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PHYSICO-CHEMICAL PROPERTIES OF PADDY CULTIVATED SOIL IN SOME VILLAGES OF BARBHAG REVENUE CIRCLE, NALBARI DISTRICT, ASSAM

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ABSTRACT

The present paper deals with the study on some physico- chemical properties of paddy cultivated soils in some villages of Barbhag revenue circle, Nalbari district. A total 150 numbers of surface soil samples (0-15cm depth) from ten villages comprising 15 composite samples from each site were collected during the period of 2018-2020. The collected samples were air dried, sieved and analyzed for various physico-chemical parameters *viz.*, soil texture, bulk density(BD),water holding capacity (WHC), soil pH, electrical conductivity (EC), organic carbon (OC), available N, available P, available K, calcium (Ca),magnesium (Mg) and available S using standard analytical methods. The study revealed significant variations of most of the physico-chemical parameters. The soil of the paddy field was acidic in nature ranging of pH from 4.84 -5.85. Electrical conductivity was normal (<1 dS m^{-1}). The soil had moderate to high amount of organic carbon ranging from 0.58-0.99%, low to medium amount of available N, ranging from 226.33 -517.53 kg ha^{-1}, low to medium available P ranging from 19.21 -50.79 kg ha^{-1} and low to medium available K ranging from 101.9-314.85 kg ha^{-1}. Further soil texture showed sandy clay loam, clay loam, clay and silty clay in the experimental zones of the field. High value of BD and medium range of WHC also recorded in the soil samples sites. Medium to high ranges of available S and sufficient concentration of Ca and Mg was also recorded in our investigation. The present investigation showed that the nutrient quality of soil samples were not satisfactory in terms of paddy cultivation. So the study suggests using of environmental friendly manures which sustain agriculture ecosystem.

(Key words: Paddy, physico-chemical, ecosystem, Barbhag)

INTRODUCTION

Soil is one of the most important resources of the nature. It is not only important for agriculture but also have more useful for all kind of living organism. All living things in earth are directly depends on soil, as it provides food, fodder, fuel and feed (Palm *et al.,* 2007). There are five major components in soil *viz.,* inorganic minerals, water, air, organic matter and living organisms. Both physical properties and nutrients status of soils are involved for evaluation of soil productivity (Jibhakate *et al*., 2009). In Assam the deterioration of soil quality is serious problem for higher productivity of crop. The declining of crop productivity, deterioration of our agricultural soils causes due to various factors such as without balanced use of chemical fertilizer, excessive tillage practice and no use of organic manure.

The food productivity and environmental quality is dependent on physico- chemical properties of soil. In connection with overall growth and development of plant, the roles of different physico-chemical parameters are significant. The major constituent in chlorophyll, protein and nucleic acid is nitrogen which supports plant growth. The role of phosphorus is development of root and storage of energy. Most of required enzymes for plant contribute from potassium. For functioning of cell wall and cell division, calcium is one of the important component. Magnesium is major constituent for chlorophyll synthesis. The role of sulphur is significant for development of enzyme and vitamins. Movement of air and water through soil are controlled by physical properties as it forms basic foundation of physical properties (Varsha *et al.,* 2018). About 20% of the total cultivable land in the world bears low soil fertility for which one fourth population of the world has to face difficulties in earning livelihood from this type of land (Thombe *et al*., 2020).

Assam is one of the important state of India which play dominant role for cultivation of rice crop covering 2.7 million of hectare under rice cultivation, out of this 55% area used for mono cropping practices. Again 63% areas are utilized for cropping of sali rice (winter rice). In Assam different traditional practices such as plugging and pudding, straw incorporation after harvest has been applying in paddy field still now. But this type practices may lead to reducing the productivity and degrading the soil quality (Gayan *et al.,* 2020).

Nalbari district is situated in central western part of Assam. It is one of the agricultural dominant districts of lower Assam. Almost 80% population directly depends in agriculture. Rice is the major crop of this district. Farmers are directly involved for functioning of rice based crop system. The present study site has been continuously

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cultivated year after year with improper management practices which involve imbalance use of nutrients without scientific knowledge of status of soil quality. The present work deals with the physico-chemical analysis of paddy cultivated soil in Barbhag revenue circle of Nalbari district, Assam. However, there is no specific evidence on the systematic study of the physico- chemical properties of cultivated soil in the region especially in Barbhag revenue circle of Nalbari district, Assam. Therefore, the present study was designed to investigate the physico-chemical parameters of cultivated soil for the evaluation of nutrient level of soil sample. The finding of the investigation may help the farmers to know that the nutrient quality of soil and so that they adopt necessary steps for enhancing the crop productivity.

MATERIALS AND METHODS

Study site

Nalbari district lies between 20^0 N latitude and 91^0 E longitudes. The climate of the site is basically subtropical in nature with warm and humid summer followed by cool and dry winter. The average rainfall of the district is 2050 mm. Temperature in winter ranges from 11^0 C to 23.2^0 C and summer temperature lies from 23.7^0 C to 35^0C. . There are seven revenue circles of Nalbari district. Barbhag revenue circle is situated in the southern part of the district. As per the census India, 2011, the circle has 13494 house holders with the population of 67522. The geographical area of the circle is 6681.9 hectares and 5629.0 hectares comprises total cropped area (Anonymous, 2022).

Sample collection

Soil samples were collected from ten different villages after harvesting the crop during the period of 2018-2020. These ten villages were Bausiudaypur, Bajali udaypur, Nanoi , Jugurkuchi, Sonkani, Ksudrakuchati, BarkuIhati, Bangalmur, Ranakuchi and Pandula.

A total of 150 numbers of surface soil samples (0-15 cm depth) were collected from ten villages (15 no. of samples from each village) with the help of core sampler. During the collection of samples, composite samples were prepared. To obtain a composite sample, 10-15 different soil samples were collected randomly and mixed thoroughly. All composite soil samples were dried at room temperature and passed through 2 mm sieve and preserved in colorless polythene bags for analyzing twelve number of various physico-chemical parameters *viz*., soil texture, bulk density, water holding capacity, soil pH, EC, OC, available N, available P, available K, Ca, Mg and available S. All physical and chemical parameters were analyzed according to standard procedure. The soil texture was determined by hydrometer method (Bouyoucos 1927). Bulk density and water holding capacity were determined as suggested by (Baruah and Barthakur, 1997). The pH was determined by using method followed by Piper (1950) and electrical conductivity was recorded as per method detailed by Jackson (1973) and organic carbon by Walkley and Black (1934). Available N was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956), available P by Olsen's method (Olsen *et al.,* 1954), available K by neutral ammonium acetate method (Black, 1965). Available S was determined by Tribidimetric method (Chesnin and Yien, 1950). Exchangeable Ca and Mg were determined by using ammonium acetate extract by atomic absorption spectrophotometer (Jackson, 1973). Different statistical analyses such as mean, standard deviation, maximum and minimum were carried out for all soil samples (Gupta, 2023).

RESULTS AND DISCUSSION

Soil physical and chemical properties

Soil texture

Soil texture directly influences soil water retention, aeration and root penetration. Soil is having different textural groups, on the basis of proportion of different size particles. During the present study four types of soil were recorded, these were sandy clay loam (SCL), clay loam (CL), silty clay (SC), and clay(C) (Table 1). Similar type of results earlier reported by Vadivelu *et al*. (2004), who recorded as sandy, loamy sand, loam, silty clay and clay on 107 soil series of Assam including the soil series of Maroa, Tihu and Nalbari of Nalbari district.

Bulk density

In the present study the bulk density varied from 1.21-1.48 g cm^{-3} with the mean value of 1.34 g cm^{-3} (Table 2). Among the villages, the highest and lowest bulk density was recorded at Bausiudaypur village (1.42 g cm^{-3}) and Barkulhati village (1.27 g cm^{-3}). It was indicated that most of the villages showed high bulk density. This is due to more puddling operation in the paddy field. These findings were confirmed by Singh *et al.* (2009), who reported that bulk density gradually increases with the compaction of soils due to operation of enormous tillage and puddling in rice-wheat cropping system of Indian Punjub. In our investigation it was found that sandy soil showed high bulk density as compared to clay soils. Similar results earlier reported by Pravin *et al.* (2013), who recorded high degree positive correlation with sand content (r = 0.9094) and significant negative correlation with clay content (r = -0.6332) in Coimbatore soils.

Water holding capacity

Water holding capacity ranged from 39.74-60.26 % with mean value of 50.14%. From the Table 2, maximum water holding capacity was noticed at Ksudrakulhati village (54.92 %), while minimum content at Sonkani village (46.17%). Water holding capacity is directly connected with organic carbon. High percentage of organic carbon contributes high WHC. It indicates that soil organic carbon influences the ability of soils to retain moisture. Same trend was observed in our investigation. Nath (2015) reported the same findings, who reported a significant correlation (r =

0.804) with organic carbon in Roadside tea cultivated soils in Dibrugarah district of Assam.

Soil pH

During the present study, pH of soil samples ranged from 4.84 - 5.85 with the mean value of 5.45. The data presented in Table 3 revealed that the highest and lowest pH value was recorded in villages Bausiudaypur and Ranakuchi with the mean value of 5.71 and 5.15 respectively. The normal pH for soil is 6.5-7.5. From our investigations it was found that soils all villages showed acidic in nature. In the study fields, farmers use inorganic fertilizers instead of organic manure, rice straw residue, which helps to decline the pH value in soils. Soil acidity may also causes due to decomposition of organic matter by micro organisms which release acid like –COOH and –OH group. (Lalrinfela *et al.,* 2016). The cultivated soils in Assam are moderately acidic. Similar results were also reported by Basumutary *et al.* (2014), who also recorded pH in the range of 4.91 to 6.28 with the mean value of 5.64 in soils of upper Brahmaputra valley zone of Assam. Reza *et al.* (2012), also investigated nature of acidity in different land use system of Jorhat district in Assam and found that paddy growing soils were strongly to moderately acidic (pH 4.4 to 5.4).

Electrical conductivity

The EC content in our investigation ranged from 0.08-0.22 dS m^{-1} with the mean value of 0.11 dS m^{-1}. The highest and lowest value was recorded in villages Sonkani and Bausiudaypur with the mean value of 0.23 dS m^{-1} and 0.04 dS m^{-1}. If EC < 1 dS m^{-1}, then soil is free from salt. So from the Table 3, it was found that soil samples in all villages showed negligible effect of salinity. Leaching of salts to lower horizons may cause the normal EC in soils. Earlier Karmakar (2014) reported same findings in Assam soils, who reported that the electrical conductivity was 0.04- 0.32 dS m^{-1}) in different land forms of north bank plain of Assam.

Organic carbon

The organic carbon content ranged from 0.58-0.99% with the mean value of 0.82%. According to Kalita and Maibangsa (2020), 60% soil samples were found under high (> 0.75%) category, 24% under medium (0.5-0.75%) and remaining 16% under low category (< 0.50 %). This type of results were confirmed by Kalita and Maibangsa (2020), who reported that organic carbon in soil ranged from 0.42 to 1.12% with an average value of 0.58 % in soils of Lumbajong block of Karbi Anglong district of Assam. From the Table 3, the highest value of organic carbon was recorded in village of Ksudrakulhati with the mean value of 0.98%. Similarly the lowest value was recorded in village of Nanoi with the mean value of 0.69%. From the Table 3, it is revealed that amount of organic carbon was not sufficient in villages of Bausiudaypur and Nanoi, but remaining villages present sufficient amount of organic carbon. Different management practices and manuring systems provides the variation of organic carbon. Cooper *et al.* (2021) reported that improper management practices, such as enormous tillage and continuous single cropping preferably rice for long time helps in decreasing the organic carbon.

Available N

In the present study the content of available N ranged from 226.33 - 517.53 kg ha^{-1} with the mean value of 345.96 kg ha^{-1}. According to Baruah and Barthakur (1997), 68% soil samples were fall under medium (272 to 544 kg ha^{-1}), 20% under high (> 544 kg ha^{-1}) and remaining 12% under low (<272 kg ha^{-1}). This revealed that soils were low to medium in available nitrogen. As Assam falls under high rain fall area, so highly mobile nitrogen may lost from rice fields through volatilization and leaching. Similar type of results were also reported by Basumutary *et al*. (2021), who recorded that available N status in soil ranged from 181.0-414.4 kg ha^{-1} with the mean value of 345.6 kg ha^{-1} in soils of Dima Haso district of Assam. Among the villages, the highest and lowest content of available N was recorded in villages of Jugurkuchi and Sonkani with the value of 385.92 kg ha^{-1} and 292.17 kg ha^{-1} respectively. From the Table 4, it is noticed that the mean amount of available N in all villages were found to be under medium range. The variation in available N content in soil occurs due to difference in physiography, different cultivation and management practices as well as removal of N by crop, loses through leaching, denitrification and volatilization (Mane *et al.,* 2022).

Available P

Available P varied in soil samples from 19.21 to 50.79 kg ha^{-1} with the mean value of 34.82 kg ha^{-1}. Based on limitation suggested by Baruah and Barthakur (1997), 58% of samples were obtained in medium range (22.5 to 56 kg ha^{-1}), 35% in low (< 22.5 kg ha^{-1}) and remaining 7% in high (> 56 kg ha^{-1}) category. This showed that all the samples analyzed were found low to medium of available phosphorus. Again the mean amount of available phosphorus in all villages was found to be under medium amount. As the soil samples in all villages were acidic in nature, so soil acidity may fixes the phosphorus into unavailable form. From the Table 4, the maximum and minimum content of available P was noticed at Ranakuchi village (40.15 kg ha^{-1}) and at Nanoi village (28.16 kg ha^{-1}) respectively. This type of results were earlier reported by Basumutary *et al.* (2019), who reported that the phosphorus content in soil ranged from 9.5-62.5 kg ha^{-1} with the average value of 32.4 kg ha^{-1} in soils of Dhubri district of Assam. The limited presence of phosphorus in certain soils could result from phosphorus binding to clay mineral surfaces over time, occurring between the application of fertilizer and the absorption of nutrients by crops (Amruta *et al*., 2023).

Available K

The available K in the study area ranged from 101.9 - 314.85 kg ha^{-1} with the mean value of 232.4 kg ha^{-1}. According to Baruah and Barthakur (1997), 50% of soil samples were found under low (< 136 kg ha^{-1}), 40% samples under medium (136 to 337.5 kg ha^{-1}) and 10% samples under high (> 337.5 kg ha^{-1}) category. From the Table 4, the

maximum content of available K was recorded in Barkulhati village (295.62 kg ha^{-1}), whereas the minimum content of potassium was observed in Sonkani village (167.92 kg ha^{-1}). Farmers applied lesser amount of K-type fertilizer in paddy fields, which supports the low to medium range of available potassium in soils. Similar results were also recorded by Basumutary *et al.* (2019), who found available K content in soil ranged from 63.2 - 332.1 kg ha^{-1} with the mean value of 176.5 kg ha^{-1} in soils of Dhubri district of Assam.

Exchangeable Ca and Mg

The exchangeable calcium and magnesium under study showed the range between 2.16-2.52 cmol (p+) kg^{-1} and 1.62 to 2.01 cmol (p+) kg^{-1} with the average value of 2.33 cmol (p+) kg^{-1} and 1.78 cmol (p+) kg^{-1}. In our findings the concentration of Ca was found to be higher as compared to magnesium. Similar findings were noticed by Devi *et al.* (2023) in upper Brahmaputra valley zone of Assam, who recorded that the exchangeable Ca and Mg varied from 1.40 to 2.64 and 0.70 to 2.00 cmol (p+) kg^{-1} with the mean value of 2.11 and 1.89 cmol (p+) kg^{-1} respectively. From the Table 5, the maximum and minimum content of Ca was recorded in Bausiudaypur (2.58 cmol (p+) kg^{-1}) and Ranakuchi villages (2.08 cmol (p+) kg^{-1}) respectively. Again maximum and minimum content of Mg was observed in villages Ksudrakulhati (2.08 cmol (p+) kg^{-1}) and Ranakuchi (1.46 cmol (p+) kg^{-1}) respectively. Considering 1.50 and 1.00 cmol (p+) kg^{-1} as critical limit for exchangeable Ca and Mg, It was observed that all villages present sufficient amount of Ca and Mg.

Available S

The status of available S in our investigation ranged from 8.93-52.61 mg kg^{-1} with the average value of 28.57 mg kg^{-1}. On the basis of ratting suggested by Ram and Dwivedi (1994), 23% of samples were found under deficient (<10 mg kg^{-1}), 42% samples in the medium (10 to 22 mg kg^{-1}) range and remaining 35% samples were in the sufficient range (>22 mg kg^{-1}). Means our soils were having medium to high amount of available sulphur in soils. From the Table 5, the maximum and miniumum content of available S was observed at Barkulhati village (38.28 mg kg^{-1}) and at Sonkani village (22.16 mg kg^{-1}) respectively. In all villages the mean content of available sulphur was sufficient, which indicates that S can meet demand of crops. Simillar type of results were observed by Borkotoky *et al.*(2024), who reported that the available S ranged from 4.51 to 63.33 mg kg^{-1} with the average value of 16.43 mg kg^{-1} in Lakhimpur district of Assam. Lack of sulphur fertilization and removal of sulphur by crops may lead to low and moderate amount of sulphur in soil (Balangoudar, 1989).

The present investigation indicated that soils of all villages of the study area were acidic in nature with normal electrical conductivity. The soil contains moderate to high amount of organic carbon with low to medium amount of available nitrogen, available phosphorus and available potassium. The available sulphur was medium to high range and sufficient concentration of calcium and magnesium was found in the study area. Moreover high value of bulk density and medium range of water holding capacity was also recorded in our investigation. The physico-chemical properties of soils declined due to continuous cultivation of rice for long period of time without the analysis and needful treatment of the soil. Therefore, to enhance the major nutrients and for better productivity we have to be adopted proper soil management practices, use of organic manure to soil which sustain the soil health as well as agriculture ecosystem.

Table 1. Soil texture of different sites of the studied areas

Village	Sand (%) Mean	Silt (%) Mean	Clay (%)Mean	Texture Types
Bausiudaypur	54.12	22.92	22.96	Sandy clay loam
Bajali Udaypur	55.25	20.79	23.26	Sandy clay loam
Nanoi	51.27	23.95	24.78	Sandy clay loam
Jugarkuchi	36.51	32.64	30.85	Clay loam
Sonkani	38.26	30.29	31.45	Clay loam
Ksudrakulhati	34.82	31.20	33.98	Clay loam
Barkulhati	35.62	30.79	33.59	Clay loam
Bangalmur	36.46	32.62	30.92	Clay
Ranakuchi	45.27	40.69	14.04	Silty clay
Pandula	42.85	40.95	16.20	Silty clay

Table 2. Range and mean value of bulk densities (BD) and water holding capacities (WHC) of soil of different villages

Village	BD (g cm^{-3})		WHC (%)	
	Range	Mean ± SD	Range	Mean ± SD
Bausiudaypur	1.29-1.55	1.42±10.11	40.12- 60.15	51.26±25.13
Bajali Udaypur	1.28-1.53	1.38±10.16	41.26-62.19	50.16±23.14
Nanoi	1.25-1.50	1.36±9.86	38.15-60.25	48.17±20.17
Jugarkuchi	1.23-1.48	1.32±9.91	43.17-65.16	54.15±18.15
Sonkani	1.15-1.43	1.29±10.09	38.15-56.28	46.17±15.17
Ksudrakulhati	1.19-1.49	1.37±10.13	39.26-65.18	54.92±16.12
Barkulhati	1.13-1.45	1.27±9.97	35.17-62.17	51.62±14.18
Bangalmur	1.23-1.53	1.53±10.21	40.92-53.16	46.17±12.72
Ranakuchi	1.14-1.41	1.31±10.29	44.17-58.92	50.16±14.19
Pandula	1.27-1.49	1.39±10.18	37.12-59.16	48.65±15.23
Average range and Mean ± SD	1.21-1.48	1.34±10.27	39.74-60.26	50.14±17.41

Table 3. Range and mean value of physico-chemical properties of soil of different villages

Village	pH		EC (dS m^{-1})		OC (%)	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Bausiudaypur	5.15-6.03	5.71±0.26	0.02-0.08	0.04+0.05	0.45-0.91	0.72+0.74
Bajali Udaypur	5.08-6.09	5.62±0.28	0.06-0.13	0.08+0.07	0.48-0.98	0.75+0.76
Nanoi	4.96-5.89	5.35±0.30	0.05-0.11	0.07±0.05	0.43-0.87	0.69 ±0.12
Jugarkuchi	4.8-6.35	5.38±0.38	0.16-0.45	0.17±0.78	0.61-1.08	0.92± 0.25
Sonkani	4.58-5.52	5.25±0.26	0.19-0.55	0.23±0.22	0.40-0.76	0.62±0.22
Ksudrakulhati	4.65-5.85	5.48±0.29	0.09-0.23	0.16±0.17	0.65-1.12	0.98±0.27
Barkulhati	4.75-5.89	5.62±0.31	0.13-6.19	0.15±0.06	0.72-1.05	0.94± 0.21
Bangalmur	4.68-5.71	5.58±0.24	0.08-0.17	0.11±0.05	0.68-1.02	0.84±0.18
Ranakuchi	4.86-5.47	5.15±0.18	0.02-0.16	0.08±0.05	0.72-1.13	0.89±0.19
Pandula	4.98-5.78	5.45±0.20	0.06-0.19	0.09±0.07	0.74-1.02	0.91±0.17
Average range and mean ± SD	4.84-5.85	5.45±0.27	0.08-0.22	0.11±0.09	0.58-0.99	0.82±0.19

Table 4. Range and mean value of macro-nutrients (available N, P, K) of soils of different villages

Village	Available N (kg ha^{-1})		Available P (kg ha^{-1})		Available K (kg ha^{-1})	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Bausiudaypur	210.92-516.26	352.16±75.15	15.20-4516	32.16±8.05	115.26-292.16	185.35± 41.25
Bajali Udaypur	220.62-525.19	365.27±77.17	16.27-48.35	30.19 ± 7.92	90.26-308.17	220.15± 70.28
Nanoi	195.17-485.12	327.16±65.12	19.15-44.16	28.16 ± 7.25	85.16-79.18	172.52± 48.27
Jugarkuchi	245.26-565.17	385.92±80.16	22.92-55.19	37.16 ± 7.87	125.27-338.92	245.76± 68.82
Sonkani	176.17-448.19	292.17±52.29	16.92-46.18	32.19 ± 6.95	70.92-272.86	167.92± 46.17
Ksudrakulhati	269.17-569.15	385.16±70.16	15.95-42.98	33.17 ± 7.52	108.75-320.15	265.85± 52.16
Barkulhati	252.18-552.17	357.19±71.62	23.18-58.19	38.98 ± 8.28	115.27-342.19	295.62± 60.19
Bangalmur	212.62-515.62	338.62±63.17	24.17- 56.28	36.85 ± 9.15	107.16-340.95	282.91± 72.16
Ranakuchi	265.92-562.17	345.12±60.19	20.18- 59.18	40.15± 11.12	120.85-345.65	255.87± 76.19
Pandula	215.27-440.25	310.85±42.16	18.25-52.26	39.25 ± 8.74	80.12-308.29	232.88± 77.26
Average range and Mean±SD	226.33-517.33	345.96±66.81	19.21-50.79	34.82±8.28	101.9-314.85	232.48±61.27

Table 5. Range and mean value of macro-nutrients (Ca, Mg, Available S) of soils of different villages

Village	Ca (c molp(+) kg^{-1})		Mg c molp(+) kg^{-1})		Available S (mg kg^{-1})	
	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Bausiudaypur	2.48-2.75	2.58±0.20	1.92-2.25	2.02 ±0.18	8.1-45.25	26.12±12.15
Bajali Udaypur	2.35-2.63	2.48 ±0.18	1.73-2.13	1.94±0.17	8.8-48.92	28.16±10.13
Nanoi	2.22-2.55	2.42± 0.23	1.78-2.12	1.90±0.13	7.4-43.16	23.18±16.25
Jugarkuchi	2.28-2.60	2.53± 0.24	1.87-2.30	2.06±0.23	8.9-50.25	31.2±19.51
Sonkani	2.07-2.43	2.24± 0.22	1.38-1.78	1.54±0.26	7.2-40.12	22.16± 8.2
Ksudrakulhati	2.32-2.69	2.51± 0.26	1.81-2.35	2.08±0.28	9.5-59.12	34.25±15.26
Barkulhati	2.15-2.55	2.18 ±0.29	1.62-1.95	1.75±0.25	9.1-62.12	38.28±18.29
Bangalmur	1.98-2.36	2.15± 0.25	1.38-1.75	1.55±0.27	8.5-54.16	25.65 ±13.25
Ranakuchi	1.88-2.30	2.08± 0.28	1.28-1.67	1.46±0.29	11.3-66.4	32.85± 22.17
Pandula	1.96-2.38	2.18± 0.30	1.45-1.79	1.58±0.25	10.5-52.6	23.91± 19.21
Average range and Mean±SD	2.16-2.52	2.33± 0.24	1.62-2.01	1.78±0.23	8.93-52.16	28.57±15.44

REFERENCES

Amurta, S. Ekapure, Sanjay S. Balapade, Kajol D. Bhoyar and Rahul V. Jadhao, 2023. Assessment of Macronutrients status of Bhandara Tehsil, Maharastra. J. Soils and Crops. **33**(1): 210-214.

Anonymous. 2022. District office of Economic and statistics.

Balangoudar, A.B. 1989. Investigation in status and forms of sulphur in soils of North Karnataka. Unpublished M. Sc. (Agri.) Thesis, University of Agricultural Science, Dhrwad (India),

Baruah, T. C. and H.P. Barthakur, 1997. A text book of soil analysis Vikas publishing House, New Delhi.

Basumutary, A.R. Baruah and B.K. Medhi, 2014. Spatial variability of fertility status of soils of upper Brahmaputra valley zone of Assam. Asian J. Soil. Soc. **9** (1) : 142-148.

Basumutary,A., D. Ozah and K. Goswami. 2019. Assessment of available Macronutrients and Micronutrients status in soils of Dhubri district of Assam. J. Indian.Soc.Soil.Sci. **67**(4): 423-430.

Basumutary, A., G. G. Kandal, A. Bardoloi and T. Sarmah. 2021. Spatial variability of fertility status in soils of Dima Hasao district of Assam. Annals.Plant. and Soil.Res. **23**(3):368-374.

Black,C.A. 1965. Methods of Soil Analysis. Part II. American Socity of Agronomy. Madison. Washington. USA. pp.1572.

Borkotoki, B., D. Bhattacharyya, K.K. Sarmah, P. Saikia, P. Goswami and B.Bora. 2024. Soil nutrient mapping of the Lakhimpur district of Assam using geospatial technology. Annals.Plant and Soil.Res.**26**(1): 1-13.

Bouyoucos, G. J.1927. The hydrometer as a New method for the mechanical analysis of soils. Soil Sci.**23**:343-352.

Chesnin, L and C. H. Yien.1950. Turbidometric determination of available sulphates. Soil. Sci. Soc.Am.Proc:**15**:149-151.

Cooper, H.B.S., S. Sjogersten,. R.M. Lank, N.T. Girkin, C.H.Vane, J.C. Calonego, M.C. Rosole and S.J. Mooney, 2021. Long term zero-tillage enhances the protection of soil carbon in tropical agriculture. Euro. J. Soil. Sci. **72** (6): 2477-2492.

Devi, M.M., D. Bhattacharya, K.N. Das and K.D. Devi, 2023. Distribution study of the different forms of soil acidity and available nutrients in upper Brahmaputra Valley zone (UBVZ) of Assam, Intl. J.Plant.Soil.Sci. **35** (18): 634-643.

Gayan, A., D. J. Nath, B. Bhattacharyya and N. Dutta, 2020. Assess-ment of soil quality indicators under rice ecosystem of Assam. J. Environ. Biol. **41**: 1655-1664.

Gupta, S.C. 2023. Fundamentals of statistics, Eight Revised Edition, Atimalaya Publishing House.

Hariram and K.N. Dwivedi, 1994. Delineation of Sulphur deficient soil samples in the central alluvial tract of Uttar Pradesh. J. Indian. Soc. Soil. Sci 284-286.

Jackson, M.L. 1973. Soil chemical analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

Jibhakate, S.B., S. N.Bhende, V. K. Kharche and V. Sevalakshmi. 2009. Physicochemical status of soils of Katol Tahsil in Nagpur district. J. Soils and Crops. **19**(1): 122-128.

Karmakar, R.M. 2014. Characterization and potentiality evaluation of soils developed in different land forms of North Bank plans zone of Assam. Agropedalogy. **24** (01): 52-63.angsa,

Kalita, N. and S. Maibangsa, 2020. Solt fertility evaluation of rice of lumbajong block of Kashi Anglong district under hill zone of Assam through nutrient indexing. Asian J. Soil. Sci. **15** (2) : 81-85

Lalrinfela,T., M.C. Talukdar, B.K. Medhi and R.K. Thakuria. 2016. Macronutrient status and their spatial variability in soils of Meleng Watershed of Jorhat district, Assam-a GIS approach. Intl. J. Adv.Res. **4** (10): 905-911.

Mane, S.S., K.T. Jadav and S. P. Chake, 2022. Appraisal of soil fertility status of Somthana Dam area of Badnapur. J.Soils and Crops. **32** (2):301-304.

Nath, T. 2015. Physicochemical properties and its relationship with water holding capacity of Roadside Tea cultivated soils in Dibrugarh District of Assam. Indian. J. Adv. Chem. Sci. **3** (3): 288-292.

Olsen, S. R. 1954. Estimation of available phosphorous in soils by extraction with Sodium bicarbonate .USDA Circ.939, United States Department of Agriculture. Washington DC.

Palm, C., P. Sanchez, S. Ahamed and A.Awiti, 2007. Soils: A con-temporary perspective, In: Annual. Rev. Environ. Reso. **32**:99-129.

Pappu Srindhi, Y.V. Singh, P.K. Sharma, R.K. Singh, A.M. Latare, I. Srinath and Y.C. Yogesh,2020. Physico-Chemical analysis of soils in Madanapalle block, Chittor District of Andra Pradesh, Int. J. Chem. Studies. **8**(3):154-158.

Piper, C. D. 1950 .Soil and Plant Analysis. Scientific Publications.New York.pp.257.

Pravin, R., Chaudhari, V. Dodha. Ahire, D. Vidya., M. Chakravarty and S. Maity, 2013. Soil bulk density as related to soil texture, organic matter content and available total nutrients of Coimbatore soil. Int. J. Sci. Res. Public**.** **3** (2):1-8.

Reza, S.K., U.Baruah,S .Bandyopadhya,D.Sarkar and D.P. Dutta, 2012. Characterization of soil acidity under different land uses in Assam. Agropedalogy. **22** (2): 123-127.

Singh, K.B., S.K. Jalota and B.D. Sharma, 2009. Effect of continuous rice wheat rotation on soil properties from four agro eco-systems of Indiaan Punjab. Communications. Soil. Sci. Plant. analysis. **40**(17-18): 2945-2958.

Subbaih, B.V. and G.L. Ahuja, 1956. A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. **25** : 259-260.

Thombe, Swati N., W.P.Badole, Shivani Kawade and R. M. Ghodpage. 2020. Assesment of soil fertilitry status in selected villages under Jalyuki Shivar in Nagpur district. J. Soils and Crops. **30**(1):132-138.

Vadivelu, S., T.K. Sen, B.P. Bhaskar, U. Baruah, D. Sarkar, A.K. Maji and K.S. Gajbhiya,2004. Soil series of Asam, NBBS Publication No. 101, NBSS and LUP (ICAR) Nagpur. 22-27.

Varsha, P., G. Poonam and A.P. Singh, 2018. Assessment of Physical properties of soil under different land use systems in a Mollisol, J.Pharmaco.Phytochem **7 (**6): 2645-2648.

Walkly,A., and I.A. Black.1934. Examination of the method for determination soil organic matter and a proposed modification of the chromic acid titration method . Soil Sci**. 37**:9-38.

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