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PHYSICOCHEMICAL CHARACTERIZATION OF THE FARM SOILS OF BINA SUBSTATION AT NALITABARI, SHERPUR (AEZ-22)

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Abstract

To investigate the physico-chemical characteristics of the soil's of Bangladesh Institute of Nuclear Agriculture (BINA) at Nalitabari, Sherpur. Forty-four composite soil samples were collected and analyzed. The results on the distribution of soil particle sizes of the 44 soil samples, 14 had a sandy loam texture, 8 had a loam texture, 16 had a clay loam texture, 3 had a sandy clay loam texture, one had a silt loam texture, and one had a sandy clay texture. The soil ranged from slightly acidic to moderately acidic. Nonetheless, the block's pH values varied from 5.90 to 7.05 depending on its depth. Soil organic C contents ranged from 0.80 to 1.76%. The status of nutrient elements viz. N, P, K and S in most of the samples was very low or very low to medium. The total N concentration of 44 soil samples at the BINA substation farm, Nalitabari (AEZ 22) ranged from 0.019 to 0.10%. The soils' available P ranged from 5.20 to 19.40 ppm, the amount of accessible S varied from 10.72 to 22.86 ppm. The exchangeable potassium concentrations of the soils varied between 0.82 and 1.548 me%, In general, soils collected from BINA substation farm, Nalitabari with varying depths have nearly identical exchangeable K contents. Considering the heavy metal the research areas' surface soil has a lower than allowed level of heavy metals. The result indicated that the evaluated soils are suitable for the cultivation of different crops following sustainable management practices with organic matter amended.

Key word: Physico-chemical analysis, Soil depth, acid soil, soil nutrients

Introduction

Bangladesh has one of the highest population densities in a disaster-prone region, making it highly vulnerable to natural hazards (Rahman *et al.,* 2018; Afrin *et al.*, 2018). The country's soils originate from various parent materials and are distributed across three primary physiographic regions: the Northern and Eastern Hills (12% of the total area), Pleistocene terraces (8%), and Recent floodplains (80%) (Islam *et al.*, 2017). Based on their formation and appearance, these soils are classified into 21 general categories (Moslehuddin *et al.*, 1997), with fourteen types found in floodplain regions, six in terraces, and one in the hilly zones. Bangladesh has been divided into 30 agro-ecological zones (AEZs) (FRG, 2024). Developing site-specific, AEZ-based nutrient recommendations can help achieve targeted yields while preserving soil fertility, making it a highly effective approach to fertilizer management (Jahan *et al.,* 2019).

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The Northern and Eastern Piedmont Plains, designated as the 22nd Agro-Ecological Zone (AEZ) of Bangladesh, cover an area of 403,758 hectares. The predominant soil types in this area include grey piedmont soils and non-calcareous grey floodplain soils. These soils range from loamy to clayey in texture, exhibit slightly to strongly acidic reactions, and generally have low to moderate fertility levels.

Acid soils are prevalent across Bangladesh, affecting approximately 30% of the country's arable land. It is estimated that 0.25 million hectares are very strongly acidic (pH <4.5), 3.71 million hectares are strongly acidic (pH 4.5-5.5), and 2.74 million hectares are slightly acidic (pH 5.6-6.5) (SRDI, 2018). Acid soils are characterized by toxic concentrations of aluminum (Al^{3+}), iron (Fe^{3+}), and manganese (Mn^{2+}), along with reduced availability of essential nutrients like phosphorus (P), calcium (Ca), and magnesium (Mg) (Rahman *et al.*, 2018). This widespread acidification is attributed to natural factors such as parent material and rainfall, as well as anthropogenic influences like intensive cropping, overuse of ammonium-based fertilizers, and deforestation (Rahman *et al.*, 2018). Acid soils not only reduce the availability of nutrients but also create toxic conditions that hinder root development and nutrient uptake, thereby limiting crop productivity (Sarker *et al.*, 2020).

In the past two to three decades, intensive agricultural practices have placed immense pressure on soil resources to meet the rising food demands of an expanding population (Sarker *et al.*, 2020). Sustainable crop production requires periodic adjustments in fertilizer application to meet specific nutrient demands (Haque *et al.*, 2019).

Deficiencies of macronutrients and micronutrientsmay be linked to imbalance fertilizer management practices by farmers. Studies suggest that nitrogen (N), phosphorus (P), and potassium (K) fertilizers contribute more significantly to crop yield during the dry season, while the effect of phosphorus is minimal during the wet season (Haque *et al.*, 2019). To address this issue, assessing soil nutrient status at the farm level is essential (Ahasan and Karim, 1988). Agricultural progress is a key driver of Bangladesh's economic development (Miah *et al.*, 2020). Sporadic studies have been conducted, but a comprehensive understanding of the soil properties in AEZs 22 is lacking (Ratul *et al.*, 2021).

This study aims to evaluate the physico-chemical properties of soils at the BINA substation farm at Nalitabari, Sherpur (AEZ 22). The findings will provide valuable insights into the status of soil acidity, nutrient availability, and fertility levels in the region. By addressing the challenges posed by acid soils, this research contributes to the broader goal of achieving sustainable agricultural intensification in Bangladesh.

Materials and Methods

Site selection

The purpose of this study was to characterize the soils of the BINA substation farms in Sherpur, Nalitabari belongs to the Northern and Eastern Piedmont Plains (AEZ 22) AEZs of the nation. The purpose of the study was to assess the physico-chemical properties of the soil in the various blocks of the farm area.

Fig. Sampling location BINA substation Nalitabari, Sherpur

Soil sample collection and preparation

In the study area, there were eleven blocks: Blocks A, B, C1, C2, D, E, F, G1, G2, LL, and HL. In March 2020, a soil sample was taken from each block separately. Soil samples were collected from each block at four different depths: 0-15 cm, 15-30 cm, 30-45 cm, and 45-60 cm. They were then transported to the laboratory. Every sample is a combination of randomly chosen locations from various blocks. The physico-chemical properties of the soil samples were analysed and examined at the Soil Science Division laboratory of BINA headquarters, Mymensingh.

Analysis of soil physical properties

The soil samples were analyzed using standard techniques, such as a hydrometer to measure particle size distribution as explained by Bouyoucos (1962), the hydrometer method was used to analyze the soil's particle size.

Analysis of soil chemical properties

Soil pH: Soil pH was measured in a suspension of soil and water on a glass electrode pH meter using a combined glass/calomel electrode, the soil-water ratio being 1: 2.5 (Jackson, 1973). Prior to making pH measurement, the electrode was calibrated using standard buffer solution at pH 4.0 and 7.0.

Organic matter: Organic carbon content of the soil was determined by wet oxidation method (Nelson and Sommers, 1982). The organic matter in soil was oxidized by 1N potassium dichromate solution and the amount of organic carbon was determined by titration against 0.5N ferrous sulphate heptahydrate solution.

Total nitrogen: Total N content in soil was determined by micro-Kjeldahl method (Bremner and Mulvaney, 1982). Soil samples were digested with conc. H_2SO_4 in presence of K_2SO_4 catalyst mixture (K_2SO_4: Cu_2SO_4, $5H_2O$: Se = 100:10:1). Nitrogen in the digest was estimated by distilling the digest with 10N NaOH followed by titration of the distillate trapped in H_3BO_3 indicator solution with 0.01N H_2SO_4.

Available phosphorus and sulphur: Available P content in soil was extracted by shaking the soil with 0.5M $NaHCO_3$ (pH 8.5). The extractable P in solution was then determined colorimetrically at 660 ηm wavelength (Olsen and Sommers, 1982). Available S content was determined by extracting soil sample with 0.15% $CaCl_2$ solution (1:5 soil-extractant ratio) from $CaCl_2$, $2H_2O$ and estimated by turbidimetric method using $BaCl_2$ crystals (Fox *et al.*, 1964).

Exchangeable base: Exchangeable potassium (K), calcium (Ca) and sodium (Na) content of soil was extracted by ammonium acetate extraction method. Extraction was done by repeated shaking and centrifugation of the soil with neutral 1N NH_4OAc followed by decantation. The extract was determined by flame photometer (Knudsen *et al.*, 1982).

DTPA extractable cations: Iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), led (Pb), cadmium (Cd) and nickel (Ni) content in soil was extracted with 0.005M DTPA solution (pH 7.3) and the concentrations was measured directly by atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

Statistical analysis

According to Russell's (1986) recommendation, the MSTAT computer package application was used to statistically evaluate the soil analysis results using mean and standard deviation.

Results

The results of soil physico-chemical characteristics e.g. particle size distribution (sand, silt and clay contents), soil pH, organic carbon, total nitrogen, available P and S, exchangeable cations (Ca, K, Na) and heavy/trace elements (Fe, Mn, Zn, Cu, Pb, Cd and Ni) contents are presented block wise in the Table 1-4.

Particle size distribution

Table 1 presents the findings on the distribution of soil particle sizes, including the distribution of sand, silt, and clay particles as well as the texture of the soils that were collected from various blocks and depths. Of the 44 soil samples, 14 had a sandy loam texture, 8 had a loam texture, 16 had a clay loam texture, 3 had a sandy clay loam texture, 1 had a silt loam texture, and 1 had a sandy clay texture. Block per block and depth, the distribution of sand, silt, and clay varied significantly. The soils ranged in texture from clay loam to sandy loam. The proportion of sand in AEZ 22 soils was greater than that of clay and silt.

Soil pH and organic carbon

The soils of various blocks with varying depths had pH values that ranged from slightly acidic to moderately acidic. The pH varied from 5.90 to 7.05 depending on its depth and blocks. Block B in the upper surface layer (0-15 cm) had the lowest pH value of 5.9 and the highest was found 6.55 in C1 block. In the deeper layer (46-60 cm) relatively higher pH value was observed and the lowest value was found in C1 block (6.30), whereas Block F and Block LL had the highest pH value of 7.05. The mean pH value of the surface layer (0-15 cm depth) was 6.28, that of the second layer (16–30 cm depth) was 6.59, that of the third layer (31-45 cm depth) was 6.67, and that of the fourth layer (46-60 cm depth) was 6.72. A significant problem that has a negative impact on crop productivity and soil fertility is soil reaction. The blocks and the depth of AEZ 22 (Northern and Eastern Piedmont Plain) did not significantly differ in terms of the pH values of the soil in the research locations. Shil *et al.* (2016) also discovered that the soil in the research locations was rather acidic to neutral in the AEZ 22. Excessive acidity damages soil health by increasing soil toxicity and nutritional element fixation (Hart *et al.*, 2013).

Organic Carbon

Soil samples from the research area (AEZ 22) had total C contents ranging from 0.80 to 1.76% (Table 2). The G2 block had the most total carbon (1.76%) among the soils of the various blocks of this AEZ, while the HL block in the fourth stratum had the lowest carbon (0.80%). The surface layer's mean total C concentration was 1.55%, which is comparable to Bangladesh's national average for soil carbon content. The investigated soils generally had low to medium levels of total carbon (FRG, 2024). All of the bio-physico-chemical characteristics of soils are accomplished by carbon, a crucial component (Islam *et al.,* 2018). Utilizing readily available organic resources, such as rice straw, cow dung, green manure, poultry manure, household wastes, and other crop residues, can raise the amount of carbon in soils, thereby enhancing soil health and guaranteeing the sustainability of crop production in the area under study.

Total nitrogen

Table 2 displays the total N concentration of 44 soil samples taken from the Northern and Eastern Piedmont Plains. The total N concentration of 44 soil samples at the Nalitabari location (AEZ 22) ranged from 0.060 to 0.10% in the surface layer and the C2 block in the surface layer have found the highest N content (0.10%). There is a decreasing trend of N content found with the deeper layer. The average surface layer content is 0.083%, which is low status of N content.

The most crucial factor in determining the effectiveness of nitrogen in agricultural fields is the amount of nitrogen in the soil (Mulvaney *et al.*, 2006). The balance of all nitrogen inputs and outputs to and from soil determines soil total nitrogen (STN), which includes both organic and inorganic forms. Rhizosphere activity frequently moderates STN (Liu *et al.*, 2018). According to BARC ratings, the total nitrogen content of the Nalitabari soils (Northern and Eastern Piedmont Plains) in various blocks and depths was nearly identical, and the status was low to medium (FRG, 2024) which is similar to this result of the study.

Available phosphorus and sulphur

Table 2 shows the amount of phosphorus that is accessible at the Nalitabari location (AEZ 22). The soils' available P ranged from 7.00 to 19.20 ppm, with the B block having the highest available P and the F block having the lowest (7.00 ppm). The optimal level of P was observed in the surface soil, with an average of 12.62 ppm.

Olsen method showed that only 39 of the 44 soil samples had more accessible P than the threshold level of 8 ppm (Table 2). The optimal pH range for soil P availability for plant usage is 6 to 7.5. Values below 5.5 and 7.5 to 8.5, which are frequently linked to soil parent material, restrict the amount of P that is available due to fixation by calcium, iron, or aluminum. Because P is easily fixed in acidic soils by interaction with Fe and Al. In the present study the average P value of the surface soil is 12.62 ppm which is low and Moslehuddin *et al.* (1997) observed a shortage of accessible P in acidic soils of terrace and hilly areas of Bangladesh which is relevant with this study.

The findings displayed in Table 2 also demonstrate the soil's accessible S content. In the Nalitabari site (Northern and Eastern Piedmont Plains), the amount of accessible S varied significantly from block to block in the surface layer, ranging from 12.14 to 19.14 ppm over depth. Among the surface layer (0-15 cm) S content, the highest was found 19.14 ppm in E block whereas the lowest 12.14 ppm was found in C1 block.

The surface layer's average available S is 14.51 ppm, indicating a little upper condition. Overall, the $CaCl_2$ extraction method revealed that nearly all of the 44 soil samples have more accessible S than the required level of 10 ppm. In the farm area, the available S status range was found to be extremely low to optimal (FRG, 2024).

The available sulphur content of the study area is low in average. In AEZ-22 (Piedmont Plains) of Bangladesh, soil generally exhibits low to medium levels of available sulfur, with some areas potentially experiencing severe deficiency. This is partly due to the sandy texture of the soil and the intensive agricultural practices in the region which is very similar to this present study (FRG, 2024).

Exchangeable potassium, calcium and sodium contents

The table 3 displays the exchangeable K content of 44 soil samples that were gathered from Nalitabari. Each block and depth has a different amount of exchangeable K. According to Table 3, the exchangeable potassium concentrations of the surface layer varied between 0.074 and 0.242 me%, with the mean surface soil values for the various blocks being 0.126 me%. In general, Nalitabari soils with varying depths have nearly identical exchangeable K contents. The majority of the soils in both AEZs had extremely low exchangeable K status.

The nutrient status of the study soil are poor is some case which is relevant to other soil of the same AEZ due to low soil pH, uneven chemical fertilizer application, increased nutrient removal by HYV crops, and a failure to incorporate crop residues and organic materials into the soil may all contribute to the poor status of essential nutrient elements like organic C, total N, available P, exchangeable K, and available S (Kumar *et al.* 2019).

The exchangeable calcium, potassium, and sodium amounts in the various soil depths at the various Nalitabari substation blocks were displayed in Table 3. The mean value of calcium in surface soil for the various blocks were 3.42 me%, with exchangeable calcium concentrations ranging from 2.90 to 3.96 me%. Regarding sodium, table 3 revealed that the exchangeable sodium levels of the soils varied between 0.239 and 0.411 me%, with the surface soil mean values of the various blocks being 0.278 me%.

Heavy/trace element contents

Table 4 displays the findings about the DTPA extractable heavy metals (Fe, Mn, Zn, Cu, Pb, Cd, and Ni) levels (ppm) of the surface soils at different Nalitabari substation blocks. The amounts of heavy and trace elements differed significantly among the research areas' blocks. With surface soil mean values of 180.16 ppm throughout the various blocks, Table 4 shows that the accessible Fe content ranged from 74.06 to 295.10 ppm.

The available manganese (Mn) content of the study areas ranged from 35.27 to 109.64 ppm in the surface layer. Among the block, the mean values were 73.33 ppmMn. The zinc is a plant nutrient as well as heavy metal and in the study areas the zinc content ranged from 0.96 to 2.87 ppm. The accessible with a mean value of 1.80 ppm for surface soil was found in the surface soil.

The copper (Cu) content of the different block in the study area ranged from 1.46 to 2.99 ppm of the surface layer (Table 4). The mean Cu content was found 2.40 ppm in the study soils. The lead (Pb) content of the study area of different block is presented in table 4. The Pb content was ranged from 0.71 to 1.86 ppm in the surface soil and the mean value was found 1.25 ppm.

The cadmium (Cd) content of the surface soil is presented in table 4. In the different block, the Cd content ranged from 0.030 to 0.083 ppm and the mean values of 0.052 ppm was found in the study soil. The nickel (Ni) content of the study area is presented in table 4. The available Ni content ranged from 0.77 to 1.337 ppm, with surface soil mean values of 0.938 ppm. The research areas' surface soil has a lower than allowed level of heavy metals.

Table 1. Soil texture in the different depth of various blocks

	Depth (cm)	%Sand	%Silt	%Clay	Textural classes
Block A	0-15	53.84	26	20.16	Sandy loam
	15-30	53.84	22	24.16	Sandy loam
	30-45	56.84	18	25.16	Sandy loam
	45-60	48.84	26	25.16	Sandy loam
Block B	0-15	45.84	30	24.16	Sandy loam
	15-30	35.84	26	38.16	Sandy clay loam
	30-45	40.84	28	31.16	Clay loam
	45-60	48.84	18	33.16	Sandy clay
Block C1	0-15	55.84	18	26.16	Sandy loam
	15-30	55.84	18	26.16	Sandy loam
	30-45	54.84	18	27.16	Sandy clay loam
	45-60	54.84	26	19.16	Silty loam
Block C2	0-15	43.84	26	30.16	Clay loam
	15-30	43.84	22	34.16	Clay loam
	30-45	50.54	19	30.46	Clay loam
	45-60	53.54	16	30.46	Clay loam
Block D	0-15	49.24	26	24.76	Sandy loam
	15-30	45.24	24	30.76	Clay loam
	30-45	45.54	22	32.46	Clay loam
	45-60	54.54	18	27.46	Sandy clay loam
Block E	0-15	47.24	30	22.76	Sandy loam
	15-30	47.24	24	28.76	Clay loam
	30-45	54.54	18	27.46	Sandy clay loam
	45-60	67.54	12	20.46	Sandy loam
Block F	0-15	51.24	24	24.76	Sandy loam
	15-30	55.24	20	24.76	Sandy loam
	30-45	68.54	12	19.46	Sandy loam
	45-60	65.54	13	21.46	Sandy loam
Block G1	0-15	47.24	26	26.76	Sandy loam
	15-30	59.24	16	24.76	Sandy loam
	30-45	65.94	12	22.06	Sandy loam
	45-60	73.94	7	19.06	Sandy loam
Block G2	0-15	56.64	22	21.36	Sandy loam
	15-30	52.64	18	29.36	Sandy loam
	30-45	45.94	22	32.94	Cay loam
	45-60	51.94	19	29.06	Clay loam
LL Block	0-15	58.64	22	19.36	Sandy loam
	15-30	58.64	14	27.36	Clay loam
	30-45	51.94	19	29.06	Clay loam
	45-60	35.94	30	34.06	Clay loam
HL Block	0-15	44.64	28	27.36	Cay loam
	15-30	45.64	25	29.36	Clay loam
	30-45	38.94	28	33.06	Clay loam
	45-60	57.94	16	26.06	Sandy loam

Table 2. Soil pH, total C, total N, available P and available S contents in different depth of soils at various blocks of Nalitabari sub-station

Block	Depth (cm)	pH	Total C (%)	Total N (%)	Available P (ppm)	Available S (ppm)
Block A	0-15	5.97	1.57	0.080	14.80	12.86
	15-30	6.43	1.14	0.039	14.00	14.06
	30-45	6.71	1.04	0.030	14.20	10.72
	45-60	6.82	1.42	-	16.80	-
Block B	0-15	5.90	1.52	0.090	19.20	16.80
	15-30	6.63	1.23	0.059	9.60	11.01
	30-45	6.45	1.28	0.046	8.40	11.58
	45-60	6.69	1.19	-	10.40	-
Block C1	0-15	6.55	1.09	0.060	15.60	12.14
	15-30	6.30	1.23	0.056	6.20	12.22
	30-45	6.46	1.42	0.039	11.80	11.70
	45-60	6.30	1.42	-	13.60	-
Block C2	0-15	6.17	1.66	0.100	13.60	12.46
	15-30	6.57	1.23	0.065	13.60	20.50
	30-45	6.66	1.04	0.041	13.60	22.86
	45-60	6.61	1.14	-	15.20	-
Block D	0-15	6.23	1.71	0.090	16.80	13.40
	15-30	6.73	1.19	0.069	14.20	18.82
	30-45	6.86	1.09	0.043	8.60	22.32
	45-60	6.93	1.04	-	13.00	-
Block E	0-15	6.27	1.42	0.080	10.20	19.14
	15-30	6.70	1.28	0.055	14.80	15.22
	30-45	6.77	1.04	0.037	10.20	14.38
	45-60	6.72	1.00	-	13.20	-
Block F	0-15	6.37	1.57	0.090	7.00	12.28
	15-30	6.81	1.42	0.040	11.40	17.56
	30-45	6.92	1.19	0.019	9.60	12.70
	45-60	7.05	1.04	-	15.40	-
Block G1	0-15	6.54	1.61	0.080	9.20	15.90
	15-30	6.64	1.38	0.061	11.00	14.86
	30-45	6.74	1.09	0.025	19.40	17.56
	45-60	6.93	1.04	-	14.20	-
Block G2	0-15	6.47	1.76	0.070	7.60	15.42
	15-30	6.58	1.23	0.051	11.20	11.26
	30-45	6.62	1.28	0.038	16.60	21.58
	45-60	6.63	1.14	-	9.00	-
LL Block	0-15	6.22	1.61	0.080	10.00	13.26
	15-30	6.78	1.23	0.058	6.60	11.82
	30-45	6.88	1.19	0.036	12.00	12.06
	45-60	7.05	1.28	-	5.20	-
HL Block	0-15	6.41	1.66	0.090	14.80	15.94
	15-30	6.32	1.02	0.062	11.80	12.14
	30-45	6.28	0.88	0.053	10.00	12.30
	45-60	6.16	0.80	-	12.20	-
Mean of surface soil		6.28	1.55	0.083	12.62	14.51
Range		5.97-7.05	1.04-1.76	0.019-0.100	5.20-19.20	10.72-22.86

Table 3. Exchangeable cations (Ca, K and Na) contents (meq %) in different depth of soils at various blocks of Nalitabari sub-station

Block	Depth (cm)	Exchangeable K	Exchangeable Ca	Exchangeable Na
Block A	0-15	0.095	3.34	0.239
	15-30	0.099	5.70	0.239
	30-45	0.148	3.84	0.318
	45-60	0.245	6.02	0.318
Block B	0-15	0.111	3.76	0.239
	15-30	0.128	3.92	0.318
	30-45	0.127	4.78	0.318
	45-60	0.118	6.60	0.398
Block C1	0-15	0.116	3.40	0.318
	15-30	0.118	3.60	0.239
	30-45	0.117	4.38	0.239
	45-60	0.164	4.72	0.239
Block C2	0-15	0.129	3.56	0.318
	15-30	0.112	4.40	0.318
	30-45	0.137	3.56	0.318
	45-60	0.119	4.86	0.318
Block D	0-15	0.074	3.38	0.239
	15-30	0.094	3.56	0.318
	30-45	0.094	3.62	0.318
	45-60	0.082	5.52	0.239
Block E	0-15	0.094	3.22	0.318
	15-30	0.097	2.80	0.318
	30-45	0.104	5.32	0.318
	45-60	0.086	4.12	0.239
Block F	0-15	0.110	2.90	0.239
	15-30	0.108	3.12	0.318
	30-45	0.087	3.40	0.239
	45-60	0.083	3.54	0.239
Block G1	0-15	0.130	3.10	0.318
	15-30	0.111	3.76	0.318
	30-45	0.097	4.62	0.239
	45-60	0.123	6.88	0.239
Block G2	0-15	0.157	3.60	0.318
	15-30	0.137	4.16	0.411
	30-45	0.193	5.62	0.318
	45-60	0.186	4.78	0.318
LL Block	0-15	0.125	3.40	0.318
	15-30	0.110	4.66	0.318
	30-45	0.154	6.76	0.411
	45-60	0.119	5.46	0.411
HL Block	0-15	0.242	3.96	0.411
	15-30	0.158	3.88	0.318
	30-45	0.135	4.13	0.239
	45-60	0.175	4.83	0.318
Mean of surface soil		0.126	3.42	0.342
Range		0.074-0.245	2.80-6.88	0.239-0.411

Table 4. Available heavy metal (Fe, Mn, Zn, Cu, Pb, Cd and Ni) contents (ppm) of the surface soils at different blocks of Nalitabari sub-station

Blocks	Available heavy metal contents (ppm)						
	Fe	Mn	Zn	Cu	Pb	Cd	Ni
Block-A	270.61	95.39	2.39	2.68	0.71	0.036	0.999
Block-B	295.10	65.43	2.87	2.99	0.92	0.034	1.039
Block-C1	74.06	35.27	0.96	1.46	0.83	0.030	0.798
Block-C2	171.46	81.50	2.00	2.87	1.45	0.046	0.933
Block-D	211.94	55.91	1.72	2.66	1.37	0.051	0.836
Block-E	166.09	109.64	1.53	2.51	1.25	0.052	0.828
Block-F	169.08	69.85	1.91	2.36	1.48	0.067	0.835
Block-G1	130.11	84.53	1.17	2.32	1.51	0.068	0.770
Block-G2	142.47	62.75	1.34	2.11	1.36	0.082	0.991
LL Block	195.17	57.21	2.10	2.48	1.86	0.083	0.952
HL Block	155.70	89.18	1.87	1.94	1.05	0.026	1.337
Mean	180.16	73.33	1.80	2.40	1.25	0.052	0.938
Range	74.06-295.1	35.27-109.64	0.96-2.87	1.46-2.99	0.71-1.86	0.03-0.083	0.77-1.337

Conclusion

The total carbon content was low to medium, the total N content was extremely low to low, the available P status was very low to optimal, the exchangeable K status was very low, and the available S status was very low to medium, among other key nutrient components identified in the different block of the study area. All of the soil samples from the Nalitabari area were found to be very slightly acidic to neutral in nature, for the cultivation of different crops following sustainable practices. This soil should be fertilized with a balance of chemical fertilizers and organic manures.

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