

Physico-chemical properties of some soils of Madhupur upazila under Tangail district

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Abstract: A laboratory study was conducted to assess the physicochemical properties of soils in six selected unions of Madhupur upazila under Tangail district for efficient land use and management. Six selected areas were Aronkhola, Alokdia, Mirzabari, Golabari, Sholakuri and Aushnara of Madhupur upazila. Twenty four soil samples were collected from 5-15 cm depth. The physicochemical analysis included soil texture classes, pH, EC, organic matter, total N, available P, S, Zn, Cu, Mn, exchangeable K and Na. The texture of the Aronkhola, Alokdia, Sholakuri and Aushnara soils were clay loam while Mirzabari and Golabari soils showed silty clay loam texture. The soil colour was found within brown to dark brown. Soil samples was 'slightly acidic' to 'medium acidic' (pH=4.29-6.05) in reaction. Organic matter contents were found at low to medium level. %Total N showed more or less same pattern of distribution as that of organic carbon. Available P and S contents were low in soils and most of thy samples contained below the critical level. The present study indicates that analyses of soils to determine its physicochemical characters are of utmost importance for better understanding and proper fertilizer recommendation for crop growth.

Keywords: Chemical properties, soils, Madhupur.

Introduction

Bangladesh is a densely populated country. The agriculture as a whole plays a vital role in the national economy of Bangladesh. Bangladesh has a wide range of complexity of lands. Soils of different areas have different requirements of fertilizers and limes for crop production and reclamation of soil acidity and alkalinity. Most of our farmers are not very much aware of modern cultivation techniques due to their inadequate knowledge. They use more and more inorganic fertilizers, mainly nitrogenous fertilizers to increase the crop yield. Excessive use of same fertilizer hinders the availability of other nutrients too. Many scientists expressed their concern over depletion of organic matter content in the soils due to improper use of inorganic fertilizers and growing one type of crop in the same land continuously through traditional practices. The proper fertilizer use depends on nutrient status of thy soils. Bangladesh spends a huge amount of natural resources and foreign exchange for making fertilizers available within the reach of thy farmers. So, judicious use of fertilizers should be assured. Madhupur tract a large upland area 4244 sq km in the central part of Bangladesh and Madhupur upazila is in the northern part of this. Land topography of this region is overall high. The high land is known as 'Tila' and plain land known as 'Baid'. Sal was thy dominant species of this upazila as well as whole Madhupur tract. Transplant aus and aman rice are commonly cultivated in Kharif season in Baid lands while potato, sweet potato, mustard and wheat are grown in Rabi season. The valleys are cultivated with boro rice in the dry season by impounding the streams for irrigation. Pineapples are grown extensively in Madhupur upazila. The area is also known for the production of mango, banana, pomelo and star apple. In view of above fact, the present fertility study was undertaken with the following objectives, to assess the physico-chemical properties of the soil, to evaluate the soil nutrient status of the areas under study, to use this information for soil reclamation and also for fertilizer recommendations to maximize crop production.

Materials and Methods

A brief description on the soil sample collection and analyses has been presented in this chapter. The soil analyses was carried out in the laboratories of the

Department of Agricultural chemistry, Soil Science and Central laboratory, BAU, Mymensingh in order to determine some physical and chemical properties of six selected unions of madhupur upazila of Tangail districts under AEZ No.28. Most of the lands of these regions are covered with forest plants. Soil samples were collected during the month of March, from the selected six unions at the depth of 5-15 cm. The soil samples were analyzed for the following parameters-soil texture, colour, pH, EC, organic matter, total nitrogen, available phosphorus, sulphur, zinc, copper, manganese, exchangeable potassium and sodium.

Methods for thy analyses of physical properties

Soil texture: Soil texture determinations were carried out by hydrometer method as outlined by Bouyoucos 1927 and piper 1950. The textural classes for different soil samples were then determined by plotting the results on a triangular diagram designed by Marshal 1947 following USDA system.

Methods for thy analyses of chemical properties

Soil pH: Soil pH was determined by glass electrode pH meter as described by Jackson 1973. The position of the electrode was adjusted in the clamp of the electrode holder. The electrode was immersed into partly settled soil suspension and pH was measured. The result was reported as soil pH measured in water (Soil and water ratio=1:2.5).

Electrical conductivity: The EC of collected soil samples was determined electrometrically (1:5 : soil: water ratio) by a conductivity meter using 0.01 M KCL solution to calibrate the meter following the procedure described by Ghosh *et al.* 1983.

Determination of organic carbon: Organic carbon was determined titrimetrically following Walkley and Black method and modified by Ghosh *et al.* 1983.

Total nitrogen: Total N content of soil was determined by Micro kjeldahl method where soil was digested with 30 % HO, and catalyst mixture. Nitrogen in the digest was determined by distillation with 40 % NaOH followed by titration of the distillate trapped in H BO with 0.01 % (NH) SO (Page *et al.* 1982).

Available phosphorus: Available soil P was determined by Olsen's method. Olsen *et al.* 1954). The sample was read with thy help of a spectrophotometer at 660 nm wave length (Jackson, 1973).

Available sulphur: Sulphur was determined by turbidimetric method with the help of a spectrophotometer (Wolf, 1982). The samples were read in a spectrophotometer at 420 nm wave length after 20 minutes.

Exchangeable potassium and sodium: Exchangeable K and Na contents were determined with the help of flame emission spectrophotometer using K filters. Percent emission was recorded following the methods outlined by Ghosh *et al.* (1983).

Available zinc, copper and manganese: Available Zn, Cu and Mn contents were determined by atomic absorption spectrophotometer (AAS, UNICAM 696) at the wave lengths of 213.9, 324.8 and 279.5, Respectively (McLaren *et al.* 1984) in the Central Laboratory of BAU, Mymensingh.

Results and Discussion

The present piece of research work was undertaken with a view to assess the physico-chemical properties of the soil for soil reclamation and fertilizer recommendations to maximize crop production of the Madhupur upazila under Tangail district. This chapter presents the results of the experiment followed by discussion. The whole results have been presented into the following three sections. 1. Physical properties of soil in the study area, 2. Chemical properties of soil in the study area, and 3. Nutrient status of the soil in the study area. Soil physical properties like soil texture and colour of twenty four spots of six selected unions of Madhupur upazila were determined and presented in Table 1.

Table 1. Physical properties of some collected soils of Madhupur upazila

Sample No.	Location	Soil separates			Textural Classes	Soil color
		Sand (%)	Silt (%)	Clay (%)		
1	Aronkhola-1	24.24	42	33.76	Clay loam	Dark brown
2	Aronkhola-2	23.67	42.33	34	Clay loam	Dark brown
3	Aronkhola-3	23.85	43.35	32.8	Clay loam	Dark brown
4	Aronkhola-4	24.15	42.83	33.02	Clay loam	Dark brown
5	Alokdia-1	23.57	42.34	34.09	Clay loam	brown
6	Alokdia-2	22.36	42.15	35.49	Clay loam	Dark brown
7	Alokdia-3	22.82	41.52	35.66	Clay loam	Dark brown
8	Alokdia-4	22.68	42.34	34.98	Clay loam	Dark brown
9	Mirzabari-1	16.37	54.33	29.3	Silty clay loam	Light brown
10	Mirzabari-2	18.46	51.79	29.75	Silty clay loam	Light brown
11	Mirzabari-3	16.34	53.84	29.82	Silty clay loam	Light brown
12	Mirzabari-4	17.06	52.99	29.95	Silty clay loam	Light brown
13	Solakuri-1	16.67	47	36.33	Clay loam	Dark brown
14	Solakuri-2	21.32	43.71	34.97	Clay loam	Dark brown
15	Solakuri-3	22.1	43.57	34.33	Clay loam	Dark brown
16	Solakuri-4	22.4	43.29	34.31	Clay loam	Dark brown
17	Golabari-1	18.47	46.12	35.41	Silty clay loam	Brown
18	Golabari-2	19.76	45.31	34.93	Silty clay loam	Light brown
19	Golabari-3	19.51	45.93	34.56	Silty clay loam	Brown
20	Golabari-4	19.66	46.22	34.12	Silty clay loam	Brown
21	Aushnara-1	23.62	43.89	32.49	Clay loam	Dark brown
22	Aushnara-2	23.9	43.09	33.01	Clay loam	Dark brown
23	Aushnara-3	24.13	43.48	32.39	Clay loam	Brown
24	Aushnara-4	23.49	43.81	32.7	Clay loam	Brown
Range		16.34 to 24.24	41.52 to 54.33	29.30 to 36.33		
Average		21.20	45.50	33.38	Clay loam to Silty clay loam	Brown to Dark brown

Soil texture: The results in Table 1 shows that soil texture of the selected spots of six selected unions of madhupur upazila were loam to silty loam type. The % sand of 24 soil samples were ranged from 16.34 to 24.24 percent with an average of 21.20 % and that of % silt were 41.52 to 54.33 % with an average of 45.50% percent while the range of % clay were 29.30 to 36.33 % with an average of 33.38 .Soil of Arorkhola, Alokdia, Solakuri and Ausnara union of Madhupur upazila were under the textural class clay loam whereas soils Mirzabari and Golabari unions were silty clay loam type. Hannan (1995) reported that the textural classes of Madhupur tract soils were mainly loam, silty clay and clay. Rahman *et al.* (2007) also reported that the mechanical fraction of Madhupur soil was sand 24.24 %, silt 42 % and clay 33.76 % resulting silty clay loam textural class.

Soil colour: Soil of the 24 selected spots of six selected unions of Madhupur upazila were light brown to dark brown in colour (Table 1).

Chemical properties: Soil chemical properties like soil pH, EC, organic matter, total N, available P, Zn, Cu, Mn,

S, exchangeable K, Na of 24 samples of six selected unions of Madhupur upazila were determined and presented in Table 2, 3, and 4.

Soil pH: The soil pH of the 24 selected locations of Madhupur upazila varied from 4.29 to 6.05 with an average of 5.30. Soil samples collected from different locations of Aronkhola-1, 2, 3, 4, Alokdia-4, Mirzabari-3, 4, Sholakuri-1, Golabari-2, 3, 4 have higher pH values than the average. On the other hand, soil samples collected from Alokdia-1, 2, 3, Mirzabari-1, 2, Sholakuri-2, 3, 4, Golabari-1, locations have pH values lower than the average. The results further revealed that the soils of all the selected locations of Madhupur upazila were acidic as the pH being below 7.0. According to BARC 2005, the soil pH of high land and medium high land under madhupur upazila ranged from 4.1-6.2 and 4.4-6.5, respectively. Rahman *et al.* (2007) also reported that the soil pH of Madhupur was 4.7.

Electrical conductivity: The soil electrical conductivity of the 24 selected locations of Madhupur upazila varied from 20 to 44 $\mu\text{S cm}^{-1}$ with an average of 31.5 $\mu\text{S cm}^{-1}$.

The highest EC value was found in case of soil sample collected from Golabari-4 and the lowest from Aronkhola-2. The results showed lower salinity level in the study areas. According to Nuruzzaman (1992), the EC of the non-irrigated soils of Madhupur upazilla ranged from 57-204 μ S cm⁻¹.

Table 2. Chemical properties of some collected soils of Madhupur upazilla.

Sample No.	Location	pH	EC(μ S cm ⁻¹)	OM(%)
1	Aronkhola-1	5.44	22	1.16
2	Aronkhola-2	5.55	20	1.25
3	Aronkhola-3	5.38	25	1.28
4	Aronkhola-4	5.45	24	1.23
5	Alokdia-1	4.29	27	1.04
6	Alokdia-2	4.76	24	1.14
7	Alokdia-3	5.03	23	1.19
8	Alokdia-4	5.88	27	1.09
9	Mirzabari-1	5.28	32	1.59
10	Mirzabari-2	5.18	33	1.34
11	Mirzabari-3	6.01	29	1.47
12	Mirzabari-4	5.60	31	1.31
13	Solakuri-1	6.05	29	1.05
14	Solakuri-2	4.47	33	1.02
15	Solakuri-3	5.11	32	1.14
16	Solakuri-4	5.30	32	1.19
17	Golabari-1	5.15	42	1.40
18	Golabari-2	5.95	43	1.41
19	Golabari-3	5.45	44	1.52
20	Golabari-4	6.00	42	1.43
21	Aushnara-1	5.10	37	1.14
22	Aushnara-2	5.15	34	1.20
23	Aushnara-3	4.94	33	1.28
24	Aushnara-4	5.08	37	1.22
Range		4.29 to 6.05	20 to 44	1.02 to 1.59
Average		5.30	31.5	1.20

Table 3. Macronutrient status of some collected soils of Madhupur upazilla

Sl. No.	Location	Total N(%)	Available P(μ g g ⁻¹)	Exchangeable k(cmol kg ⁻¹)	Available S(μ g g ⁻¹)
1	Aronkhola-1	0.15	11.40	0.14	6.70
2	Aronkhola-2	0.12	11.50	0.15	6.21
3	Aronkhola-3	0.14	10.30	0.15	6.51
4	Aronkhola-4	0.14	11.45	0.12	6.31
5	Alokdia-1	0.11	6.90	0.23	16.36
6	Alokdia-2	0.13	7.80	0.19	16.92
7	Alokdia-3	0.14	9.30	0.23	15.18
8	Alokdia-4	0.11	9.50	0.19	13.84
9	Mirzabari-1	0.20	10.20	0.08	8.11
10	Mirzabari-2	0.18	9.90	0.08	7.11
11	Mirzabari-3	0.17	13.50	0.06	7.31
12	Mirzabari-4	0.16	11.50	0.08	8.40
13	Solakuri-1	0.09	13.20	0.14	8.27
14	Solakuri-2	0.12	7.50	0.16	7.65
15	Solakuri-3	0.11	9.50	0.14	7.45
16	Solakuri-4	0.10	10.20	0.11	7.87
17	Golabari-1	0.16	13.80	0.11	14.04
18	Golabari-2	0.18	14.50	0.09	15.04
19	Golabari-3	0.17	13.70	0.13	14.40
20	Golabari-4	0.15	14.70	0.16	16.60
21	Aushnara-1	0.12	10.10	0.19	17.12
22	Aushnara-2	0.11	10.20	0.23	16.35
23	Aushnara-3	0.12	9.30	0.17	16.80
24	Aushnara-4	0.14	10.30	0.21	13.60
Range		0.09 to 0.20	6.90 to 14.70	0.06 to 0.23	6.21 to 17.12
Average		0.14	10.84	0.67	11.44

Organic matter: The soil organic matter of the 24 selected locations of Maadhupur upazilla varied from 1.02 to 1.59 % with an average of 1.20 %. Soil samples collected from different locations of Aronkhola union-2, 3, 4, Mirzabari-1, 2, 3 and 4, Golabari-1, 2, 3, 4 and Aushnara-3, 4 have higher organic matter content than the average. On the other hand, soil samples collected from alokdia-1, 2, 3, 4, Aushnara-1, 2, Sholakuri-1, 2, 3, 4 locations have organic matter values lower than the average. Maximum organic matter content of the soils was

found in the Mirzabari-1 location. Similarly the lowest content of organic matter was in the soil of the location Solakuri-2. According to Rahman *et al.* 2007, the organic matter content of Madhupur was 1.77 %. Nuruzzaman (1992) also found that % organic carbon of some non-irrigated soils of Madhupur upazilla ranged from 0.50-0.85.

Total Nitrogen: Results presented in Table 3 show that the % total nitrogen in soils ranged from 0.09 to 0.20 percent having an average value of 0.14 %. 13 samples collected

from Aronkhola-1, 3, 4, Alokdia-3, Mirzabari 1, 2, 3, 4, Golabari-1, 2, 3, 4 and Aushnara-4 presented greater amount than the average while Aronkhola-2, Alokdia-3, Sholakuri-1, 2, 3, 4 and Aushnara-1, 2, 3 presented lower amount. Highest % total N content in the soils was found

in the location Mirzabari-1. As per soil grade interpretation made by Bangladesh Agricultural Research Council (1997) nitrogen status of soils reflected that all samples were at very low level.

Table 4. Micronutrient status of some collected soils of Madhupur upazila

Sl.No.	Location	Exchangeable Na	Available Zn	Available Mn	Available Cu
1	Aronkhola-1	0.20	1.17	48.75	1.01
2	Aronkhola-2	0.24	1.28	52.56	1.36
3	Aronkhola-3	0.25	1.17	56.27	1.26
4	Aronkhola-4	0.27	1.32	63.94	1.29
5	Alokdia-1	0.29	0.71	73.64	1.12
6	Alokdia-2	0.35	0.65	62.92	1.71
7	Alokdia-3	0.28	0.83	51.83	1.38
8	Alokdia-4	0.29	0.72	38.49	1.92
9	Mirzabari-1	0.26	0.32	61.14	2.51
10	Mirzabari-2	0.24	0.24	51.37	2.76
11	Mirzabari-3	0.28	0.22	35.66	2.38
12	Mirzabari-4	0.25	0.32	46.9	2.64
13	Solakuri-1	0.35	0.68	71.29	2.52
14	Solakuri-2	0.35	0.47	63.76	2.41
15	Solakuri-3	0.33	0.344	68.63	2.21
16	Solakuri-4	0.34	0.36	36.32	2.24
17	Golabari-1	0.24	0.311	40.45	2.31
18	Golabari-2	0.24	0.266	50.43	2.53
19	Golabari-3	0.24	0.36	44.45	2.38
20	Golabari-4	0.25	0.224	50.43	2.47
21	Aushnara-1	0.25	1.26	44.76	1.33
22	Aushnara-2	0.25	1.26	66.35	1.26
23	Aushnara-3	0.26	1.17	61.27	1.38
24	Aushnara-4	0.24	1.42	56.56	1.71
Range		0.20 to 0.35	0.22 to 1.44	36.66 to 73.64	1.01 to 2.76
Average		0.27	0.72	54.13	1.92

Available phosphorus: Available phosphorus content in the soils of 24 selected locations of Madhupur upazila varied from 5.4 to 16.5 $\mu\text{g g}^{-1}$ with an average of 9.81 $\mu\text{g g}^{-1}$. Soil samples collected from different locations of Aronkhola-1, 2, 4, Mirzabari-3, 4, Sholakuri-1, Golabari-1, 2, 3, 4 had higher P values than the average. Similar findings were observed in BARC (2005).

Exchangeable potassium: Exchangeable K content in the soils ranged from 0.06 to 0.23 cmol kg^{-1} with an average value of 0.15 cmol Kg^{-1} (Table 3). Out of 24 locations there are 12 locations where soil exchangeable K content was higher. The highest K content was found from location Aushnara-2 while the lowest K content was from the location Mirzabari-3. BARC (2005) reported that the available K of Madhupur ranged from 0.09-0.18 cmol kg^{-1} soil. These results poorly confirmed the observations of BARC (2005).

Available sulphur: Available S of the 24 selected locations of Madhupur upazila varied from 6.21 to 17.12 $\mu\text{g g}^{-1}$ with an average of 11.44 $\mu\text{g g}^{-1}$ (Table 3). Highest S content was in Aushnara-1 soil where as the lowest content of S was found from the soil of Aronkhola-2. The result on the level of S deficiency in the study area seems comparable with that of nitrogen. This indicates the need of sulphur fertilization application to the soil for better crop production

Exchangeable sodium: The concentration of exchangeable Na in the soil ranged from 0.14 to 0.35 cmol kg^{-1} with an average value of 0.25 cmol kg^{-1} . The results of the present study showed the lower content of exchangeable Na. This lower amount of Na content of this

region might be due to the non irrigated crop cultivation in the study area. Because non-irrigated soil contain less exchangeable sodium than irrigated soils (Shankararayana, 1963).

Available zinc: Zinc content was at very low levels and expressed the deficiency of this nutrient. The result indicated that most of the samples were deficient in Zn possibly due to intensive cultivation of various crop in this area. BARC (2005) also held the same views.

Available copper and manganese: Sarker (1995) observed that Cu content in Madhupur tract soil ranged from 1.27 to 3.29 $\mu\text{g g}^{-1}$. The concentration of available copper in soils ranged from 1.01 to 2.76 $\mu\text{g g}^{-1}$ and the average value was 1.92 $\mu\text{g g}^{-1}$ (Table 4). The results on soil analysis showed that the available copper in maximum soils were at optimum level. The content of available manganese in soils varied from 36.66 to 73.64 $\mu\text{g g}^{-1}$ having an average value of 54.13 $\mu\text{g g}^{-1}$ (Table 4). The average Mn content of the soil sample was above the optimum level. Khan *et al.* (1997) showed that DTPA extractable Mn status of the different series of the Madhupur clay soils was 11 to 90 mg kg^{-1} .

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