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Thematic maps based fertility status of panchayat villages of Ramanathapuram District in Tamil Nadu

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Abstract

Thematic maps were prepared for S and micronutrients viz., Zn, Fe, Mn, Cu and B by considering the panchayat village fertility status, fertility rating based on nutrient index values and spatial variability maps prepared based on soil analytical data. Locations of soil samples which was marked on base maps at 1: 50,000 scales prepared from State Revenue Maps and digitized using Arc-info GIS. The total area estimated for the Ramanathapuram district was 411238.2 ha comprising 11 blocks. Considering the critical limits of soil micronutrients, all soil associations were not adequately supplied with DTPA extractable micronutrients at panchayat village level. Thematic maps were generated to show the extent of micronutrients deficiency or sufficiency based on micronutrient status at panchayat village level. The present study revealed that there is wide variation in soil fertility status of soils developed on various land forms in Ramanathapuram district.

Keywords: DTPA – extractable micronutrients, sulphur, thematic maps.

Introduction

Indian soils are showing heavy depletion of micronutrients and almost 50 per cent of the soils are deficient in Zn, 17 per cent in Fe and 6 per cent in Mn (Singh 2001) ^[1]. Micronutrient requirements are steadily increasing worldwide and the widespread deficiency of micronutrients in the soils could be attributed to several reasons such as natural deficiency existing in some soil types, geology, climatic factors, crop removal, soil, water and crop management practices, destruction of organic matter etc. Low availability of micronutrients in the normal and calcareous soils is the important abiotic stress observed in world agriculture and it was reported that, about 10 M ha area is found to be Zn deficient and approximately more than 85 per cent of the deficiency was observed in calcareous soils having high pH (Singh *et al.* 2005). Hence, it is very much essential to understand the micronutrient related constraints to crop productivity and soil health to sustain the crop yields and soil fertility crop productivity. The availability of micronutrients in the soil vary with change in soil pH, electrical conductivity, organic matter (OM), and free CaCO₃ content in the soil, crops and cropping system adopted, fertilization practices etc. (Yadav and Meena 2009) ^[2]. The interaction among soil properties and micronutrient availability can be best understood by correlating the physico-chemical properties with available pool of nutrients thus helps in suggesting suitable management strategies to increase the micronutrients availability and crop productivity. The deficiency may either be primarily due to their low contents or secondarily by soil factor that reduce the availability (Sharma and Chaudhary 2007) ^[1]. The extent of micronutrient deficiency varies not only in different states and districts but also in different blocks within the district. Hence, the study was conducted to assess the micronutrient availability of soils in Ramanathapuram district of Tamil Nadu in different cropping system.

Materials and Methods

One thousand eight hundred and twenty samples were collected from Ramanathapuram district in eleven blocks, covering all panchayat villages. The surface geo referenced soil samples were processed and analysed for pH, organic carbon, CEC, and available nitrogen, phosphorus, potassium and sulphur following standard methods. The DTPA – extractable Fe, Zn, Mn and Cu were extracted with di-ethylene tri- amine penta-acetic acid (DTPA) solution

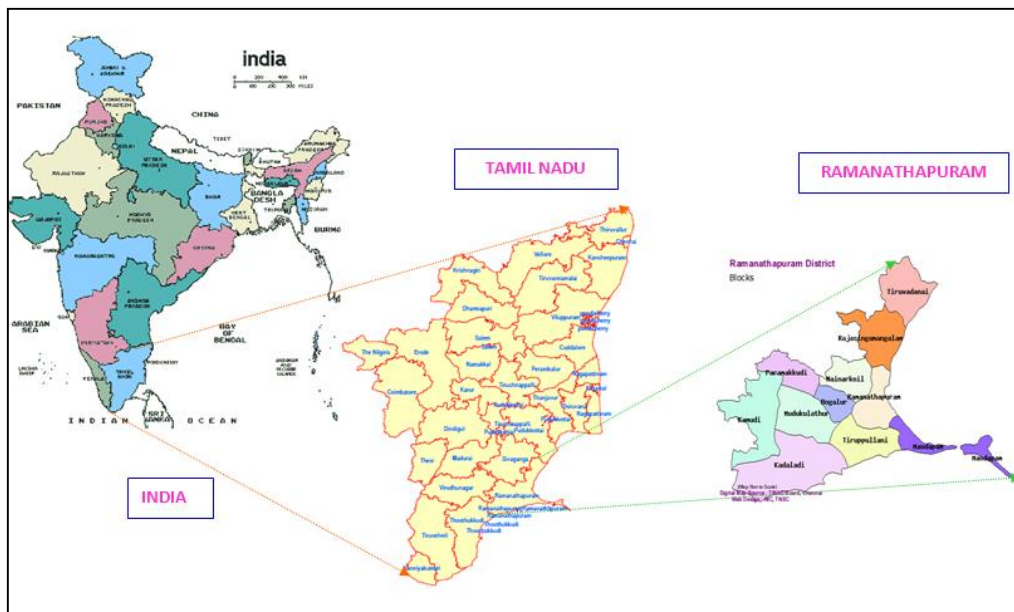
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(Lindsay and Norwell 1978) and subsequently analysed with

the help of atomic absorption spectrophotometer (Chemito-203).



Results and Discussion

Table 1: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available S in soils of Ramanathapuram district.

S. No	Name of the block	Available Sulphur					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	7	0	31	56.3	0.0	235.4
2	Nainarkoil	0	0	38	0.0	0.0	280.3
3	Bogalur	3	2	21	15.5	9.6	155.8
4	Paramakudi	0	0	41	0.0	0.0	302.1
5	Ramanathapuram	0	0	28	0.0	0.0	280.8
6	Tiruppullani	0	0	36	0.0	0.0	280.2
7	Mudukulathur	0	2	50	0.0	13.8	363.8
8	Kamudi	2	17	36	17.5	164.8	360.4
9	Kadadi	0	7	55	0.0	60.4	574.8
10	Thiruvadana	0	15	34	0.0	113.0	354.1
11	Mandapam	0	1	29	0.0	7.3	462.2
	Total	12	44	399	89.3	368.9	3649.8

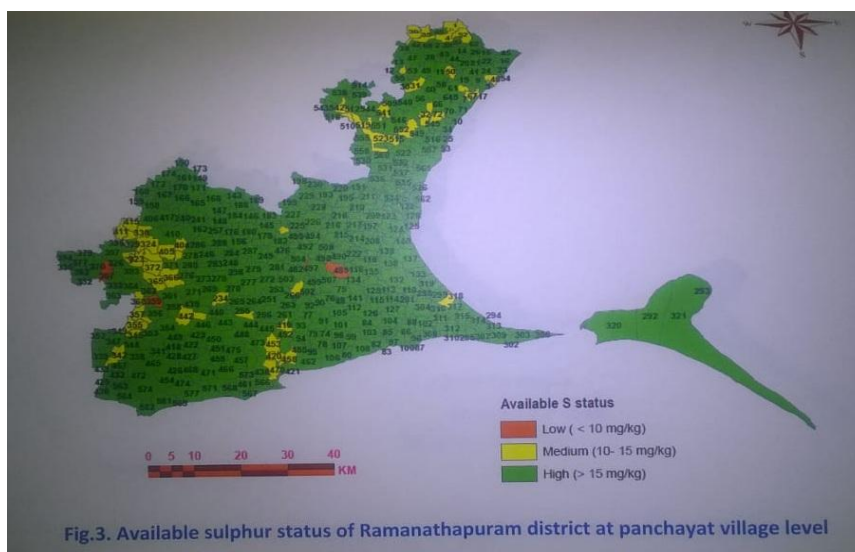


Fig 1

The fertility status of CaCl₂-S in the soils of Ramanathapuram district at panchayat village level were assessed and totally

12, 44 and 399 panchayat villages fall under the low, medium and high fertility status respectively (Table 1). As per the total

geographical area of the district about 89.3 sq.km was deficient in available Sulphur (2.2 per cent); 368.9 sq.km was medium in available sulphur (9 per cent); and 3649.8 sq.km was high (88.7 per cent) in available sulphur (Fig. 1).

The fertility status of $\text{CaCl}_2\text{-S}$ in the soils of Ramanathapuram district revealed that totally 12, 44 and 309 panchayat villages fall under the low, medium and high fertility status

respectively with total geographical area of 89.3 sq.km was deficient (2.2 per cent); 368.9 sq.km medium in (9 per cent); and 3649.8 sq.km was high (88.7 per cent) in available sulphur. The high status of available sulphur as depicted in the map might be due to the addition of sulphur containing fertilizers and farm inputs.

Table 2: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available Fe in soils of Ramanathapuram district.

S. No	Name of the block	Available Iron					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	0	0	38	0	0	293.0
2	Nainarkoil	0	0	38	0	0	281.5
3	Bogalur	0	0	26	0	0	182.0
4	Paramakudi	0	0	41	0	0	303.4
5	Ramanathapuram	0	0	28	0	0	282.0
6	Tiruppullani	0	0	36	0	0	281.4
7	Mudukulathur	0	2	50	0	18.1	361.2
8	Kamudi	0	20	35	0	155.3	381.4
9	Kadadi	0	19	43	0	235.9	402.2
10	Thiruvadanai	0	0	49	0	0	458.8
11	Mandapam	0	11	19	0	117.5	354.1
	Total	0	52	403	0	526.8	3581.1

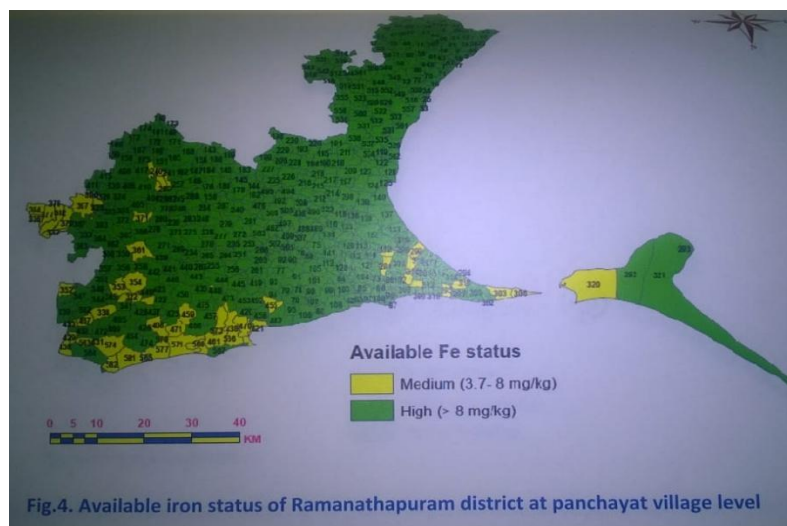


Fig 2

According to the fertility status of DTPA-Fe availability at panchayat village level, the soils of Ramanathapuram district revealed that 52 and 403 panchayat villages comes under the fertility status category of medium and high respectively (Table 2). None of the village mean fertility status was not fall under the low category. In Ramanathapuram district, 526.8

sq.km (12.8 per cent) and 3581.1 sq.km (87.1 per cent) area were noticed under medium and high fertility category respectively with respect to available Fe (Fig. 2)

Perusal of the thematic map on available iron status of the Ramanathapuram district at panchayat level clearly indicates that the available iron content was under very high status.

Table 3: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available Mn in soils of Ramanathapuram district.

S. No	Name of the block	Available Manganese					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	0	0	38	0	0	292.4
2	Nainarkoil	0	0	38	0	0	280.9
3	Bogalur	0	0	26	0	0	181.6
4	Paramakudi	0	0	41	0	0	302.8
5	Ramanathapuram	0	0	28	0	0	281.4
6	Tiruppullani	0	0	36	0	5.5	275.3
7	Mudukulathur	0	0	52	0	0	378.6
8	Kamudi	0	0	55	0	0	544.0
9	Kadadi	0	11	51	0	118.5	518.3
10	Thiruvadanai	0	0	49	0	0	457.9

11	Mandapam	0	5	25	0	28.0	442.7
	Total	0	16	439	0	152.0	3956

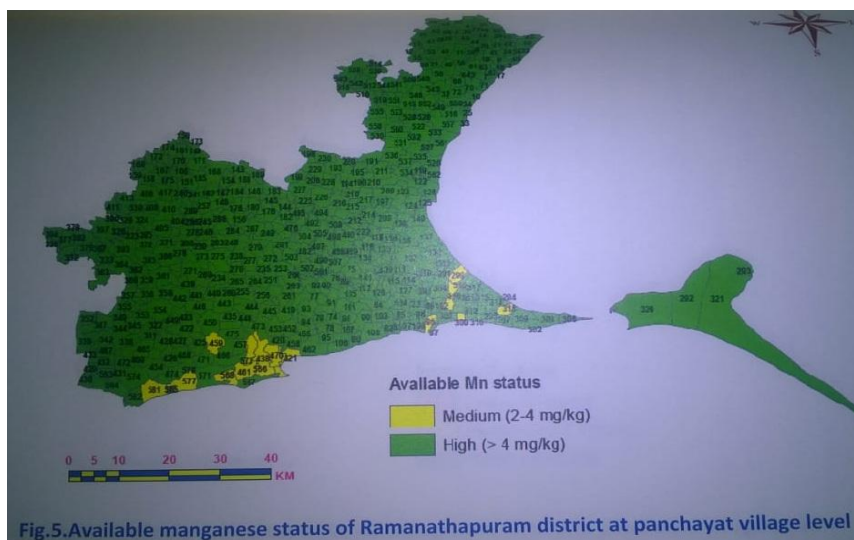


Fig 3

In Ramanathapuram district, 16 and 439 panchayat villages comes under the fertility status of medium and high respectively for DTPA-Mn availability at panchayat village level (Table 3). Nearly about 96.2 per cent of total geographical area (3956 sq.km ha) and 3.8 percent (152.0 sq. km) of Ramanathapuram district was classified under medium and high fertility status with respect to Mn nutrient status (Fig. 3)

The thematic map on available manganese status indicates that all panchayat villages in Ramanathapuram district were grouped under high fertility status except sixteen villages classified under medium category of available Mn. Nearly about 96.2 per cent of total geographical area (3956 sq.km) of Ramanathapuram district was classified under high in Mn nutrient status.

Table 4: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available Zn in soils of Ramanathapuram district.

S. No	Name of the block	Available Zinc					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	8	14	16	26.0	121.3	144.4
2	Nainarkoil	32	5	1	249.1	25.0	5.8
3	Bogalur	20	4	2	146.1	24.2	10.6
4	Paramakudi	38	1	2	284.8	5.1	11.8
5	Ramanathapuram	24	2	2	251.5	14.7	20.4
6	Tiruppullani	19	11	6	127.3	99.2	51.2
7	Mudukulathur	50	2	0	364.5	12.7	0.0
8	Kamudi	31	18	6	352.4	155.7	33.9
9	Kadadi	52	10	0	571.4	63.2	0.0
10	Thiruvadana	36	9	4	397.4	47.0	22.1
11	Mandapam	25	5	0	447.3	21.9	0.0
	Total	335	81	39	3217.9	590.0	300.2

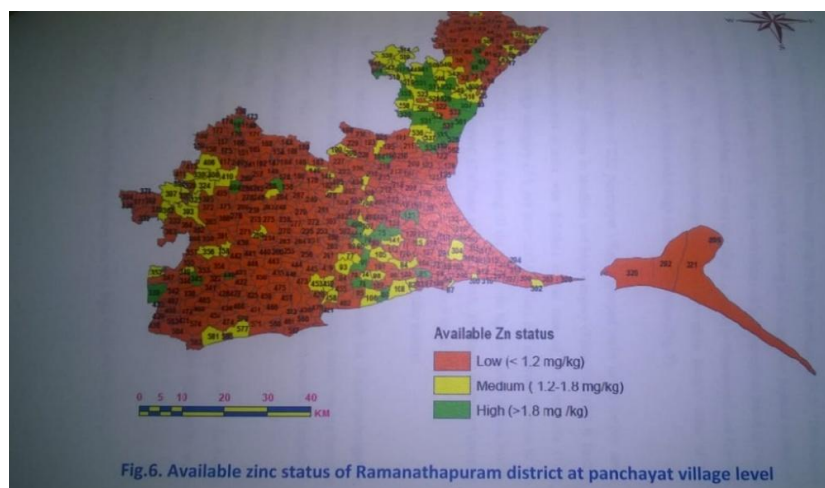


Fig 4
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With regard to available Zn, the thematic maps showed that 335 nos of Panchayat villages in Ramanathapuram district were grouped under low fertility status while 81 and 39 nos under medium and high category respectively with an area of 3217.9 sq.km (78.2 per cent) for deficient, 590 sq.km (14.3 per cent) for medium and 300.2 sq.km (7.3 per cent) for high

category (Table 4). But the very low organic carbon content of the soils indicates that corrective measures would be required to avoid Zn deficiency in near future and similar observations have been made by Katyal and Datta (2004) and Sood *et al.* (2009) [5].

Table 5: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available Cu in soils of Ramanathapuram district.

S. No	Name of the block	Available Copper					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	27	11	0	199.7	89.4	0.0
2	Nainarkoil	6	9	23	33.8	58.1	185.6
3	Bogalur	3	7	16	14.4	61.7	103.3
4	Paramakudi	15	17	9	127.6	115.7	56.1
5	Ramanathapuram	4	11	13	78.2	82.6	117.4
6	Tiruppullani	27	3	6	204.1	21.2	52.3
7	Mudukulathur	27	19	6	217.0	110.4	46.8
8	Kamudi	13	19	23	103.4	279.0	155.4
9	Kadadi	21	22	19	172.0	290.4	167.1
10	Thiruvadana	37	12	0	400.6	62.4	0.0
11	Mandapam	10	14	6	106.1	118.0	277.9
	Total	190	144	124	1657	1289	1162

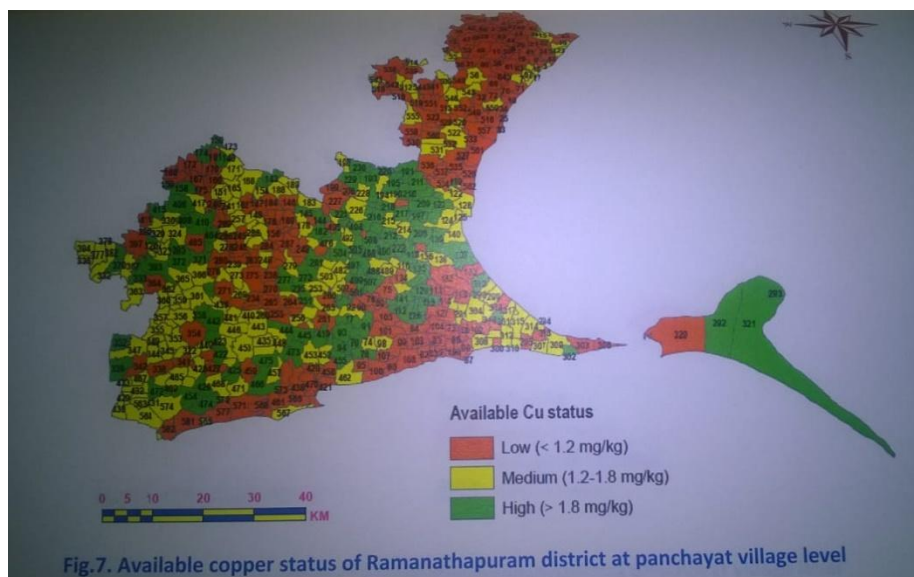


Fig 5

The maximum number of 190 panchayat villages grouped under low cu fertility status followed by 144 and 124 villages in medium and high category respectively (Table 5). DTPA-Cu fertility of Ramanathapuram district was deficient to the tune of 40.3 per cent (1657 sq.km) which was followed by medium group to the percentage of 31.3 (1289 sq.km) and high category (28.3 per cent; 1162 sq.km). Among the villages, the highest number of panchayat villages having low fertility status were observed in Thiruvadana block (37 nos),

medium category in Kadaladi block (22 nos) and high Cu status in Nainarkovil and Kamudi blocks (each 23 nos). In Rajasingamangalam and Thiruvadani blocks, none of the panchayat village was not found under high available Cu status (Fig.5). Deficient Cu availability was specifically recorded in the soils under chillies based cropping systems could be ascribed to the low organic content in the soils (Sood *et al.* 2009) [5].

Table 6: Area and fertility status (based on nutrient index) of No. of Panchayat villages for available B in soils of Ramanathapuram district.

S. No	Name of the block	Available Copper					
		No. of Panchayat Villages			Area (sq.km)		
		Low	Medium	High	Low	Medium	High
1	Rajasingamangalam	14	24	0	110.1	297.3	0
2	Nainarkoil	1	33	4	10.9	258.5	16.1
3	Bogalur	20	6	0	130.1	54.4	0
4	Paramakudi	12	26	3	11.6	288.8	7.4
5	Ramanathapuram	14	12	2	138.5	144.1	3.4
6	Tiruppullani	6	20	10	62.6	144.7	78.1
7	Mudukulathur	41	11	0	263.1	121.6	0

8	Kamudi	42	10	3	442.7	100.3	9.9
9	Kadadi	23	25	14	20.5	259.7	178.9
10	Thiruvadanai	40	9	0	266.7	209.3	0
11	Mandapam	9	21	0	109.3	369.2	0
	Total	222	197	42	1566.0	2248.1	293.9

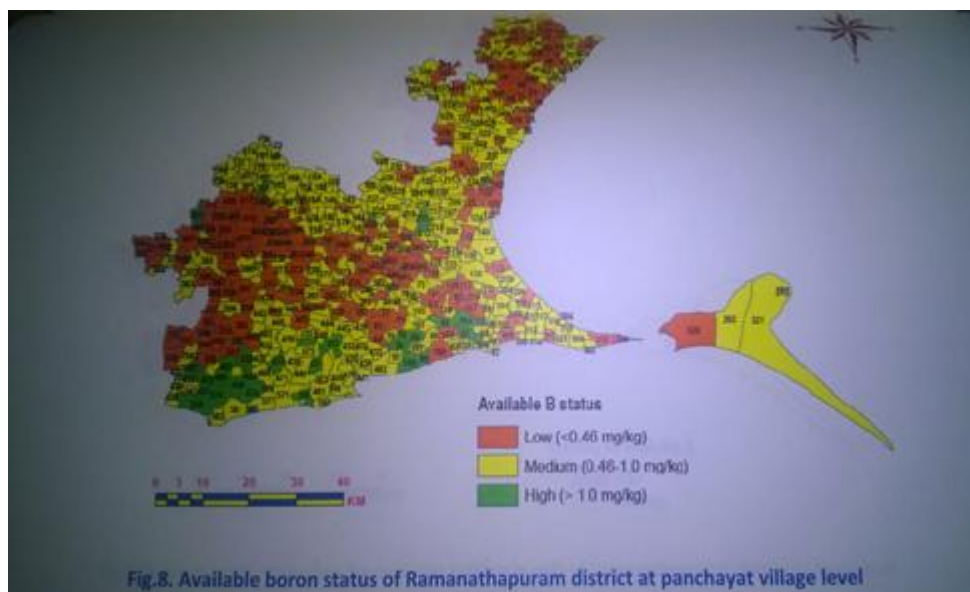


Fig 6

With regard to boron, it can be clearly viewed from the map that 38 per cent of the district recorded available boron content under low status (> 0.46 ppm). The highest number of 222 panchayat villages grouped under low B fertility status followed by 197 and 42 villages in medium and high category (Table 6). HWS-B fertility status of Ramanathapuram district was deficient to the tune of 38.1 per cent (1566 sq.km); medium 54.7 (2248.1 sq.km) and high (7.1 per cent; 293.9 sq.km) category.

Perusal of the thematic map clearly depicts the severity of deficiency micronutrient especially for Zn, Cu and B in Ramanathapuram district and revealed the importance of site specific nutrient application.

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