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Evaluating the Soil Nutrient Status using GIS and Remote Sensing Technology-A Case Study at Coimbatore District

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ABSTRACT

Background: Soil nutrients are the major source of plant nutrition that helps for the plant growth. Soil resource is currently facing threats due to various soil nutrients deficiency. Assessing the spatial variability of soil nutrients quality is necessary for agriculture. Quickly and efficiently monitoring soil nutritional status using remote sensing technology is of great significance for farmland soil productivity, food security and sustainable agricultural development.

Methods: The present study focuses on spatial variability of soil quality. Current research has been conducted to estimate and map soil nutrient contents in large areas using GIS technology and other related maps were prepared from remote sensing data in ArcGIS 10.1. 288 soil samples were collected for the study from different Blocks of the Coimbatore District of Tamil Nadu. The Organic carbon, N, P, K, pH and EC status of the soil were analysed and reported.

Result: The organic carbon status of the soil is very low in most of the parts of Coimbatore and the pH status is slightly alkaline. The primary nutrients N, P and K were found to be low and found to have micronutrient imbalance which is highly influenced by the changes in pH.

Key words: GIS, Remote sensing, Soil nutrient, Spatial data.

INTRODUCTION

As a main source of plant nutrition and soil, nutrients such as nitrogen, phosphorus and potassium play a vital role in plant growth (Chen *et al.* 2015; Dong *et al*. 2017). Even though, traditional estimations provide accurate estimates of soil nutrient contents, they are time-consuming and costly for the generation of spatially explicit estimates for the entire study area (Andrews and Carroll, 2001). 288 soil samples from different blocks of Coimbatore receiving 550 mm to 900 mm rainfall annually with arid climate were collected for the study. The results indicate that the status of organic carbon in the soil is very low in most of the parts of Coimbatore and the pH status is slightly alkaline in most of the places. This has to be taken into consideration and the soil has to be reclaimed. Regarding the nutrient status of the soil, the primary nutrients were found to low, with regards to the secondary and micronutrients, there was an imbalance which is highly influenced by the changes in pH.

MATERIALS AND METHODS

Study area

The study area Coimbatore lies at 11°1′6″N 76°58′21″ E in south India at 411 metres (1349 ft) above sea level on the banks of the Noyyal River, in northwestern Tamil Nadu (Fig 1). It covers an area of 642.12 km^2 (247.92 sq mi). It is surrounded by the Western Ghats mountain range to the west and the north, with reserve forests of the Nilgiri Biosphere Reserve on the northern side. The Noyyal River forms the southern boundary of the district, which has an extensive tank system fed by the river and rainwater. The soil is predominantly black, which is suitable for cotton cultivation, but some red loamy soil is also found.

The district has a hot semi-arid climate (*BSh*), with a wet season lasting from September to November due to the northeast monsoon. The mean maximum temperature ranges from 35.9°C (96.6°F) to 29.2°C (84.6°F) and the mean minimum temperature ranges from 24.5°C (76.1°F) to 19.8°C (67.6°F). Due to the south-west monsoon winds passing through the Palghat gap, elevated regions of the city receive rainfall in the months from June to August. After a warm and foggy September, the north-east monsoon starts from October, lasting until early November. The average annual rainfall is around 600 mm (23.6 in) with the northeast and the southwest monsoons contributing to 47% and 28% respectively to the total rainfall.

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Methodology

In the study area *viz*., 288 villages in different Taluks of Coimbatore (Table 1), the soil samples were collected by using a spade by digging a V-shaped hole and then a thin slice of soil was taken from one side of the hole. Then the soil samples were dried and sieved. Then 100-250 g of soil sample (each in 288 samples) was sent to the laboratory for analysis. Samples were analyzed for macro nutrients and micro nutrients by using the standard procedures. The physico chemical properties like EC (dSm^{-1}), pH, macronutrients like Organic carbon (%), nitrogen, phosphorus and micronutrients potassium, iron, manganese, zinc, copper were measured using standard procedure to understand the soil nutrient status (Table 2). The Coimbatore district map was scanned and geo-referenced using ArcGIS software. Ground Co-ordinates are gained from Google map. Using these co-ordinates pixel co-ordinates of scanned image are converted into ground co-ordinates. The geo-referenced map was digitized by creating personal geo-database and feature classes (point, line and polygon). The map was digitized and it was projected for accurate information. The layout of the map was prepared with latitude and longitude for better understanding and more informative (Basnyt *et al.* 2004).

Fig 1: Study area.

RESULTS AND DISCUSSION

Macronutrients

Nitrogen

Nitrogen is an essential macronutrient for plant and it is the main component of amino acids, which are the building blocks of plant proteins and enzymes. The nitrogen deficient plant leaves will be light green in colour. The lower leaves turn yellow and start drying up as if suffering from shortage of water. The analyzed soil samples varies from 161-427 kg/ha of Nitrogen content in the study area and the average available N value is 240 kg/ha which indicates low status suggesting need for nitrogen management (Fig 2 and Fig 17).

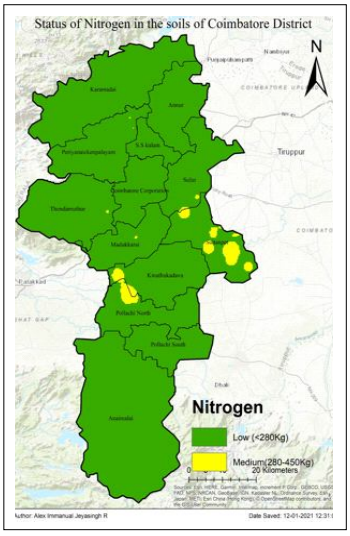

Fig 2: Nitrogen map.

Phosphorus

Phosphorus is indispensible in the growth and production of legumes, as it increases the activity of nodular bacteria which fix nitrogen in the soil. Phosphorus deficiency causes stunted growth and leaves become smaller in size. The analyzed sample varies from 11.61-29.15 kg/ha in the study area. The average P content in the entire district is 15.2 kg/ha which falls in the medium range of soil P availability (Fig 3 and Fig 18).

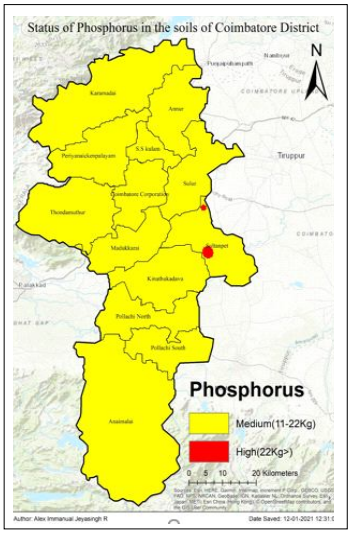

Fig 3: Phosphorous map.

Potassium

Potassium plays a vital role in the formation or synthesis of amino acids and proteins from ammonium ions which are absorbed from the soil. Deficiency of potassium causes the margins of leaves turn brownish and dry up. The stem remains slender. The analyzed sample varies from 213-1234 kg/ha in the study area. The average potassium content of the soil is 583 kg/ha which is in the high range indicating that the soil is rich in K content (Fig 4 and Fig 17).

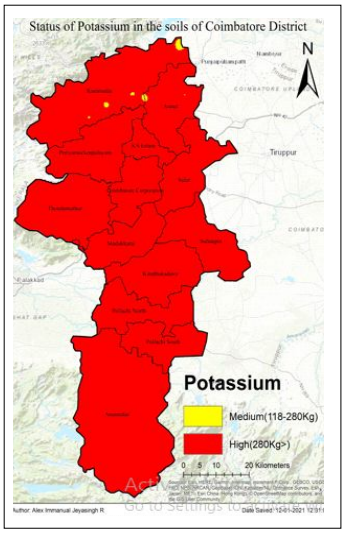

Fig 4: Potassium map.

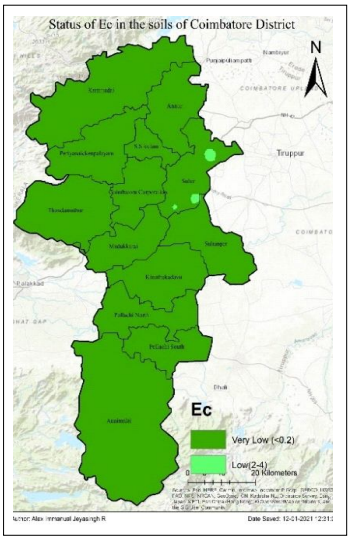

Fig 7: EC map.

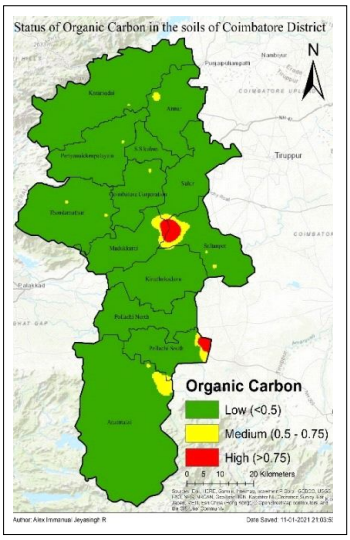

Fig 5: Organic carbon map.

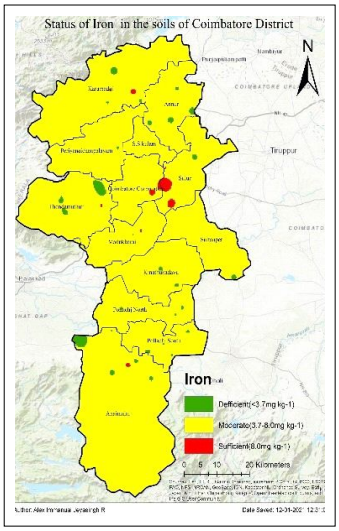

Fig 8: Iron map.

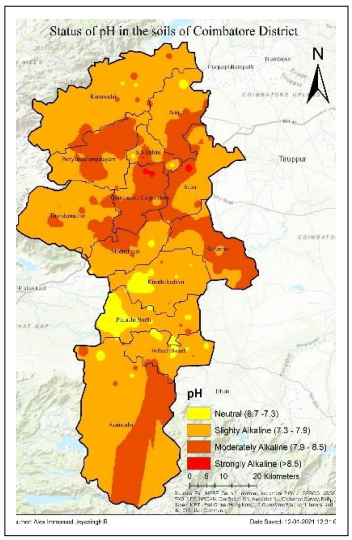

Fig 6: pH map.

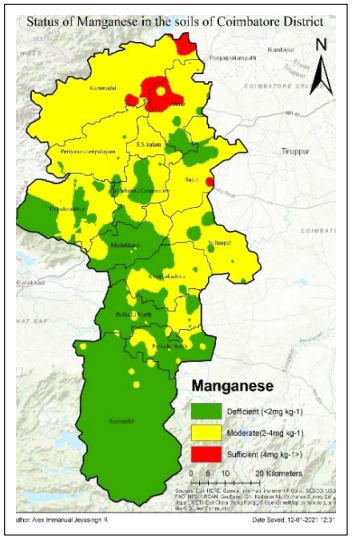

Fig 9: Manganese map.

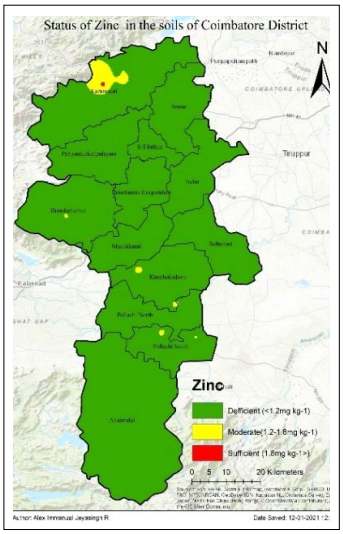

Fig 10: Zinc map.

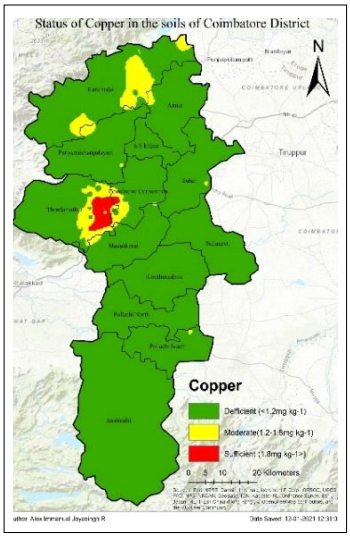

Fig 11: Copper map.

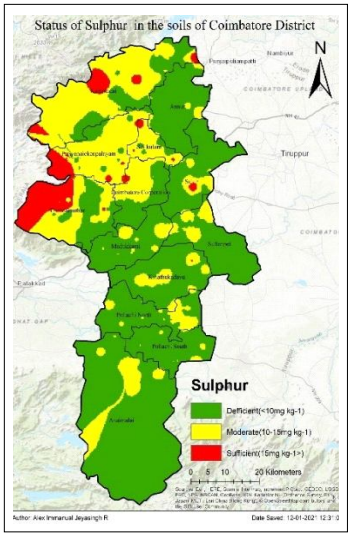

Fig 12: Sulphur map.

Soil organic carbon, pH and EC

Soil organic carbon

As soil organic matter is derived mainly from plant residues, it contains all the essential plant nutrients. Therefore, accumulated organic matter is a storehouse of plant nutrients (Bauer and Black, 1994). The stable organic fraction (humus) adsorbs and holds nutrients in a plant-available form. The organic carbon percentage ranges from 0.22-2.27 in the study area (Fig 5 and Fig 16).

Soil pH

The pH range 5.5-6.5 is optimal for plant growth as the availability of nutrients is optimal. This is also suitable for most soil microbes as plants grow well in this range of pH and produce more root exudates as a carbon source available for survival and multiplication of microbes. The pH ranges from 6.7-8.85. It is beyond the suitable range (Fig 6 and Fig 14).

Soil EC

Soil electrical conductivity (EC) is a measure of the quantity of salts in soil. It is an important indicator of soil health. It affects crop yields, crop suitability, plant nutrient availability and activity of soil microorganisms. Excess salts hinder plant growth by affecting the soil-water balance. Soils containing excess salts occur naturally in arid and semiarid climates. The EC of the study area ranged between 0.11-3.35 dS/m and with a mean value of 0.39 dS/m (Fig 7 and Fig 15).

Micronutrients

Iron

Although iron does not enter into the composition of chlorophyll, its deficiency manifests itself in chlorosis, yellowing or whitening of leaves. The concentration of iron plays an important role in the oxidation process in leaf cells. Sever deficiency results in chlorosis and leaves turn white

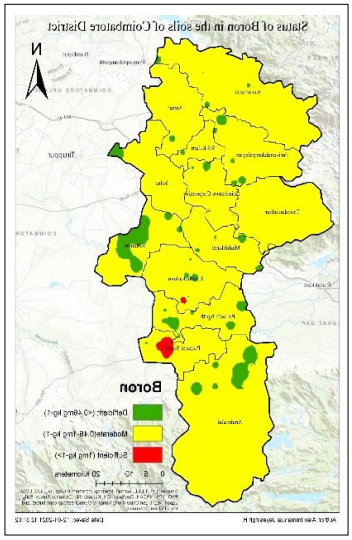

Fig 13: Boron map.

and eventual leaf loss and the growth of plants is very much restricted. The analysed sample varies from 2.35-10.35 ppm in the study area with the average of 4.81 ppm. This value is sufficient for the normal plant growth. So the soil is rich in iron content in most of the areas of the district (Fig 8 and Fig 19).

Manganese

Manganese is an essential element having a role in the formation or synthesis of chlorophyll. Due to deficiency of manganese the carbohydrate synthesis is disturbed resulting in retarded growth. The analyzed sample varies from 1.09-19.44 ppm and the average manganese content is 2.23 ppm in the study area and hence the manganese content is high in the soil (Fig 9 and Fig 19).

Zinc

Zinc is associated with the development of chlorophyll in leaves and a high content of zinc is correlated with a high amount of chlorophyll. In its absence growth is less, buds

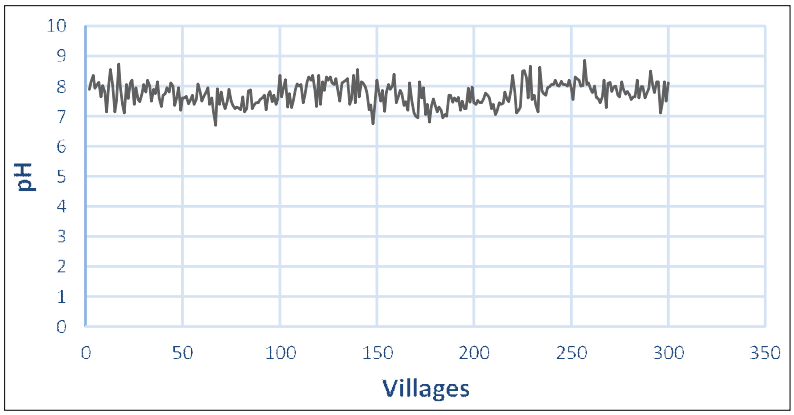

Fig 14: SOIL pH in 288 villages of Coimbatore.

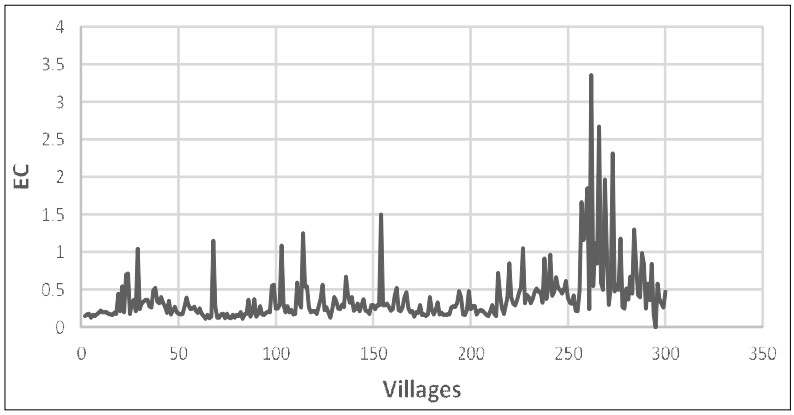

Fig 15: Soil EC in 288 villages of Coimbatore.

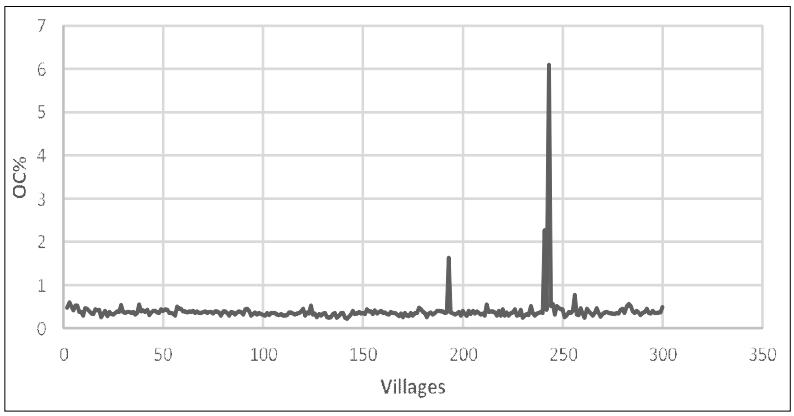

Fig 16: Soil OC% in 288 villages of Coimbatore.

fall off and seed development is limited. Extreme deficiency of zinc results in chlorotic conditions and in darker coloured veins of leaves. The sample values range between 0.48-1.87 ppm in the study area. The average zinc content is 0.90 ppm which is sufficient for the plant growth and the zinc content of the soil falls in the high range (Fig 10 and Fig 19).

Copper

In the chloroplasts of leaves there is an enzyme which is concerned with the oxidation-reduction processes. The presence of copper is essential for this enzyme to function. Thus, copper plays an important role in the process of photosynthesis. In extreme deficiency there may occur excessive leaf shedding. The analysed sample varies from

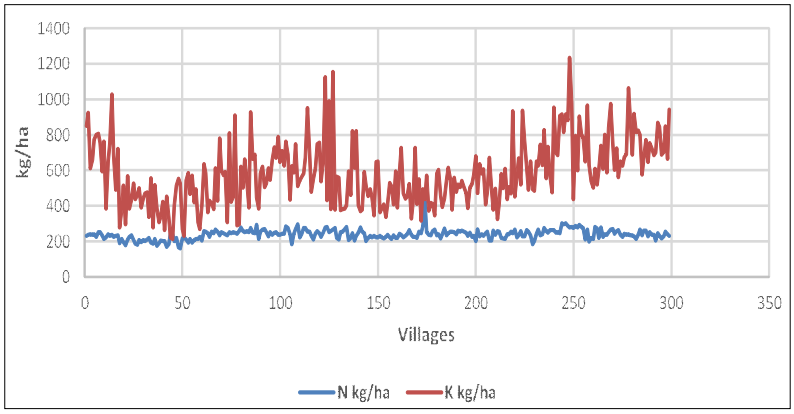

Fig 17: Soil N and K in 288 villages of Coimbatore.

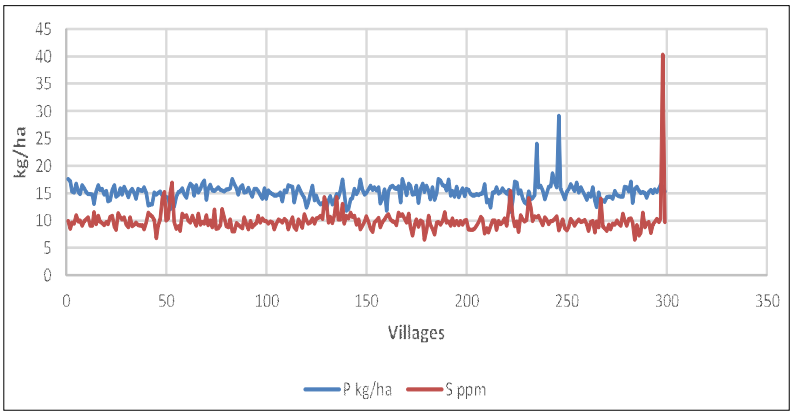

Fig 18: Soil P and s in 288 villages of Coimbatore.

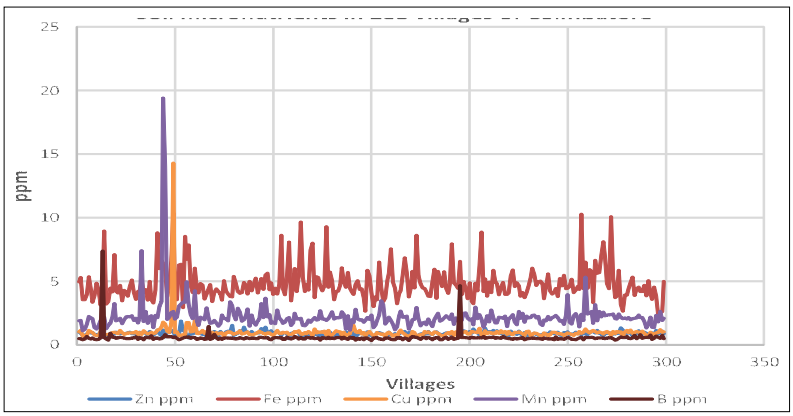

Fig 19: Soil micronutrients in 288 villages of Coimbatore.

Table 1: List of the study area (288 villages in Coimbatore under different Taluks).

S.No.	Village	CD block name	S.No.	Village	CD block name	S.No.	Village	CD block Name	S.No.	Village	CD block name	S.No.	Village	CD block name	S.No.	Village	CD block name
1	Angalakurichi	Anaimalai	49	Kemmarampalayam	Karamadai	97	Kuniyamuthur	Madukkarai	145	Chikkarayapuram	Pollachi North	193	Nattukalpalayam	Pollachi South	241	Thalakkarai	Sulthanpet
2	Arthanaripalayam	Anaimalai	50	Marudur	Karamadai	98	Kurichi	Madukkarai	146	Chinnanegamam	Pollachi North	194	Palayur	Pollachi South	242	Vadambacheri	Sulthanpet
3	Jallipatti	Anaimalai	51	Mooduthurai	Karamadai	99	Madukkarai	Madukkarai	147	Devambadi	Pollachi North	195	S.Malayandipattinam	Pollachi South	243	Vadavalli	Sulthanpet
4	Kaliyapuram	Anaimalai	52	Nellithurai	Karamadai	100	Malumichampatti	Madukkarai	148	Eripatti	Pollachi North	196	S.Ponnapuram	Pollachi South	244	Vadavedampatti	Sulthanpet
5	Kambalapatti	Anaimalai	53	Odanthurai	Karamadai	101	Mavuthampathy	Madukkarai	149	Giddasurampalayam	Pollachi North	197	Samathur	Pollachi South	245	Varapatti	Sulthanpet
6	Karianchettipalayam	Anaimalai	54	Sirumugai	Karamadai	102	Mylaripalayam	Madukkarai	150	Gollapatti	Pollachi North	198	Seelakkampatti	Pollachi South	246	Arasur	Sulur
7	Kottur	Anaimalai	55	Thekkampatti	Karamadai	103	Nachipalayam	Madukkarai	151	Ill Servakaranpalayam	Pollachi North	199	Singanallur	Pollachi South	247	Irugur	Sulur
8	Marchinaickenpalayam	Anaimalai	56	Tholampalayam	Karamadai	104	Orattukuppai	Madukkarai	152	Kabulipalayam	Pollachi North	200	Sinjuvadi	Pollachi South	248	K.Madapur	Sulur
9	Odayakulam	Anaimalai	57	Velliangadu	Karamadai	105	Ottakkal Mandabam	Madukkarai	153	Kallipatti	Pollachi North	201	Solapalayam	Pollachi South	249	Kadampadi	Sulur
10	Periyapodhu	Anaimalai	58	Andipalayam	Kinathukadavu	106	Palathurai	Madukkarai	154	Kondegoundenpalayam	Pollachi North	202	Thalaivalpalayam	Pollachi South	250	Kaduvettipalayam	Sulur
11	Pethanaickenur	Anaimalai	59	Arasampalayam	Kinathukadavu	107	Pichanur	Madukkarai	155	Kulathur	Pollachi North	203	Thenkumarapalayam	Pollachi South	251	Kalangal	Sulur
12	Pichinnampalayam	Anaimalai	60	Chettikkapalayam	Kinathukadavu	108	Seerapalayam	Madukkarai	156	Kullakkapalayam	Pollachi North	204	Thondamuthur	Pollachi South	252	Kangeyampalayam	Sulur
13	Somandurai	Anaimalai	61	Devanampalayam	Kinathukadavu	109	Singanallur	Madukkarai	157	Kullichettipalayam	Pollachi North	205	Unjavelampatti	Pollachi South	253	Kaniyur	Sulur
14	Thenchitur	Anaimalai	62	Devarayapuram	Kinathukadavu	110	Sowripalayam	Madukkarai	158	Kurumbapalayam	Pollachi North	206	Vakkampalayam	Pollachi South	254	Kannampalayam	Sulur
15	Thensangampalayam	Anaimalai	63	Govindapuram	Kinathukadavu	111	Sundakkamuthur	Madukkarai	159	Mannur	Pollachi North	207	Veeralpatti	Pollachi South	255	Karumathampatti	Sulur
16	Thuraiyur	Anaimalai	64	Kakkadavu	Kinathukadavu	112	Thambagoundenpalayam	Madukkarai	160	Moolanur	Pollachi North	208	Z.Kottampatti	Pollachi South	256	Kittampalayam	Sulur
17	A.Mettupalayam	Annur	65	Kaniyalampalayam	Kinathukadavu	113	Thirumalaiyampalayam (N)	Madukkarai	161	N.Chandrapuram	Pollachi North	209	Zamin Uthukuli	Pollachi South	257	Moppripalayam	Sulur
18	A.sengapalli	Annur	66	Kappalankarai	Kinathukadavu	114	Thirumalaiyampalayam (S)	Madukkarai	162	N.Kumarapalayam	Pollachi North	210	A.S.Kulam	Sarkarsamakulam	258	Mylampatti	Sulur
19	Allapalayam	Annur	67	Kattampatti	Kinathukadavu	115	Upplipalayam	Madukkarai	163	Nalluthukuli	Pollachi North	211	Chinnavedampatti	Sarkarsamakulam	259	Neelambur	Sulur
20	Ambothi	Annur	68	Kinathukadavu	Kinathukadavu	116	Vazhukuparai	Madukkarai	164	Okkilipalayam	Pollachi North	212	Ganapathi	Sarkarsamakulam	260	Pathuvampalli	Sulur
21	Annur	Annur	69	Kodangipalayam	Kinathukadavu	117	Vellalur	Madukkarai	165	Poosaripatti	Pollachi North	213	Idikarai	Sarkarsamakulam	261	Pattanam	Sulur
22	Kanjampalli	Annur	70	Kondampatti	Kinathukadavu	118	Anuparpalayam	Periyanaickenpalayam	166	Poosnaikanthali	Pollachi North	214	Kalapatti East	Sarkarsamakulam	262	Peedampalli	Sulur
23	Kanuvakkarai	Annur	71	Kothavadi	Kinathukadavu	119	Billichi East	Periyanaickenpalayam	167	Puliyampatti	Pollachi North	215	Kalapatti West	Sarkarsamakulam	263	Rasipalayam	Sulur
24	Karegoundenpalayam	Annur	72	Krishnarayapuram	Kinathukadavu	120	Billichi West	Periyanaickenpalayam	168	Puravipalayam	Pollachi North	216	Kallipalayam	Sarkarsamakulam	264	Semmandampalayam	Sulur
25	Kariampalayam	Annur	73	Kurunellipalayam	Kinathukadavu	121	Chinnathadagam	Periyanaickenpalayam	169	R.Ponnapuram	Pollachi North	217	Keeranatham	Sarkarsamakulam	265	Sulur	Sulur
26	Kattampatti	Annur	74	Kuthiraiyalampalayam	Kinathukadavu	122	Gudalur North	Periyanaickenpalayam	170	Ramapattinam	Pollachi North	218	Kondayampalayam	Sarkarsamakulam	266	Alandurai	Thondamuthur
27	Kunnathur	Annur	75	Mettubavi	Kinathukadavu	123	Gudalur Sounth	Periyanaickenpalayam	171	Rasakkapalayam	Pollachi North	219	Sanganur	Sarkarsamakulam	267	Devarayapuram	Thondamuthur
28	Kuppanur	Annur	76	Mettupalayam	Kinathukadavu	124	Kavundampalayam	Periyanaickenpalayam	172	Rasichettipalayam	Pollachi North	220	Saravanampatti	Sarkarsamakulam	268	East Chetherai chavadi	Thondamuthur
29	Kuppepalayam	Annur	77	Mullupadi	Kinathukadavu	125	Kurudampalayam	Periyanaickenpalayam	173	Sangampalayam	Pollachi North	221	Sarkarsamakulam	Sarkarsamakulam	269	Ikkarai Boluvampatti	Thondamuthur
30	Masagoundenchettipalayam	Annur	78	Muthur	Kinathukadavu	126	N.S.N.Palayam	Periyanaickenpalayam	174	Sanmegoundenpalayam	Pollachi North	222	Vellakinaru	Sarkarsamakulam	270	Jagirnaickenpalayam	Thondamuthur
31	Naranapuram	Annur	79	Nallalipalayam	Kinathukadavu	127	Naickenpalayam	Periyanaickenpalayam	175	Servakaranpalayam	Pollachi North	223	Vellamadai	Sarkarsamakulam	271	Kkkanaickenpalayam	Thondamuthur
32	Odderpalayam	Annur	80	Panapatti	Kinathukadavu	128	Nanjundapuram	Periyanaickenpalayam	176	T.Kottampatti	Pollachi North	224	Vellanaipatty	Sarkarsamakulam	272	Kumarapalayam	Thondamuthur
33	Pachapalayam	Annur	81	Periakalandai	Kinathukadavu	129	No.4.Veerapandi	Periyanaickenpalayam	177	Thalakkarai	Pollachi North	225	Villankurichi	Sarkarsamakulam	273	Madampatti	Thondamuthur
34	Pasur	Annur	82	Pottaiyandipurambu	Kinathukadavu	130	P.N.Palayam	Periyanaickenpalayam	178	Thimmankuthu	Pollachi North	226	Appanaickenpatti	Sulthanpet	274	Madvarayapuram	Thondamuthur
35	Pilliappampalayam	Annur	83	Sankarayapuram	Kinathukadavu	131	Pannimadai	Periyanaickenpalayam	179	Thippampatti	Pollachi North	227	Bogampatti	Sulthanpet	275	Narasipuram	Thondamuthur
36	Pogalur	Annur	84	Sirukalandai	Kinathukadavu	132	Puliyakulam	Periyanaickenpalayam	180	Thoppampatti	Pollachi North	228	Edayarpalayam	Sulthanpet	276	Perur Chettipalayam	Thondamuthur
37	Vadakkalur	Annur	85	Sokkanur	Kinathukadavu	133	Somayampalayam	Periyanaickenpalayam	181	Vadakkipalayam	Pollachi North	229	J.Krishnapuram	Sulthanpet	277	Peur	Thondamuthur
38	Vadavalli	Annur	86	Solanur	Kinathukadavu	134	Telungupalayam	Periyanaickenpalayam	182	Vellalapalayam	Pollachi North	230	Jallipatti	Sulthanpet	278	Pooluvapatty	Thondamuthur
39	Bellathi	Karamadai	87	Solavampalayam	Kinathukadavu	135	Thudiyalur	Periyanaickenpalayam	183	Z.Muthur	Pollachi North	231	Kallapalayam	Sulthanpet	279	Ramanathapuram	Thondamuthur
40	Belleplayam	Karamadai	88	Sulakkal	Kinathukadavu	136	Veerakeralam	Periyanaickenpalayam	184	Amarampalayam	Pollachi South	232	Kammalapatti	Sulthanpet	280	Semmedu	Thondamuthur
41	Chikkadasampalayam	Karamadai	89	Vadapudur	Kinathukadavu	137	Veerapandi	Periyanaickenpalayam	185	Gomangalam	Pollachi South	233	Kumarapalayam	Sulthanpet	281	Theethipalayam	Thondamuthur
42	Chikkarampalayam	Karamadai	90	Vadasithur	Kinathukadavu	138	A.Nagoor	Pollachi North	186	Gomangalampudur	Pollachi South	234	Malaipalayam	Sulthanpet	282	Thenkarai	Thondamuthur
43	Chinnakallipatti	Karamadai	91	Vaguthampalayam	Kinathukadavu	139	Achipatti	Pollachi North	187	Kanjampatti	Pollachi South	235	Pachapalayam	Sulthanpet	283	Thennamanallur	Thondamuthur
44	Illuppanatham	Karamadai	92	Varadanur	Kinathukadavu	140	Anupparpalayam	Pollachi North	188	Kolarpatti	Pollachi South	236	Pappampatti	Sulthanpet	284	Thondamuthur	Thondamuthur
45	Irumborai	Karamadai	93	Arisipalayam	Madukkarai	141	Avalappampatti	Pollachi North	189	Koolanaickenpatti	Pollachi South	237	Poorandampalayam	Sulthanpet	285	Vadavalli	Thondamuthur
46	Jadayampalayam	Karamadai	94	Chettipalayam	Madukkarai	142	Ayyampalayam	Pollachi North	190	Naickenpalayam	Pollachi South	238	S.Ayyampalayam	Sulthanpet	286	Vedapatti	Thondamuthur
47	Kalampalayam	Karamadai	95	Ettimadai	Madukkarai	143	Bodipalayam	Pollachi North	191	Nallampalli	Pollachi South	239	Selakkarichal	Sulthanpet	287	Vellimalaipatinam	Thondamuthur
48	Karamadai	Karamadai	96	K.G.Palayam	Madukkarai	144	Boligoundenpalayam	Pollachi North	192	Nallur	Pollachi South	240	Senjeriputhur	Sulthanpet	288	West Chetherai Chavadi	Thondamuthur

Table 2: Soil nutrient status of the Taluks in Coimbatore (Average of the villages in each Taluk).

Latitude	Longitude	CD block name	pH	EC	OC%	N	P	K	S	Zn	Fe	Cu	Mn	B
						kg/ha	kg/ha	kg/ha	ppm	ppm	ppm	ppm	ppm	ppm
10.53-11.4	76.99-78.59	Anaimalai	7.95	0.18	0.43	235	15.54	720	9.86	0.84	4.4	0.88	1.70	0.91
9.45-11.27	76.86-77.17	Annur	7.75	0.40	0.37	202	15.15	422	9.61	0.90	4.30	0.93	2.32	0.54
10.97-11.39	76.91-77.13	Karamadai	7.68	0.25	0.39	205.47	14.18	402.05	10.96	0.95	6.01	1.88	4.26	0.57
10.4-11.89	76.94-78.91	Kinathukadavu	7.49	0.20	0.37	252.18	15.76	545.94	9.57	0.96	4.37	0.91	2.14	0.54
10.73-10.96	76.86-77.03	Madukkarai	7.85	0.38	0.34	248.36	14.82	648.84	9.64	0.87	5.34	0.93	1.94	0.52
11.01-11.17	76.87-76.99	Periyanaickenpalayam	7.99	0.29	0.32	247	14.06	590	10.68	0.80	5.05	0.97	2.0	0.52
10.23-12.47	76.91-79.01	Pollachi North	7.5	0.28	0.36	241	15.53	479	9.65	0.86	4.75	0.86	1.99	0.50
10.58-12.06	76.92-77.07	Pollachi South	7.48	0.27	0.41	241	15.19	506	9.31	0.96	4.90	0.93	2.09	0.65
11.04-11.52	76.98-77.43	Sarkarsamakulam	7.800	0.47	0.35	239	14.68	629	10.70	0.86	4.67	0.92	2.11	0.49
10.82-11.44	76.9-77.28	Sulthanpet	8.0	0.48	0.78	275	16.87	784	9.69	0.88	4.57	0.85	2.10	0.48
11-11.26	76.92-77.25	Sulur	7.90	1.2	0.35	245	14.45	674	9.46	0.90	5.86	0.99	2.43	0.52
10.87-11.44	76.72-76.92	Thondamuthur	7.8	0.50	0.40	238	15.4	773.0	10.7	0.94	3.97	0.96	1.99	0.59
			7.77	0.41	0.41	239.08	15.14	597.82	9.99	0.89	4.85	1.00	2.26	0.57

0.61-1.79 ppm in the study area with the average of 0.9 ppm. The study area soil samples have high range copper content (Fig 11 and Fig 19).

Sulphur

Sulphur serves many functions in plants. It is used in the formation of amino acids, proteins and oils. It is necessary for chlorophyll formation, promotes nodulation in legumes, helps develop and activate certain enzymes and vitamins and is a structural component of two of the 21 amino acids that form protein. The sample varies from 6.5 to 16.8 ppm in the study area and the average is 9.93 ppm which is well above the crop requirement of 3-5 ppm. So the sulphur content of the soil is high (Fig 12 and Fig 18).

Boron

Boron is one of the essential nutrients for the optimum growth, development, yield and quality of crops. It performs many important functions in plants and is mainly involved in cell wall synthesis and structural integration. The analysed sample varies from 0.33 to 7.37 ppm and the average is 0.56 ppm in the study area and is sufficient for plant growth (Fig 13 and Fig 19).

CONCLUSION

Through soil testing of it was concluded that the status of organic carbon in the soil is very low in many places of Coimbatore district (less than 0.5 OM), pH status is slightly alkaline (7.3 to 7.9) in and it is moderately alkaline 7.9 to 8.5. This has to be taken into consideration and the soil has to be reclamation measures have to be adopted. Regarding the nutrient status of the soil, the primary nutrients were found to be low, with regards to the secondary and micronutrients, there was an imbalance which is highly influenced by the changes in pH.

Conflict of interest: None.

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