Research Article

Journal of Plantation Crops, 2014, 42(3):348-357

Identifying and mapping soil fertility constraints for coconut in Coimbatore and Tiruppur districts of Tamil Nadu state, India

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(Manuscript Received: 13-09-13, Revised: 08-05-14, Accepted: 19-06-14)

Abstract

The plantation crops like coconut being perennial in nature mine nutrients from limited volume of soil for a long time and hence, to sustain the high productivity, soil nutrients status should be monitored and have to be replenished. The present study was carried out to identify and map the soil fertility constraints for enabling site-specific nutrient management to enhance the productivity of soil. Study area was the coconut land cover of Coimbatore and Tiruppur districts of Tamil Nadu state. In this study, survey was carried out in the coconut plantations of these districts (73 sites in Coimbatore and 37 sites in Tiruppur) and soil samples were collected and analyzed for their physico-chemical and chemical properties. Using the analytical results thematic maps on soil fertility constraints were prepared. The developed maps showed that 62 and 30 per cent of soils of coconut land cover found to be in moderately alkaline and alkaline condition respectively. Around 96 per cent area was in non-saline condition. Organic carbon status was low in 65 per cent of the coconut land cover. Available N, P, and K were low in 65, 0.8 and 0.02 per cent area respectively and S was deficient in 0.05 per cent area. Fe deficiency was recorded in 7 per cent of the area and there was no Mn deficiency in the study area. Available Zn, Cu and B were deficient in 89, 62 and 5 per cent area respectively.

Keywords: Coconut, constraints mapping, soil fertility

Introduction

In agriculture, the present goal of sustainable high productive agriculture needs scientific management of the soil resources for the agricultural growth to ensure food security for now and in future. Factors affecting crop yield and quality are site-specific (Reetz and Fixen, 2000). Spatially and temporally dynamic soil management practices are two important factors in a successful site-specific management strategy. Identifying spatial variability in soil fertility is important to rationalize nutrient use and optimize productivity especially in the case of existing perennial plantations like coconut (*Cocos nucifera*).

Coimbatore and Tiruppur districts of Tamil Nadu state has coconut as major crop and considering the larger extent of area under coconut and the dependency of farmer's livelihood in these two districts on coconut, developing site specific nutrient management strategies based on the soil fertility related constraints will be useful for the region's agricultural growth through the improvement in the coconut yield. Hence, the present study was carried out with the objectives to identify and preparing thematic maps of soil fertility related constraints for coconut to enable site specific nutrient management.

Materials and methods

The study area covers Coimbatore and Tiruppur districts of Tamil Nadu state in India. Geographically positioned within north latitude between 10°10' and 11°30' and east longitude between 76°40' and 77°30' and has the maximum temperature of 38.0 °C and minimum of 17.4 °C. Coimbatore district receive

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306 mm rainfall from the north-east monsoon and 765 mm from south-west monsoon. This district has coconut as major crop with an area of 79,532 ha and with a productivity of 14,470 nuts ha^{-1} $year^{-1}$ (CDB, 2010).

Tiruppur district has 47,826 ha of coconut with the productivity of 3864 nuts ha^{-1} $year^{-1}$ in the year 2009-10 (CDB, 2010). The mean maximum and minimum temperatures during summer and winter vary between 35 °C and 18 °C. The average annual rainfall in the plains is around 700 mm with the north-east and the south-west monsoons contributing to 47 per cent and 28 per cent respectively to the total rainfall.

Selection of sample areas

An extensive survey was carried out covering 110 geo-referenced collection sites located across Coimbatore and Tiruppur districts of Tamil Nadu state. The coconut plantations in these districts were not contiguous, hence, the soils under coconut land cover were considered for the field studies. The sampling was done covering the sampling points representing different soil series found under coconut cover and also the sampling points was distributed to represent the major coconut growing areas in the district.

Collection of soil samples and analysis

Soil samples were collected from Coimbatore (73 sites) and Tiruppur (37 sites) for analysis. Samples were taken from three soil depths *viz.*, 0-30 cm, 30-60 cm and 60-90 cm at one meter away from the bole of the palm following standard procedures. In total 326 soil samples comprising three depths were collected from the two districts.

Soil analysis

The soil samples were processed after air drying. They were ground using wooden mallet and passed through 2 mm sieve. These soil samples were analyzed using standard procedures for various physical and chemical properties like pH, EC, organic carbon, macro and micronutrient status. Soil reaction (pH) by pH meter with glass electrode in the soil water ratio of 1:2.5 (Jackson, 1973), electrical conductivity (EC) by conductometry in the soil water ratio of 1:2.5 (Jackson, 1973), organic carbon by chromic acid wet digestion method (Walkley and Black, 1934), available nitrogen by alkaline $KMnO_4$ method (Subbiah and Asija, 1956), available phosphorus using 0.5 M $NaHCO_3$ extractant (Olsen *et al*., 1954), available potassium by flame photometry (Stanford and English, 1949), available sulphur using 0.15% $CaCl_2$ extractant (Williams and Steinberg, 1959), available iron, manganese, copper and zinc using DTPA extraction (Lindsay and Norvell, 1978) and hot water soluble boron by Azomethane H reagent method (Berger and Troug, 1939).

GIS for preparation of thematic maps

The sample plantations were geo-coded using the latitude and longitude recorded using GPS from the soil survey conducted. The base map was prepared using the digital map of the study area prepared from the topo-sheets, coconut land cover map and the digitized sample plantations. Then the database was exported to ArcGIS 8.2 *via* dBase IV format and the attribute table was geo-coded. Using the already developed coconut land cover map, thematic maps on soil fertility related constraints for the coconut land cover were generated.

Results and discussion

Soil fertility of coconut land cover in Coimbatore and Tiruppur districts

Soil reaction

In the entire study area soil reaction ranged from 6.6 to 8.8 with a mean of 7.7 in the soil layer of 0-30 cm. In 30-60 cm depth the range was 6.3-8.7 with a mean of 7.8. In the third depth (60-90 cm) pH value ranged from 6.2-8.9 with a mean value of 7.7. The variation in soil pH may be related to parent material, rainfall and topography (Thangasamy *et al.*, 2005).

The pH of the overall study area was found to be neutral in 29 per cent of the samples in 0-30 cm soil depth, 27 per cent in 30-60 cm depth and 29 per cent in 60-90 cm soil depth. Alkalinity was registered in 71, 72 and 70 per cent of the samples of soil depths 0-30, 30-60 and 60-90 cm respectively. Similarly, around 30 per cent of the samples were found to be neutral and 70 per cent were in alkaline condition in Coimbatore and Tiruppur districts (Table 1).

The high pH of the soils might be due to the presence of high degree of base saturation. The soil pH increased with increasing depth which may be due to leaching of bases from the surface horizons to subsurface horizons with percolating water, crop removal and root exudation (Thangaswamy *et al.,* 2005 and Kannan, 2007). The pH was increasing upto second depth which might be due to the accumulation of bases and then decreased in the 60-90 cm depth.

Soil electrical conductivity

The EC was found to be in the range of 0.05 to 3.58, 0.04 to 3.62, and 0.04 to 3.60 dS m^{-1} respectively in the three soil depths 0-30, 30-60 and 60-90 cm with the mean of 0.35, 0.35 and 0.32. The EC values are relatively uniform in the 0-30 cm and 30-60 cm depths but slightly decreased in the 60-90 cm depth and this may be due to the fertilizer application in these two depths and the illuvial nature of the second depth might have reduced the movement of the nutrients to the deeper layer resulting in a comparatively lower EC (Table 1).

Electrical conductivity status of around 95 per cent soil samples of the study area was found to be non-saline, five per cent was in saline and one per cent in highly saline condition in all the three soil depths studied. Coimbatore district showed around 97 per cent of the samples in non-saline condition while three per cent in saline condition. Comparatively, Tiruppur district exhibited more number of samples in saline condition (8%) and in highly saline condition (3%).

Organic carbon

Coimbatore district registered higher organic carbon content in all the three depths and also in soil depth weighted average (SDWA) values at 0-90 cm soil depth than the Tiruppur district. The mean value of the three depths and SDWA in Coimbatore district were 0.58, 0.43, 0.31 and 0.45 per cent which is higher than the mean values of the Tiruppur district *viz*., 0.54, 0.38, 0.27 and 0.41 per cent (Table 1).

Organic carbon content of the different soil depth studied showed decreasing trend from the surface to deeper layers. Overall organic carbon status of the soil in the study area was low to medium. High temperature and good aeration in the soil increases the rate of oxidation of organic matter resulting in reduction of organic carbon content. Similar results were reported by Arokiyaraj *et al.,* (2011) for Nagapattinam district.

In Coimbatore district, organic carbon status (based on SDWA) showed comparatively higher percentage (42%) of samples in medium category when compared to Tiruppur district (31%). In the overall study area, SDWA values showed 61 per cent of the samples in low category, 39 per cent in medium category and none were found in high category.

Table 1. Physico-chemical and organic carbon status of the soils of coconut land cover in Coimbatore and Tiruppur districts

Soil property	District	Soil depth															
		(0-30 cm)				(30-60 cm)				(60-90 cm)				weighted average			
		Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)
pH	Coimbatore	6.6	8.8	7.8	5.9	6.5	8.6	7.8	5.5	6.6	9.0	7.7	6.2	6.7	8.5	7.8	5.4
	Tiruppur	6.6	8.5	7.7	5.8	6.3	8.7	7.8	6.7	6.2	8.8	7.8	6.4	6.4	8.6	7.8	6.0
	Overall study area	6.6	8.8	7.8	5.9	6.3	8.7	7.8	5.9	6.2	9.0	7.8	6.2	6.4	8.6	7.8	5.6
EC (dSm^{-1})	Coimbatore	0.1	1.7	0.3	97.3	0.0	1.8	0.3	103.3	0.0	1.1	0.2	88.6	0.0	1.1	0.3	82.8
	Tiruppur	0.1	3.6	0.5	124.8	0.1	3.6	0.5	125.7	0.1	3.6	0.5	130.8	0.1	3.6	0.5	123.2
	Overall study area	0.1	3.6	0.4	122.6	0.0	3.6	0.4	127.0	0.0	3.6	0.3	137.7	0.0	3.6	0.4	120.7
OC (%)	Coimbatore	0.2	1.2	0.6	35.2	0.1	0.8	0.4	41.3	0.0	0.7	0.3	49.2	0.2	0.7	0.5	36.4
	Tiruppur	0.2	0.9	0.5	33.1	0.1	0.7	0.4	40.8	0.0	0.6	0.3	56.9	0.1	0.7	0.4	34.4
	Overall study area	0.2	1.2	0.6	34.6	0.1	0.8	0.4	41.4	0.0	0.7	0.3	52.2	0.1	0.7	0.4	36.0

Available nitrogen

In the overall study area soil depth weighted average values ranged from 101 to 322 kg ha^{-1} with the mean of 190 kg ha^{-1}. In the study area, 92 per cent of the samples were found to be low in available nitrogen, eight per cent in medium status and none were found in high status. Based on the SDWA values, Tiruppur district showed comparatively low available nitrogen status than Coimbatore district. Tiruppur district showed 94 per cent of soil samples under low fertility status and 90 per cent in Coimbatore district (Table 2). Decreasing trend was observed in the available nitrogen from the surface to the deeper layers as that of organic carbon because available nitrogen status depends on the variations in the organic carbon content, clay content and application of fertilizers (Paliwal, 1996).

Available phosphorus

In Coimbatore district, mean value of available phosphorus (SDWA) was 29.5 kg ha^{-1} and in Tiruppur district it was 24.4 kg ha^{-1}. In the study area majority of the samples were in medium or high in available phosphorus status (35 per cent in medium category and 48 per cent in high category) and only 17 per cent was found to be in low category (Table 2). Among Coimbatore and Tiruppur districts, Tiruppur showed more P deficiency which registered 25 per cent in low status compared to Coimbatore district which showed only 14 per cent of the samples in low P status. The variations in available phosphorus depend on the difference in organic carbon, clay content, soil reaction and fixation and adsorption processes of the soil. The results are in line with the observation made by Thangasamy *et al.* (2005) and Arokiyaraj *et al.* (2011).

Available potassium

In the study area, the mean value of available potassium was 455, 407 and 953 kg ha^{-1} in 0-30, 30-60 and 60-90 cm soil depth respectively. The SDWA value of all the taluks in Coimbatore and Tiruppur district showed potassium in high status (Table 2). High K found in these districts might be due to the predominance of K rich parent materials like micaceous and feldspars minerals in black soils, more intensive weathering, release of labile K from organic residues, application of K fertilizers *etc*., (Pal and Mukhopadhyay, 1992). Based on the SDWA of the over all study area, it was found that 4 per cent of the samples were deficient in soil available potassium. Coimbatore district showed slightly more K deficiency than Tiruppur district, 4 per cent of the samples in Coimbatore district were

Table 2. Range and mean values of macro-nutrient status of the soils of coconut land cover in Coimbatore and Tiruppur districts

Soil property	District	Soil depth															
		(0-30 cm)				(30-60 cm)				(60-90 cm)				weighted average			
		Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)
Av. N (kg ha^{-1})	Coimbatore	132	364	224	28	114	337	199	26	92	281	165	22	130	322	197	23
	Tiruppur	112	396	204	31	105	328	182	27	56	261	147	30	101	296	182	26
	Overall study area	112	396	218	29	105	337	194	27	56	281	159	25	101	322	192	24
Av. P (kg ha^{-1})	Coimbatore	7.0	130.2	38.0	83.4	6.2	125.3	28.3	94.2	2.3	103.5	20.9	107.9	7.3	110.0	29.5	87.3
	Tiruppur	5.1	276.7	32.2	136.6	4.2	184.7	23.3	131.4	1.2	155.7	16.7	161.1	3.8	205.7	24.4	135.6
	Overall study area	5.1	276.7	36.0	100.1	4.2	184.7	26.6	105.0	1.2	155.7	19.8	121.2	3.8	205.7	27.9	101.9
Av. K (kg ha^{-1})	Coimbatore	110	1061	447	50	102	976	388	51	89	953	343	58	105	970	394	49
	Tiruppur	115	990	471	45	112	973	447	57	78	871	409	60	114	907	443	50
	Overall study area	110	1061	455	48	102	976	407	54	78	953	361	60	105	970	411	50
Av. S (mg kg^{-1})	Coimbatore	9.1	75.9	28.0	51.9	8.8	79.5	30.5	54.4	3.3	76.3	27.1	53.3	9.0	63.5	28.7	44.1
	Tiruppur	17.2	76.5	38.7	40.3	11.2	77.1	39.6	48.8	8.2	74.4	36.6	45.8	12.2	75.6	38.5	39.9
	Overall study area	9.1	76.5	31.5	49.7	8.8	79.5	33.5	53.6	3.3	76.3	30.1	52.6	9.0	75.6	31.9	44.9

found to be in low fertility status but it was only 3 per cent in Tiruppur district.

Low K status observed in few samples of these districts may be due to some of the soils having less clay fractions and potassium low parent material apart from low fertilizer K application. In addition Kaolinite type of clay mineralogy may be the cause for their medium and low ratings. Similar results were observed by Parameshwara Pulakeshi (2010).

Avaialable sulphur

Available sulphur content found in the study area was (mean values) 31.5, 33.4, 30.1 and 31.9 mg kg^{-1} respectively in 0-30, 30-60 and 60-90 cm soil depth and SDWA. The sulphur content was increasing from surface up to 30-60 cm depth and then decreased. The SDWA value showed 99 per cent of the samples were in sufficient status and only one per cent found to be slightly deficient in available sulphur in the over all study area. These observations are in agreement with the findings of Poongothai *et al.* (2000) in the erstwhile Coimbatore district.

Available iron

In the study area SDWA values ranged from 2.2 to 37.0 ppm and the mean was 6.6 ppm. In Coimbatore district, mean was 6.9 ppm and in Tiruppur district 5.7 ppm (Table 3). Iron status of the red soils fall under sufficient and excess category and black calcareous soils show Fe deficiencies that may be due to precipitation of Fe^{2+} by $CaCO_3$ which leads to the decrease in the Fe availability (Ravikumar *et al.,* 2007 and Parameshwara Pulakeshi, 2010**).** Coarse texture and low organic matter also affect iron availability in varying extent and intensity (Katyal and Rattan, 2003). In the overall study area, based on SDWA, 19 per cent of the samples were found to be deficient in available iron for coconut. The extent of deficiency was 24 per cent in Tiruppur district and 14 per cent in Coimbatore district.

Available manganese

In the over all study area all the samples showed sufficiency in available manganese for coconut based on the SDWA value. In Coimbatore and Tiruppur district also showed sufficiency in all the samples. The high status of Mn content in soil may be attributed to the facts that lower oxidation status of Mn which is more soluble than higher oxidation state at normal pH range of soil (Table 3). Organic compounds synthesized by microorganisms or plants, as root exudates having oxidizing or reducing power also affect manganese availability as reported by Meena *et al*. (2006) and Rajeswar and Aariff Khan (2009).

Available zinc

Available zinc content in the study area ranged from 0.1-6.2, 0.05-5.5, 0.01-4.1 and 0.1-3.5 ppm respectively in 0-30, 30-60, 60-90 cm depth and SDWA with the mean values of 1.1, 0.78, 0.67 and 0.84 ppm respectively. Coimbatore district showed higher zinc content than Tiruppur district (Table 3). Around 85 per cent of the samples were deficient in available zinc in the overall study area based on the SDWA values. Widespread zinc deficiency observed might be caused by the precipitation of zinc as hydroxides and carbonates under alkali pH range.

Available copper

Copper content in Tiruppur district was found to be lower than Coimbatore district. Range of available copper found in the study area were 0.01-4.9, 0.1-5.8, 0.14-4.5 and 0.1-4.4 ppm respectively in 0-30, 30-60, 60-90 cm depth and SDWA with the mean values of 1.4, 1.2, 1.0 and 1.2 ppm respectively. Available copper status of the overall study area based on the SDWA value showed 64 per cent of the samples as deficient (Table 3). In Coimbatore district 52 per cent of the samples were found to be deficient which is comparatively lower than the Tiruppur district which registered 76 per cent of the samples as deficient. Copper deficiency might be caused by the high pH observed which might have reduced the Cu availability by precipitation of copper as its hydroxides. Thus newly formed hydroxides of copper would have either become the part of lattice or occluded with the hydroxides of Fe, Al and Mn (Jegan and Subramanian, 2006).

Available boron

In the study area SDWA value of available boron ranged from 0.07 to 3.15 ppm and the mean was 1.01 ppm. In Coimbatore district boron content ranged from 0.07 to 3.15 ppm with a mean value of

Table 3. Range and mean values of micro nutrient status of the soils of coconut land cover in Coimbatore and Tiruppur districts

Soil property	District	Soil depth															
		(0-30 cm)				(30-60 cm)				(60-90 cm)				weighted average			
		Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)	Min	Max	Mean	CV (%)
DTPA-Fe(ppm)	Coimbatore	2.6	16.6	7.1	50.6	2.6	15.1	6.8	48.3	2.5	17.7	6.7	50.2	2.7	16.1	6.9	47.9
	Tiruppur	2.2	37.0	5.6	100.7	2.3	23.8	5.2	70.9	2.0	25.0	4.9	80.5	2.3	28.6	5.3	82.0
	Overall study area	2.2	37.0	6.6	66.8	2.3	23.8	6.2	55.6	2.0	25.0	6.1	59.7	2.3	28.6	6.3	58.7
DTPA-Mn(ppm)	Coimbatore	3.3	16.2	8.0	31.3	2.8	13.5	7.7	28.2	0.6	15.6	7.6	33.7	2.8	12.6	7.8	27.1
	Tiruppur	2.2	12.8	6.8	37.3	2.1	12.7	6.1	41.4	2.1	12.8	6.0	41.2	2.3	12.8	6.3	36.0
	Overall study area	2.2	16.2	7.6	33.9	2.1	13.5	7.2	33.6	0.6	15.6	7.1	37.2	2.3	12.8	7.3	31.0
DTPA-Zn(ppm)	Coimbatore	0.1	6.2	1.1	96.9	0.1	3.3	0.8	79.3	0.0	2.5	0.6	76.0	0.1	2.6	0.8	66.9
	Tiruppur	0.1	3.2	1.0	68.5	0.1	5.5	0.7	123.5	0.1	4.1	0.8	108.7	0.1	3.5	0.8	71.0
	Overall study area	0.1	6.2	1.1	88.6	0.1	5.5	0.8	93.3	0.0	4.1	0.7	93.4	0.1	3.5	0.8	68.0
DTPA-Cu(ppm)	Coimbatore	0.0	5.0	1.5	72.5	0.1	4.3	1.3	74.8	0.1	4.0	1.1	78.0	0.1	4.2	1.3	67.9
	Tiruppur	0.2	4.8	1.2	81.8	0.2	5.8	1.0	101.2	0.2	4.5	0.9	98.8	0.3	4.4	1.0	84.0
	Overall study area	0.0	5.0	1.4	75.7	0.1	5.8	1.2	82.6	0.1	4.5	1.0	84.3	0.1	4.4	1.2	73.0
HWS-B(ppm)	Coimbatore	0.1	3.2	1.1	67.7	0.1	3.3	1.1	72.4	0.1	2.8	0.9	74.7	0.1	3.2	1.0	68.7
	Tiruppur	0.1	3.2	1.1	67.4	0.3	2.9	1.0	66.7	0.1	2.3	0.9	79.6	0.2	2.8	1.0	66.1
	Overall study area	0.1	3.2	1.1	67.3	0.1	3.3	1.0	70.5	0.1	2.8	0.9	75.3	0.1	3.2	1.0	67.6

1.02 ppm. In Tiruppur district the range was 0.21-2.80 ppm and the mean was 0.98 ppm (Table 3). Boron deficiency was observed in 21 per cent of the samples in the study area. In Coimbatore district 18 per cent of the samples were deficient and in Tiruppur district 24 per cent were deficient. Boron deficiency was also reported by Poongothai *et al.* (2000) in the Coimbatore district.

Area extent of fertility related constraints identified from the thematic maps

Soil reaction and conductivity

Soil pH of the existing coconut land cover of Coimbatore and Tiruppur districts showed 9,460 ha which is only 8 per cent of the total area under normal condition (<8.0). Major area was found to be in the pH range 8.0 to 8.5 which covered 71,532 ha (62%) followed by the soils in the pH >8.5 which covered 34,801 ha (30%). Soil electrical conductivity was found to be in non saline (<1 dS m^{-1}) condition in majority of the area (1,08,493 ha , 96 %) followed by saline (1 to 3 dS m^{-1}) condition (4,510 ha, 4%) and only 0.02 per cent of the area was found to be under high salinity (>3dSm^{-1}) (Table 4; Fig. 1).

Soil organic carbon

Soil organic carbon content was found to be in low fertility status (<0.5 %) in 64.9 per cent of the coconut land cover (73,386 ha), followed by 35.1 per cent under medium status (0.5 to 0.75 %). High organic carbon was not observed in the coconut land cover studied. Overall organic carbon status of the soil in the study area was low to medium (Table 4; Fig. 1).

Available nitrogen

The spatial distribution of available N in the coconut land cover indicated that deficiency was more prevalent (72,965 ha, 64.6%) followed by medium status of available N (40,056 ha, 35.4%). High available nitrogen status was not found in the coconut land cover of Coimbatore and Tiruppur districts (Table 4; Fig. 1). Similar results were reported by Padmavathi (2011) who also reported low nitrogen status in Udumalapet block and medium status in Avinashi block of Tiruppur districts. Most of the coconut growing soils of the Coimbatore and Tiruppur districts was found to be

Table 4. Soil fertility constraints identified for coconut and their area extent in the existing coconut land cover of Coimbatore and Tiruppur district derived from the thematic maps

Property	Range		Area (ha)	Per cent to the total area
pH	<8.0	Neutral	9460	8.2
	8.1- 8.5	Slightly alkaline	71532	61.8
	>8.5	Alkaline	34801	30.1
EC (dS m^{-1})	<1	Non saline	108493	96.0
	1.1-3.0	Saline	4510	4.0
	>3	Highly saline	19	0.0
OC (%)	<0.5	Low	73386	64.9
	0.51-0.75	Medium	39636	35.1
	>0.75	High	0	0.0
Av. N (kg ha^{-1})	<280	Low	72965	64.6
	281-450	Medium	40056	35.4
	>450	High	0	0.0
Av. P (kg ha^{-1})	<11	Low	860	0.8
	11.1-22.0	Medium	36788	32.6
	>22	High	75373	66.7
Av. K (kg ha^{-1})	<118	Low	19	0.0
	118-280	Medium	4338	3.8
	>280	High	108645	96.2
Av. S (kg ha^{-1})	<10	Deficient	57	0.1
	>10	Sufficient	112964	100.0
Av. Fe (ppm)	<3.7	Deficient	7874	7.0
	>3.7	Sufficient	110824	93.0
Av. Mn (ppm)	<2.0	Deficient	0	0.0
	>2.0	Sufficient	113022	100.0
Av. Zn (ppm)	<1.2	Deficient	101154	89.0
	>1.2	Sufficient	11868	11.0
Av. Cu (ppm)	<1.2	Deficient	70041	62.0
	>1.2	Sufficient	42980	38.0
Av. B (ppm)	<0.44	Deficient	5638	5.0
	>0.44	Sufficient	107384	95.0

deficient in the available nitrogen. Similarly Padmavathi (2011) reported 86.4 per cent of samples in the erstwhile Coimbatore district were found to be deficient in available N.

Available phosphorus

The maximum area (75,373 ha, 66.7%) of the coconut land cover of the Coimbatore and Tiruppur district showed high available P (>22 kg ha^{-1}) status, followed by medium available P status (11 to 22 kg ha^{-1}) found in 36,788 ha (32.55 %). Available phosphorus status was low (<11 kg ha^{-1}) in 0.76 per cent (860 ha) of coconut land cover (Table 4; Fig. 1).

Available potassium

Considering the available K status, major portion (1,08,645 ha, 96.2%) of the coconut land cover of Coimbatore and Tiruppur districts was classified under high (>280 kg ha^{-1}) fertility status (Fig. 19). Around 3.8 per cent (4,338 ha) of the coconut land cover were medium (118-280 kg ha^{-1}) in available K status and only 0.02 per cent coconut land cover area were under low (>280 kg ha^{-1}) in available K status (Table 4; Fig. 1).

Available sulphur

The available S status of the coconut land cover of Coimbatore and Tiruppur districts found to be sufficient in most of the area (99.95 per cent, 1,12,964 ha) and only a negligible area (0.05 per cent, 57 ha) showed deficiency of available S (Table 4; Fig. 1).

Available micronutrients

Available iron content of the area under coconut land cover of Coimbatore and Tiruppur districts were found to be sufficient (3.7 ppm) in 1,10,824 ha (93%) and deficient in 7,874 ha (5%) area. Most of the areas under coconut land cover in the two districts studied were sufficient (>2.0 ppm) in available manganese status (Table 4; Fig. 2). With respect to available zinc, 89 per cent (1,01,154 ha) of the coconut land cover registered deficiency (<1.2 ppm) and 11 per cent (11,868 ha) coconut land cover area was sufficient in soil available zinc. Around 85 per cent of the samples were deficient in available zinc in the overall study area based on the SDWA values (Table 4; Fig. 2). Considering the available copper 62 per cent (70,041 ha) of the coconut land cover was deficient (<1.2 ppm) and 38 per cent (42,980 ha) area was sufficient (Table 4; Fig. 2). Available boron content of 95 per cent of the coconut land cover

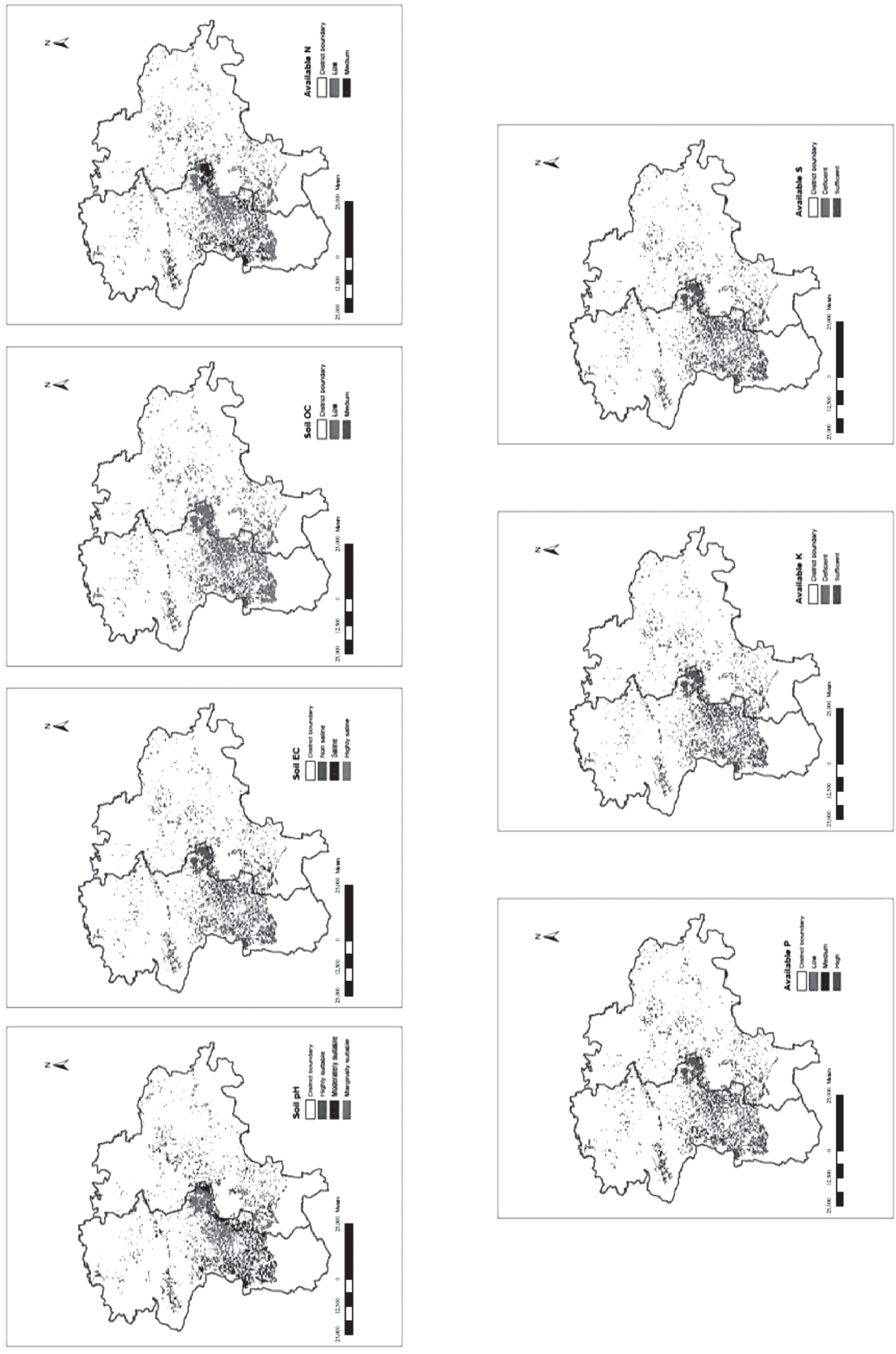

Fig. 1. **Spatial distribution of soil physico-chemical, organic carbon and macro nutrient status in the coconut land cover of Coimbatore and Tiruppur districts of Tamil Nadu state**

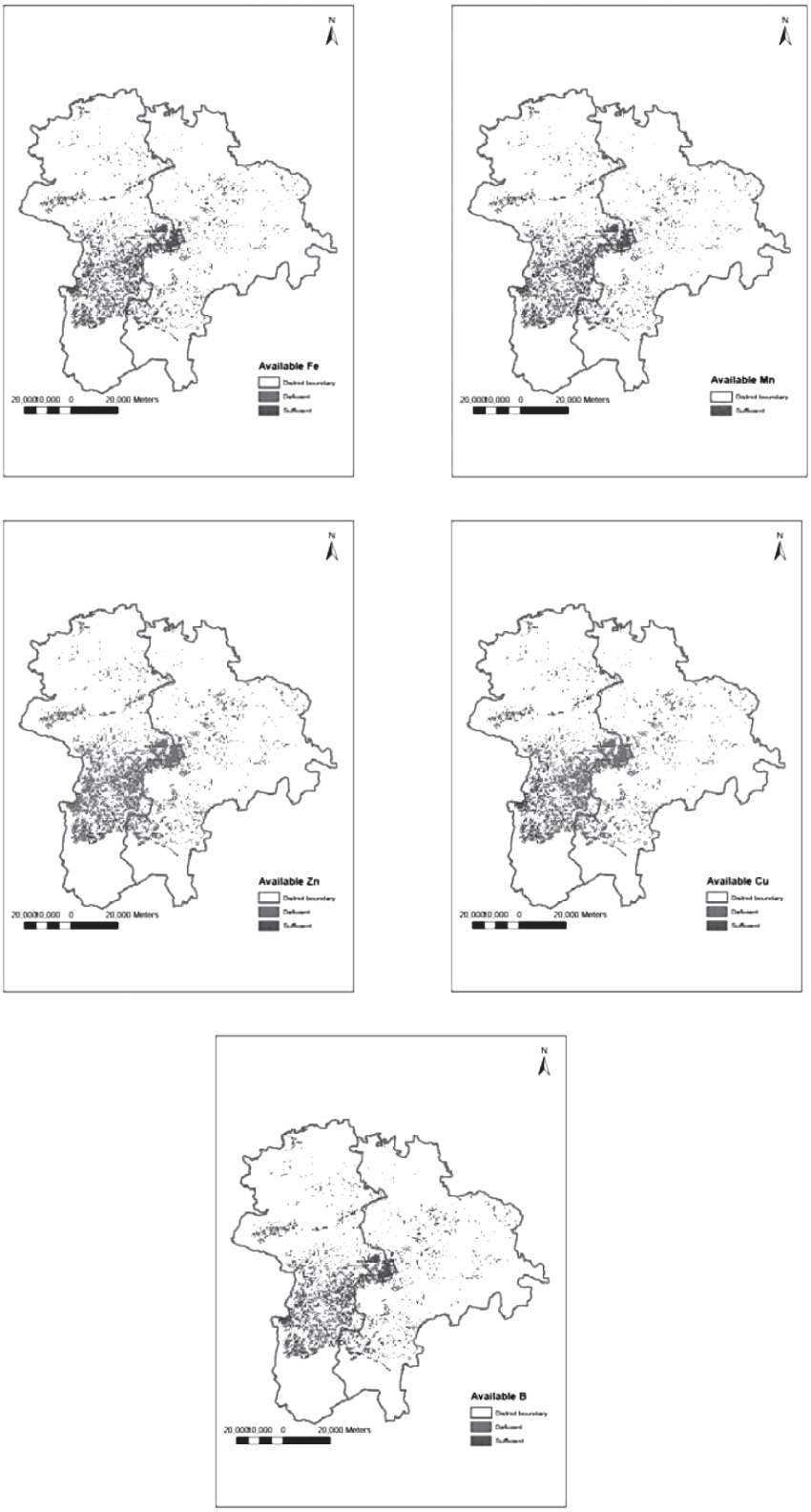

Fig. 2. Spatial distribution of soil micro-nutrient status in the coconut land cover of Coimbatore and Tiruppur districts of Tamil Nadu state

was found to be sufficient (>0.44 ppm) for coconut cultivation and the remaining 5 per cent (1,07,384 ha) of the coconut land cover was found to be deficient (Table 4; Fig. 2).

Conclusion

From this study, the soil fertility constraints of the soils under coconut land cover in the study area were found to be the existence of alkalinity, low organic carbon status, macro and micro nutrient deficiency for coconut production. The spatial information developed on the soil fertility related constraints may be useful for prioritizing the nutrient management practices in this region.

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