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Soil Fertility Assessment of Selected Villages in Bhuban Block, Dhenkanal, Odisha, India

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Abstract

Using the Global Positioning System (GPS), the soil fertility condition of the Bhuban Block in the Dhenkanal district of Odisha was prepared. In 5 villages in the Bhuban Block of the Dhenkanal district, located in the central mid-tableland Agroclimatic region of Odisha, India, a study on the status of soil fertility was conducted. It is evident that the Bhuban Block's several villages have varying textural classes, from loam to sand. In this block, the percentage of sand in the surface soil ranged from 67.6% to 83.0%. Silt percentages ranged from 5.4% to 16.9%. Clay percentages ranged from 9.4% to 21.0%. In Bhuban Block brown color soils were discovered. The pH of the soil varied between 4.62 and 7.21, averaging at 5.3. The soil's organic carbon varied between 0.118–1.025 g/kg, with an average of 0.546 g/kg. The available N content varied from 113.75–165.00 kg/ha and the mean was 143.07 kg/ha. The available P content varied from 0.74–10.53 kg/ha and the mean was 4.84 kg/ha. The available K content varied from 68.32–300.16 kg/ha and the mean was 117.82 kg/ha. The available sulfur content varied from 5.25–19.95 mg/kg and the mean was 12.38 mg/kg. The hot water soluble B content varied from 0.32–0.92 mg/kg with a mean value 0.54 mg/kg.

Keywords: Agroclimatic region, Bhuban, GPS, rabi season, soil fertility status

INTRODUCTION

Study Area

The research area is the Bhuban Block in the Dhenkanal district, which is situated between latitudes 20'29"N and 21°11"N and longitudes 85° 58' E to 86°20"E. The research area is in Odisha's Mid Central Tableland Agroclimatic Zone.

Climate

The research region has hot, dry, subhumid weather with an average of 1421 mm of precipitation per year. In general, December, and January are frigid, whereas April and May are hot and sticky. The rainy season typically begins in June. This place gets 38.7°C on average in the summer and 14°C on average in the winter. The district, which spans 4,452 km², is composed of 1215 localities and 8 administrative blocks [1]. The main agricultural products grown in the district include sugarcane, fruits, vegetables, groundnuts, green, and horse gram, and sesamum.

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Soils

Brown color soils are found in Bhuban Block. The primary crops cultivated in the district consist of sugarcane, fruits, vegetables, groundnuts, green gram, horse gram, and sesame along the river Brahmani and its tributaries. The landscape of the region showcases raised hills and valleys adorned with dense forests. The pedological process of

colluviation has similarly occurred in these topographical forms. The foot slopes of most hills contain colluvial deposits, primarily utilized for paddy cultivation during the Kharif season, followed by pulses and vegetables in the Rabi season.

MATERIALS AND METHODS

A comprehensive soil survey of the region was carried out using the USDA soil survey manual [2]. The analysis of textural classes was performed using the Bouyoucus Hydrometer method [3]. The pH of a 1:2 (w/v) soil and water mixture was measured with a digital pH meter using a glass electrode. The EC of the 1:2 (w/v) soil and water mixture was measured using an EC meter. Soil organic carbon was assessed using the rapid titration technique developed by Walkley and Black [4]. The determination of available phosphorus was conducted using Olsen's method [5]. Nitrogen availability was assessed using the alkaline potassium permanganate technique [6]. The available potassium was measured using the neutral normal ammonium acetate extraction technique with a digital flame photometer [7]. Boron that is accessible was performed using the hot water extraction technique [8], and the available sulfur was measured by 0.15% $CaCl_2$ technique [9–11].

RESULTS AND DISCUSSION

Soil Reaction

The soil reaction (pH), electrical conductivity (EC), and organic carbon (OC) content in soils of Bhuban Block, Dhenkanal are presented in Table 1. The mean soil pH (1:2) of the surface soil samples from each of the 5 villages was determined to be 5.30, with variations ranging from 4.62 to 7.21. The nature of the soil was acidic. Thus, it seems that a significant crop production limitation in the research area is the acidity of the soil. Dash et al. (2018) have previously reported findings that are quite like them.

Table 1. Range and mean of pH, EC, and organic carbon of Bhuban block.

Name of the village	pH (1:2)		EC (1:2) (dS m^{-1})		OC (g/kg)	
	Range	Mean	Range	Mean	Range	Mean
Dhalapada	5.27–7.21	6.14	0.08–0.19	0.132	0.454–0.768	0.653
Kendupada	4.65–5.44	4.18	0.037–0.063	0.049	0.118–0.472	0.334
Renadapatna	4.62–5.38	4.89	0.045–0.089	0.06	0.236–0.472	0.367
Barun	5.12–5.45	5.29	0.061–0.109	0.080	0.354–0.728	0.574
Surapratappur	5.26–6.73	6.0	0.049–0.0235	0.118	0.583–1.025	0.804

Electrical Conductivity

Less than 1 dS m^{-1} was determined to be the electrical conductivity (1:2) of surface soil samples throughout the entire study area. Because of this, every soil in the research area was suitable for growing every kind of crop because of its soluble salt level.

Organic Carbon

The soil's organic carbon content had a mean value of 0.546 g/kg and ranged from 0.118 to 1.025 g/kg showed the percentage of organic carbon in each of the research area's settlements. According to the findings, the soil had a modest amount of organic matter in it.

Available Nitrogen

Table 2 presents the available nutrients status namely available (N, P, K, S, and B). The available nitrogen content of 5 villages was found to range from 113.75 to 165.00 kg/ha, with a mean of 143.07 kg/ha; The available nitrogen status of the individual villages was as follows: Dhalapada's soils ranged from 137.5 to 165.00 kg/ha with an average of 150.20 kg/ha; Kendupada's soils ranged from 130 to 153.75 kg/ha with an average of 143.54 kg/ha; Renadapatna's soils ranged from 113.75 to 156.25 kg/ha with an average of 138.95 kg/ha; Barun's soils ranged from 125 to 156.5 kg/ha with an average of 135.19 kg/ha; Surapratappur's soils ranged from 136.25 to 157.5 kg/ha with an average of 147.5 kg/ha.

Table 2. Range and mean of available nutrients status (N, P, K, S, and B) of Bhuban block.

Name of the village	Available nutrient Status									
	N		P		K		S		B	
	Kg/ha						mg/kg			
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Dhalapada	137.5–165	150.20	4.41–10.53	6.41	87.36–260.8	134.96	8.05–19.95	15.57	0.32–0.64	0.46
Kendupada	130–153.75	143.54	0.74–3.68	2.20	68.32–129.92	102.44	10.85–15.75	13.3	0.55–0.73	0.62
Renadapatna	113.75–156.25	138.95	5.15–9.31	7.51	68.32–300.16	151.2	7.00 –12.25	10.61	0.32–0.73	0.50
Barun	125–156.5	135.19	3.68–9.8	5.51	69.44–171.36	106.58	5.25–19.25	11.75	0.32–0.82	0.49
Surapratappur i	136.25–157.5	147.5	1.47–4.41	2.57	68.74–125.44	93.95	10.15–11.5	10.67	0.5–0.92	0.66

Available Phosphorus

The available phosphorus content of 5 villages was found to range from 0.74 to 10.53 kg/ha, with a mean of 4.84 kg/ha; The available phosphorus status of the corresponding villages is as follows: The study determined that the soils in Dhalapada's values ranged from 4.41 to 10.53 kg/ha, averaging 6.41 kg/ha; those in Kendupada varied from 0.74 to 3.68 kg/ha, with an average of 2.20 kg/ha; in Renadapatna, they ranged from 5.15 to 9.31 kg/ha, averaging 7.51 kg/ha; in Barun, values ranged from 3.68 to 9.8 kg/ha, with an average of 5.51 kg/ha; soils in Surapratappur ranged from 1.47 to 4.41 kg/ha, averaging 2.57 kg/ha.

Available Potassium

The available potassium content of 5 villages was found to range from 68.32 to 300.16 kg/ha, with a mean of 117.82 kg/ha; The available potassium status for each village is as follows: Dhalapada's soils were found to range from 87.36 to 260.8 kg/ha, with a mean value of 134.96 kg/ha Kendupada's soil ranged from 68.32 to 129.92 kg/ha, averaging 102.44 kg/ha; Renadapatna's soil varied from 68.32 to 300.16 kg/ha, averaging 151.2 kg/ha; Barun's soil fluctuated from 69.44 to 171.36 kg/ha, averaging 106.58 kg/ha Surapratappur's soil were found to range from 68.74 to 125.44 kg/ha, with a mean value of 93.95 kg/ha.

Available Sulfur

The sulfur content present in 5 villages was observed to vary between 5.25 and 19.95 mg/kg, averaging 12.38 mg/kg. The sulfur availability in the respective villages is as follows: Dhalapada's soils exhibited a range of 8.05 to 19.95 mg/kg with an average of 15.75 mg/kg; Kendupada's soils showed a range of 10.85 to 15.75 mg/kg with an average of 13.3 mg/kg; Renadapatna's soils presented a range of 7.00 to 12.25 mg/kg with an average of 10.61 mg/kg; Barun's soils had a range from 5.25 to 19.25 mg/kg with an average of 11.75 mg/kg; Surapratappur's soils were found to range from 10.15 to 11.5 mg/kg with an average of 10.67 mg/kg.

Available Boron

The boron content in 5 villages ranged from 0.32 to 0.92 mg/kg, averaging 0.54 mg/kg; The available boron status of the individual villages is as follows: Dhalapada's soils were found to be between 0.32 to 0.64 mg/kg with a mean value of 0.46 mg/kg; Kendupada's soils were found to be between 0.55 to 0.73 mg/kg with a mean value of 0.62 mg/kg; Renadapatna's soils were found to be between 0.32 to 0.73 mg/kg with a mean value of 0.50 mg/kg; Barun's soils were found to be between 0.32 to 0.82 mg/kg with a mean value of 0.49 mg/kg; Surapratappur's soils were found to be between 0.5 to 9.2 mg/kg with a mean value of 0.66 mg/kg;

CONCLUSION

It was found that the surface soils were less acidic. Therefore, the right liming materials need to be used. Organic matter must be applied liberally to consistently preserve the fine quality of the soil. It is

inferred that 25% more potash, phosphatic, and nitrogenous fertilizer should be used for crops. It should be applied to the soil's additional sources of boron fertilizers, as it was noted that the soils were lacking in accessible boron.

Competing Interests

There are no competing interests, according to the authors.

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