# GPS based Soil Profile study with micronutrient analysis Soils of Ganjam

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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  $\text{Cmol}(p^+)/\text{kg}$  & 2.18 to 2.98  $\text{Cmol}(p^+)/\text{kg}$  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  $\text{Cmol}(p^+)/\text{kg}$  Ca, 4.32 to 9.40  $\text{Cmol}(p^+)/\text{kg}$  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 (Bharadwaj*et al.* 1994). 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. Applications of micronutrients increase enzymatic activity, nodulation, chlorophyll formation, seed setting, and seed quality.

#### 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.

Geography of Ganjam district:



Fig : Community development blocks of Ganjam district, Odisha

Table 2.1 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°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

#### 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 (1954). The colour of soil was expressed both in symbolic notation and common name.

## 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 (Piper, 1950) 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).

PHYSICAL PARAMETERS	METHODS	REFERENCE
Texture	Mechanical analysis method (Bouyoucos	C.S Piper,1950
	Hydrometer method )	
CHEMICAL PARAMETERS	METHODS	REFERENCE
Available- S	Turbidimetric method	Chesin and Yien (1951)
Micronutrients- Fe, Mn, Cu & DTPA Extractant		(Lindsay and Norvell 1978) as
Zn		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&	Neutral normal Ammonium Acetate	As described by Page et al
mgcmol(p+)/kg		( 1982)

#### Table 2.2 Methods adopted for soil analysis

## 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.

## 3.1. 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 Site characteristics

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 <sub>1</sub>
Surface drainage	Well drained
Land use	Pulse-Pulse (as inter crop )
Natural vegetation	Mango, Neem, Banyan

# 3.2 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 fie Table 4.1.1 Morphological and Physical properties of pedon soils

Pedon 1										
Genetic Horizons	Depth (cm)	Structure	BD Mg	PD	pore space (%)	Colour	Sand (%)	Silt (%)	Clay (%)	Texture
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 <sub>2</sub>	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 <sub>2</sub>	48-102	Angular blocky	1.58	2.46	35.77	Greyish brown	46.4	18.6	35	Clay loam

Table 3.1 2.2	Physical and

morphological properties of pedon soil

# 3.3 Distribution of Secondary nutrient in pedon soils

Secondary nutrient content of pedon soils were analysed and presented in table no 4.1.3. The exchangeable  $Ca^{2+}$  content in pedon1 varied from 4.40 to 5.60 cmolp+kg<sup>-1</sup> but that of in pedon2 varied from 14.4 to 22.52 cmolp+kg<sup>-1</sup> where as the exchangeable Mg<sup>2+</sup> (cmolp+kg<sup>-1</sup>) content in pedon1 varied from 2.18 to 2.98 cmolp+kg<sup>-1</sup> but that of in pedon2 varied from 4.32 to 9.40 cmolp+kg<sup>-1</sup>. 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.

Pedon No	Genetic	Depth	Са	Mg	S
	Horizons	(cm)	( cmol(p+)/kg)	(cmol(p+)/kg	(mg/kg)
	Ар	0-12	4.40	2.18	8.20
Pedon -1	Bt <sub>1</sub>	12-42	4.50	2.80	6.20
	Bt <sub>2</sub>	42-82	5.60	2.98	3.10
Pedon -2	Ар	0-16	14.4	4.32	11.29
	$\mathbf{B}\mathbf{w}_1$	18-48	17.88	7.70	9.97
	Bw <sub>2</sub>	48-102	22.52	9.40	6.99

Table 3.2 Distribution	of Secondary	nutrients in	pedon	soils
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# 3.4 Micronutrient content in pedon soils

# In order to know the profile distribution of micronutrient soil horizon sample were analysed

Pedon	Genetic Horizons	Depth (cm)	Fe (mg/kg)	Mn (mg/kg)	Cu (mg/kg)	Zn (mg/kg)	B (mg/kg)
1	Ар	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 <sub>2</sub>	42-82	54.56	5.60	0.33	0.36	0.10
2	Ар	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 <sub>2</sub>	48-102	27.6	6.40	0.24	0.29	0.32

 Table 3.3
 Micronutrient content of pedon soils

## 4. CONCLUSION

- 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<sup>3</sup> that of pedon2 varied from 1.35 to 1.58 Mg/m<sup>3</sup>. The PD ranged between 2.30 to 2.48Mg/m<sup>3</sup> & 2.30 to 2.46Mg/m<sup>3</sup> 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 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.

## REFERENCES

- Arora S and Chahal DS. 2009. Boron desorptin kinetics in Inceptisols representing Benchmark Soils of Punjab, J. Indian Soc. Soil Sci. 57(1): 145-153.
- [2]. Arvind KS, Pankaj., K. Tiwariand and Chandra, Prakash. 2014. Micronutrients deficiencies vis-a-vis food and nutritional security of India . *countrydian J. Fert.*, Vol. 10 (12), pp.94-112 (19 pages) . AICRP on Micronutrients, Indian Institute of Soil Science
- [3]. BansalRL and Takkar PN. 1985. Distribution of Zn, Fe, Cu and Mn in soils and wheat plants of Jalandhar district (Punjab), *Journals of Research of Punjab Agriculture University*. 22, 25-32.
- [4]. Bassirani N, Abolhassan M and Galavi M. 2011. Distribution of available micronutrients as related to the soil characteristics of Hissar; Haryana (India) African Journal of Agricultural Research, Vol. 6(18): 4239-4242.
- [5]. Bell RW and Dell B. 2008. Micronutrients for Sustainable Food, Feed, Fibre and Bioenergy Production. First edition, IFA, Paris, France .
- [6]. Curi N and Franzmeier DP.1980. Toposequence of Oxisols from the Central Plateau of Brazil, <u>Soil Science Society of America</u> <u>Journal</u>, Vol. 48 No. 2, p. 341-346
- [7]. Datta M and Ram M. 1993. Status of micronutrients in some soil series of Tripura. Journal of the Indian society of soil science, 41(4): 776-777.
- [8]. Dhane SS and Shukla LM. 1995. Distribution of DTPA-extract-able Zn, Cu, Mn, and Fe in some soil series of Maharashtra and their relationship with some soil properties. *Journal of the Indian Society of Soil Science* 43 (4): 597-600.

- [9]. Food and Nutritional Security of India AICRP on Micronutrients Indian journal of Fertilizer, Vol 10 (12): 94-112.
- [10]. Kushwala AK, Singh S and Singh RN, 2009. Available nutrients and responce of Lentil(Lenseesculenta) to Boron application in rainfed upland soils of Ranchi. J. Indian Soc. Soil Sci. 57(2): 219-222.
- [11]. Lindsay WL and Norvell WA. 1978. Development of DTPA soil test for Zn, Fe, Mn and Cu. Soil ScienceSociety of America Journal 42, 421-428.
- [12]. Mani PK, and Haldar M. 1996. Effect of Dolomite on Boron transformation in acid soil in relation to nutrition of greengram.J. Indian Soc. Soil Sci. 44(3):pp 458-461.
- [13]. Meena HB, Sharma RP and Rawat US. 2008. Status of Macro and Micronutrients in some soils of Tonk District of Rajasthan. Journal of the Indian society of soil science. 54(4), 508 -512
- [14]. Meena HB, Sharma RP and Rawat US.(2006) Status of Macro and Micronutrients in some soils of Tonk District of Rajasthan. Journal of the Indian society of soil science. 54(4): 508 -512.
- [15]. Mishra A, Das D, Saren S and Dey P. 2016.GPS and GIS based soil fertility maps of Nayagarh district, Odisha annals of plant and soil research 18(1): 23-28.
- [16]. Rao DP, Desai PS, DK and Roy PS. 1997. Remote sensing applications: Thrust Area. Journal of the Indian Society of Remote Sensing. 25: 195-224.
- [17]. Rathore GS, Khamparia RS, Gupta GP, Dubey SB, Sharma BL and Tomar VS. 1995. Twenty five years of micronutrients research in soils and crops of Madhya Pradesh. *Department of Soil Science and Agricultural Chemistry, J.N.K.V., Jabalpur.*
- [18]. Rawat PS.; Mathpal KN. 1981. 'Micronutrient status of some soils of UP hills'. In J. Indian Soc. SoilSci., 29: 208-214
- [19]. Sahrawath KL, Wani SP, Rego TJ, parthasarathi G and Murthy KVS. 2007. widespread deficiency of S, B, Zn in dryland soils of the Indian semi arid tropics. *Current science I* vol 93. No 10.
- [20]. Sakel R, Singh AP, Singh BP. and Singh RB. 1986. Availability of Zinc, iron, Copper and Manganese in sub Himalaya and forest soils as influenced by cation soils property. *Journals of Indian society of soil science*. 34, 191-193.
- [21]. Sharma JC and Chaudhary SK. 2007. Vertical distribution of micronutrient cations in relation to soil characteristics in lower Shiwaliks of Solan District in North – West Himalayas. *Journal of the Indian society of soil science*. 55(1), 40-44.
- [22]. Sharma YM, Khamparia RS, Dubey SB, and Gupta. 2001. Micronutrient status in soils and plants of Rajgarh district of Madhya Pradesh, Annual of Agricultural Research, 22(1), 115 -119
- [23]. Singh D, Denge RS.and Dixit RG. 1971. Copper status of medium black soils (Indore district). J.N.K.V.V.Research J. 5; 14-17.
- [24]. Singh K. and Raj H. 1996. Micronutrient status of cotton wheat growing soils in Relation to soil properties. *Journal of the Indian* Society of Soil Science. 44 (1); 176-177.
- [25]. Sood A, Patel LB and Sharma PK. 2003. N, P and K Status of Sub Mountainous Tract of Punjab, Journal of the Indian Society of Soil Science, 19; 33-40.
- [26]. Sood A, Sharma PK, Tur NS and Nayyar VK 2009 Micronutrient Status and their Spatial Variability in Soils of Muktsar District of Punjab – A GIS Approach *Journal of the Indian Society of Soil Science*, Vol. 57, No. 3, 300-306.
- [27]. Tendon HLS. 1986. Secondary and micronutrients in agriculture guide book cum directory. Fertilizer development and consultation, New Delhi.
- [28]. Verma VK, Patel LB, Toor GS and Sharma PK. 2005. Spatial Distribution of Macronutrients in Soils of Arid Tract of Punjab, India, International Journal of Agriculture & Biology, 7(2), 370- 372.
- [29]. Vijaya MK, Bakiyathu S, Kannan B and Mahendran PP. 2015. Delineation and geographic information system (GIS) mapping of soil nutrient status of sugarcane growing tracts of Theni district, Tamil Nadu *African Journal of Agricultural*