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An Appraisal of Available Nutrients Status and Soil Fertility Mapping for Salem District of Tamil Nadu

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A systematic set of georeferenced soil samples were collected from Salem district, Tamil Nadu using GPS (Global Positioning System) and analysed for pH, EC, available macro and micronutrients. The fertility data of 348 soil samples revealed that a major percentage of the samples is alkaline (84.1%), non-saline (96%), low in OC (40.8%) and available N (92.5%) and medium in available P (47.8%) and K (68.9%). The soils are predominantly deficient in Zn and sufficient in S, Fe, Cu, Mn and B. The maps showing the spatial variability in macro and micronutrients were generated using Arc-GIS software version 9.3. The soil fertility maps clearly revealed that, the major area of the district is alkaline, non-saline, medium in OC, low, high and medium in available N, P and K, respectively. With respect to available S and micronutrients, Zn is predominantly deficient, while all others are in sufficient status.

Key words: Georeferenced soil samples, Macro and micronutrients, Fertilizter prescription, STCR-IPNS.

The continuous use of fertilizers and manures in the intensive cropping system has resulted in the depletion of nutrients from the soil reserves (Dhane and Shukla, 1995). Application of fertilizers by the farmers without prior knowledge on soil fertility status may result in adverse effect on soils and crops; both in terms of nutrient deficiency and toxicity either by the inadequate or overuse of fertilizers. In the past, the sampling was done by random method and scanty attention was paid to collect the geo-referenced soil sample. Moreover, the whole district was taken as a single mapping unit. With the invent of modern technologies *viz*., GPS and GIS, it is now possible to monitor the soil fertility and crop health through systematic surveys. GPS provides real time, continuous, economic and very precise positioning technique and useful for the establishment of geodetic control survey *i.e.* location of precise control points, geodynamics surveys, monitoring mars movements and Geo-physical and cadastral survey (Guo *et al*., 2002) This will be helpful to monitor the changes in fertility status of the study area with site-specific nutrient requirement of the crop. Keeping this facts in view present study was carried out during 2011-13 to assess the soil fertility status and to prepare soil fertility maps using GPS and GIS techniques for Salem district.

Study Area

Salem district is an inland district surrounded by Dharmapuri district on the north, Namakkal district on the south, Tiruchirapalli, Villupuram and Perambalur districts on the east and Erode district on the west. The district lies between 11°.66' N and 78° 14' E with annual mean rainfall of 979.5 mm and mean annual temperature of 27.8°C. The total geographical area of the district is 5,20,530 ha with an elevation of 278m. Irugur, Tulukkanur, Salem and Perinaickenpalyam are the major soil series out of fifteen soil series that have been identified in Salem district.

The major crops cultivated are rice, tapioca, turmeric, maize, fodder sorghum, and vegetables. Salem district has nine taluks *viz*., Attur, Salem, Vazhapadi, Gangavalli, Omalur, Mettur, Edapadi, Sankari and Yercaud.

Materials and Methods

Collection of soil samples

A total of 348 samples were collected from 58 villages (10 per cent of the total villages in the district) based on Multistage Stratified Random sampling method, Six soil samples representing three different farmer's categories *viz*., small (< 1 ha), medium (1-3 ha) and large (>3 ha) were collected from each selected village at 0-15 cm depth by adopting standard procedures of soil sample collection. The geocoordinates (Latitude °N and Longitude °E) were collected from each sampling site distributed over the entire Salem district by GPS (Garmin Etrex Vista HCX model).

Analysis of samples

The collected soil samples were processed and sieved through 2 mm sieve (0.2 mm sieve for organic carbon), labelled and stored. The samples were analyzed for 12 chemical parameters *viz*. pH and EC (Jackson 1973), organic carbon (Walkley and Black, 1934), available N (Subbiah and Asija, 1956),

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available P (Olsen et al.,1954; Bray and Kurtz,1945), available K (Stanford and English, 1949), available S (Williams and Steinbergs, 1959) , available Zn, Fe, Cu, and Mn (Lindsay and Norvell, 1978) and available boron (Berger and Truog, 1944).

Based on the nutrients ratings as followed in Tamil Nadu, the soil sample were categorized into low, medium and high categories for macronutrients and as deficient, moderate and sufficient for available micronutrients. Making use of the number of samples in each category the percent sample category and Nutrient Index Values (NIV) were computed as given below; and the taluks were categorized into different fertility ratings.

Per cent sample category

$$\text{Per cent sample category} = \frac{\text{No. of "Low" or "Medium" or "High" category}}{\text{Total no. of samples}} * 100$$

Nutrient index values and fertility rating

Nutrient index value was calculated from the per cent of soils under low, medium and high available nutrient categories, as represented by

$$NIV = \frac{[(P_H*3)+ (P_M*2)+ (P_L*1)]}{100}$$

Where, NIV = Nutrient Index Value

P_L, P_M and P_H are the percentage of soil samples falling in the category of low, medium and high nutrient status respectively; and given weightage of one, two and three respectively (Ramamoorthy and Bajaj, 1969) The index values are rated into various categories *viz*., low (<1.67), medium (1.67-2.33) and high (>2.33) for OC and available NPK. For available S and micronutrients, the ratings are very low (< 1.33), low (1.33-1.66), marginal (1.66-2.00) adequate (2.00-2.33), high (2.33-2.66) and very high (> 2.66).

Generation of thematic soil fertility maps

Database on soil available nutrient status was generated in Microsoft Excel package at TNAU and the Soil fertility maps were prepared at Indian Institute of Soil Science, Bhopal by using Arc-GIS software version 9.3. The thematic maps on available nutrient status were generated by categorizing the fertility status as 'Low', 'Medium' and 'High' by showing appropriate legend for OC and available NPK; 'deficient', 'moderate' and 'sufficient' for available S and micronutrients.

Results and Discussion

Soil fertility status, per cent sample categorisation, nutrient index values of Salem District of Tamil Nadu

i) pH and electrical conductivity (Tables 1 and 2)

The pH of the surface soil ranged from 5.09 – 9.51 with an overall mean of 8.03; and about 7.4, 8.5 and 84.1 per cent of the samples analyzed were found to be acidic, neutral and alkaline respectively. In Yercaud taluk, 66.7 per cent of the samples were acidic whereas in Mettur, Edapadi and Attur taluks,100, 95.8 and 95 per cent samples respectively were under alkaline pH. In Yercaud and Gangavalli taluks 26.2 and 16.7 per cent of the samples were under neutral pH, and in all the other taluks predominantly alkaline pH was observed.

The electrical conductivity of the soil ranged from 0.03 – 1.51 dS m^{-1} with a mean of 0.31 dS m^{-1}. In all the taluks, the major area was under non-saline condition and about 96.0 per cent of the samples analysed were found to be non-saline.

ii) Organic carbon (Table 1,2 and 4)

The overall organic carbon status of the soil ranged from 0.20 – 2.93 with a mean value of 0.60 per cent. Yercaud taluk recorded the highest mean organic carbon status of 1.08 per cent followed by Attur taluk (0.63 %). The organic carbon status was found to be distributed to 40.8, 32.9 and 26.3 per cent in low, medium and high categories respectively. The nutrient index values ranged from 1.46 to 2.60 with a mean value of 1.85. The fertility rating ranged from low to high with an overall rating of medium. The medium status might be due to marginal addition of crop residues.

iii) Available NPK (Tables 1, 3 and 4)

The overall available nitrogen status varied from 123 to 431 kg ha^{-1} with a overall mean value of 200 kg ha^{-1}. Among the different taluks, Gangavalli, Omalur, Mettur had recorded the highest per cent of low available N status (100%) followed by Vazhapadi (97.2%), Edapadi and Sankari (95.8%), Attur (88.3 %), Salem (86.4%) and Yercaud taluks (69%). With respect to per cent sample category, 92.5 and 7.5 per cent samples were under low and medium categories, respectively. Nutrient index value for available nitrogen ranged from 1.00 to 1.31 with a mean value of 1.07. The fertility rating of all the taluks and the overall rating for the district was low. This might be due to the fact that being alkaline in major area of the district, applied N in soil is lost through various mechanisms like ammonia volatilization, nitrification succeeding denitrification, chemical and microbial fixation, leaching and run off (De Datta and Buresh 1989) which would have resulted in low amount of available N in soil.

The overall Olsen – P ranged from 7 to 79 kg ha^{-1}; and Bray-P ranged from 15 - 135 kg ha^{-1} with an overall mean value of 20.65 and 58.21 kg ha^{-1} respectively. The overall per cent sample category under low, medium and high was 13.6, 47.8 and 38.6 respectively. Nutrient index value for available phosphorus ranged from 1.75 to 2.58 with a mean value of 2.25. The fertility rating of different taluks ranged from medium to high, with overall rating of medium. Medium status of P in majority of the soils might be attributed to continuous application phosphatic fertilizers to crops which would have resulted in slow build up phosphorus data as the

Table 1. Range and mean values of available macro and micronutrients in different taluks of Salem district

Taluk	pH	EC	OC	N	P	K	S	Zn	Fe	Cu	Mn	B
			(%)	kg ha^{-1}				mg kg^{-1}				
Attur	6.76-9.17 (8.30)	0.10-1.51 (0.50)	0.22-0.96 (0.63)	151-364 (223)	9-79 (22.17)	75-426 (208)	20.8-50.5 (32.66)	0.01-5.73 (0.87)	2.23-7.52 (13.22)	0.09-4.47 (2.17)	1.17-66.45 (10.69)	0.10-2.40 (1.26)
Salem	6.51-9.51 (8.20)	0.05-1.24 (0.33)	0.20-0.98 (0.51)	129-392 (202)	8-58 (19.59)	100-402 (195)	13.5-43.8 (30.49)	0.11-4.08 (0.80)	0.96-44.00 (14.70)	0.04-5.40 (2.09)	1.67-15.20 (8.58)	0.10-2.6 (0.97)
Vazhapadi	7.19-9.37 (8.16)	0.03-1.20 (0.33)	0.20-0.96 (0.60)	132-325 (182)	9-59 (20.28)	102-456 (191)	13.8-46.8 (29.67)	0.35-1.98 (0.81)	4.69-37.43 (14.08)	0.40-8.14 (2.24)	5.09-15.65 (9.97)	0.10-3.4 (0.63)
Gangavalli	6.56-9.12 (8.08)	0.08-1.28 (0.41)	0.20-0.88 (0.53)	146-252 (185)	13-32 (22.44)	112-350 (207)	27.8-45.8 (37.64)	0.04-3.51 (0.62)	0.75-32.53 (14.05)	0.33-6.50 (2.31)	0.50-73.00 (12.85)	0.10-4.0 (1.43)
Omalur	6.98-8.83 (8.30)	0.08-1.49 (0.39)	0.20-0.97 (0.57)	123-252 (175)	10-56 (24.46)	102-555 (193)	14.5-48.8 (33.59)	0.06-5.21 (0.78)	0.42-30.06 (11.39)	0.23-4.56 (1.99)	0.76-73.14 (12.11)	0.10-1.90 (0.93)
Mettur	8.06-8.63 (8.42)	0.08-0.62 (0.30)	0.20-0.94 (0.44)	129-246 (181)	15-38 (23.08)	101-286 (162)	25.5-47.8 (35.75)	0.23-0.98 (0.46)	3.44-14.33 (7.90)	0.64-2.82 (1.49)	3.62-10.89 (7.15)	0.01-1.60 (0.99)
Edapadi	6.99-8.97 (8.34)	0.04-0.65 (0.24)	0.20-0.92 (0.46)	151-319 (197)	7-26 (13.21)	139-571 (254)	5.75-36.8 (26.93)	0.18-0.78 (0.36)	2.69-15.68 (6.28)	0.94-3.92 (1.50)	7.59-72.34 (27.73)	0.70-2.6 (1.20)
Sankari	6.71-8.65 (8.16)	0.07-0.49 (0.17)	0.23-0.97 (0.57)	123-286 (179)	10-59 (28.00)	119-314 (176)	21.8-41.3 (33.32)	0.09-6.82 (1.19)	3.39-33.42 (16.18)	0.41-2.99 (1.62)	1.89-13.51 (6.62)	0.80-2.4 (1.22)
Yercaud	5.09-7.71 (6.35)	0.06-0.52 (0.16)	0.44-2.93 (1.08)	202-431 (275)	7-28 (12.64) 15-135* (58.21*)	106-599 (310)	10.3-30.3 (22.29)	0.04-8.77 (2.24)	6.40-39.38 21.85)	1.09-6.84 (2.72)	14.51-75.22 (55.34)	0.50-2.0 (1.27)
Over all Mean	5.09-9.51 (8.03)	0.03-1.51 (0.31)	0.20-2.93 (0.60)	123-431 (200)	7-79 (20.65) 15-135* (58.21*)	75-599 (211)	5.75-50.5 (31.37)	0.01-8.77 (0.90)	0.42-44.00 (13.29)	0.04-8.14 (2.01)	0.50-75.2 (16.78)	0.01-4.0 (1.10)

Data in paranthesis are mean values

efficiency of applied P is very low (Aulakh and Pasricha, 1999)

The available potassium status in surface soils of different taluks ranged from 75 to 599 kg ha^{-1} with an overall mean value of 211 kg ha^{-1}. Considering the mean values, the highest value of 310 kg ha^{-1} was recorded in Yercaud taluk and the lowest value of 162 kg ha^{-1} in Mettur taluk. The per cent sample category under low, medium and high ranged from nil to 27.8, 35.7 to 87.5 and 4.2 to 57.1 respectively. The 'low' per cent category was relatively higher in Vazhapadi taluk (27.8), while no low per cent category was observed in Edapadi and Sankari taluks. Nearly, 57.1 per cent of samples in Yercaud taluk was high in available K. Nutrient index values ranged from 1.86 to 2.50 with a mean value of 2.10; and the fertility rating ranged from medium to high with an overall medium fertility rating. Owing to intensive cultivation with K demanding crops, there would have been continuous drain of K from the soil reserve over the years without sufficient replenishment, which might have attributed to relatively less build up of available K in major part of the district, which is a matter of concern that the crops like cereals, tapioca, sugarcane, vegetables and oil seeds normally remove more K than N and P for every ton of produce. This shows that if sufficient quantity of potassium is not added externally there will be potassium mining from the soil. These results are in confirmation with the findings of Bhangu and Sidhu, (1991), Naidu *et al.* (2011).

Table 2. Per cent sample category of soil pH, EC and organic carbon in different taluks of Salem district

Taluk	pH			EC (dS m^{-1})			OC (%)		
	Acidic	Neutral	Alkaline	Non - Saline	Slightly Saline	Saline	Low	Medium	High
Attur	0.0	5.0	95.0	88.3	11.7	0.0	28.3	38.3	33.3
Salem	0.0	6.1	93.9	86.4	13.6	0.0	56.1	19.7	24.2
Vazhapadi	0.0	8.3	91.7	97.2	2.8	0.0	33.3	38.9	27.8
Gangavalli	0.0	16.7	83.3	100.0	0.0	0.0	38.9	38.9	22.2
Omalur	0.0	1.9	98.1	100.0	0.0	0.0	40.7	35.2	24.1
Mettur	0.0	0.0	100.0	100.0	0.0	0.0	70.8	8.3	20.8
Edapadi	0.0	4.2	95.8	95.8	4.2	0.0	58.3	37.5	4.2
Sankari	0.0	8.3	91.7	95.8	4.2	0.0	29.2	62.5	8.3
Yercaud	66.7	26.2	7.1	100.0	0.0	0.0	11.9	16.7	71.4
Over all Mean	7.4	8.5	84.1	96.0	4.0	0.0	40.8	32.9	26.3

iv) Available Sulphur (Tables 1, 3 and 4)

The available S status ranged from 5.75 to 50.5 mg kg^{-1} with an overall mean value of 31.37 mg kg^{-1}. Among the taluks, the mean available S status was found to be low in Yercaud taluk (22.29 mg kg^{-1}), and high in Gangavalli taluk (37.64 mg kg^{-1}). The deficient, moderate and sufficient per cent sample category was found to the tune of 0.5, 3.6 and 95.9 respectively. The per cent deficiency of 4.2 was observed only in Edapadi taluk and nil deficiency in all other taluks. The nutrient index values varied from 2.83 to 3.00 with a mean of 2.95. The fertility rating for all the taluks was very high and hence, the overall rating was also very high. The very high status of S may be due to the continuous addition of S through superphosphate and also through ground water, which contain sufficient amount of S to meet the requirement of the growing plants. These results are in confirmation with the findings of Pasricha *et al.* (2001).

Table 3. Per cent sample category of soil available macro nutrients in different taluks of Salem district

Taluk	N			P			K			S		
	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High
Attur	88.3	11.7	0.0	16.7	46.7	36.7	16.7	60.0	23.3	0.0	0.0	100.0
Salem	86.4	13.6	0.0	25.8	47.0	27.3	13.6	71.2	15.2	0.0	4.5	95.5
Vazhapadi	97.2	2.8	0.0	16.7	58.3	25.0	27.8	58.3	13.9	0.0	2.8	97.2
Gangavalli	100.0	0.0	0.0	0.0	55.6	44.4	5.6	83.3	11.1	0.0	0.0	100.0
Omalur	100.0	0.0	0.0	1.9	44.4	53.7	13.0	74.1	13.0	0.0	0.0	100.0
Mettur	100.0	0.0	0.0	0.0	54.2	45.8	12.5	83.3	4.2	0.0	0.0	100.0
Edapadi	95.8	4.2	0.0	29.2	66.7	4.2	0.0	66.7	33.3	4.2	8.3	87.5
Sankari	95.8	4.2	0.0	4.2	33.3	62.5	0.0	87.5	12.5	0.0	0.0	100.0
Yercaud	69.0	31.0	0.0	28.6	23.8	47.6	7.1	35.7	57.1	0.0	16.7	83.3
Over all Mean	92.5	7.5	0.0	13.6	47.8	38.6	10.7	68.9	20.4	0.5	3.6	95.9

v) Available micronutrients (Tables 1, 5 and 6)

The overall DTPA-Zn status ranged from 0.01 – 8.77 mg kg^{-1} with a mean value of 0.90 mg kg^{-1}. Among the nine taluks, almost all had deficient Zn status except Yercaud, where moderate Zn status was noticed (2.24 mg kg^{-1}). The DTPA -Fe status varied from 0.42 to 44.0 mg kg^{-1} with a mean value of 13.29 mg kg^{-1}. Contrarily, Fe was found to be sufficient in all the taluks. The availability of Cu ranged from 0.04 to 8.14 mg kg^{-1} with a mean of 2.01 mg kg^{-1}. The mean Cu status in different taluks showed that, the soils of Mettur and Edapadi taluks were deficient in Cu availability, while the rest of the taluks showed moderate to sufficient Cu status. The Mn availability in the soils varied from 0.50 to 75.2 mg kg^{-1} with a mean of 16.78 mg kg^{-1}. The lowest mean value of 6.62 mg kg^{-1} was observed in Sankari taluk and the highest mean value in Yercaud taluk (55.34 mg kg^{-1}). Similar to Fe, Mn was also found to be sufficient in all the taluks. The mean hot water soluble boron availability in all the taluks indicated deficient B status and it ranged from 0.01 to 4.0 mg kg^{-1} with a mean of 1.10 mg kg^{-1}.

Table 4. Nutrient index values and fertility ratings of OC and macronutrients in different taluks of Salem district

Taluk	Nutrient Index value									
	OC	N	P	K	S	OC	N	P	K	S
Attur	2.05	1.12	2.20	2.07	3.00	Medium	Low	Medium	Medium	Very high
Salem	1.68	1.14	2.02	2.02	2.95	Medium	Low	Medium	Medium	Very high
Vazhapadi	1.94	1.03	2.08	1.86	2.97	Medium	Low	Medium	Medium	Very high
Gangavalli	1.83	1.00	2.44	2.06	3.00	Medium	Low	High	Medium	Very high
Omalur	1.83	1.00	2.52	2.00	3.00	Medium	Low	High	Medium	Very high
Mettur	1.50	1.00	2.46	1.92	3.00	Low	Low	High	Medium	Very high
Edapadi	1.46	1.04	1.75	2.33	2.83	Low	Low	Medium	Medium	Very high
Sankari	1.79	1.04	2.58	2.13	3.00	Medium	Low	High	Medium	Very high
Yercaud	2.60	1.31	2.19	2.50	2.83	High	Low	Medium	High	Very high
Over all Mean	1.85	1.07	2.25	2.10	2.95	Medium	Low	Medium	Medium	Very high

On an average Zn was predominantly deficient in all the taluks (79.9 %) followed by Cu (16.7 %), B (15.2 %), Fe (5.6 %) and Mn (1.8 %). Among the taluks, 100 per cent of the samples collected from Further, Mettur and Edapadi taluks showed Zn deficiency which increased with increase in pH and decreased with increase in organic carbon, CaCO3, and clay content. Similar observations were made by Takkar et al. (1977) and Sood et al. (2009); and almost all the taluks had sufficient Fe availability except Edapadi, which showed Fe deficiency (16.7%). With reference to Cu, Mettur (37.5 %), Edapadi (33.3 %)

Table 5. Per cent sample category of soil available micronutrient status in different taluks of Salem district.

Taluk	Zinc			Iron			Copper			Manganese			HWSB		
	D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
Attur	81.7	13.3	5.0	3.3	16.7	80.0	1.7	26.7	71.7	1.7	8.3	90.0	1.7	11.7	86.7
Salem	81.8	10.6	7.6	1.5	31.8	66.7	15.2	19.7	65.2	1.5	6.1	92.4	25.8	31.8	42.4
Vazhapadi	86.1	8.3	5.6	0.0	25.0	75.0	11.1	19.4	69.4	0.0	0.0	100.0	66.7	2.8	30.6
Gangavalli	88.9	5.6	5.6	5.6	22.2	72.2	11.1	11.1	77.8	5.6	5.6	88.9	16.7	11.1	72.2
Omalur	88.9	5.6	5.6	7.4	16.7	75.9	9.3	38.9	51.9	3.7	1.9	94.4	22.2	33.3	44.4
Mettur	100.0	0.0	0.0	8.3	37.5	54.2	37.5	29.2	33.3	0.0	4.2	95.8	4.2	54.2	41.7
Edapadi	100.0	0.0	0.0	16.7	62.5	20.8	33.3	50.0	16.7	0.0	0.0	100.0	0.0	50.0	50.0
Sankari	75.0	12.5	12.5	8.3	12.5	79.2	29.2	33.3	37.5	4.2	12.5	83.3	0.0	29.2	70.8
Yercaud	16.7	40.5	42.9	0.0	2.4	97.6	2.4	14.3	83.3	0.0	0.0	100.0	0.0	35.7	64.3
Over all Mean	79.9	10.7	9.4	5.6	25.3	69.1	16.7	27.0	56.3	1.8	4.3	93.9	15.2	28.9	55.9

and Sankari (29.2 %) taluks had higher per cent of Cu deficiency as compared to other taluks. The soils of Salem, Attur, Omalur and Sankari taluks had lower Mn deficiency (1.5, 1.7, 3.7 and 4.2 %, respectively) while the soils of Vazhapadi, Mettur, Edapadi and Yercaud taluks exhibited no Mn deficiency. The availability of Fe, Cu and Mn status increased with increase in organic carbon and clay content. Takkar et al. (1969); Bansal and Takkar (1985) also reported `similarly. The HWSB status showed that, the soils of Vazhapadi taluk had higher deficiency (66.7 %); and no deficiency in Edapadi, Sankari and Yercaud taluks.

The fertility ratings of the soils were assessed by working out the nutrient index values. The nutrient index value ranged from 1.00 – 2.26 for Zn; 2.04 – 2.98 for Fe;1.83 – 2.81 for Cu; 2.79 – 3.00 for Mn and 1.6,4 – 2.85 for B. Notably very low fertility rating was recorded for Zn in most of the taluks; adequate to very high for Cu; very high for Mn; adequate to very high for Fe and HWSB. The overall fertility rating for micronutrients in the soils of Salem district revealed very low Zn, high Fe, Cu and B, and very high Mn status.

Table 6. Nutrient index value and Fertility rating of micronutrients in different taluks of Salem district

Taluk	Zn	Fe	Cu	Mn	HSWB	Zn	Fe	Cu	Mn	HSWB
Attur	1.23	2.77	2.70	2.88	2.85	Very low	Very high	Very high	Very high	Very high
Salem	1.26	2.65	2.50	2.91	2.17	Very low	High	High	Very high	Adequate
Vazhapadi	1.19	2.75	2.58	3.00	1.64	Very low	Very high	High	Very high	Low
Gangavalli	1.17	2.67	2.67	2.83	2.56	Very low	Very high	Very high	Very high	High
Omalur	1.17	2.69	2.43	2.91	2.22	Very low	Very high	High	Very high	Adequate
Mettur	1.00	2.46	1.96	2.96	2.38	Very low	High	Marginal	Very high	High
Edapadi	1.00	2.04	1.83	3.00	2.50	Very low	Adequate	Marginal	Very high	High
Sankari	1.38	2.71	2.08	2.79	2.71	Low	Very high	Adequate	Very high	Very high
Yercaud	2.26	2.98	2.81	3.00	2.64	Adequate	Very high	Very high	Very high	High
Overall Mean	1.30	2.63	2.40	2.92	2.41	Very low	High	High	Very high	High

Thematic Soil Fertility Maps

The thematic maps depicting the soil fertility status of Salem district were generated using sampling point data and by krigging. The soil fertility maps pertaining to all the 12 chemical parameters are depicted in Table 7 and Fig 1 to 10.

1. Soil pH, EC and OC

With regard to soil pH, the soils are predominantly alkaline followed by neutral and acidic; out of the total geographical area, one, five and 94 per cent

of the area is under acidic, neutral and alkaline respectively. In the case of EC, 100 per cent of the area is under non-saline. The organic carbon status was predominantly medium accounting to about 58 per cent of the total area followed by low (29 %) and high (13 %).

2. Available NPK&S and Micronutrients

About 98 per cent of the total area was under 'low' available N category and only two per cent of the area was under medium category. In the case of available P, the status was predominantly under high category representing 52 per cent of the total area followed by

Table 7. Per cent area under different fertility categories based on soil fertility maps

Parameters	Per cent category		
	Acidic/Non- saline/ Low/ deficient	Neutral/Slightly saline/ Medium/ moderate	Alkaline /Saline / High / Sufficient
pH	1	5	94
Electrical Conductivity	100	0	0
Organic Carbon	29	58	13
Available Nitrogen	98	2	0
Available Phosphorus	0	48	52
Available Potassium	0	89	11
Available Sulphur	0	0	100
Available Zinc	82	9	9
Available Iron	0	9	91
Available Copper	0	28	72
Available Manganese	0	0	100
Available Boron	1	28	71

Soil fertility maps of Salem district

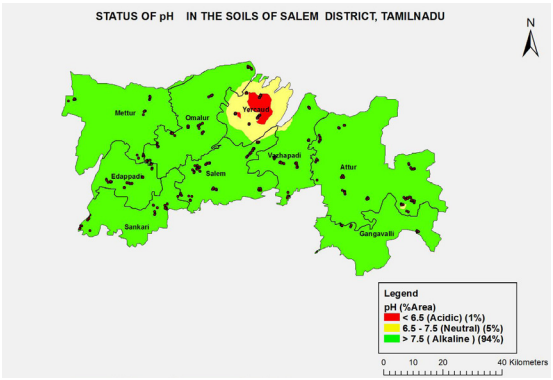

Fig.1. pH

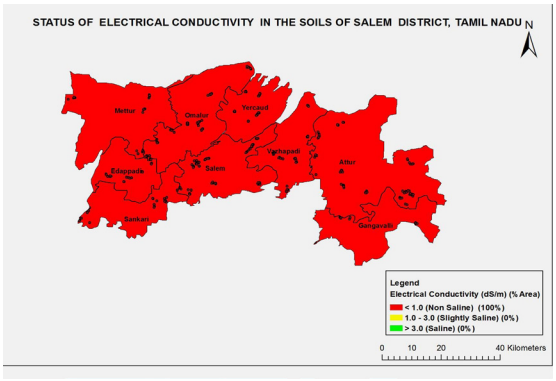

Fig.2. EC

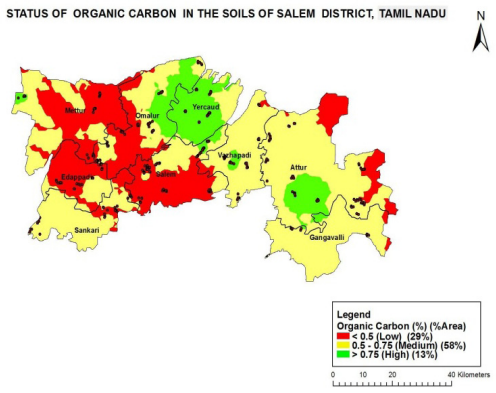

Fig.3. Organic Carbon

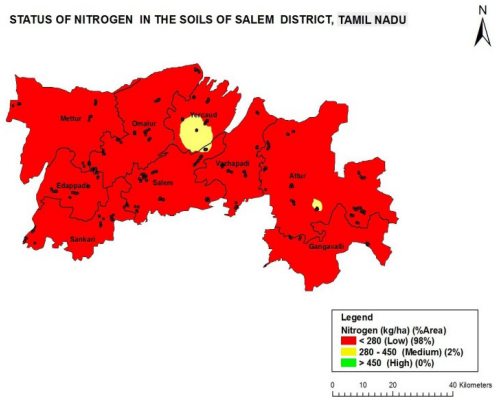

Fig.4. Available Nitrogen

Soil fertility maps of Salem district

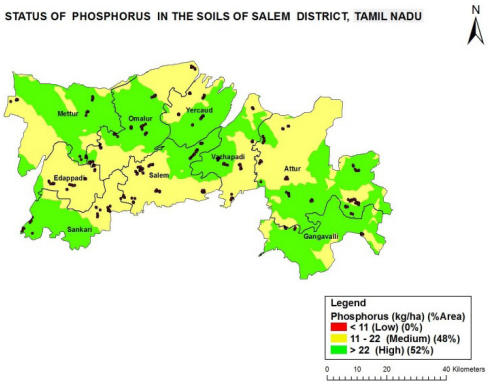

Fig. 5. Available Phosphorus

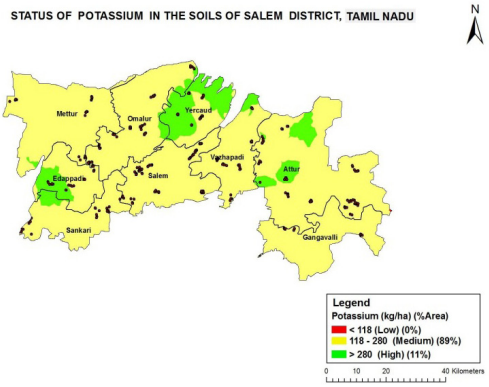

Fig.6. Available Potassium

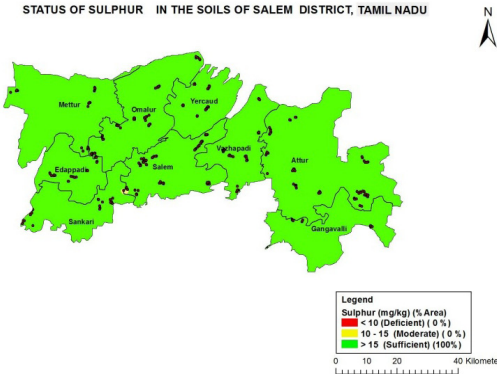

Fig.7. Available Sulphur

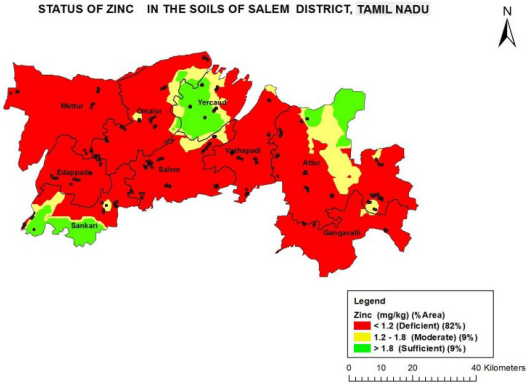

Fig.8. Available Zinc

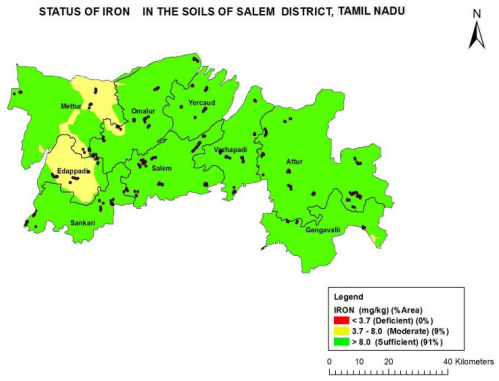

Fig.9. Available Iron

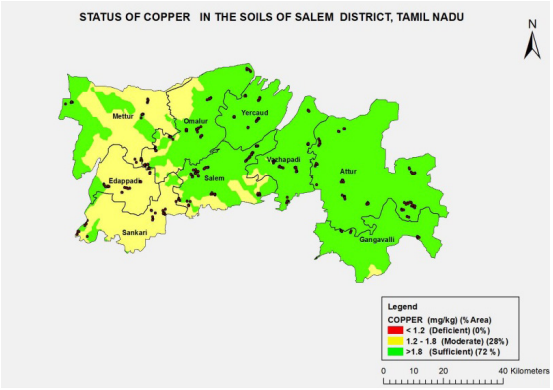

Fig.10. Available Copper

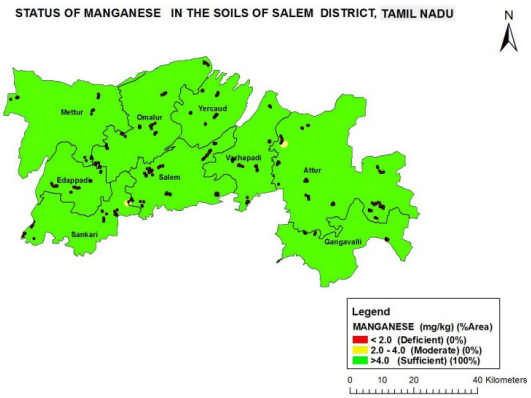

Fig.11. Available Copper

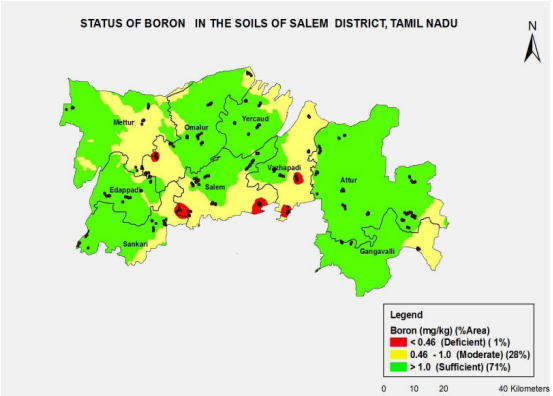

Fig.12. Available Copper

medium in 48 per cent of the area and no area was reported under low category. With respect to available K, the area under medium and high was 89 and 11 per cent; and no area was reported under low category. Contrary to Nitrogen status, cent per cent of the area has been reported under high available S status.

As far as available micronutrients were concerned, 82 per cent of the area had Zn deficiency and each of the nine per cent area was insufficient and moderate in Zn status. About 91 per cent area had sufficient Fe condition. In case of available Cu, sufficiency was observed in 72 per cent of the area followed by moderate in 28 per cent; and no area was found in deficient condition. On the contrary to Zn, 100 per cent of the area had insufficient Mn status. In the case of available B, sufficiency was reported in 71 per cent of the area, while 28 per cent area was reported under moderate status and only very negligible area (one per cent) was under deficient status.

Conclusion

The soil fertility maps clearly revealed that, the major area of Salem district in Tamil Nadu is alkaline, non-saline, medium in OC, low, high and medium in available N, P and K, respectively. With regard to available S and micronutrients, Zn is predominantly deficient, while all others are in sufficient status. Based on the soil fertility mapping in problem soil areas, recommended reclamation measures are to be followed; in nutrient deficient areas, under usage of fertilizers is to be avoided; and in highly fertile areas, rationalized use of fertilizers is recommended. The spatial maps generated under the study will be a guiding tool to decide the amount and kind of fertilizers and nutrients to be applied for optimum / economic returns. Adopting site specific soil test; yield target based fertilizer prescriptions under Integrated Plant Nutrition System (STCR–IPNS) including secondary and micronutrients to various crops / cropping sequences will have greater advantage. This in turn will increase the nutrient use efficiency to sustain soil health and crop production. Further, it will be useful to monitor the soil fertility changes in the district over long periods. Ultimately, it will be highly useful to the researchers, planners, policy makers, extension workers of the State Department of Agriculture, fertilizer industries and farmers.

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