Eco. Env. & Cons. 28 (2) : 2022; pp. (774-778)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i02.030

Characterization of Soil Quality Parameters under Plain and Hilly Region of East Siang District, Arunachal Pradesh

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(Received 18 August, 2021; Accepted 20 September, 2021)

ABSTRACT

The investigation conducted at the laboratory of Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha; Mirzapur during the year 2021. The objective of this study was to characterize the physico-chemical properties under plain and hilly areas soil of East Siang District, Arunachal Pradesh. By using GPS camera, 30 soil samples under plain area and 30 soil samples under hilly area was collected. The physical and chemical properties of soil were critically analyzed. According to the soil nutrient index of the study area, the soils of east siang district found out to be low in the available Nitrogen content, Potassium, and sulphur content of soil and medium in organic carbon and phosphorus content of the soil of both plain and hilly region. The plain area soils were found acidic to neutral in reaction and free from salinity. The pH of hilly area soil was found acidic in reaction and free from salinity.

Key words: *Plain areas, Hilly areas, Soil nutrient index, Physical and chemical properties.*

Introduction

Soil is a dynamic natural body containing unconsolidated mineral and organic matter covering up the uppermost layer of the earth's surface. It plays a crucial role in the functioning of the ecosystem on which all flora and fauna depend. (Agyemang *et al*., 2011). A single agricultural field contains soils with various arguable nutrient contents in them. (Clark *et al*., 2005). The fluctuations in the weather conditions end up in making the soil nutrients more dynamic. (Barraclough, 1986). The physical and chemical properties of soil control the biological functions which in turn gives rise to its nutrients cycling, plant growth and decomposition of various organic materials. East Siang is one among 25 districts in Arunachal Pradesh where the present study is being carried out.

Materials and Methods

Study location

Various samples of soil were collected from the plain and hilly areas of East Siang District, Arunachal Pradesh and studied thoroughly for better understanding of the physical and chemical parameters present in the course lab of M.Sc. (Ag) Soil Sciences – Soil and Water Conservation, RGSC (BHU). East Siang District is a plain area located in the eastern foothills of the Himalayas, 155 M above mean sea level alongside hills in Arunachal Pradesh. It is also known as the land of the rising sun. Its co-

ordinates lie between 27º43′ to 29º20′ N and 94º42′ to 95º35′ E covering up an area of about 4005 sq.km. The district is divided into four sub divisions and 15 blocks with 167 villages. Its headquarters is Pasighat town. The area is surrounded by hills and major area is covered under forests with waterfalls. Cold mountainous climate in the north with tropical climate existing in the south where winter temperature drops upto 7 ºC and summer temperature upto 36 ºC. The highest annual rainfall in the district is 2910.18 mm. All types of soils i.e. Red soils, Alluvial soils and Black soils exists in the region. Soil colour in this region is found to be red yellow to mild yellow. The soil texture of the East Siang District area is loamy sand to sandy loam.

Soil Sampling and Processing

By using GPS camera 30 soil samples were collected each from plain and hilly areas of East Siang District, Arunachal Pradesh. Firstly, the soil was dug in V-shape at a depth of 15 cm with the help of spade. From each field 4-5 samples were collected in zig-zag manner. The collected 3 kg samples were reduced to 1 kg by quadratic method. The soil samples were air dried for 2 days. After drying, samples were crushed, grounded and powdered with wooden roller. Then, samples were made to pass through 2mm sieve. The processed soil samples of 500 gm were brought to laboratory for analysis.

Bulk density and Particle density were determined by pycnometer. Water holding capacity was determined by Keen'sbox (Piper, 1966). The pH was determined by pH meter (Jackson 1973). Electrical conductivity was determined by electrical conductivity meter (Jackson, 1973). Nitrogen was determined by alkaline permanganate method (Subbiah and Asija, 1956) method. Phosphorus was determined by Bray's method (1945) for acidic medium and Olsen's method (1954) for basic medium. Potassium was determined by using flame photometer. Calcium and Magnesium by complexometric titration method. Organic carbon by rapid titration method (Walkley and Black, 1934) and Sulphur was determined by spectrophotometer (Chesnin and Yien, 1950).

Results and Discussion

The data shows that the plain areas soil bulk density and particle density was ranging from 1.14-1.32 Mg/m^3 and 2.0-2.6 Mg/m^3. The pH was ranging from 4.8-7.2 with acidic to neutral and mean value of 5.7. The highest pH (7.2) was reported in sample 22 and the lowest pH (4.8) was reported in sample 16 and 19 equally by Vijayakumar *et al*., (2011). The electrical conductivity was ranging from 0.038-0.274 dSm^{-1}. The highest EC (0.274) dSm^{-1}) was reported in sample 17 while the lowest EC (0.038 dSm^{-1}) was reported in sample 13 by Kumar *et al*., (2017). The organic carbon was ranging from 0.21-1.69%. The highest O.C (1.69%) was found in sample 3 and the lowest O.C (0.21%) was found in sample 18 and 30 equally. The available nitrogen was ranging from 105-360 kg/ha. The highest nitrogen content (360 kg/ha) was found in sample 3 and the lowest nitrogen content (105 kg/ha) was found in sample 12,18 and 30 equally by Muhr *et al*. (1963). The available phosphorus content was ranging from 12.2-21.5 kg/ha. The highest 21.5kg/ha was observed in sample 2 and lowest 12.2 kg/ha in sample 26. The available potassium content was ranging from 67.2-235.2 kg/ha. The highest K (235.2 kg/ha) was found in sample 28 and the lowest (67.2 kg/ha) was found in the sample 11,29 and 30 equally. The available calcium content was ranging from 1.5-11.4 Meq/100g. The magnesium content was ranging from 0.12-4.10 Meq/100g. The sulphur content was ranging from 0.11-0.23 mg/kg.

The data show that the hilly areas soil bulk density and particle density was ranging from 1.16-1.44 Mg/m^3 and 2.0-2.6 Mg/m^3. The pH was ranging from 4.7-6.7. The highest pH (6.7) was found in sample 35 and 39 equally and the lowest (4.7) was found in sample 37. The electrical conductivity was ranging from 0.041-0.247 dSm^{-1}. The highest EC (0.247 dSm^{-1}) was found in sample 54 and the lowest EC (0.041 dSm^{-1}) was found in sample 57. The organic carbon was ranging from 0.15-1.47%. The highest O.C. (1.47 %) was found in sample 52 and the lowest O.C. (0.15%) was found in sample 45. The available nitrogen content was ranging from 100-400 kg/ha. The highest N (400 kg/ha) was found in sample 34 and the lowest N (100 kg/ha) was found in sample 45. The available phosphorus was ranging from 12.3-18.3 kg/ha. The highest P (18.3 kg/ha) was found in sample 56 and the lowest P (12.3 kg/ha) was found in sample 31. The available potassium was ranging from 67.2-257.6 kg/ha. The highest K (257.6 kg/ha) was found in sample 37 and the lowest K (67.2 kg/ha) was found in sample 33 by Jain *et al*., (2014). The available calcium content was

Table 1. Soil Quality Parameters under Plain Region of East Siang District, Arunachal Pradesh

Sample No.	BD Mg/m^3	PD Mg/m^3	WHC (%)	pH	ECd Sm^{-1}	OC (%)	N kg/ha	P kg/ha	K kg/ha	Ca Meq/100g	Mg Meq/100g	S mg/kg
S_1	1.28	2.5	40.5	5.1	0.271	0.67	200	16.6	134.4	3.7	1.21	0.17
S_2	1.24	2.5	40.6	5.4	0.113	0.49	175	21.5	78.4	5.7	0.72	0.15
S_3	1.16	2	40.4	5.1	0245	1.69	360	16.5	190.4	2.4	3.10	0.14
S_4	1.18	2.5	43.92	6.8	0.092	0.91	265	17.5	190.4	2.2	1.31	0.17
S_5	1.3	2.5	46.10	6.9	0.050	0.63	200	21.1	100.8	11.4	0.81	0.12
S_6	1.28	2	44.20	5.4	0.054	0.27	150	17.1	100.8	4	0.58	0.13
S_7	1.22	2.5	45.84	5.2	0.079	0.63	200	13.8	156.8	7.6	0.18	0.15
S_8	1.16	2	45.21	5.6	0.084	0.94	265	16.3	112	3.1	1.31	0.16
S_9	1.18	2.3	42.38	5.3	0.128	1.47	320	18.3	190.4	3	2.2	0.13
S_{10}	1.26	2.5	44.01	5.4	0.047	0.63	200	13.6	89.6	2.3	0.72	0.15
S_{11}	1.3	2	49.78	5.6	0.089	0.46	175	14	67.2	3	2.50	0.14
S_{12}	1.22	2.4	50.82	6.9	0.073	0.25	105	16.3	168	4.8	1.10	0.16
S_{13}	1.28	2	43.35	5.1	0.038	0.67	200	17.3	78.4	3	0.91	0.13
S_{14}	1.32	2.5	49.59	5.0	0.048	0.85	250	20.2	100.8	1.5	1.30	0.17
S_{15}	1.28	2.5	44.06	5.5	0.066	0.78	230	18.3	168	3.1	0.12	0.16
S_{16}	1.28	2.5	44.98	4.8	0.049	0.6	200	20.8	89.6	3	0.71	0.11
S_{17}	1.28	2	45.94	5.1	0.274	0.24	125	19.2	145.6	3.4	2.61	0.12
S_{18}	1.14	2.5	48.01	4.9	0.072	0.21	105	13.2	145.6	1.7	1.31	0.13
S_{19}	1.22	2.5	49.02	4.8	0.091	0.42	175	13.3	123.2	6.2	1.81	0.14
S_{20}	1.24	2.5	43.45	5.6	0.064	0.64	200	13.5	100.8	7	0.12	0.12
S_{21}	1.24	2.6	46.44	6.5	0.096	0.27	150	14.2	100.8	7.9	4.10	0.14
S_{22}	1.26	2.5	43.10	7.2	0.079	0.40	175	15.7	78.4	4.8	3.20	0.15
S_{23}	1.24	2	49.20	6.3	0.128	0.55	195	16.2	100.8	6.7	2.30	0.14
S_{24}	1.26	2.5	44.29	5.8	0.090	0.58	195	13.2	123.2	2.2	3.11	0.13
S_{25}	1.22	2.4	42.52	5.6	0.132	0.36	167	13.7	145.6	2.3	2.81	0.15
S_{26}	1.26	2.5	47.34	5.5	0.058	0.58	195	12.2	190.4	4.2	0.51	0.12
S_{27}	1.2	2.4	47.70	5.7	0.043	0.45	175	14.8	224	9.9	0.25	0.15
S_{28}	1.32	2.4	42.85	5.8	0.042	0.84	250	12.5	235.2	8.9	0.18	0.11
S_{29}	1.28	2.4	49.86	6.1	0.065	0.23	115	16.3	67.2	5.6	0.92	0.23
S_{30}	1.26	2	44.73	7.1	0.077	0.21	105	18.3	67.2	7.5	3.10	0.18
Mean	1.24	2.35	45.37	5.70	0.094	0.59	194	16.23	128.8	4.73	1.50	0.145
Range	1.14-1.32	2.0-2.6	40.4-50.82	4.8-7.2	0.038-0.274	0.21-1.695	105-360	12.2-21.5	67.2-235.2	1.5-11.4	0.12-4.10	0.11-0.23
S.D.	0.047	0.35	2.99	1.41	0.062	0.344	59.45	2.68	48.21	2.61	1.12	0.024
C.V.	**3.81**	**15.06**	**6.59**	**24.79**	**66.47**	**57.43**	**30.63**	**16.55**	**37.43**	**55.17**	**74.72**	**16.86**

Table 2. Soil Quality Parameters under Hilly Region of East Siang District, Arunachal Pradesh

Sample No.	BD Mg/m^3	PD Mg/m^3	WHC (%)	pH	EC dSm^{-1}	OC (%)	N kg/ha	P kg/ha	K kg/ha	Ca Meq/100g	Mg Meq/100g	S mg/kg
S_{31}	1.28	2.5	46.56	5.8	0.070	0.49	175	12.3	134.4	3.9	1.40	0.12
S_{32}	1.18	2.5	46.58	5.3	0.066	0.94	265	13.1	224	2.6	0.60	0.14
S_{33}	1.16	2.5	47.29	6.4	0.070	0.70	230	15.9	67.2	1.8	2.02	0.17
S_{34}	1.16	2.5	44.62	5.4	0.085	1.18	400	17.3	145.6	2.9	1.10	0.17
S_{35}	1.32	2	45.16	6.7	0.111	0.55	195	12.8	123.6	8	1.82	0.15
S_{36}	1.22	2.5	49.29	4.9	0.111	0.85	250	18.1	190.4	1.3	1.30	0.16
S_{37}	1.2	2	43.72	4.7	0.100	1.15	345	16.2	257.6	1.1	0.82	0.17
S_{38}	1.3	2.1	45.47	5.9	0.098	0.49	175	13.6	156.8	4.7	1.40	0.14
S_{39}	1.2	2.5	42.78	6.7	0.188	1.33	300	15.9	145.6	7.2	0.61	0.14
S_{40}	1.18	2.5	41.74	5.4	0.064	0.67	200	15.7	190.4	6.3	0.12	0.16
S_{41}	1.28	2.5	48.46	6.0	0.113	0.75	230	15.3	112	9.2	0.24	0.14
S_{42}	1.24	2.5	42.69	5.1	0.094	0.73	230	16.3	100.8	10.3	0.65	0.15
S_{43}	1.34	2.6	54.66	5.5	0.095	0.31	167	15.7	78.4	4.9	0.13	0.14
S_{44}	1.32	2.3	44.15	5.8	0.082	0.49	175	18.1	156.8	7.2	0.10	0.11
S_{45}	1.44	2.4	49.49	5.7	0.119	0.15	100	13.8	246.4	6.5	1.80	0.12
S_{46}	1.26	2.5	46.94	5.8	0.098	0.54	195	15.9	67.2	5.1	0.21	0.18
S_{47}	1.2	2	44.66	5.8	0.152	1.11	320	15.4	190.4	11.7	0.62	0.12
S_{48}	1.44	2.5	45.01	6.1	0.094	0.23	115	15.9	168	6.2	0.23	0.13
S_{49}	1.2	2	49.21	5.5	0.065	0.76	230	14.6	201.8	5.1	0.51	0.13
S_{50}	1.22	2.5	43.05	5.7	0.126	1.02	285	13.3	123.2	6.5	0.33	0.14
S_{51}	1.32	2.5	48.72	5.8	0.042	0.61	200	13.6	112	6.6	0.18	0.16
S_{52}	1.18	2.4	43.06	5.6	0.140	1.47	320	15.5	100.8	6	0.35	0.15
S_{53}	1.22	2.5	54.23	5.7	0.108	0.96	265	16.2	168	7.4	0.31	0.16
S_{54}	1.26	2.5	42.73	6.3	0.247	0.49	175	13.3	179.2	10.5	0.41	0.16
S_{55}	1.24	2.5	49.35	5.9	0.080	0.33	167	13.6	212.8	5.3	0.22	0.14
S_{56}	1.18	2.5	47.23	5.8	0.124	1.30	300	18.3	180.8	7.8	0.53	0.16
S_{57}	1.24	2.5	46.37	5.8	0.041	0.78	230	16.1	89.6	5.7	0.80	0.11
S_{58}	1.22	2.5	46.59	5.6	0.067	0.51	195	12.7	190.4	6.4	0.12	0.11
S_{59}	1.16	2	40.17	5.7	0.085	0.55	195	15.7	145.6	5.4	0.78	0.14
S_{60}	1.18	2	50.71	5.2	0.075	1.24	285	17.02	156.8	5.7	0.33	0.14
Mean	1.24	2.37	46.35	5.72	0.10	0.75	230.4	15.28	153.8	5.97	0.66	0.143
Range	1.16-1.44	2.0-2.6	40.17-54.66	4.7-6.7	0.041-0.247	0.15-1.47	100-400	12.3-18.3	67.2-257.6	1.1-11.7	0.10-2.02	0.11-0.18
S.D.	0.74	0.35	2.93	0.45	0.041	0.348	67.94	1.69	50.36	2.55	0.55	0.19
C.V.	59.92	14.87	6.33	7.41	41.81	45.92	29.48	11.05	32.73	42.77	83.23	9.843

ranging from 1.1-11.7 Meq/100g. The highest Ca (11.7 Meq/100g) was found in sample 47 and the lowest Ca (1.1 Meq/100g) was found in sample 37. The magnesium was ranging from 0.10-2.02 Meq/100g. The highest Mg (2.02 Meq/100g) was found in sample 33 and the lowest Mg (0.10 Meq/100g) was found in sample 44. The available sulphur content was ranging from 0.11-0.18 mg/kg by Kanwar, 1976.

Conclusion

According to the nutrient index, the soil of East Siang District under plain and hilly region was found low in nitrogen, potassium and sulphur content and medium in organic carbon and phosphorus content. The pH of soil was found from acidic to neutral in reaction and free from salinity. So, it was hereby concluded that availability of nutrient was unevenly distributed. Low availability of nutrient was due to low pH of specific soil or their properties or crop and also due to heavy and continuous rainfall the essential nutrient leached out from the soil. It was observed that besides heavy application of FYM, low availability of nutrient were occurred in many of the samples and there was very minute differences found in the nutrient content of both plain and hilly region.

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