The Pharma Innovation Journal 2022; SP-11(5): 1450-1458

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(5): 1450-1458

www.thepharmajournal.com
Received: 25-02-2022
Accepted: 20-04-2022

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Assessment of fertility status of soil in major cropping systems from different blocks of Ganjam District Odisha

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Abstract
This study was focussed to assess the physico-chemical properties in soil around different blocks of Ganjam district Odisha. Depth wise soil samples were collected from nine Major cropping systems of selected spots at 0-15, 15-30 and 30-45 cm. Total 27 samples were selected for analysis. The results revealed that soil colour varied from brown colour to Very dark greyish brown in dry condition while from Very dark greyish brown to yellowish brown in wet condition. The texture was mostly sandy loam, sandy clay loam and loamy sand. The bulk density ranged from 1.271 to 1.813 (Mg m^{-3}), particle density from 2.221 to 3.336 (Mg m^{-3}), pore space from 30.94 to 51.62 (%), water holding capacity from 40.95 to 66.67 (%), specific gravity from 2.07 to 2.52. The pH ranged from 6.217 to 6.643, E.C. ranged from 0.041 to 0.178 (dS m^{-1}). The soil organic carbon ranged from 0.668 to 1.141 (%). Available nitrogen ranged from 131.45 to 268.19 (kg ha^{-1}), Available Phosphorous ranged from 10.01 to 15.78 (kg ha^{-1}). Ammonium extractable Potassium ranged from 233.68 to 295.56 (kg ha^{-1}) all of which showed decrease in value with increase in depth. Exchangeable calcium ranged from 0.7 to 8.3 (cmol (p^+) kg^{-1}), exchangeable magnesium ranged from 0.8 to 5.5 (cmol (p^+) kg^{-1}) and available sulphur ranged from 0.76 to 5.35 (pp all of which varied significantly with site and depth. The results indicated that farmers required maintaining soil health card, adopting suitable management practices and providing proper nutrition to the soil to beat the pollution effect.

Keywords: Soil Physicochemical properties, depth, Nutrients, *etc*.

Introduction
The world is the Earth and each one life there on, including human civilization (Wikipedia.org, 2021). Agriculture is one of the world's oldest economic practices. It has developed into a technologically advanced industry and it currently plays a considerable role in global sustainability (Harrell, 2014) [16]. Soils need maintenance, but exploitation of soils has only intensified because of increasing pressure. Today, soils globally provide ample food for 7 billion people. The provision though is unevenly distributed and 1 billion people are structurally underfed. To Produce for food for 9-10 billion people by 2050, the biophysical also because the socio-economic availability of food further as of the food productive capacity are to be strongly improved. Crucial is that the capacity of land users worldwide to manage their soils sustainably and productively (ISRIC, 2021) India could be a country in South Asia and has vast dimensions with varied conditions of geology, relief, climate and vegetation. Therefore, it's an outsized sort of soil groups, distinctly different from one another. Different criteria are applied to classify Indian soils-geology, relief, fertility, chemical composition and physical structure, etc. The formation of the soil in an exceedingly particular climate is so perfect that each climate type and its own soil (Balasubramanian, 2017) [5]. Soil is one amongst the foremost valuable natural resources which are becoming degraded with time and cultivated lands are decreasing because of rising population, fast urbanisation, and industrialization. Soil fertility is degrading due to excessive nutrient loss and inadequate nutrient replenishment through manures and fertilizers. As a result of this example, Indian agriculture is under pressure to produce more food from shrinking arable land. This warrants the Indian agriculture to supply more food from shrinking arable land. Hence, adoption of intensive cropping is unavoidable and future food production are counting on mineral fertilisers to provide plant nutrients necessary for maintaining adequate food production and to arrest the declined soil productivity due to nutrient depletion. The Soil Health Card (SHC) scheme was launched by

the Govt. of India in February 2015. Under the scheme, the govt. has mandated the availability of soil health cards to any or all farmers. These cards will carry crop-wise recommendations of nutrients and fertilizers required by an individual farmer to enhance soil productivity through the judicious use of inputs. All soil samples are required to be tested in a soil testing lab, with an expert then assessing the soil quality and suggesting measures to deal with any deficiencies. The SHC displays the test results and proposals together with the farmer's personal details like Aadhaar card numbers and plot details. The program operates under the belief that soil health cards will inform recipients of the status of their soil health and supply recommendations on the suitable application of key nutrients with regard to the particular crops being grown (Singh *et al.*, 2018). Soil Testing is well recognized as a sound scientific tool to assess inherent power of soil to provide plant nutrients (Ganorkar *et al.*, 2017)

Materials and Methods

The location of Ganjam district lies between_19.5860° N latitude and 84.6897° E longitude. It covers a section of 8070.60 sq km. The samples were collected from the choosen sites at the identical time within the summer season at the end of cropping cycles. Soil Samples were collected at a depth of 0-15 cm, 15-30 cm and 30-45 cm at the location. Ganjam soil consists of Sandy Loam, Loam Costal alluvium in few patches in coastal plains in eastern parts. As the study was conducted in farmer's field, each cropping system has been considered as a separate treatment. T1 (Rice – Rice), T1 (Rice – Rice), T3 (Rice – Vegetable), T4 (Vegetable – Vegetable), T5 (Sugarcane sole), T6 (Ground nut – Groundnut), T7 (Rice - Maize – Cowpea), T8 (Rice-Black gram), T9 (Rice – Mustard).

Statistical analysis

The data recorded during the course of investigation was subjected to statistical analysis of variance (ANOVA) technique (Fisher, 1960). The type of ANOVA adopted for the experiment was two-factor analysis without replication. The implemented design of experiment within the analysis done was completely Randomized Design (CRD). It is used when experimental units are homogeneous because it involves only two basic principles of the look of the experiment, *viz.*, replication and randomization. CRD is employed for laboratory purpose only. The significant and non-significant treatment effects were judged on the idea of 'F' (Variance ratio) test.

Results and Discussion

Analysis of Physical Properties of Ganjam District at different depths.

The texture in Ganjam district was The soils of the study locations varied from sandy loam to loamy sand and sandy clay loam in texture. The sand, silt and clay per cent varied from 48.57 to 83.25, 10.6 to 25.6 and 9.2 to 32.0, respectively in surface soils whereas the corresponding values for sub surface soils are 45.2 to 83.5, 6.8 to 18.8 and 10.5 to 34.5%. The Bulk density ranged from 1.271 (Vegetable-Vegetable) cropping system to 1.813 (Mg m^{-3}) (Rice-Vegetable) Cropping system. The particle density ranged from 2.221 to 3.336 (Mg m^{-3}). The maximum value found in B_2V_1 in Vegetable - Vegetable cropping system (15-30 cm depth) 3.336 (Mg m^{-3}) which indicates that the soil has comparatively lower organic matter and the minimum value found in B_2V_2 in Sugarcane sole cropping system (0-15 cm depth) 2.221 (Mg m^{-3}) which indicates the presence of high organic matter The pore space (%) ranged from 30.94 to 51.62 (%). The maximum value found in B_3V_1 i.e. in Rice-Maize - Cowpea cropping system (0-15 cm depth) 51.62 (%) and the minimum value found in B_1V_3 i.e. in Rice-Vegetable (30-45 cm depth) 30.94 (%). Pore space was found to decrease with increase in depth attributed to increase in compaction in the sub surface. The water holding capacity (%) ranged from 40.95 to 66.67 (%). The maximum value found in B_1V_2 i.e in Rice- Greengram cropping system (0-15 cm depth) 66.67 (%) and the minimum value found in B_3V_2 i.e in Rice- Blackgram cropping system (15-30 cm depth) 40.95 (%). WHC value decreases with the increasing depth because of soil compaction and reduction in pore space. The specific gravity ranged from 2.07 to 2.52. The maximum value found in B_3V_3 i.e in Rice – Mustard cropping system (0-15 cm depth) 2.52 and the minimum value found in B_1V_1 i.e in Rice-Rice cropping system (30-45 cm depth) 2.07 and this due to presence of organic matter and porous particles in soil.

Analysis of Chemical Properties of Ganjam District at different depths.

The pH ranged from 6.217 to 6.643. The maximum value found in B_1V_1, Rice-Rice cropping system (30-45 cm depth) 6.643 and the minimum value found in B_2V_1, Vegetable - Vegetable cropping system (0-15 cm) cm depth) 6.217, thereby indicating the soils are acidic to neutral. The electrical conductivity ranged from 0.041 to 0.178 dS m^{-1}. The maximum value found in B_3V_1, Rice-Maize-Cowpea Cropping system (30-45 cm depth) 0.178 dS m^{-1} and the minimum value found in B_2V_3 i.e in Groundnut- Groundnut Cropping Ssytem (30-45 cm depth) 0.041 dS m^{-1}**.** The soil organic carbon (%) ranged from 0.223 to 1.302 (%). The maximum value found in B_2V_1, Vegetable -Vegetable Cropping System (0-15 cm depth) 1.141 (%) and the minimum value found in B_1V_2 i.e in Rice- Greengram cropping system (15-30 cm depth) 0.668 (%). The Available Nitrogen (kg ha^{-1}) ranged from 131.45 to 268.19 (kg ha^{-1}). The maximum value found in B_2V_2, Sugarcane Sole Cropping System (0-15 cm depth) 268.19 (kg ha^{-1}) and the minimum value found in B_3V_3 i.e in Rice- Mustard Cropping System (30-45 cm depth) 131.45 (kg ha^{-1}). The Available Phosphorous (kg ha^{-1}) ranged from 10.01 to 15.78 (kg ha^{-1}). The maximum value found in B_3V_3, Rice-Mustard Cropping system (0-15 cm depth) 15.78 (kg ha^{-1}) and the minimum value found in B_1V_1, Rice-Rice Cropping System (30-45 cm depth) 10.01 (kg ha^{-1}). The Available Potassium (kg ha^{-1}) ranged from 233.68 to 295.56 (kg ha^{-1}). The maximum value found in B_3V_2, Vegetable -Vegetable Cropping System (0-15 cm depth) 295.56 (kg ha^{-1}) and the minimum value found in B_1V_1, Rice-Rice Cropping System (30-45 cm depth) 233.68 (kg ha^{-1}). The Available Potassium decreases with the increasing depth. The exchangeable calcium (cmol (p^+) kg^{-1}) ranged from 0.7 to 8.3 (cmol (p^+) kg^{-1}). The maximum value found in B_2V_2, Rice-Greengram cropping system (0-15 cm depth) 8.3 (cmol (p^+) kg^{-1}) and the minimum value found in B_3V_2, Rice-Blackgram cropping system (30-45 cm depth) 0.7 (cmol (p^+) kg^{-1}). The Exchangeable Magnesium (cmol (p^+) kg^{-1}) ranged from 0.8 to 5.5 (cmol (p^+) kg^{-1}). The maximum value found in B_2V_1, Vegetable-Vegetable cropping system (0-15 cm depth) 5.5 (cmol (p^+) kg^{-1}) and the minimum value found in B_2V_1, Vegetable-Vegetable cropping system (30-45 cm depth) 0.8 (cmol (p^+) kg^{-1}). The Available Sulphur (ppm) ranged from 0.76 to 5.35 (ppm). The maximum value found in B2V1, Rice-Vegetable cropping system (0-15 cm depth) 5.35 (ppm) and the minimum value found in B_3V_2, Rice-Blackgram cropping system (0-15 cm depth) 0.76 (ppm).

Table 1: Global Positioning System Coordinates of the Soil sampling sites

S. No.	Name of Blocks	Name of the Villages	Latitude(N^0)	Longitude (E^0)
1	Polasara (B_1)	Laxmanapalli (V_1)	19˚42'14.04"	84˚49'8.4''
		Madhupalli (V_2)	19˚46'50.71''	84˚48'46.85''
		Hirapalli (V_3)	19˚42'1.65''	84˚47'1.37''
2	Buguda (B_2)	Adipur (V1)	19˚48'39.01''	84˚48'1.37''
		Sorada (V_2)	19˚45'28.72''	84˚25'23.03''
		Sorada (V_2)	19˚36'55.73''	84˚28'26.82''
3	Bhanjanagar (B_3)	Madhupur (V_1)	19˚18'18.82''	84˚42'54.74''
		Rambha (V_2)	19˚30'48.89''	84˚41'8.10''
		Tanarada (V_3)	19˚54'23.94''	84˚36'48.25''

Table 2: Site and locational details

Treatment	Cropping system	Location
T_1	Rice – Rice	Laxmanapalli, Block- Polasara
T_2	Rice - Green gram	Madhupalli, Block – Polasara
T_3	Rice – Vegetable	Hirapalli, Block – Polasara
T_4	Vegetable – Vegetable	Adipur, Block – Buguda
T_5	Sugarcane sole	Sorada, Block – Buguda
T_6	Ground nut – Groundnut	Udayapur, Block-Buguda
T_7	Rice - Maize – Cowpea	Madhupur, Block-Bhanjanagar
T_8	Rice-Blackgram	Rambha, Block – Bhanjanagar
T_9	Rice – Mustard	Tanarada, Block – Bhanjanagar

Table 3: Method of Analysis

Parameters	Methods	Scientist(years)
Soil Texture (Sand, Silt, Clay %)	Bouyoucos Hydrometer	Bouyoucos (1927) [13]
Particle Density (Mg m^{-3})	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Bulk Density (Mg m^{-3})		
Pore Space (%)		
Water retaining capacity (%)		
Specific gravity	Pycnometer	Black,(1965)
Soil pH	Digital pH meter	Jackson, (1958)
Electrical Conductivity(dS m^{-1})	Digital EC meter	Wilcox, (1950)
Organic Carbon (%)	Wet oxidation method	Walkley and Black, (1947) [12]
Available Nitrogen (kg ha^{-1})	Kjeldahl method	Subbaiah, (1956)
Available Phosphorous (kg ha^{-1})	Calorimetric method	Olsen *et al*., (1954) [23]
Available Potassium (kg ha^{-1})	Flame photometer method	Toth and Prince, (1949)
Exchangeable Ca^{2+} and Mg^{2+}[cmol (p^+) kg^{-1}]	EDTA	Jackson, 1973 [10]
Available Sulphur (ppm)	Turbidimetric method	Bardsley and Lancaster, (1960) [9]

Table 4: Soil Texture

Blocks	Villages	Depth(cm)	%Sand	%Silt	%Clay	Textural class
Polasara	B_1V_1	0-15	55.27	18.16	26.57	Sandy Clay loam
		15-30	50.20	20.26	29.54	Sandy Clay loam
		30-45	59.20	18.31	22.49	Sandy Clay loam
	B_1V_2	0-15	62.90	16.20	20.90	Sandy Clay Loam
		15-30	58.27	12.50	29.23	Sandy Clay Loam
		30-45	77.27	8.16	14.57	Sandy Clay Loam
	B_1V_3	0-15	80.27	9.16	10.57	Sandy Loam
		15-30	81.50	7.76	10.74	Sandy Loam
		30-45	83.17	9.16	7.67	Sandy Loam
Buguda	B_2V_1	0-15	80.77	6.16	13.07	Sandy loam
		15-30	80.87	8.16	10.97	Sandy loam
		30-45	80.27	7.06	12.67	Sandy loam
	B_2V_2	0-15	67.27	10.16	22.57	Sandy loam
		15-30	76.27	8.36	15.37	Sandy loam
		30-45	70.25	9.16	20.59	Sandy loam
	B_2V_3	0-15	79.25	11.69	9.06	Sandy loam

		15-30	81.64	7.68	10.68	Sandy loam
		30-45	83.50	8.53	7.91	Sandy loam
Bhanjanagar	B_3V_1	0-15	80.75	10.52	8.73	Loamy Sand
		15-30	83.25	6.65	10.10	Loamy sand
		30-45	81.20	7.93	10.87	Loamy Sand
	B_3V_2	0-15	48.45	20.80	30.93	Sandy Clay Loam
		15-30	47.50	21.57	14.57	Sandy Clay Loam
		30-45	49.47	22.30	28.23	Sandy Clay Loam
	B_3V_3	0-15	77.59	9.05	13.36	Loamy Sand
		15-30	78.05	8.59	13.36	Loamy Sand
		30-45	75.50	10.25	14.25	Loamy Sand

Table 5: Assessment of Bulk density, Particle density and pore space in major cropping systems from different blocks of Ganjam district, Odisha

	Bulk density (Mg m^{-3})			**Particle density (Mg m^{-3})**			**Pore space (%)**		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	1.541	1.571	1.582	2.671	2.679	3.680	42.30	41.35	40.00
B_1V_2	1.444	1.532	1.712	2.501	2.512	2.514	42.26	39.01	31.82
B_1V_3	1.354	1.532	1.813	2.501	2.514	2.516	45.86	39.06	30.94
B_2V_1	1.271	1.273	1.365	2.363	2.365	2.367	46.21	46.17	42.33
B_2V_2	1.356	1.358	1.359	2.221	2.224	2.226	38.98	38.93	38.91
B_2V_3	1.501	1.512	1.571	2.501	2.502	2.504	39.98	39.56	37.26
B_3V_1	1.292	1.312	1.351	2.671	2.674	2.678	51.62	50.93	49.33
B_3V_2	1.321	1.334	1.411	2.501	2.513	2.523	47.18	46.91	44.07
B_3V_3	1.312	1.332	1.357	2.501	2.504	2.509	47.54	47.20	45.91
	F-test	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**
Due to depth	S	0.064159	0.00028	S	0.00485	8.11326	S	2.257661	5.98E-05
Due to site	S	0.118973	0.0007388	NS	0.139867	6.52205	S	4.623633	0.005975

Table 6: Assessment of Water holding capacity and Specific gravity in major cropping systems from different blocks of Ganjam district, Odisha

	Water holding capacity (%)			**Specific gravity**		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30cm**	**30-45 cm**
B_1V_1	47.10	47.35	47.37	2.11	2.17	2.07
B_1V_2	66.67	60.10	59.63	2.12	2.25	2.25
B_1V_3	48.87	45.00	60.89	2.15	2.13	2.13
B_2V_1	44.66	55.47	48.06	2.25	2.45	2.45
B_2V_2	50.00	48.78	54.39	2.31	2.31	2.31
B_2V_3	59.98	54.35	42.87	2.22	2.16	2.16
B_3V_1	55.57	53.77	42.50	2.17	2.36	2.36
B_3V_2	53.89	40.95	53.24	2.35	2.22	2.22
B_3V_3	49.88	52.96	55.94	2.52	2.18	2.18
	F-test	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**
Due to depth	NS	1.008703	0.255983	NS	0.004491	0.058169
Due to site	NS	4.216385	0.742891	S	0.09378	0.979968

Table 7: Assessment of pH, EC and Organic Carbon in major cropping systems from different blocks of Ganjam district, Odisha

	pH			**EC (dS m^{-1})**			**O.C (%)**		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	6.221	6.523	6.643	0.081	0.091	0.098	0.753	0.751	0.750
B_1V_2	6.512	6.613	6.632	0.071	0.101	0.087	0.671	0.669	0.668
B_1V_3	6.234	6.512	6.578	0.062	0.065	0.054	0.771	0.760	0.759
B_2V_1	6.217	6.301	6.387	0.052	0.081	0.074	1.141	1.140	1.139
B_2V_2	6.351	6.360	6.366	0.101	0.042	0.098	0.881	0.880	0.879
B_2V_3	6.501	6.512	6.517	0.092	0.063	0.041	0.714	0.713	0.711
B_3V_1	6.234	6.239	6.241	0.091	0.093	0.178	0.751	0.750	0.657
B_3V_2	6.417	6.423	6.431	0.061	0.056	0.079	0.702	0.701	0.699
B_3V_3	6.332	6.337	6.340	0.068	0.094	0.068	0.991	0.990	0.988
	F-test	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**
Due to depth	S	0.06393	0.0028	NS	0.006075	0.160664	S	0.007437	3.11215
Due to site	S	0.1084	0.91703	NS	0.018504	0.515115	S	0.158504	0.23075

Table 8: Assessment of Available Nitrogen, Phosphorous and Potassium in major cropping systems from different blocks of Ganjam district, Odisha

	Nitrogen (Kg ha $^{-1}$)			Phosphorous (Kg ha $^{-1}$)			Potassium (Kg ha $^{-1}$)		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	255.77	249.88	246.61	12.92	10.02	10.01	239.88	236.89	233.68
B_1V_2	265.22	260.44	259.35	14.88	12.77	11.13	255.78	251.34	248.45
B_1V_3	252.77	250.48	245.51	14.83	13.22	12.07	247.79	241.67	240.45
B_2V_1	253.81	245.61	240.76	13.43	12.55	11.88	257.94	254.33	251.77
B_2V_2	268.19	261.18	253.75	11.34	10.99	10.33	270.45	264.44	261.78
B_2V_3	255.77	250.61	242.17	12.98	11.44	10.98	265.88	257.57	251.56
B_3V_1	251.48	247.44	239.81	11.04	10.27	10.12	288.78	285.78	282.39
B_3V_2	249.76	242.75	239.54	14.54	13.22	12.33	295.56	293.67	289.88
B_3V_3	237.33	235.51	231.45	15.78	14.13	13.44	277.99	267.33	264.22
	F-test	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**
Due to depth	NS	28.92908	0.637955	S	1.102412	6.30407	S	4.255189	6.06E-16
Due to site	NS	9.73263	0.226797	S	1.355655	6.60707	S	18.54165	1.91E-07

Table 9: Assessment of Exchangeable Calcium, Magnesium and Available Sulphur in major cropping systems from different blocks of Ganjam district, Odisha

	Exchangeable calcium (cmol (p $^+$) kg $^{-1}$)			Exchangeable Magnesium (cmol (p $^+$) kg $^{-1}$)			Available Sulphur (ppm)		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	5.5	5.8	7.3	4.2	3.3	1.9	13.89	13.71	12.58
B_1V_2	4.5	4.6	4.6	3.6	3	1.7	12.98	11.66	10.38
B_1V_3	4.4	3.2	0.8	4.4	2.5	1.3	13.35	12.22	11.33
B_2V_1	7.4	5.5	3.3	5.5	4.4	0.8	15.15	12.71	11.65
B_2V_2	8.3	4.2	1.2	2.8	4.5	5.2	12.58	11.89	9.81
B_2V_3	5.4	5.6	7.7	4.8	3.1	1.9	15.59	14.98	12.89
B_3V_1	4.2	7.2	7.8	1.7	4.6	5.4	17.88	14.21	13.22
B_3V_2	3.4	2.7	0.7	2.2	1.7	0.8	18.77	12.21	11.89
B_3V_3	3.3	4.3	3.4	5	6.1	6.7	20.87	16.87	14.78
	F-test	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed. (±)**	**C.D.@ 0.05%**
Due to depth	NS	0.541904	0.081879	NS	0.516199	0.095727	S	1.828493	0.000266
Due to site	NS	1.52525	0.383974	NS	1.201979	0.270826	S	13.70556	2.80E-65

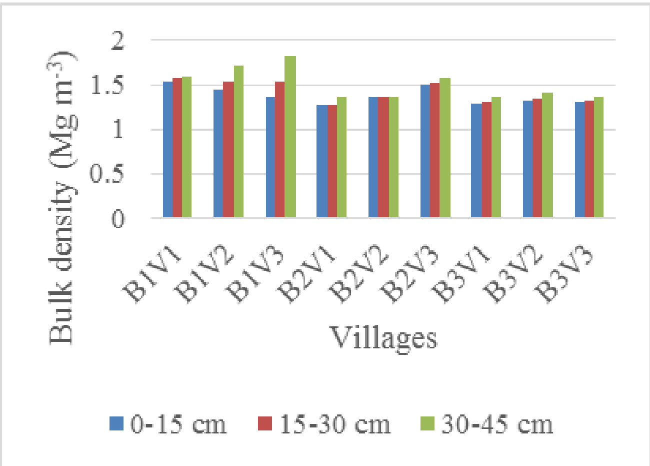

Fig1: Graphical representation of Bulk density (Mg m $^{-3}$)

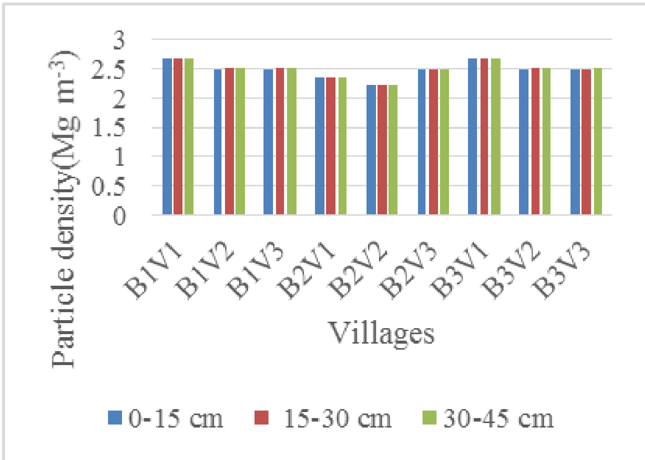

Fig 2: Graphical reprenstation of Particle density of study area. (Mg m $^{-3}$) of study area

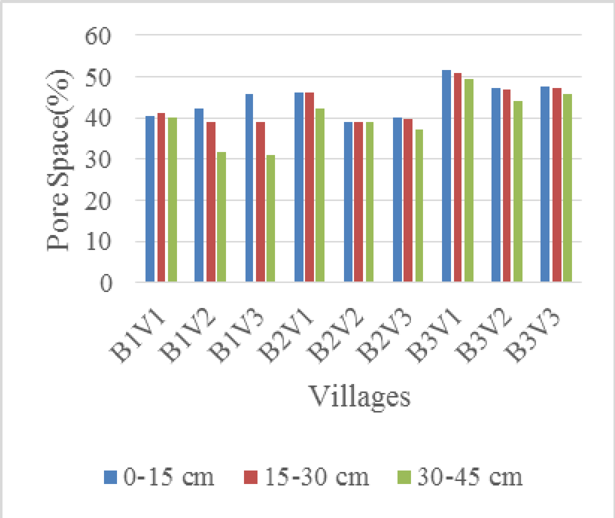

Fig 3: Graphical representation of Pore space (%)

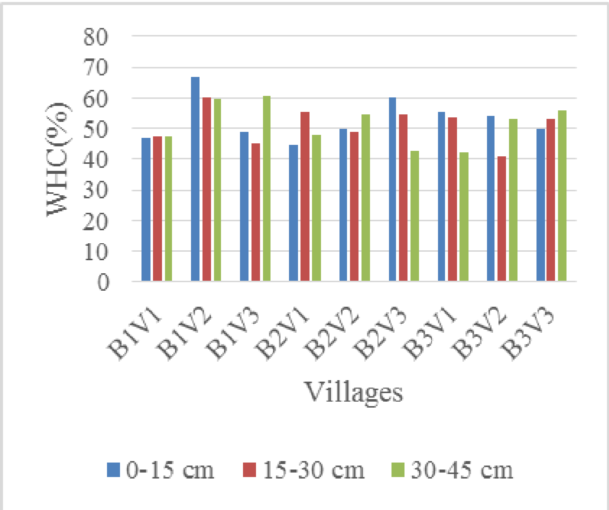

Fig 4 : Graphical representation of Water holding Capacity (%) of study area

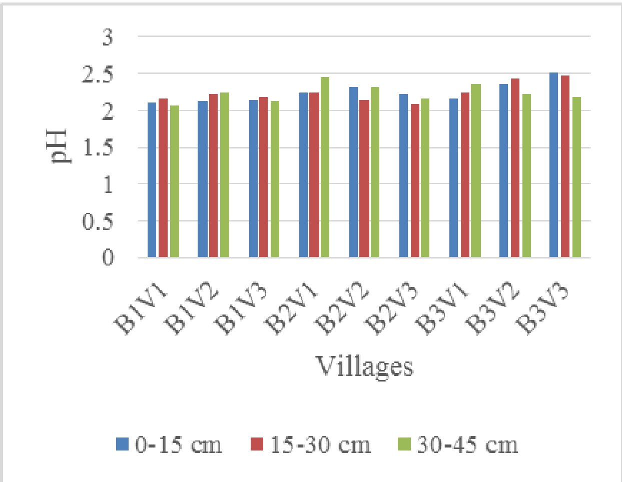

Fig 5: Graphical represntation of Specific gravity

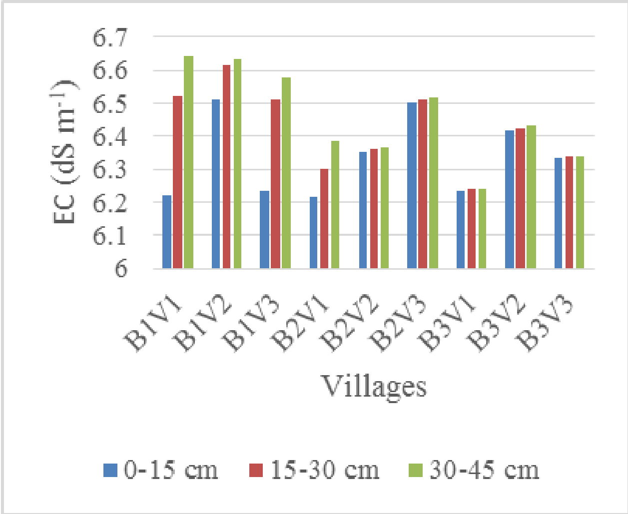

Fig 6: Graphical represntation of pH of study area of study area

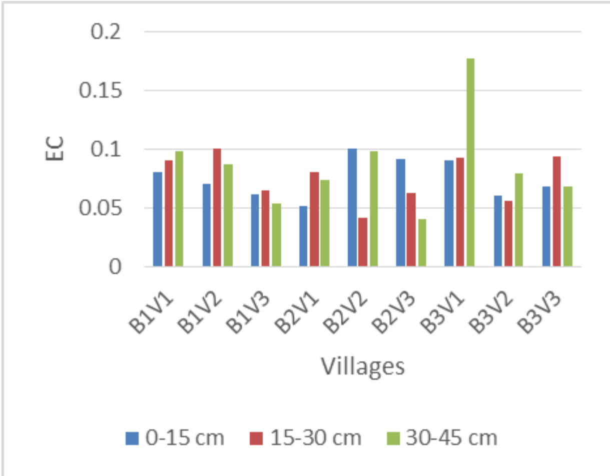

Fig 7: Graphical represntation of Organic Carbon (%)

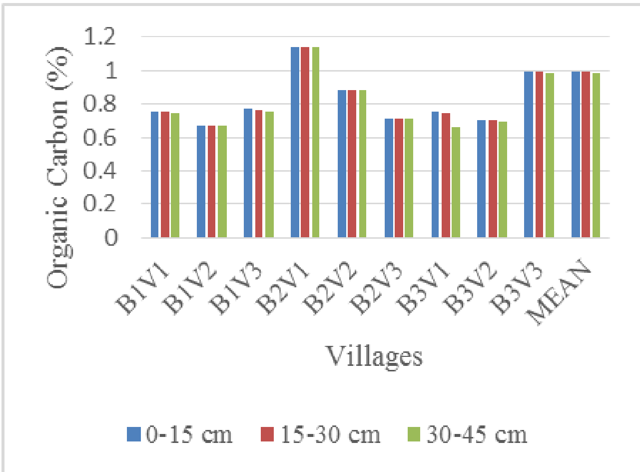

Fig 8: Graphical reprentation of Available N of study area (Kg ha^{-1}) of study area

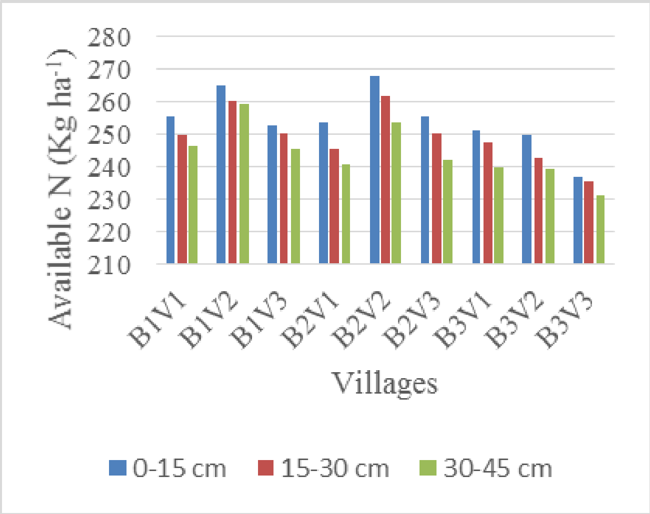

Fig 9: Graphical representation of Available P (Kg ha^{-1})

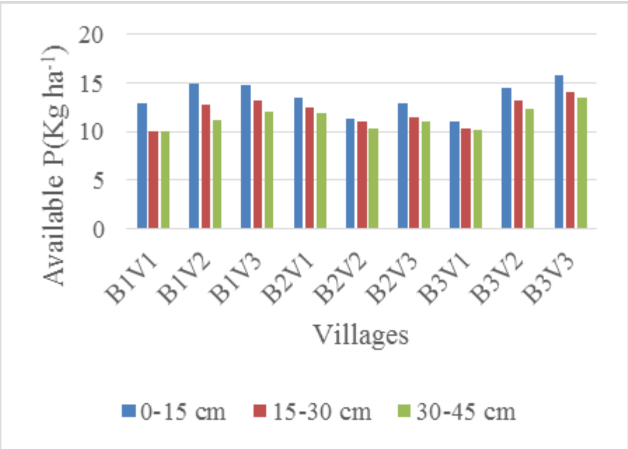

Fig 10: Graphical reprentation of Available K of study area (Kg ha^{-1}) of study area

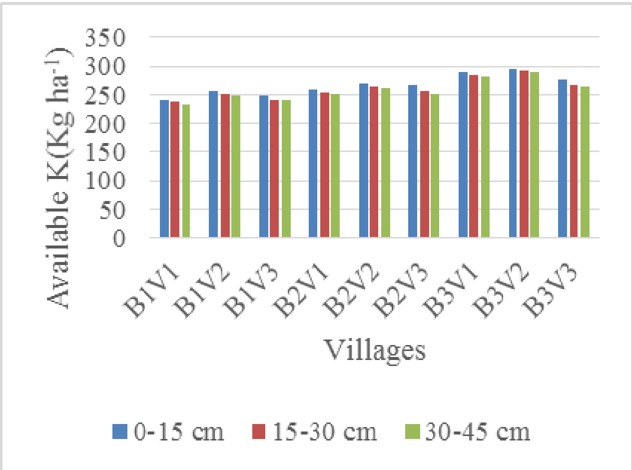

Fig 11: Graphical reprentation of Exchangeable Calcium (cmol (p^{+}) kg^{-1}) of study area

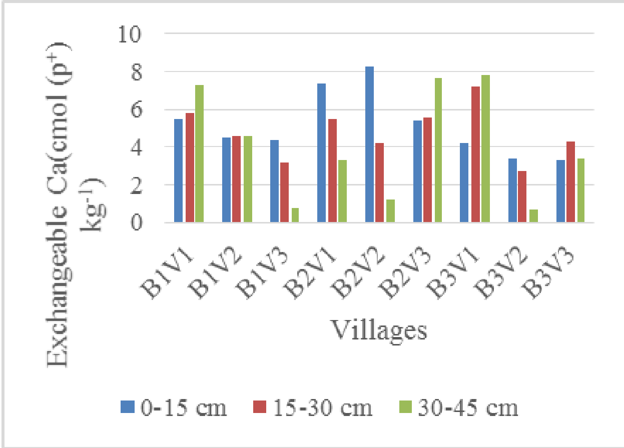

Fig 12: Graphical representation of Exchangeable Calcium (cmol (p^{+}) kg^{-1}) of study area Magnesium (cmol (p^{+}) kg^{-1}) of study area

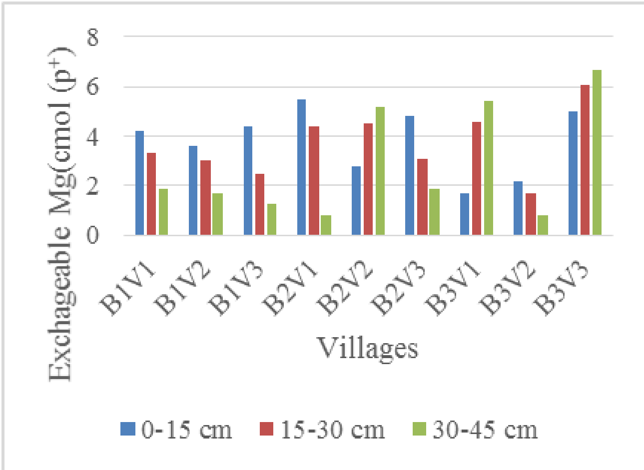

Fig 13: Graphical reprentation of Available Sulphur (ppm) of study area

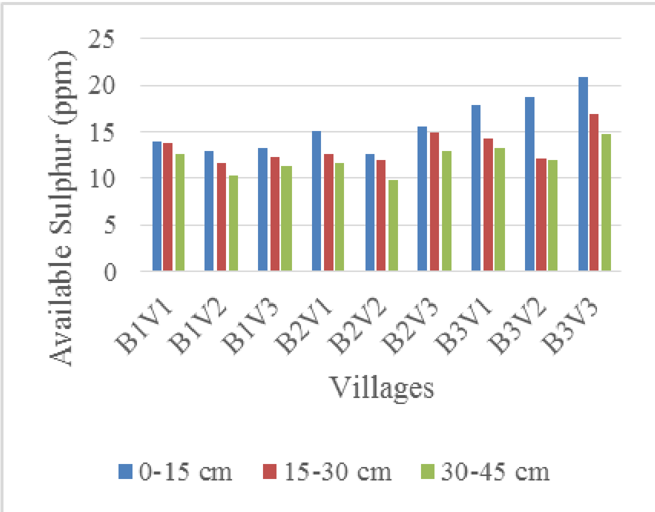

Fig 14: Graphical representation of Exchangeable Calcium (cmol (p^{+}) kg^{-1}) of study area Magnesium (cmol (p^{+}) kg^{-1}) of study area

Conclusion

It is concluded from the trial that the soils of Ganjam district with 9 major cropping system are sandy loam to sandy clay loam with adequate BD, PD and pore space. Soil pH is Acidic to neutral as favourable Electrical Conductivity for plant growth, fertile with high organic content. The deficiency of the nutrients can be mitigate by the use of organic and inorganic fertilizers. It shows that the soils are good for cultivation of paddy, maize, millet, pulses, sugarcane *etc.* Farmers are required to maintain Soil Health Card according to the guidelines of central and state government for crop cultivation and advise to adopt suitable management practices and provide proper nutrition to soil health. Time to time inventory should be maintained to overcome to the pollution effect in their respective soil.

Acknowledgement

The author expresses his gratitude to the HOD Sir, Advisor, Co-advisor, Co-author, seniors, and juniors of the Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India, as well as the NAI, SHUATS for providing the opportunity to pursue a Master's degree.

Conflict of interest: I, Rojalin Hota, as a Corresponding Author, confirm that none of the other authors have any conflicts of interest related to this publication.

Funding Agency: None.

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