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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).

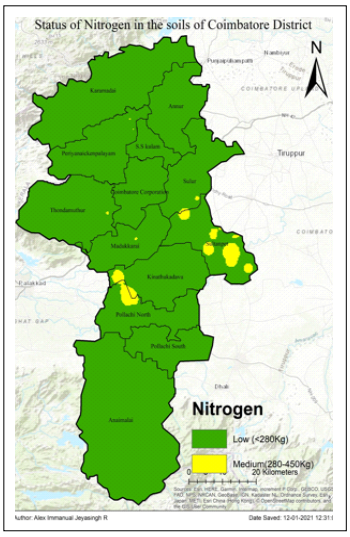



**Fig 2:** Nitrogen map.

### 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).

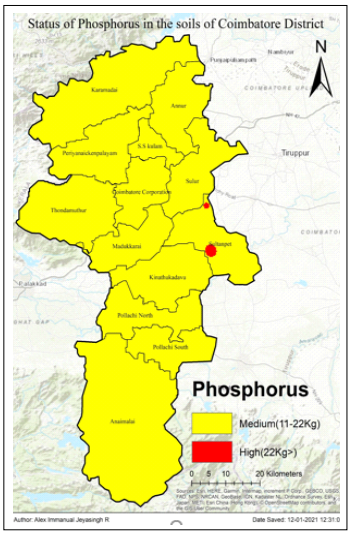



**Fig 3:** Phosphorous map.

### 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).

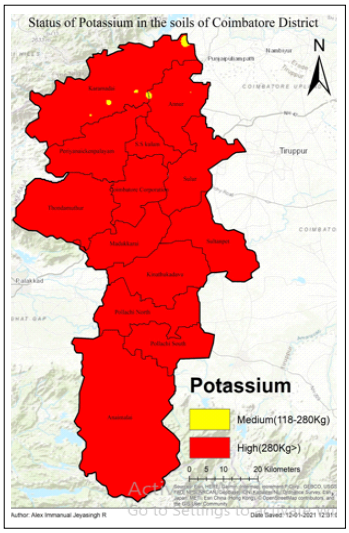



**Fig 4:** Potassium map.

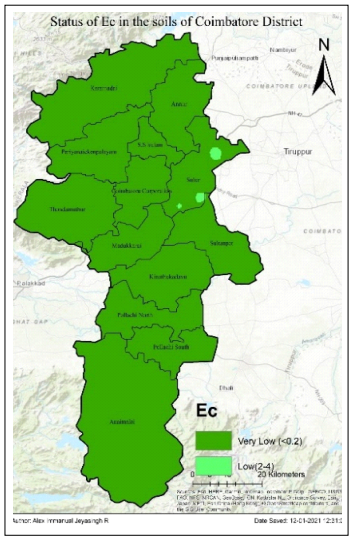



**Fig 7:** EC map.

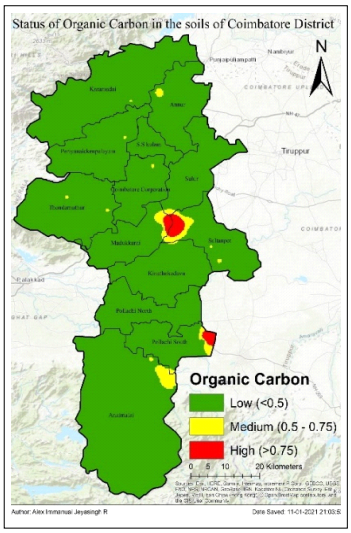



**Fig 5:** Organic carbon map.

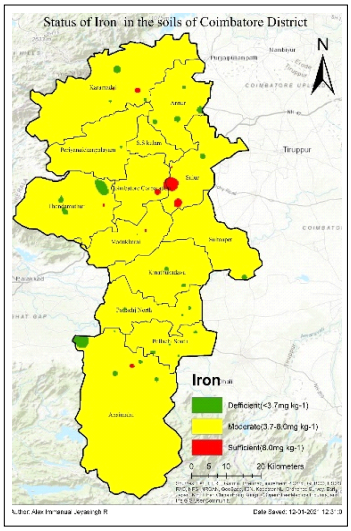



**Fig 8:** Iron map.

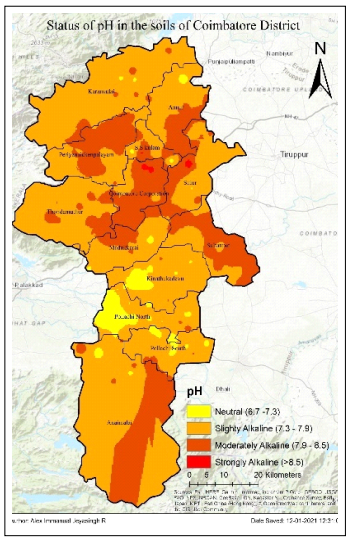



**Fig 6:** pH map.

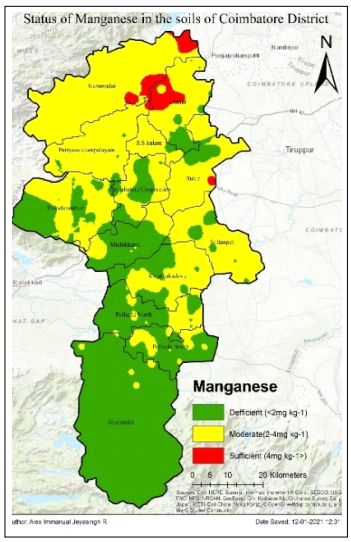



**Fig 9:** Manganese map.

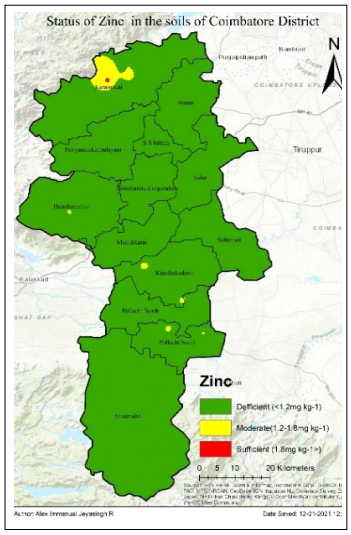



**Fig 10:** Zinc map.

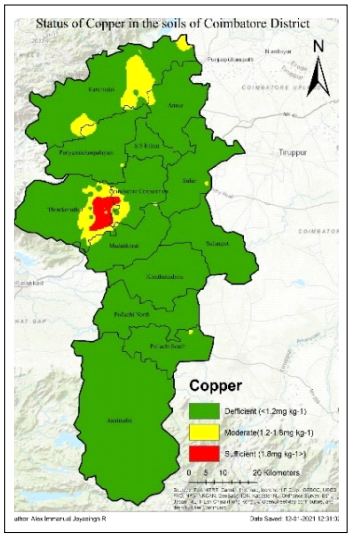



**Fig 11:** Copper map.

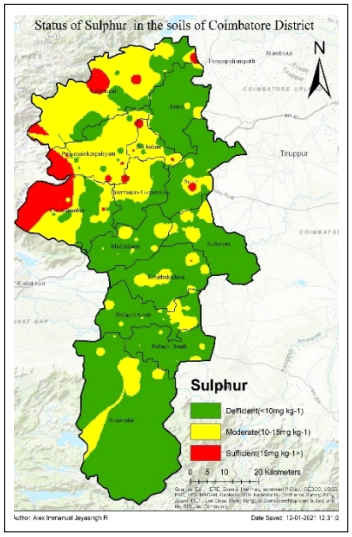



**Fig 12:** Sulphur map.

**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

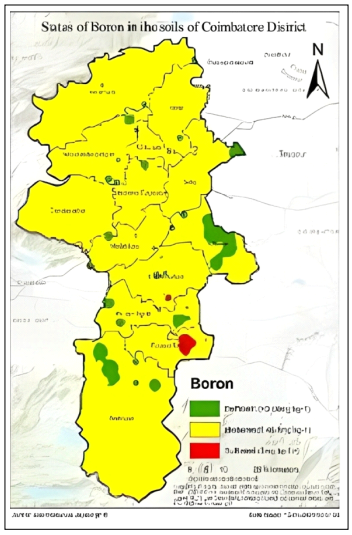



**Fig 13:** Boron map.

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

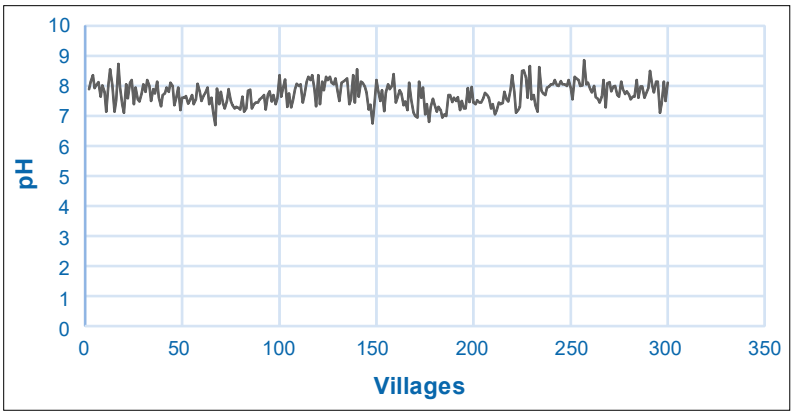



**Fig 14:** Soil pH in 288 villages of Coimbatore.

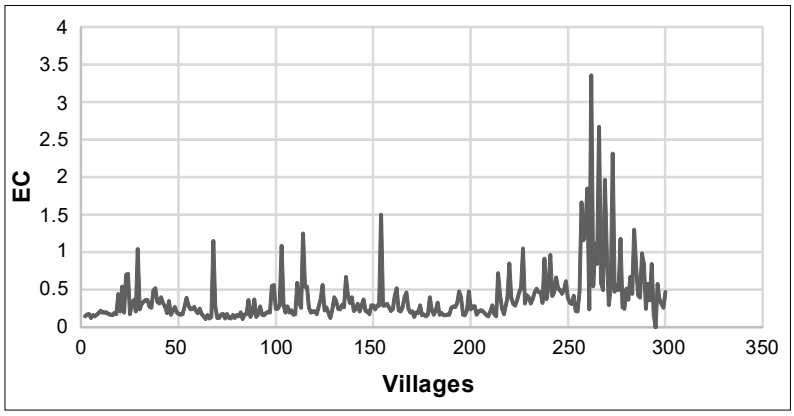



**Fig 15:** Soil EC in 288 villages of Coimbatore.

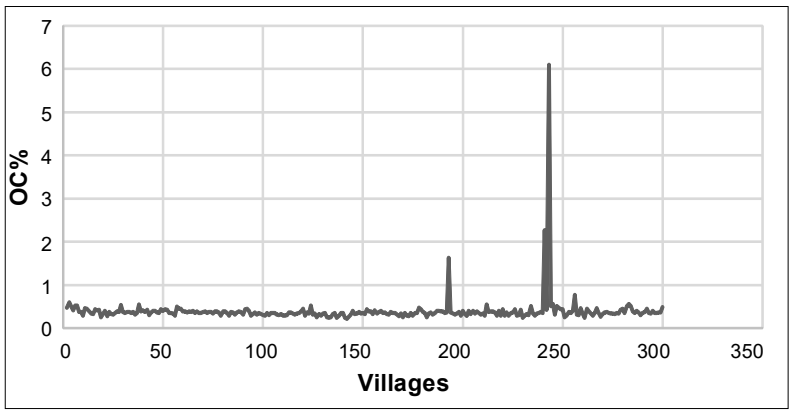



**Fig 16:** Soil OC% in 288 villages of Coimbatore.

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

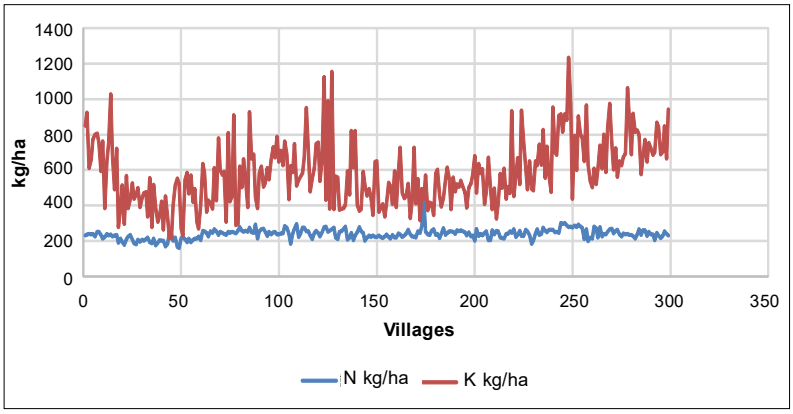



**Fig 17:** Soil N and K in 288 villages of Coimbatore.

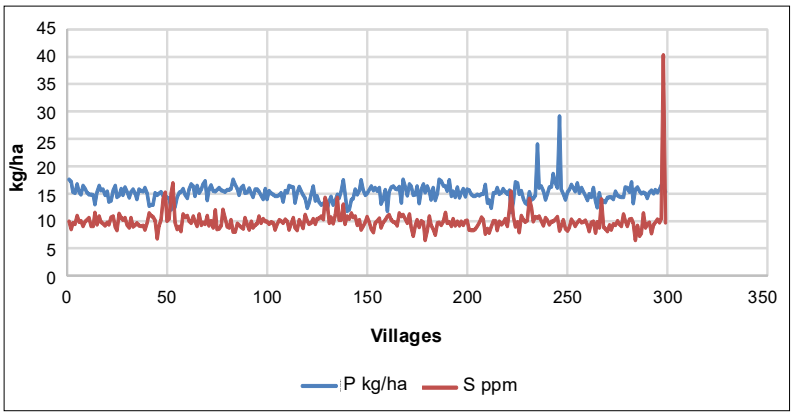



**Fig 18:** Soil P and s in 288 villages of Coimbatore.

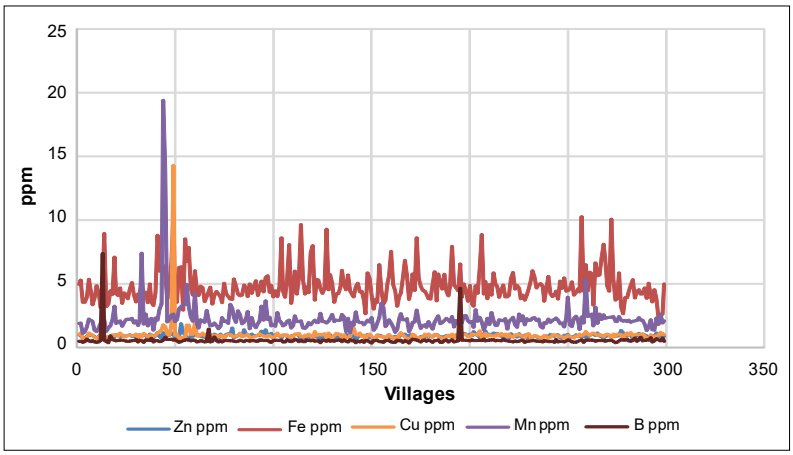



**Fig 19:** Soil micronutrients in 288 villages of Coimbatore.

**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.Malaiyandipattinam | 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 | Thalaivaipalayam | 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 | Uppilipalayam | 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 | Santhegoundenpalayam | Pollachi North | 222 | Vellakinaru | Sarkarsamakulam | 270 | Jagirnaickenpalayam | Thondamuthur |
| 31 | Naranapuram | Annur | 79 | Nallatipalayam | 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 | Panninadai | 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 | Iluppanatham | 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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