Original Research Article

GPS Based Soil Profile Study in Respect to Morphological and Nutrient Analysis in Pedon of Ganjam District

Abstract:

GPS based two pedons- one each from up and medium land during dry season, studied in the field & analysis done in laboratory. The difference in properties between two pedons was mostly due to lateritic and basaltic parent material in pedon1. It was found that Ca and Mg content increased downwards from 4.4 to 5.6 Cmol(p^+)/kg & 2.18 to 2.98 Cmol(p^+)/kg and Sulphur content decreased downwards and varied from 3.1 to 8.2 mg/kg compared to those of pedon2 were 14.4 to 22.52 Cmol(p+)/kg Ca, 4.32 to 9.40 Cmol(p^+)/kg Mg & 6.99 to 11.29 mg/kg S. The DTPA-Fe, Mn, Cu, Zn, and HWS-B content varied from 54.56 to 85.96, 5.06 to 21.72, 0.33 to 0.86, 0.36 to 0.52, & 0.10 to 0.41 mg/kg respectively & those nutrients in pedon2 were varied from 25.04 to 30.12, 6.4 to 12.04, 0.24 to 0.66, 0.29 to 0.77 and 0.32 to 0.67 mg/kg respectively.

Key wards: *Profile, bulk density (BD), texture, pore space, parent material*

1. INTRODUCTION

Agriculture plays a pivotal role in socio-economic development of the people. Production and productivity of any field crop depends on soil health (*Bassirani et al*. 2011). In India effective nutrient management played a major role in accomplishing food grain production. Sulphur, Calcium and Magnesium requirement are highest for oilseed crops followed by pulses and cereals. Sulphur influences the productivity of these crops next to primery nutrients. Oilseeds and pulses are also sensitive to micronutrients (*Aravand et al* 2014). Applications of micronutrients increase enzymatic activity, nodulation, chlorophyll formation, seed setting, and seed quality (Bell 2008).

2. MATERIALS AND METHODS

The research work on "Survey and GIS based fertility mapping of soils of Ganjam district" was conducting in Ganjam district of Odisha state. The detail location of soil samples collected and cultivated crop type and the methods followed for analysis were put in the following paragraphs (*Mishra et al 2016*).

Geography of Ganjam district:

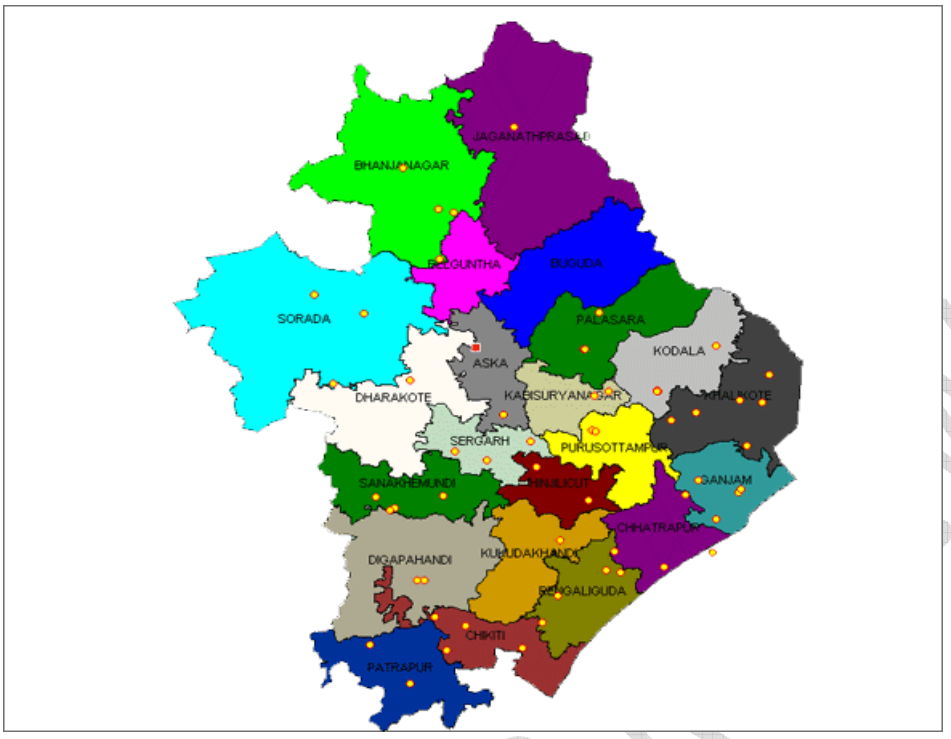

Fig 1 : Community development blocks of Ganjam district,Odisha

Table 1. Cropping area of Ganjam district and Odisha

crop	Ganajam 000'ha	Odisha in 000'ha	% of contribution
Rice	275.9	4180.0	6.60
Total cereals	282.8	4371.0	6.46
Total pulses	40.0	474.0	8.43
Total oilseeds	24.2	140.0	17.28
Total vegetables	56.5	690.07	8.18
Total fibers	50	134.31	3.72
Total spices	2.9	154.94	1.87
Sugar cane	2.5	38.73	6.45

2.1 Processing of Sample

Collected samples were brought to the laboratory spread out on paper. Leaves, Coarse concretions, stones, pieces of roots, and other un-decomposed organic residues were removed. Large lumps of moist soil were broken by hand. Samples were air dried at 20-25^{o}C and 20% to 60% relative humidity inside the laboratory under shade. Samples were mixed during drying to expose bottom layer to top. After air drying soil samples were crushed properly with help of a wooden hammer and mortar and sieved through a 2 mm sieve. The material larger than 2 mm

was discarded. They were stored with proper labeling in polythene bottles for analysis of physical, chemical & other properties.

2.2 METHOD OF ANALYSIS

2.2.1 Morphological properties

These properties are very common characteristics of soil which can be observed by naked eye. They give lot of information about soil formation and other properties. These properties were estimated by eye observation and use of Munsell colour chart. In the laboratory the samples were divided into two parts 1 part kept as such with clods undisturbed another part put under processing like previously described surface soil samples.

Soil colour

The colour of the soil samples in clod form air dried condition were determined by matching the colour with Munsell soil colour chart .The colour of soil was expressed both in symbolic notation and common name.

2.2.2 Physical properties

Soil texture

Fifty gram of sample soil was taken in a beaker and 15 ml Sodium hexametaphosphate (10 %) added and stirred for 10 minutes in a 1000 ml beaker. The contents was transferred to 1000 ml measuring cylinder with volume make up. Temperature and hydrometer reading were taken At 5 minutes and 5 hours. Percentage of sand, silt and clay were determined with the help of the formula (Tendon, 1986) and the textural classes were determined by the help of textural triangle (International system).

Chemical properties

The soil samples were analyzed for the physical &chemical properties i.e organic carbon, and available nutrient (Ca, Mg, S, Fe, Mn, Cu, Zn and B). (Lindsay 1978).

Table 2. Methods adopted for soil analysis

PHYSICAL PARAMETERS	METHODS	REFERENCE
Texture	Mechanical analysis method (Bouyoucos Hydrometer method)	C.S Piper,1950
CHEMICAL PARAMETERS	METHODS	REFERENCE
Available- S	Turbidimetric method	Chesin and Yien (1951)
Micronutrients- Fe, Mn, Cu & Zn	DTPA Extractant	(Lindsay and Norvell 1978) as described by

		Page, et al 1982)
Organic carbon (g/kg)	Walkley and Black,(1947)	Page.et al 1982
Available Boron	Hot water soluble method	John *et al*., 1975
Exchangeable ca& mgcmol(p+)/kg	Neutral normal Ammonium Acetate	As described by Page et al (1982)

3. RESULTS AND DISCUSSION

In order to "Survey and GIS based fertility mapping of soils of Ganjam district" both profile and surface soil sample were collected using GPS during 2017-18.The samples were studied in the field and noted in the format prescribed by NBSS & LUP Nagpur, India. Both pedon and surface soil samples were processed and analysed in laboratory, analysed, results were recorded and presented in the following sections and subsections for understanding, interpretation and use. (Rao 1997).

Characterisation of pedon

Location - Centre for Pulse Research, Berhampur located at village Ankushpur of Kukudakhandi block where one pedon was exposed at upland situation

Pedon 1 CPR Berhampur upland

Chart 1: Site characteristics

Location	CPR, OUAT farm, Ganjam, latitude 19.5743^{o}N and longitude 84. 3542° E "
Land form	Upland
Slope	5%, S-N
Surface condition:	Cultivated upland (pulse crops,)
Parent material:	Laterite
Ground water table	12-15 m
Erosion:	e_1
Surface drainage	Well drained
Land use	Pulse-Pulse (as inter crop)
Natural vegetation	Mango, Neem, Banyan

3.1 Physical and morphological properties of pedon soil

Morphological and physical properties of soil indicate the appearance and physical behaviour of soil in relation to plant growth. Some of the properties like depth, horizon were recorded in the table 3. Here it shows that BD and PD both are varies in pedon 1 and pedon 2. Similarly Soil colour changes with the depth of soil from light grey to greyish brown. The texture quality also changes according to pedon. In pedon 1 texture started from loamy sand where as in pedon 2 texture in sandy laom.

Table 3. Physical and morphological properties of pedon soil

Genetic Horizons	Depth (cm)	Structure	BD	PD	pore space (%)	Colour	Sand (%)	Silt (%)	Clay (%)	Texture
			Mg/m^3							
Pedon 1										
Ap	0-22	Subangular blocky	1.48	2.30	36	Light grey	80.4	8.8	10.80	Loamy sand
Bt_1	22-54	Angular blocky	1.56	2.36	34.50	Brownish yellow	78.4	7.6	14	Sandy loam
Bt_2	54-82+	Angular blocky	1.63	2.48	34.20	Strong brown	69.4	4.6	26	Sandy clay loam
Pedon 2										
Ap	0-16	Subangular blocky	1.35	2.30	41.30	Greyish brown	67.4	21.6	11	Sandy loam
Bw_1	18-48	Angular blocky	1.40	2.32	39.65	Light grey	56.6	19.6	23.80	loam
Bw_2	48-102	Angular blocky	1.58	2.46	35.77	Greyish brown	46.4	18.6	35	Clay loam

3.2 Distribution of Secondary nutrient in pedon soils

Secondary nutrient content of pedon soils were analysed and presented in table no 4. The exchangeable Ca^{2+} content in pedon1 varied from 4.40 to 5.60 cmolp+kg^{-1} but that of in pedon2 varied from 14.4 to 22.52 cmolp+kg^{-1} whereas the exchangeable Mg^{2+} (cmolp+kg^{-1}) content in pedon1 varied from 2.18 to 2.98 cmolp+kg^{-1} but that of in pedon2 varied from 4.32 to 9.40 cmolp+kg^{-1}. The sulphur content varied from 3.10 to 8.20 mg/kg in pedon1 soils but that of pedon2 it was ranged from 6.99 to 11.29 mg/ kg. Similar result was found in (Meena 2008, Sood 2003, 2009, Verma 2005)

Table 4. Distribution of Secondary nutrients in pedon soils

Pedon No	Genetic Horizons	Depth (cm)	Ca cmol(p+)/kg)	Mg cmol(p+)/kg	S (mg/kg)
Pedon -1	Ap	0-12	4.40	2.18	8.20
	Bt_1	12-42	4.50	2.80	6.20
	Bt_2	42-82	5.60	2.98	3.10
Pedon -2	Ap	0-16	14.4	4.32	11.29
	Bw_1	18-48	17.88	7.70	9.97
	Bw_2	48-102	22.52	9.40	6.99

3.4 Micronutrient content in pedon soils

In order to know the profile distribution of micronutrient soil horizon sample were analysed Micro-nutrients content of pedon soils were analysed and presented in table no 5. The exchangeable Fe^{2+} content in pedon1 varied from 54.56 to 85.96 mg kg^{-1} but that of in pedon2 varied from 30.12 to 25.04 mg kg^{-1} whereas the exchangeable Mn^{2+} (mg kg^{-1}) content in pedon1 varied from 5.60 to 21.72 mg kg^{-1} but that of in pedon 2 varied from 6.40 to 12.04 mg kg^{-1}. The copper and zinc content varied from 0.33 to 0.86 mg/kg and 0.36 to 0.52 in pedon1 soils but that of pedon 2 it was ranged from 0.24 to 0.66 mg kg-1 and 0.29 to 0.77 mg kg-1. The results also shows that available boron content varies from 0.10 to 0.41 mg kg^{-1} in pedon 1 and 0.32 to 0.67 mg kg^{-1} in pedon 2. Similar findings were found in Arora 2009, Sakel 1986, Sharma 2007 and Singh 1971)

Table 5. Micronutrient content of pedon soils

Pedon	Genetic Horizons	Depth (cm)	Fe (mg/kg)	Mn (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	B (mg/kg)
1	Ap	0-12	85.96	21.72	0.86	0.52	0.41
	Bt_1	12-42	73.76	8.24	0.54	0.44	0.36
	Bt_2	42-82	54.56	5.60	0.33	0.36	0.10
2	Ap	0-16	30.12	12.04	0.66	0.77	0.67
	Bt_1	18-48	25.04	11.16	0.54	0.31	0.54
	Bt_2	48-102	27.6	6.40	0.24	0.29	0.32

4. CONCLUSION

The results of present study these lead to suggest that two pedons representing up & medium land situation were exposed during dry period after kharif 2017. Both site & soil characteristics were studied. The upland soils are shallow and medium land soils are deeper in depth. The colour of upland soils was reddish brown whereas medium land soils are black in colour with thicker horizons. The former soils were light in texture whereas the latter soils was heavier in texture containing high clay. The BD of pedon1 varied from 1.48 to 1.63 Mg/m^3 that of pedon2 varied from 1.35 to 1.58 Mg/m^3. The PD ranged between 2.30 to 2.48Mg/m^3& 2.30 to 2.46Mg/m^3 in pedon1 & pedon2 respectively. Both the form of density in two pedons were increasing downwards & the value were of a typical mineral soils but the pore space showed reverse trend on confirming the compactness and aging of soils towards subsurface horizons. The pore space varied from 34.2 to 36 &35.77 to 41.30percentage in pedon1 & pedon2 respectively.Pedon1 was light texture soil whereas pedon2 was a heavy texture soil. The sand percentage in pedon1 varied from 69.4% in the surface to 80.4% in subsurface horizon. In pedon2 sand percentage varied from 46.4% in the surface to 67.5% in subsurface horizon showing decreasing trend in below layers. Reverse quantity of clay was found from surface to below layers. Clearly indicating the difference in parent material & soil forming processes. The profile distribution of micro nutrient showed that DTPA- Fe, Mn, Cu, Zn, and B (Mani 1996 and Dhane 1995) content varied from 54.56 to 85.96 mg/kg, 5.60 to 21.72mg/kg,0.33 to 0.86mg/kg,0.36 to 0.52 mg/kg, 0.10 to 0.41 mg/kg respectively & those nutrient in pedon2 were varied from 25.04 to 30.12mg/kg,6.4 to 12.04mg/kg, 0.24 to 0.66mg/kg, 0.29 to 0.77mg/kg, 0.32 to 0.67 mg/kg respectively. The DTPA –Fe, Mn, Cu were found to be sufficient in both up & medium land soil, except Zn &B. In upland soil these content were decreasing towards below layers, whereas medium land soil were shown decreasing trend with some deviation in second horizon.

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