very high. Organic matter content increases with depth in both the soils that vary from 18.2 - 45.5% in *Satla* and 24.2-44.7% in *Harta* soil. Total Nitrogen and Sulpher content shows the same trend as organic matter (Table 2). Total N varies from 0.78 - 1.7% and sulpher from 135.5 - 449.0 µgm/gm of soils. Almost all the macro and micronutrients are very high throughout the profile. The data shows that organic matter content and other cations are very high which means CEC is high. Pungent smell of H_2S gas was evolved during excavation of the profile.

Table- 1. pH, EC_e and organic matter (OM) content of (a) *Harta* and (b) *Satla* soil series.

(a) Harta soil series

Horizon	Depth (cm)	pH	EC_e ds/m	OM %
Ap_1	0-7	6.8	5.1	40.8
Ap_2	7-17	6.9	5.2	43.0
Oa	17-28	6.3	2.1	44.7
Oe	28-55	6.7	4.8	24.2
Oi	55-95+	6.4	0.94	41.4

(b) Satla soil series

Horizon	Depth (cm)	pH	EC_e ds/m	OM %
Ap	0-10	6.2	1.5	23.8
Oa	10-30	6.4	5.5	18.2
Oe	30-55	6.0	0.9	29.3
Oi_1	55-84	5.9	7.3	45.5
Oi_2	84-105+	6.4	4.8	33.9

Table 2. Macronutrient contents of (a) *Harta* and (b) *Satla* Soil series.

(a) Harta soil series

Horizon	Depth (cm)	Total N %	Ca	Mg	K	P	S
			meq/100 gm of soil				
Ap_1	0-7	1.54	23.5	7.8	0.43	6.9	135.5
Ap_2	7-17	1.7	24.2	7.7	0.38	9.1	135.5
Oa	17-28	1.57	25.2	6.5	0.29	6.1	449.0
Oe	28-55	0.78	21.5	6.50	0.54	4.4	232.5
Oi	55-95+	1.01	26.0	7.00	0.27	15.8	367.6

(b) Satla soil series

Horizon	Depth (cm)	Total N %	Ca	Mg	K	P	S
			meq/100 gm of soil				
Ap	0-10	1.10	22.0	5.00	0.27	12.4	175.8
Oa	10-30	0.9	20.7	4.50	0.41	9.8	146.5
Oe	30-55	1.09	23.3	5.25	0.42	4.5	367.0
Oi_1	55-84	1.60	28.0	6.25	0.32	4.8	351.0
Oi_2	84-105+	1.34	21.5	3.50	0.18	7.8	334.9

Table-3. Micronutrient contents of (a) *Harta* and (b) *Satla* Soil series.

(a) Harta soil series

Horizon	Depth (cm)	B	Cu	Fe	Mn	Zn
		µgm/gm of soil				
Ap_1	0-7	3.6	1.1	409.2	8.6	6.1
Ap_2	7-17	3.7	1.5	407.9	16.3	8.1
Oa	17-28	4.2	0.6	369.6	6.6	6.4
Oe	28-55	3.0	11.2	165.8	36.1	11.5
Oi	55-95+	2.5	1.8	47.8	24.4	8.8

(b) Satla soil series

Horizon	Depth (cm)	B	Cu	Fe	Mn	Zn
		µgm/gm of soil				
Ap	0-10	2.3	2.8	381.7	13.0	1.9
Oa	10-30	1.6	4.2	364.3	7.5	0.9
Oe	30-55	1.8	1.2	365.3	3.7	0.4
Oi_1	55-84	3.4	0.5	404.1	4.6	1.1
Oi_2	84-105+	2.5	1.5	31.9	48.4	6.5

Physical Properties

Physical properties of peat soil, *Harta* and *Satla* soil series at different horizons are described in Appendix-1 and Appendix-2. It shows that the organic soils are seasonally deeply to moderately deeply flooded, poorly to very poorly drained, very dark greyish brown to black muck or peat. Topsoil is dark grey to very dark grey clayey mineral layer and depth ranges from 10-17 cm. A lump of soil is lighter in weight than mineral soil when dried. Very late draining, low bearing capacity, irreversible shrinking property after drying, deep flooding in the wet season are the main limitations of peat soil. It may be mentioned that the drying of peat soil is hazardous due to the irreversible subsidence of the ground level.

Management of Organic Soil

The physical and chemical properties show that management of peat soil is very difficult. There are some development possibilities in small area having mineral horizon either at the top or close to the top but it depends on the thickness of mineral horizon. The thicker one will perform better management, e.g. tillage, sowing, transplanting etc. In large extensive area, development possibilities are limited due to lack of mineral matter in the profile. One way to overcome this difficulty is to improve the soils by allowing sediments settling on these peat basins from the adjoinig tidal rivers. This process of sedimentation should be continued for several years to make the land high and potential for agriculture. Consequently, at least two crops could be grown in a year. *Boro* followed by Transplanted/Broadcast *aman* could be grown by irrigation. There are

several management procedures of peat soil practised in these areas. Two of them widely used are described:

i) *Sarjan* procedure: Generally this procedure is practised in medium high to medium lowland, having late draining phase. In this case land is divided into several subplots. Between two subplots there is a ditch for keeping water permanently. Every subplot is raised by taking the soil from the adjoining site. Optimum size of the plot is 8m X 1.5m. It may be changed depending on the presence of mineral matter at the surface. The crops on the raised beds are mainly vegetables, sugercane and Dhaincha. Fish are cultured in the ditches between the two beds.

ii) *Gher* procedure: It is one type of fish culture area where both crops and fish are produced alternatively at the same time. The dyke (*ail*) is raised along the boundary of the plot by taking soil from inside of the plot. The digging part will be turned into a ditch to keep water for long time (dry season). The soil of the ditch is kept by the side of a raised dyke having a certain length, breadth and height. The landuse patterns are: *Boro*- shrimp (*Galda*) and *Boro* –mixed shrimp and T. *aman*. Vegetables and banana are grown on the raised dykes.

Development Possibilities of Peat Soils at Beel Dakatia

Beel Dakatia covering an area of about 10,000 hectares is moderately to deeply flooded, poorly drained peat basin. The whole basin was under permanently waterlogging since 1989 due to improper drainage condition. Sedimentation through tidal effect is one of the alternatives of the development possibilities of *Beel* Dakatia. It is observed from the previous experience that sediments did not reach to the distant part of the *Beel*. This could be done by excavating the channel opposite to the embankment, passing through the basin. The channels near the Hari river and Jahanabad Cantonment can be excavated upto the main river Bhairab. Feasibility of excavation of the above mentioned channels may be tested.

Conclusion

The improvenent of peat soil is not impossible but it is a difficult task. It is necessary to identify the category of problematic peat soils. Less problematic soils; organic soils with more than 25cm inorganic (mineral) layer could be developed through proper management individually with less cost involvement in a limited area. The more problematic soils; organic soils with less than 25cm inorganic (mineral) layer should be improved through Government agencies with high cost involvement in a large area. The soil chemical analysis data shows that organic matter (OM), N, P, K, Ca, Mg, S, Cu, Mn, Zn, B, Fe are very high in amount whereas physical properties of the soils are not favourable for the development of agriculture. In some cases, where mineral soils are present at the top of the layer, development activities could be done easily. In case of soil with full organic layer, soil could be improved through sedimentation process.

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APPENDIX-1

Soil Profile Description

USDA soil Classification:	Fluvaquentic Medisaprists
Soil series:	*Harta*.
Location:	Vill: Lebudia, Union: Chhagondaha, Thana: Terokhada.
Topography:	Peat basin.
Landuse:	*Boro*-Broadcast *aman* or Fallow – Mixed *aus* and broadcast *aman*.
Drainage:	Very poor.

Horizon	Depth	Description
AP_1	0-7cm:	Very dark grey (10YR3/1) moist; clay; massive; slightly sticky, non plastic wet, friable moist; many very fine tubular pores; many very fine roots;abrupt smooth boundary;pH 7.0.
AP_2	7-17cm	Dark Grey (10YR 4/1) moist: clay; massive; slightly sticky; non plastic; many very fine tubular pores; many very fine roots; abrupt wavy boundary;pH 6.0.
O_a	17-28cm	Very dark Grey (10YR3/1) moist; mucky clay; weakly developed coarse to very coarse prismatic structure; broken thick dark greyish brown cutans along the ped faces; slightly sticky, non plastic wet; clear smooth boundary; pH 6.5.
O_e	28-55cm	Very dark grey (10YR3/1) wet; no colour changes when squeezed firmly; fibers comprise less than 1/3 of total mass; when squeezed in hand, liquid removed is turbid and about 2/3 of the mass passes between the fingers, pH 7.0.
O_i	55-95cm	Very dark greyish brown (10YR 3/2) wet; fibers Comprise less than half of the total mass; when squeezed in hand, liquid removed is turbid and about half of the mass passes between the fingers.

APPENDIX-2

Soil Profile Description

USDA soil Classification:	Fluvaquentic Medisaprists.
Soil series:	*Satla*.
Location:	Vill: Maisaiali, Union: Atra Gilletala, Thana: Fultala.
Topography:	Peat basin.
Landuse:	Fallow –Mixed *aus* and broadcast *aman*.
Drainage:	Very poor.

Horizon	Depth	Description
AP	0-10 cm	Very dark grey (10YR3/1) moist; clay; massive; Slightly sticky, non plastic wet, friable moist; many very fine tubular pores; many very fine roots; abrupt smooth boundary; pH 7.0.
O_a	10-30 cm	Very dark Greyish (10YR3/2) moist; mucky clay; weakly developed coarse prismatic structure; broken thin dark grey cutans along the ped faces; slightly sticky, non plastic wet; clear smooth boundary; pH 7.0.
O_e	30-55 cm	Very dark greyish brown (10YR3/2) wet; no colour changes whensqueezed firmly; fibers comprise less than 1/3 of total mass; when squeezed in hand, liquid removed is turbid and about 2/3 of the mass passes through the fingers; pH 7.5.
Oi_1	55-84 cm	Very dark grey (10YR3/1) wet; no colour when squeezed firmly; fibers comprise less than half of the total mass; when squeezed in hand, liquid removed is turbid and about half of the mass passes between the fingers; pH 8.0.
Oi_2	84-105 cm	Very dark greyish brown (10YR3/2) wet; no colour changes when squeezed firmly; fibers comprise less than half of the total mass; when squeezed in hand, liquid removed is turbid and about half of the mass passes between the fingers; pH 8.0.