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Physico-Chemical Properties of Soils from Different Locations in Erstwhile Karimnagar District, Telangana, India

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A B S T R A C T

The present investigation entitled Physico – Chemical properties of soils from different locations in erstwhile Karimnagar district. The investigation is conducted to analyze and understand the Physico-Chemical properties of the soil in 20 different mandals of Better Cotton Initiative (BCI) Project area. The study was conducted in 206 villages under 20 mandals in erstwhile Karimnagar district. Total 544 Soil samples are collected from selected different locations after harvest of crops and were analyzed in the laboratory for soil quality parameters and the results were interpreted that the soils of study area are reddish brown in color, angular to sub angular blocky in structure, slightly alkaline PH (7.35) low levels to slightly saline in nature EC (0.58 dSm^{-1}) an average available soil Organic carbon (0.32%), an average soil available nitrogen is low (218 kg ha^{-1}), available phosphorus (58.07 kg ha^{-1}) and available potassium (305.05 kg ha^{-1}) are high.

Introduction

Soil is a natural body developed as a result of pedogenic processes through weathering of rocks, consisting of mineral and organic content, having precise mineralogical, chemical, physical and biological properties as a medium for plant growth (Velayutham and Bhattacharya, 2000). At present, the greatest challenge for Indian agriculture is to boost production and productivity as well as sustainability of agriculture (FAO, 2017). The sustainability of any system has become major concern now a days. The Soil sustainability is essential for improve the production and productivity. The evaluation of soil fertility is perhaps the most basic decision-making tool in order to impose appropriate nutrient management strategies (Brady and Weil, 2002).

There are various techniques for soil fertility evaluation, among them soil testing is the most widely used in the world (Havlin *et al.*, 2010). Soil testing assess the current fertility status and provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields and to

maintain the adequate fertility in soils for longer period. The texture, structure, colour, bulk density, hydraulic conductivity, etc. are important soil physical parameters.

Similarly, soil reaction (pH) and electrical conductivity (EC) are physico-chemical parameters and organic carbon percent (OC %), available macro and micronutrients are important soil chemical parameters. The physical and chemical tests provide information about the capacity of soil to supply mineral nutrients (Ganorkar and Chinchmalatpure, 2013).

Materials and Methods

Study Area

The present study was conducted under Better Cotton Initiative programme which covers the erstwhile Karimnagar district and it is located under Northern Telangana zone lies approximately between the latitudes 17° 50' and 19° 05' N and longitudes 78° 29' and 80° 22' E. The average normal rainfall in the district is 920 mm and most of it is received during the southwest monsoon.

The soils of erstwhile Karimnagar district are highly heterogeneous in nature. The major rock types occurring in the district are granites, gneisses, sandstone, limestone, shale, quartzite etc. The major soil types in this district are black soils (55%) and red sandy loam soils (45%). To generate soil quality the surface soil samples from (0-15 CMS) where collected. Total 544 soil samples were collected in the grid basis from 20 mandals (it covers around 75% of the villages under the project) which is under erstwhile Karimnagar district. Procedure used for collection of soil firstly selection of the sampling spot, next removal of the foreign materials, make a "V" shape cut to a depth of 15 cms and collected the soil and mixed it after that by making coning and quartering method we have collected the required amount of the soil. All the soil samples were air dried, grounded and passed through 2mm sieve for physical and chemical analysis. The soil samples were analyzed in the laboratory for soil fertility parameters viz., Soil pH, electrical conductivity (EC), Organic Carbon, Nitrogen, Phosphorus and Potassium. The methodology was described in Table 1.

Results and Discussion

The soil data analyzed for Soil Texture, Soil Color, Soil Structure, pH, EC, soil available N, P_2O_5 and K_2O. The results were represented below.

Soil Texture

Soil texture affects the soil sustainability. The sand, silt and clay are the three components of soil texture. It affects absorption of nutrients, microbial activities, the infiltration and retention of water, soil aeration, tillage and irrigation practices (Gupta, 2004). In our results showed that the percent sand of soil samples was ranged from 25.3 to 85.5 with the mean value of 55.4 and that of percent silt were 5.3 to 14.7 with a mean of 10 while the clay percent ranged from15.8 to 53.4 with a mean of 34.6.

Soil Color

Soil color reflects on the transformation and translocation occurred in the soil due to chemical, biological and physical attributes. It shows water drainage, aeration, and organic matter content in the soil. It was found that the majority of the study area showed reddish brown (5YR 4/6).

Soil Structure

Soil structure refers to the pattern of spatial arrangement of soil particles in a soil mass (Brady and Weil, 2004). It was noticed that the majority of the area, angular to sub angular blocky structure was observed.

Soil pH

The soils of erstwhile Karimnagar district were neutral to slightly alkaline in reaction. It ranged

from 6.6 to 8.1 with an overall mean value of 7.35. The results showed highest pH was recorded in Huzurabad (8.1) and the lowest pH was recorded in Ramadugu (6.6) Fig:1.

Soil EC

The electrical conductivity of soils of erstwhile Karimnagar district were ranged from 0.16 dSm^{-1} to 1 $dSm^{-1}$with an overall mean value of 0.58 dSm^{-1} showing that the soils were low to medium saline and assuring a good crop-growing condition. The highest EC was recorded in Elkathurthi (1 dSm^{-1}) and while the lowest EC was recorded in Kalvasrirampur (0.16 dSm^{-1}) (Fig.2).

Soil Organic Carbon

The Organic Carbon of soils of erstwhile Karimnagar district were ranged from 0.26% to 0.38 % with an overall mean value of 0.32% showing that the soils are low in organic carbon content. The highest OC was recorded in Vinavanka (0.38%) and while lowest OC was recorded in Illanthakunta (2.6%) (Fig.3).

Available Nitrogen

Nitrogen is taken up by plants in greatest quantity next to carbon, oxygen and hydrogen, but in the tropics for crop production it is one of the most deficient elements (Mesfin, 1998). The available nitrogen content was ranged from 163.96 to 273.885 kg ha^{-1} with a mean value of 218.92 kg ha^{-1}. This indicates low to medium content of available nitrogen. The highest Nitrogen was recorded in Jullapally (273.885 kg ha^{-1}) and while lowest was recorded in Kalvasrirampur (163.96 ha^{-1}) (Fig.4).

Available Phosphorus

Phosphorus is the master key to agriculture. The growth of both cultivated and uncultivated plants is limited by availability of P in the soils (Foth and Ellis, 1997). The available phosphorus (P_2O_5) was ranged from 30.725 to 85.42 kg ha^{-1} with a mean value of 58.07 kg ha^{-1}. This showed high status of available phosphorus. The highest level of P_2O_5 was recorded in vinavanka (85.42 kg ha^{-1}) and while lowest was recorded in Kothapally (30.725 kg ha^{-1}). Fig: 5.

Available Potassium

Next to N and P, Potassium (K) is the third most important essential element that limit plant productivity. The available potassium (K_2O) content was ranged from 203.52 to 406.53 $kgha^{-1}$ with a mean value of 305.025 $kgha^{-1}$. This suggests high status of the available potash in the soils. The highest K_2O was recorded in Muttharam (406.53 kg ha^{-1}) and lowest was recorded in Julapally (203.52 kg ha^{-1}) (Fig.6).

According to the study on the state of soil fertility in the erstwhile Karimnagar district, the soils are reddish brown in color, angular to sub angular blocky in structure, slightly alkaline pH, low levels to slightly saline in nature, it is advisable to apply gypsum periodically, green manure and organic manures for its amelioration and also advisable to 20 % extra dosage of required chemical fertilizers to sustain the yields. On the other hand, organic carbon and available nitrogen are low in content.

Considering the status of soil organic carbon and low available nitrogen, the practices like Farm Yard Manure or compost, Biomass production, crop residue retention, intercropping or crop rotation with the legumes and etc. can be suggested for its improvement. The available phosphorous and potassium are higher.

Considering the status of the phosphorus and potassium reduce the usage of complex fertilizers, increase use of Bio fertilizers, soil test-based fertilizers application, grow cover crops with legumes etc. These soils should be adequately managed and supplemented with the appropriate amount of organic and inorganic fertilizers. This work has been done under the Better Cotton Initiative project with the support of WWF-INDIA.

Table.1 Methods adopted for the soil analysis

S. No	Soil parameters	Units	Methods Adopted
1	Soil Texture		Hydrometer method (Bouyoucos, 1962)
2	Soil Color		Munshell-colour chart (Albert Henry Munsell 1971)
3	Soil Structure		Field-feel
4	pH		Glass electrode, pH meter (Jackson 1958)
5	EC	dSm^{-1}	EC meter (Wilcox 1950)
6	Organic Carbon	%	Wet oxidation method (Walkley and Black 1934)
7	Nitrogen	Kg ha^{-1}	Kjeldhal (Subbaih and Asija 1956)
8	Phosphorus	Kg ha^{-1}	Calorimetric (Olsen *et al.*, 1954)
9	Potassium	Kg ha^{-1}	Flame photometric method (Toth and Prince 1949)

Table.2 Soil physico- chemical properties of different mandals in erstwhile Karimnagar district

S. No	Mandal	No. of Samples		pH	EC(dS M^{-1})	OC (%)	N (Kg ha^{-1})	P_2O_5 (Kg ha^{-1})	K_20 (Kg ha^{-1})
1	Bhemmdevarapally	51	Range	8.7-5.7	0.68-0.03	0.48-0.258	263.456 - 150.749	69.272-10.611	591.92-106.65
			Mean	7.2	0.355	0.36	207.10	39.941	349.285
2	Chigurumamidi	31	Range	8.3-6.3	0.96-0.03	0.589-0.159	260.915 -134.52	100.68-10.46	391.92-103.65
			Mean	7.3	0.49	0.374	197.71	55.57	247.785
3	Huzurabad	12	Range	8.5-7.7	0.69-0.03	0.48-0.245	257.364 - 158.887	82.962-12.08	461.54-103.65
			Mean	8.1	0.86	0.36	208.125	47.521	282.595
4	Saidhapur	40	Range	8.4-5.9	0.96-0.03	0.589-0.159	260.915 -134.52	86.184-16.1	591.92-110.8
			Mean	7.15	0.49	0.37	197.71	51.142	351.36
5	Elkathurthi	26	Range	8.1-6	1.87-0.13	0.5-0.25	284-118.7	137.52-8.85	580.5-164.77
			Mean	7.05	1	0.375	201.35	73.185	372.635
6	Illanthakunta	29	Range	8.05-6.05	0.94-0.13	0.37-0.15	312.5-110.8	140.59-12.58	381.9-112.46
			Mean	7.05	0.535	0.26	211.65	76.585	247.18
7	Jammikunta	23	Range	8.8-6.5	0.89-0.12	0.51-0.21	357-146.5	122.42-13.69	384.5-93.92
			Mean	7.65	0.505	0.36	251.75	68.055	239.21
8	Kamalapur	60	Range	8.18-6.3	1.02-0.13	0.33-0.23	289.38-109.5	132.48-12.51	407.4-62.84
			Mean	7.24	0.575	0.28	199.44	72.49	235.12

9	Vinavanka	21	Range	7.84-6.51	1.01-0.16	0.5-0.27	293.5-128.3	152.32-18.52	515.7-106.1
			Mean	7.175	0.585	0.38	210.9	85.42	310.9
10	Choppadandi	18	Range	8.2-5.3	0.39-0.1	0.4-0.269	291.3-106.45	99.4-16.9	349.45-145.35
			Mean	6.75	0.245	0.33	198.87	58.15	247.4
11	Gangadhara	32	Range	8.7-5.3	0.5-0.03	0.45-0.2890.	396.45-137.9	85.4-21.75	349.45-145.35
			Mean	7	0.26	0.36	267.175	53.575	247.4
12	Julapally	6	Range	8.3-6.6	0.42-0.03	0.389-0.34	296.45-251.32	64.25-21.75	223.54-184.21
			Mean	7.45	0.225	0.36	273.885	43	203.87
13	Karimnagar	18	Range	8.4-6.1	0.39-0.1	0.4-0.269	356.9-161.4	85.4-16.45	449.45-145.35
			Mean	7.25	0.245	0.33	259.15	50.925	297.4
14	Kothapally	6	Range	7.4-6.6	0.65-0.08	0.4-0.32	361.89-156.9	45-16.45	248.5-161.54
			Mean	7	0.365	0.36	259.39	30.725	203.52
15	Ramadugu	40	Range	8.3-4.9	0.5-0.1	0.45-0.289	396.54-104.47	85.4-16.45	349.45-245.35
			Mean	6.6	0.3	0.36	250.505	50.925	297.4
16	Kalvasrirampur	33	Range	8.02-6	1.07-0.15	0.32-0.28	218.42-109.5	84.5-16.41	514.8-116.85
			Mean	7.01	0.16	0.3	163.96	50.455	315.825
17	Manthini	16	Range	7.5-6.39	1.02-0.15	0.42-0.29	239.4-118.02	59.61-12.59	568.51-109.59
			Mean	6.9	0.585	0.35	178.71	36.1	339.05
18	Mutharam	35	Range	8.05-6.33	1.02-0.18	0.42-0.25	289.38-114.91	88.59-12.58	700.6-112.46
			Mean	7.19	0.6	0.335	202.145	50.58	406.53
19	Odhela	35	Range	7.91-6.44	1.07-0.16	0.51-0.16	239.4-112.18	50.42-16.24	614.8-115.12
			Mean	7.175	0.615	0.335	175.79	33.33	364.96
20	Sultanabad	12	Range	7.48-6.15	0.87-0.18	0.41-0.15	310.2-106.49	56.6-20.32	336.58-167.42
			Mean	6.815	0.52	0.28	208.345	38.46	252
	Average Mean value			7.35	0.58	0.32	218.92	58.07	305.025

Fig.1

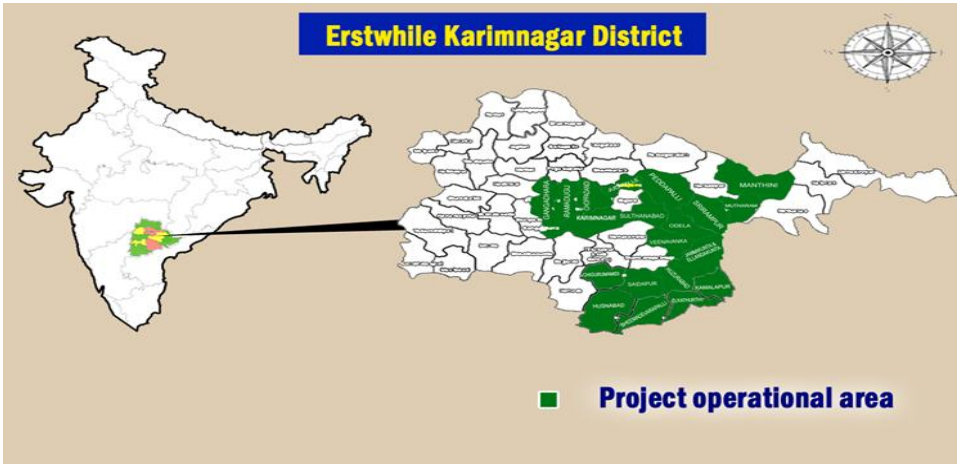


Fig.2

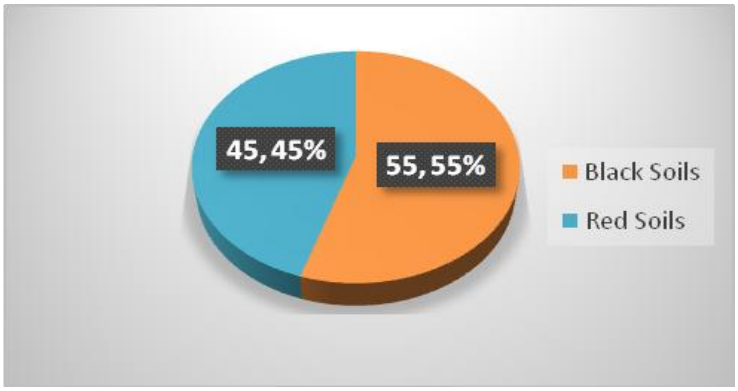


Fig.3 It represents the pH values of each mandal under the research area.

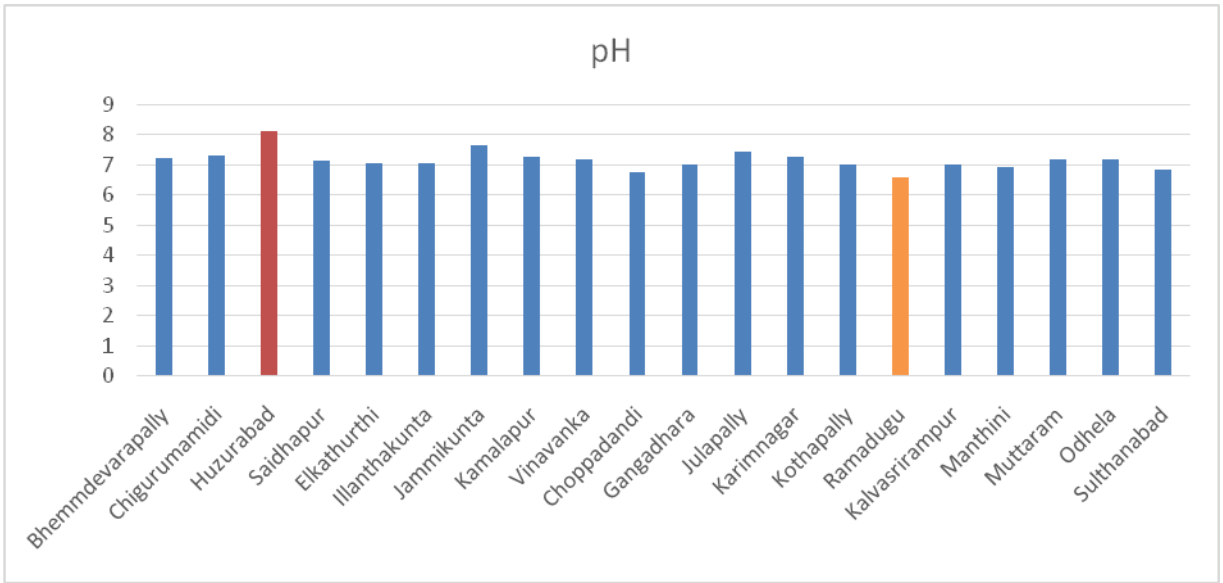


Fig.4 It represents the EC values of each mandal under the research area.

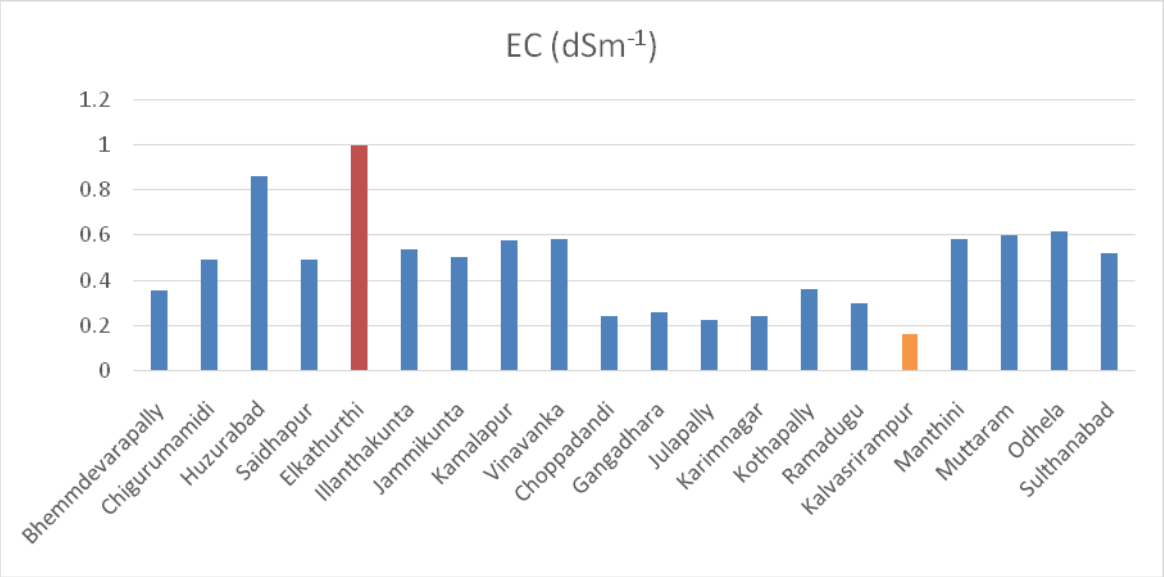


Fig.5 It represents the Organic Carbon values of each mandal under the research area.

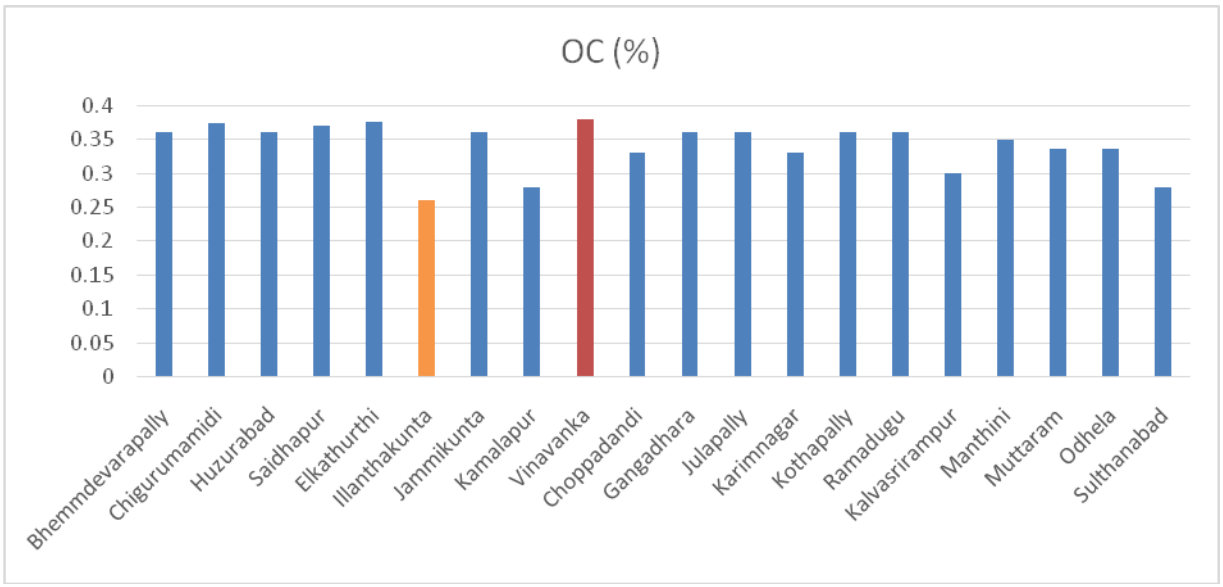


Fig.6 It represents the Nitrogen values of each mandal under the research area

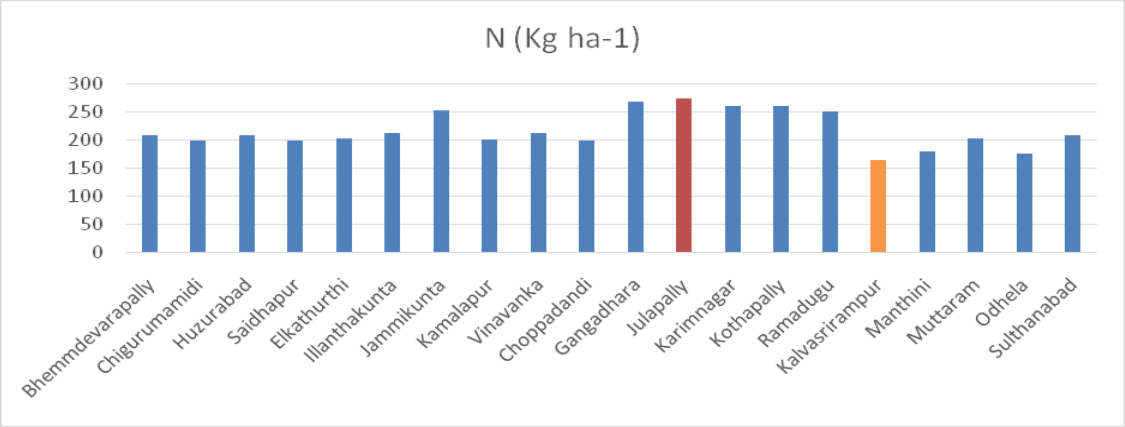


Fig.7 It represents the Phosphorus values of each mandal under the research area.

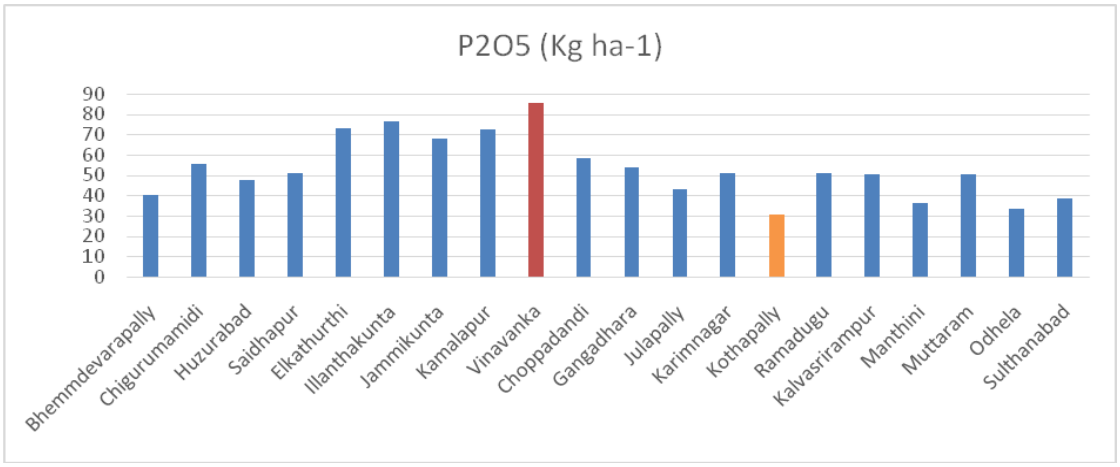
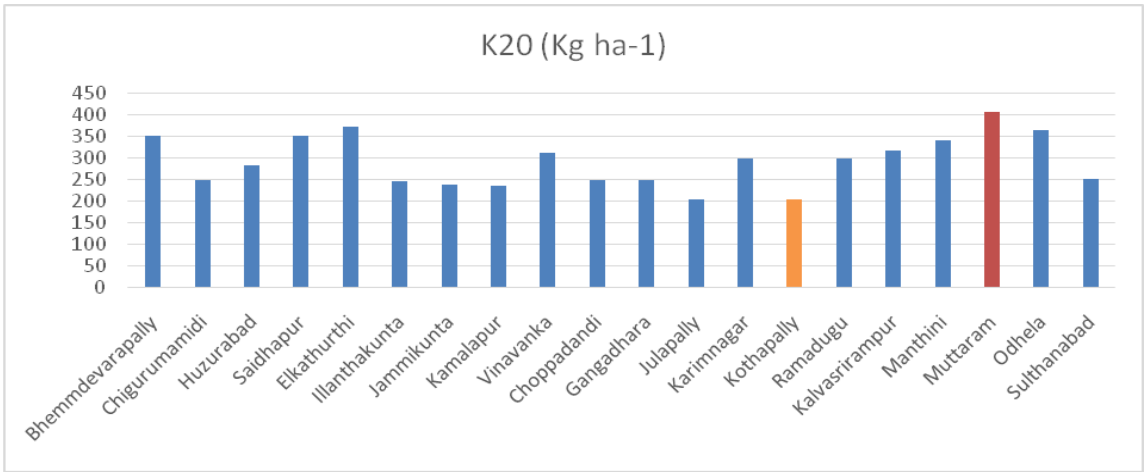


Fig.8 It represents the Potassium values of each mandal under the research area.



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