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 the laboratory. The difference in properties between two pedons was mostly due to lateritic and basaltic parent material in pedon1. The morphology of mineral soils explains the evolution that occurs in the soil body during the process of soil formation, which is predominantly influenced by the parent material and climate. Determination of epipedon and endopedon of diagnostic horizons through description and interpretation of soil profile properties is the basis of land classification, as the knowledge of soil properties, capabilities, and utilization. The results of the study found that, based on its morphological and chemical characteristics, the soil in pedon 1 had brighter colors, higher micronutrient availability, and a thicker horizon compared to the soil in pedon 2. Meanwhile, the pedon 1 is light texture, crumb structure and pedon 2 is heavy texture and sub angular blocky structure. Both the form of density in two pedons was increasing downwards & the value were of a typical mineral soils, but the pore space showed a reverse trend on confirming the compactness and aging of soils towards subsurface horizons. Same results tendency found in micronutrients analysis where pedon 1 rich in micronutrients as compare to pedon 2 .

Key wards: *Pedon, texture, pore space, micronutrients*

1. INTRODUCTION

The natural fertility of mineral soils is reliant on the mineral composition of the parent material or soil nutrient supply. The higher the soil nutrient holds, the higher the degree of soil richness. Nutrients in the soil are exceptionally reliant on the sythesis, amount, and sort of minerals. Negligible soils from sedimentary rocks had low mineral stores or nutrient supply. Negligible soils in Ganjam areas are portrayed by different soil surfaces from sand to clay because of acidic sedimentary rocks shaped from two kinds of soil parent material, to be specific coarse-finished sandstone and fine-finished claystone or siltstone (Suharta, 2010). The attributes of acidic sedimentary rocks fluctuate because of their arrangement cycle, which relies upon the idea of the segment material, the cycle or model of the statement, and the natural states of the deposition area.

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 (Fig 1). 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*). Total cropping pattern and area wise land distribution and percentage contribution of crops in Odisha state also presented in table 1.

Geography of Ganjam district:

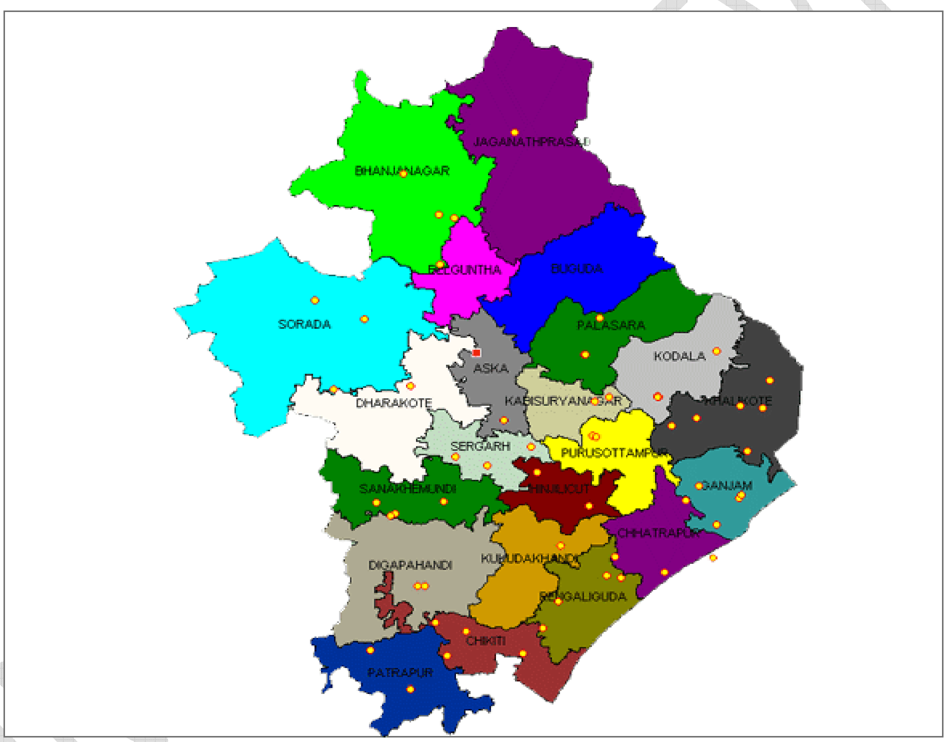

Fig 1 : Community development blocks of Ganjam district,Odisha

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

Reference: https://ganjam.nic.in/agriculture

2.1 METHOD OF ANALYSIS

2.1.1 Processing of Sample

Soil samples were taken at each horizon from the two soil pedon to analyze the soil chemical and physical properties. 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. Soil samples were dried and sieved with a 2 mm diameter 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.

2.1.1 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. The morphological characteristics of the two soil profiles are presented below.

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. Pedon 1 tended to be dark reddish-brown, (10R 4/6). In moist conditions, the colour of the soil from the lower horizon was dark-brown (10R 3/2) in pedon 2 which gradually turned into darker in depth of soil.

2.2.2 Physical properties

Soil texture

Soil physical and chemical properties analysis method were presented in Table 2. The texture of the soil was dominated by sand in top soil although there was an increase in clay on the next horizon; it did not indicate the presence of argillic horizon, due to did not meet the requirement of an arigillic horizon. Suharta (2010) stated that rough soil texture (sand

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dominance) leads to the low ability of the soil to retain water and nutrients, and the soil becomes prone to drought and sensitive to erosion. 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).

2.2.3 Chemical properties

The soil samples were analysed for the chemical properties i.e organic carbon, and available secondary and micronutrients (Ca, Mg, S, Fe, Mn, Cu, Zn and B) are mentioned in Table 2.

Table 2. Methods adopted for soil analysis

Physical/ Chemical parameters	Methods	Reference
Texture	Mechanical analysis method (Bouyoucos Hydrometer method)	C.S Piper,1950
Available- S	Turbidimetric method	Jackson, l973
Micronutrients- Fe, Mn, Cu & Zn	DTPA Extractant	Page, et al 1982
Organic carbon (g/kg)	Walkley and Black,(1947)	Walkley and black
Available Boron	Hot water soluble method	Jackson, l973
Exchangeable Ca & Mg cmol(p+)/kg	Neutral normal Ammonium Acetate	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 presented chart 1.

Chart 1. CPR Berhampur upland

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Location	CPR, OUAT farm, Ganjam, latitude 19.5743°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. The profile thickness of pedon 1 was more than 112 cm. In this depth the parent material was found. The thickness of Pedon 2 was more than 90 cm, and the water table was found at this depth. There was no organic horizon in both profiles.

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Table 3. Physical and morphological properties of pedon soil

Pedon 1										
Genetic Horizons	**Depth (cm)**	**Structure**	**BD**	**PD**	**pore space (%)**	**Colour**	**Sand (%)**	**Silt (%)**	**Clay (%)**	**Texture**
			Mg/m^3							
Ap	0-22	Crumb	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

Chemical analysis of the 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

The available micronutrients were varied in these two sites from low to very low with depth. This was the common situation, where the micronutrients content in the upper layer was higher than in the lower layer (Suharta, 2010). Through increased use of soil testing and plant analyses, micronutrient deficiencies have been verified in many soils. Some reasons limiting the incidental additions of micronutrients include: High-yield crop demands remove micronutrients from the soil, increased use of high-analysis NPK fertilizers containing lower quantities of

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micronutrient contaminants and advances in fertilizer technology reduce the residual addition of micronutrients. These factors contribute to the significant increase in usage of and need for micronutrients in order to achieve full balanced nutrition.

In order to know the profile distribution of micronutrient soil horizon sample were analysed micro-nutrients content of pedon soils were analysed through DTPA extract (Dhane et al 1995) and presented in table no 5. The exchangeable Fe^{2+} content in pedon1 varied from 54.56 to 85.96 mg/kg but that of in pedon2 varied from 30.12 to 25.04 mg/kg whereas the exchangeable Mn^{2+} (mg/kg) content in pedon1 varied from 5.60 to 21.72 mg/kg 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 and 0.29 to 0.77 mg/kg. The results also show that available boron content varies from 0.10 to 0.41 mg/kg in pedon 1 and 0.32 to 0.67 mg/kg in pedon 2. Similar findings were found in Arora 2009, 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 the present study these lead to suggest that two pedons representing up & medium land situation. Both site & soil characteristics were studied. With the combination, examination and analysis of these pedons, we have identified important characteristics along with providing a consistent and improved means of estimating physical and chemical properties. 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 which gives a better understanding of layer pedons. 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

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to 2.48Mg/m^3& 2.30 to 2.46Mg/m^3 in pedon1 & pedon2 respectively. Both the form of density in two pedons was increasing downwards & the value were of a typical mineral soils, but the pore space showed a reverse trend on confirming the compactness and aging of soils towards subsurface horizons. The pore space varied from 34.2 to 36 &3 5.77 to 41.30 percentages 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 the surface to below the layers. It clearly indicates 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 (Mani et al 1996). In upland soil these content was decreasing towards below layers, whereas medium land soil were shown to decreasing trend with some deviation in second horizon. Similar micronutrients found in Adhikary et al 2020.Therefore, amelioration technology and fertilization technology can be carried out as an effort to improve chemical properties and low soil fertility of the soil.

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