ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF SOIL FROM DIFFERENT BLOCKS OF ADILABAD DISTRICT, TELANGANA, India

Abstract

An Assessment of Physico-chemical properties of soil from different blocks of Adilabad district, Telangana was carried out in 2022-23. To determine the availability of macro nutrient in soil of these soil samples and provide the assessment of 9 sampling locations were selected. Soil samples were collected at the depth of 0-15 cm, 15-30 cm and 30-45 cm respectively. Soil textural classes were sandy clay loam. Bulk Density varies from (1.36 to 1.64 Mg m^{-3}). Particle Density varies from (2.34 to 2.49 Mg m^{-3}). % Pore Space (41.23 to 49.16 %), The Water Holding Capacity varies from (36.65 to 45.89%) the physical condition of the soil was found good. The pH of soil is alkaline in nature (7.43 to 8.90) and the Electrical Conductivity (0.17 to 0.49 dSm^{1}) was suitable for all crops. Organic carbon was found low to medium (0.31 to 0.48%). These soils have low Nitrogen (190.00 to 220.00 kg ha^{-1}) in all villages. Phosphorus (16.14 to 25.58 kg ha^{1}) is found medium to high. Potassium (219.87 to 277.51 kg ha^{-1}) is found medium in range. Calcium (3.68 to 5.45 meq $100g^{-1}$) and Magnesium (1.89 to 2.76 meq $100g^{-1}$) are sufficient in this soil. There is an including awareness of the need to pay greater attention in the role of macronutrients enhancement in the soil for good soil health and proper nutrition of plant so as to attain optimum economic yield and soil is suitable for all major tropical and sub-tropical crops.

Key words: Adilabad district, Physico-chemical properties, Soil Health

INTRODUCTION

"Soil is one of the most important resources of the nature. All living things depends on plants, and plants grow in soil for day-to-day need. Soils are medium in which crop grow to food and cloth. Soil is not only important for agriculture but also have more useful for living organisms. Soil as a component of the terrestrial ecosystem fulfils many functions including those that are essential for sustaining plant growth. The importance of soil as a reservoir of nutrients and moisture for the production of forage and plant species has been recognized since the beginning of the forest management as a science. Any parts of earth surface that support vegetation also bears a covering of soil. Vegetation distribution and development largely depends on the soil condition". (Tale and Ingole, 2015). **"**The deficiency of nutrients has become major constraint to productivity and sustainability of soils. For the better growth of plants, amongst many other factors, thirteen essential elements are required to be present in soil in proper proportion and available form. Soil fertility is the status or the inherent capacity of the soil to supply nutrients to plants in adequate amounts and in suitable proportions. Soil productivity is the capacity of the soil to produce crops with specific system of management and is expressed in terms of yields. Soil fertility and productivity are the key pillars for food production and soil quality is of equal significance in the background of soil degradation caused by many factors. Crop growth is influenced by aerial and soil environment. Suitable environment is necessary

for better germination, growth and yield of crops. The higher nutrient availability is favourable when soil has higher water holding capacity, proper aeration and less soil strength or mechanical resistance. All productive soils may be fertile, but all fertile soils need not be productive which may be due to problems like water logging, saline or alkaline conditions, adverse climate etc" (IOSR-JAC, 2014). "The concept of soil fertility includes not only the quantity of nutrients a soil contains but how well nutrients are protected from leaching, how available the nutrients are and how easily plant roots can function. Depending upon the cropping pattern, leaching, erosion, etc soil loses a considerable amount of nutrients every year. Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximum crop yield. It also helps in reducing excess and indiscriminate use of fertilizers, pesticides, fungicides etc which eventually cause pollution since farmers and planners are lack of knowledge regarding the quantity of these to be applied" (Shivannaand Nagendrappa, 2014).

Keeping in view of importance of soil's physical and chemical properties, the present study of Physico-chemical properties of soil collected from various locations of district of Adilabad, Telangana undertaken. The soil sample collection is from 3 blocks of Adilabad District in the state of Telangana. Each selecting 3 villages. Samples will be collected randomly from a site of each village using soil auger, Khurpi Knife by composite sampling method at a depth of 0-15cm, 15-30cm, 30-45cm.

A comparison of the Physico-chemical Properties of some of the soils of different regions of the Telangana state has been undertaken by comparing the results of the present study with the studies done earlier in the other regions of the state. Hence, a detailed study for evaluation of soils is needed to realize the concept of Physico-chemical analysis successfully. With this following objective, a study has been undertaken in soil resources inventory for sustainable land use planning in Adilabad region of Telangana.

MATERIALS AND METHODS

Sampling site and collection

Telangana, state of India, is situated on the Deccan plateau in the central stretch of the eastern seaboard of the Indian Peninsula. it is bordered by the states of Maharashtra to the north, Chhattisgarh to the northern, Karnataka to the west, and Andhra Pradesh to the east and south. The capital of the state is Hyderabad.

Soil samples were collected from 3 different Blocks of Adilabad district in Telangana during kharif-2022. Three different locations selected from each block. Samples were collected randomly from three site of each block using soil auger, Khurpi, Knife by composite sampling method at depths of 0-15cm,15-30cm and 30-45cm. Twenty-Seven Samples are collected with the help of GPS. All the samples were divided into four parts and then among them two samples are collected and only half kg sample is being taken for the soil analysis by the conning and quartering method. Completely Randomized Design was used as the experiment design in the analysis (CRD).

Methods

"Analysis of the soil samples were under the methods, the physical parameters include Soil Colour, Soil Texture, Bulk Density, Particle Density, Pore Space, Water Holding Capacity, whereas chemical parameters include pH, Electrical Conductivity, Organic Carbon, Macronutrients (N, P, K, Ca, Mg,). The samples were matched against standard Munsell colour chart" (Munsell, 1971). Soil textural class was determined by using Hydrometer (Bouyoucos, 1927). "Bulk density, Particle density, Water holding capacity was determined by using Graduated Measuring Cylinder method" (Muthuvel *et al.*, 1992). "pH was estimated with the help of Digital pH meter after making 1:2 soil water suspension" (Jackson, 1958). "Electrical Conductivity was estimated with the help of Digital Conductivity meter" (Wilcox, 1950). "Percent Organic Carbon was estimated by Wet Oxidation method" (Walkley and Black, 1947). "Available Nitrogen was estimated by Alkaline Potassium Permanganate method, using Kjeldahl apparatus (Subbiah and Asija, 1956), Available Phosphorus was estimated by Olsen's extraction followed by Spectrophotometric method (Olsen *et al.*, 1954), Available Potassium was estimated by Neutral normal Ammonium Acetate extraction followed by Flame photometric method (Toth and Prince, 1949), Exchangeable Calcium and Magnesium were estimated by EDTA method" (Cheng and Bray, 1951).

RESULTS AND DISCUSSION

Physical Properties

The Soil Textural classes identified as Sandy Clay Loam. The sand, silt and clay percentage varied from 46.56 to 60.56 sand, 11.36 to 19.36 silt and 25.08 to 34.08 clay in Sandy Clay Loam. Bulk Density was varied from the 1.36 to 1.64 Mg m^{-3} and the highest Bulk Density was found in S_2 (1.64 Mg m^{-3}) from Jainath Block. "The bulk density increases with the increase in soil depth. The reason is soil compactness, which will be more at high depth and soil organic carbon will be decreased with increases the depth because of lower organic carbon and higher compactness of soil bulk density will be increased with increase in depth". (Gangothri and Dadhich,2021) The Particle Density varied from 2.34 to 2.49 Mg m^{-3} and the highest Particle Density was found in S_9 (2.49 Mg m^{-3}) from Boath Block. Particle density varies according to mineral content of soil particles. In most of the soil the particle density is about 2.66 Mg m^{-3} (Verma *et al.*, 2019). The Pore Space (%) ranged from 41.23 to 49.16 %. The highest Pore Space % was found at S_6 (49.16%) from Ichoda Block. The pore space found to decrease with increase in depth at attributed to increase in compaction in the sub surface. Surface soils are having high amount of macro and micro pores compared to sub surface soil due to presence of high organic matter (Verma *et al.*, 2019). The Water Holding Capacity (%) ranged from 36.65 to 45.89 % and the highest water holding capacity was found at S_6 from Ichoda Block hold the water best at 45.89%. "The water holding capacity value decrease with increase in depth because of soil compaction and reduction in pore space. Soils vary in their water holding capacity according to their structure, texture and bulk density relationship to total pore size distribution" (Singh *et al.*, 2019)

Table 1: Evaluation of Bulk density and Particle density (Mg m^{-3}) of Soils of Adilabad District

Block Name & Sites	Bulk Density (Mg m^{-3})			Particle Density (Mg m^{-3})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Jainath						
S_1	1.40	1.44	1.47	2.38	2.43	2.48
S_2	1.38	1.55	1.84	2.37	2.41	2.44
S_3	1.53	1.56	1.58	2.38	2.42	2.46
Ichoda						
S_4	1.38	1.36	1.38	2.34	2.40	2.44
S_5	1.50	1.45	1.49	2.35	2.41	2.47
S_6	1.53	1.54	1.60	2.37	2.42	2.46
Boath S_7	1.53	1.56	1.58	2.38	2.43	2.47
S_8	1.53	1.54	1.60	2.35	2.40	2.46
S_9	1.50	1.56	1.58	2.38	2.43	2.48

	F-Test	S.Em. ±	C.D. @5%	F-Test	S.Em. ±	C.D. @5%
Depth (0-15 cm)	S	0.024495	0.072779	NS	0.038805	-
Depth (15-30 cm)	S	0.025786	0.076614	NS	0.037809	-
Depth (30-45 cm)	S	0.020413	0.060651	NS	0.044017	-

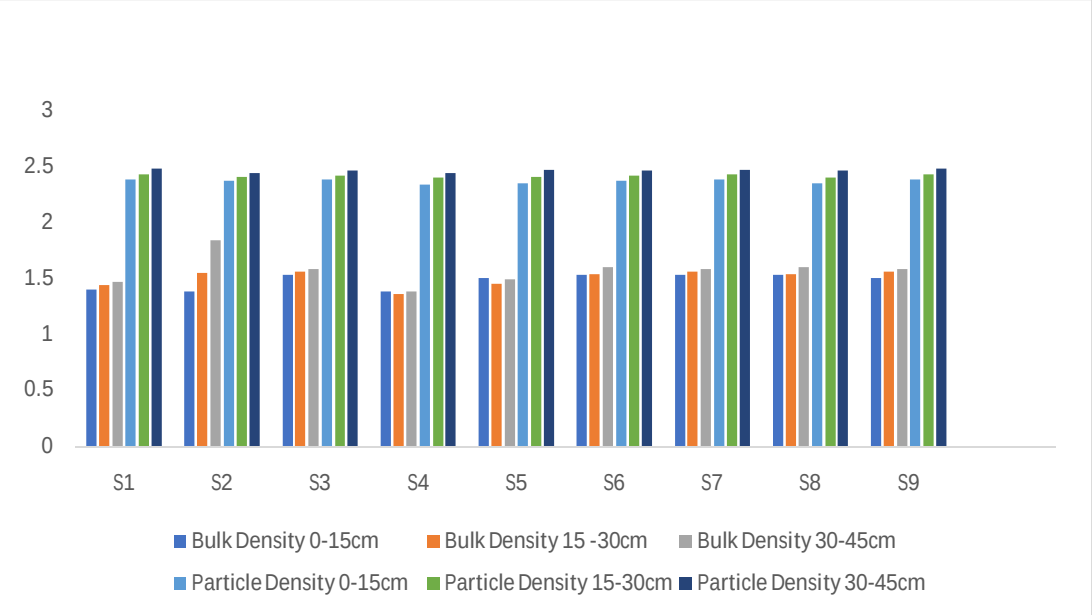


Fig 1: Bulk density and Particle density (Mg m^{-3})

Table 2: Estimation of Water Holding Capacity, Pore Space (%) of Soils of Adilabad District

Block Name & Sites	Pore Space (%)			Water Holding Capacity (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Jainath						
S_1	47.98	45.67	43.01	42.56	40.09	38.59
S_2	48.73	46.76	43.51	42.20	40.13	38.32
S_3	45.89	43.17	41.23	40.64	38.20	36.65
Ichoda						
S_4	47.16	46.98	43.56	43.40	40.32	38.98
S_5	48.57	46.84	44.21	43.08	40.81	39.87
S_6	49.16	48.34	46.04	45.89	43.45	40.65
Boath						
S_7	48.21	45.46	43.34	44.32	41.89	39.06
S_8	49.09	46.94	43.02	43.12	40.49	38.79
S_9	47.78	45.32	42.78	43.21	41.92	38.13
	F-Test	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**
Depth (0-15 cm)	S	0.637188	1.893183	S	0.646975	1.922262
Depth (15-30 cm)	S	0.743546	2.209189	S	0.398562	1.184190
Depth (30-45 cm)	S	0.617412	1.834427	S	0.545969	1.622154

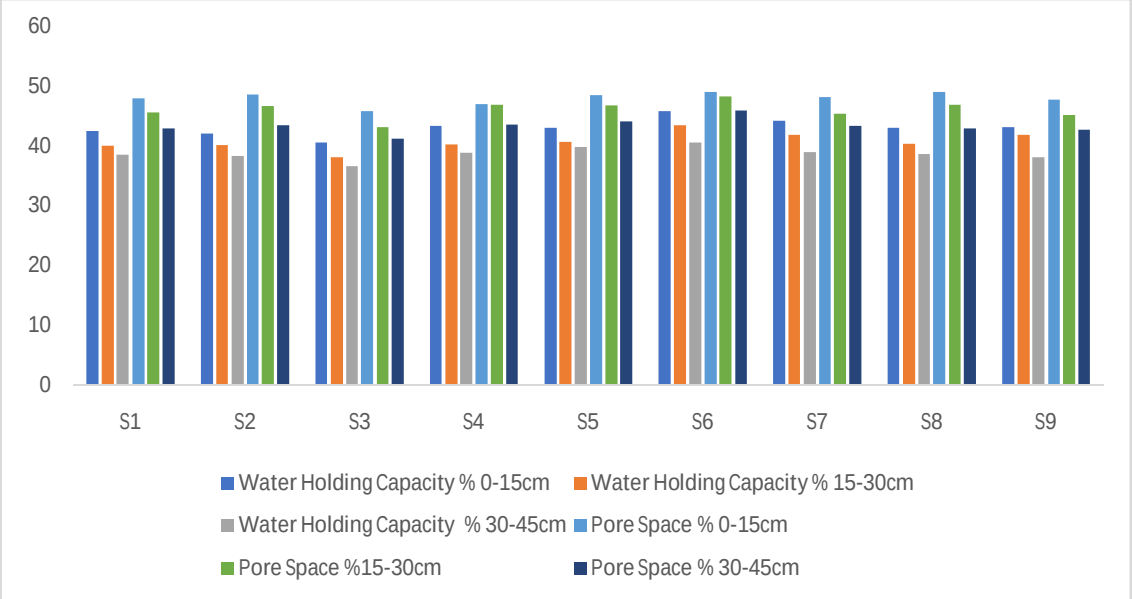


Fig 2: Pore Space and Water Holding Capacity (%)

Chemical Properties

The pH value ranged from 7.43 to 8.90 and the highest value was recorded at site S_3 (pH 8.90) from Jainath Block. pH value increases with the increasing depth because at upper horizons receive maximum leaching by rainfall and by dissolved carbonic acids and presence of high amount of exchangeable sodium ions (Kumari *et al.,* 2017). The Electrical Conductivity ranged from (0.17 to 0.49 dS m^{-1}) and the highest value was recorded at the site S_7 (0.49 dS m^{-1}) from Boath Block. It indicates that, these soils were non- saline to slightly in nature (Satyanarayana *et al*., 2021). The value of total Organic Carbon (%) varied from 0.31 to 0.48%. "The Organic Carbon decreases with increasing depth due to the fact that surface soil contains undecomposed and partial decomposed organic matter while subsoil contains decomposed Organic matter which has undergone chemical and biological changes" (Singh *et al*., 2014)

Table 3: Estimation of soil pH (1:2), EC (ds m^{-1}) and Organic Carbon (%)

Block Name Sites	**pH**			**EC (dS m^{-1})**			**OC (%)**		
Jainath	**0-15 cm**	**15-30 cm**	**30-45cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
S_1	8.18	8.25	8.45	0.35	0.34	0.41	0.48	0.45	0.41
S_2	7.45	7.50	7.88	0.31	0.35	0.37	0.45	0.41	0.39
S_3	8.65	8.81	8.90	0.25	0.35	0.41	0.46	0.43	0.41
Ichoda									
S_4	8.24	8.42	8.63	0.38	0.39	0.43	0.45	0.43	0.39
S_5	8.04	8.16	8.48	0.17	0.22	0.27	0.44	0.41	0.39
S_6	7.83	8.03	8.42	0.36	0.41	0.44	0.35	0.33	0.31
Boath									
S_7	8.25	8.51	8.76	0.42	0.45	0.49	0.47	0.43	0.40
S_8	8.15	8.61	8.16	0.41	0.43	0.46	0.43	0.41	0.35
S_9	7.43	7.63	7.76	0.21	0.23	0.33	0.48	0.44	0.41
	F-Test	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**

Depth (0-15 cm)	S	0.079147	0.235159	S	0.005140	0.015273	S	0.006054	0.017989
Depth (15-30 cm)	S	0.100188	0.297674	S	0.004122	0.012247	S	0.005681	0.0168795
Depth (30-45 cm)	S	0.098743	0.293338	S	0.006360	0.01889	S	0.003646	0.0108339

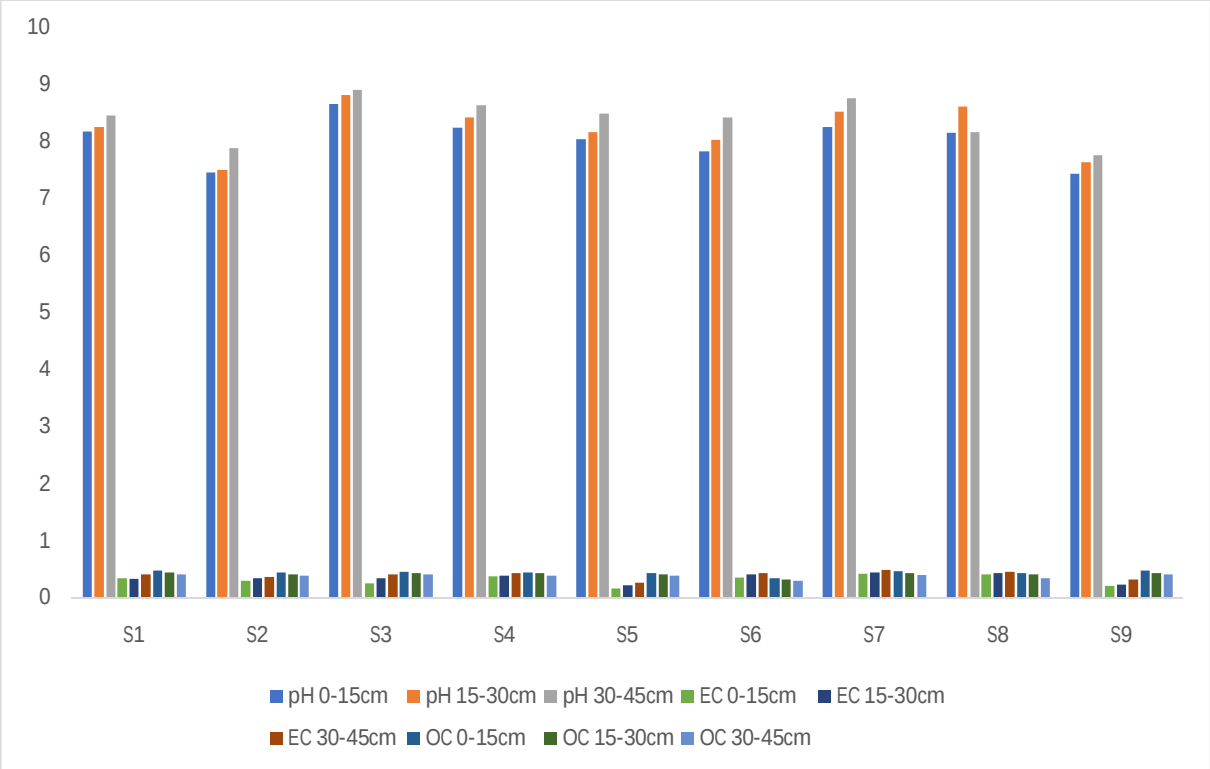


Fig 3: pH, EC (ds m^{-1}) and Organic Carbon (%)

Primary Nutrients

The Available Nitrogen content of soil ranged from 198 to 252 kg ha^{-1}. "Available Nitrogen decreases with the increasing depth due to the fact it is positively corelated with organic matter content which decreases with depth and might be due to higher pH to depth" (Rajmani *et al.*, 2020). The Available Phosphorus content of soil ranged from 16.14 to 25.58 kg ha^{-1}. "Available Phosphorous decrease with the increasing depth. Higher level of Available Phosphorous in surface soil could be attribute of favourable soil pH and organic matter content" (Wani *et al.*, 2017). Available Potassium content of soil ranged from 219.87 to 277.51 kg ha^{-1}. "Available Potassium decreases with the increasing depth. The high content of available potassium on surface soil may be attributed to the release of labile K form organic residues and application of potassium fertilizers" (Wani *et al.*, 2017).

Table 4: Evaluation of Available Nitrogen, Available Phosphorous and Available Potassium (kg ha^{-1})

Block Name Sites	Nitrogen (kg ha^{-1})			Phosphorous (kg ha^{-1})			Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	30-45cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Jainath									
S_1	244.75	232.51	226.71	21.86	18.65	16.94	244.75	232.51	226.71
S_2	256.45	241.19	232.36	24.58	21.12	18.18	256.45	241.19	232.36
S_3	263.10	251.41	245.45	22.19	18.89	16.14	263.10	251.41	245.45
Ichoda									
S_4	235.75	227.32	219.87	23.42	20.38	17.53	235.75	227.32	219.87
S_5	266.01	249.91	235.37	25.58	21.12	19.35	266.01	249.91	235.37
S_6	256.89	242.21	236.21	21.57	19.92	16.34	256.89	242.21	236.21
Boath									
S_7	277.51	269.23	258.61	24.68	21.21	18.86	277.51	269.23	258.61
S_8	266.42	257.51	249.87	25.12	20.67	17.37	266.42	257.51	249.87
S_9	271.56	266.79	256.45	23.35	20.17	16.89	271.56	266.79	256.45
	F-Test	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**
Depth (0-15 cm)	S	3.238263	11.8113	S	0.305152	0.90665	S	4.46732	13.27318
Depth (15-30 cm)	S	1.714064	7.87969	S	0.311785	0.92636	S	4.02908	12.74866
Depth (30-45 cm)	S	2.426687	9.38574	S	0.257987	0.76652	S	3.26769	9.708827

Secondary Nutrients

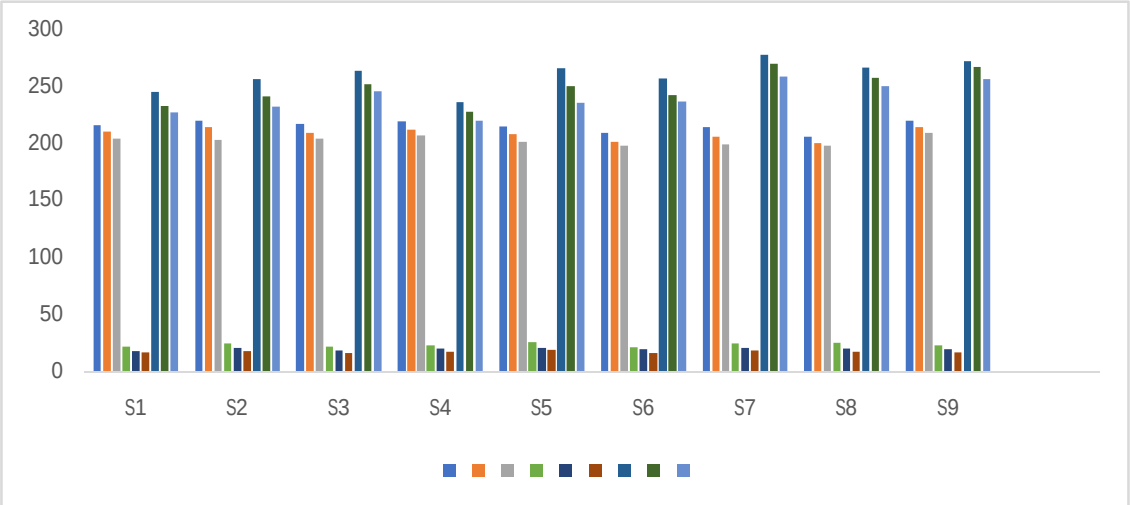
Exchangeable Calcium content of soil ranged from 3.68 to 5.45 meq $100g^{-1}$ with the highest value recorded at site S_6 (5.45) meq $100g^{-1}$ from Ichoda Block. Exchangeable Magnesium content of soil ranged from 1.89 to 2.76 meq $100g^{-1}$ with the highest value recorded at S_4 (2.76) meq $100g^{-1}$ from Ichoda Block. Exchangeable Calcium and Magnesium decreases with the increasing in depth due to the attributes of high pH towards the depth (Malvath *et al.,* 2018). Calcium and Magnesium are very sufficient in this soil.

Table 5: Evaluation of Exchangeable Calcium and Magnesium (meq $100g^{-1}$)

Block Name & Sites	Exchangeable Calcium [meq $100g^{-1}$]			Exchangeable Magnesium [meq $100g^{-1}$]		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm

Jainath						
S_1	4.82	4.66	4.23	2.68	2.42	2.24
S_2	4.25	4.04	3.68	2.76	2.54	2.40
S_3	4.16	4.02	3.74	2.72	2.63	2.44
Ichoda						
S_4	4.66	4.39	4.02	2.76	2.66	2.54
S_5	5.37	5.14	4.96	2.69	2.44	2.18
S_6	5.45	5.11	4.84	2.38	2.18	1.94
Boath						
S_7	5.18	4.93	4.76	2.24	2.14	2.02
S_8	5.04	4.84	4.62	2.14	2.06	1.90
S_9	4.95	4.74	4.41	2.02	1.93	1.89
	F-Test	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**
Depth (0-15 cm)	S	0.067288	0.199923	S	0.033628	0.099916
Depth (15-30 cm)	S	0.064924	0.192901	S	0.031174	0.096226
Depth (30-45 cm)	S	0.051665	0.153507	S	0.041628	0.123684

Fig 4 : Available Nitrogen, Available Phosphorous and Available Potassium (kg ha-1)



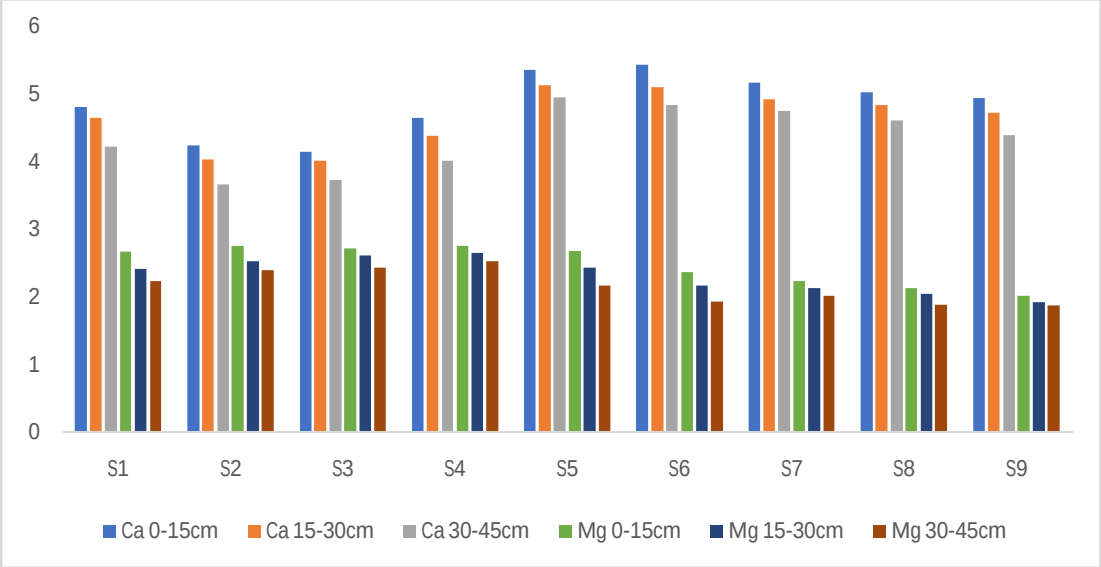


Fig 5: Exchangeable Calcium and Magnesium [meq $100g^{-1}$]

CONCLUSION AND SUGGESTION

It is concluded that the soils of three blocks of the district are sandy clay loam with adequate Bulk Density, Particle Density and pore space. It is Alkaline in nature, electrical conductivity as favourable for plant growth but with some management practices, organic carbon is low content, and Nitrogen was found to be low and phosphorus are medium to high and potassium is found be medium in range. Secondary nutrients i.e., calcium and magnesium are quite adequate. The deficiency of the nutrients can be mitigated by the use of organic and inorganic fertilizers. It shows that the soils are good for cultivation of Cotton, paddy, red gram, jowar, soya bean, horticulture crops etc. Based on the results Soil and health Card has prepared and given to farmers. It suggests that still improvement can be done by improving cropping pattern, decomposing of organic waste, mulching, and tillage practices with the knowledge and experience gained through study may be developed in future to help the farmers regarding the quality produce, high yields through soil conservation and maintain better environment Protection,

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Table 6: Block wise Pore Space Distribution

Block Name & Sites	Pore Space (%)			Pore Space (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Jainath						
S_1	47.98	45.67	43.01	42.56	40.09	38.59
S_2	48.73	46.76	43.51	42.20	40.13	38.32
S_3	45.89	43.17	41.23	40.64	38.20	36.65
Ichoda						
S_4	47.16	46.98	43.56	43.40	40.32	38.98
S_5	48.57	46.84	44.21	43.08	40.81	39.87
S_6	49.16	48.34	46.04	45.89	43.45	40.65
Boath						
S_7	48.21	45.46	43.34	44.32	41.89	39.06
S_8	49.09	46.94	43.02	43.12	40.49	38.79
S_9	47.78	45.32	42.78	43.21	41.92	38.13
	F-Test	**S.Em. ±**	**C.D. @5%**	**F-Test**	**S.Em. ±**	**C.D. @5%**
Depth (0-15 cm)	S	0.637188	1.893183	S	0.646975	1.922262
Depth (15-30 cm)	S	0.743546	2.209189	S	0.398562	1.184190
Depth (30-45 cm)	S	0.617412	1.834427	S	0.545969	1.622154