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Status of DTPA-Extractable Cationic Micronutrients and Physio Chemical Properties of Geo Referenced Soils Under Irrigated and Rainfed Ecosystems of Vellore District in Tamilnadu, India

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A B S T R A C T

The DTPA extractable cationic micronutrient and some important soil physico-chemical properties were investigated in two ecosystems namely irrigated and rainfed conditions of Vellore district of Tamil Nadu using GPS and GIS techniques. Considering the critical limits of soil micronutrients, all soil associations were not adequately supplied with DTPA extractable micronutrients in both the ecosystems. Irrespective of land use, the DTPA extractable cationic micronutrients were positively related with organic carbon content and negatively related to calcium carbonate content. The soils under rainfed condition possessed lesser values of all the nutrient availability than irrigated soil environment except for zinc which nutrient content is equal. Deficient soil samples for manganese and copper were found in some blocks under irrigated conditions and all the blocks for zinc deficiency except Gudiyattam block and for iron deficiency none of the block is deficient. In rainfed ecosystem, iron and manganese deficiency is noticed in some blocks and zinc deficiency in all the blocks and copper deficiency is seen in all the blocks except Alangayan block.

Introduction

Indian agriculture during the past 50 years has achieved a fourfold growth in food production by adopting modern agricultural practices. However, intensive cultivation of high yielding varieties, increased use of NPK fertilizers free from secondary and micronutrients, decreased use of organic manures and lack of crop residue recycling have led to depletion of native nutrient fertility and resulted in wide spread deficiencies of secondary and micronutrients. The deficiency may either be primarily due to their low contents or secondarily by soil factor that reduce the availability (Sharma and Chaudhary, 2007). Micronutrients are as essential as macronutrients but required in smaller quantities by plants. The extent of micronutrient deficiency varies not only in different states and districts but also in different blocks within the district. Micronutrient deficiencies is the one of the main causes for low yield or crop yield

decline in irrigated (Katyal and Rattan, 2003) and rainfed cropping system (Rego *et al.*, 2007). On the basis of computation of exhaustion period of micronutrient reserve under different cropping system soil zinc is the most limiting micronutrient (Rattan *et al.*, 2009).

Besides soil characteristics, land use pattern also plays a vital role in governing the nutrient dynamics and fertility of soils (Venkatesh *et al.*, 2003). Due to continuous cultivation, soils under a particular land use system may affect physico-chemical properties which may modify DTPA-extractable micronutrients content and their availability to crops. So, analysis of these properties along with micronutrient status of different land use systems may have significant importance. Scanty information is available on status of cationic micronutrients under different ecosystems in the Vellore district of Tamil Nadu. An attempt has, therefore, been made to generate information regarding the DTPA- extractable Fe, Zn, Mn and Cu status under two dominant land use systems, viz. irrigated and rainfed ecosystem of vellore district of Tamil Nadu using GPS and GIS techniques (Fig. 1).

Materials and Methods

One thousand three hundred and nineteen samples representing rainfed ecosystem were collected. The major crops cultivated under rainfed conditions were Groundnut, redgram, cowpea, sorghum, horse gram, cotton and ragi. Seven hundred and fourteen samples representing irrigated ecosystem were collected and major crops grown under irrigated situation were rice, sugarcane, groundnut, ragi, sorghum, coconut, maize, turmeric and lilly. The rainfed and irrigated ecosystem spread all over the blocks in Vellore district. The surface geo referenced soil samples were processed and analysed for pH, organic carbon, CEC, and available nitrogen, phosphorus and potassium following standard methods. The DTPA– extractable Fe, Zn, Mn and Cu were extracted with diethelene tri- amine penta-acetic acid (DTPA) solution (Lindsay and Norwell 1978) and subsequently analysed with the help of atomic absorption spectrophotometer (Chemito-203).

Results and Discussion

The pH of the soils in irrigated system ranged from 6.25 to 8.82 with a mean of 7.64 (Table 2). The highest mean soil pH was found in K.V. Kuppam and Alangayan (7.76) followed by Thirupattur (7.75) block (Table 3). Almost all soils in irrigated condition were slightly alkaline in soil reaction. Generally the soils under rainfed condition had neutral to alkaline soil pH (7.89) with a range of 6.32 to 8.81 (Table 2). The highest mean is noticed in Natrampally (7.74) block and the lowest is noticed in Gudiyattam (7.39) block. The overall mean electrical conductivity in the soils of Vellore district in irrigated environment showed low salt content (0.27 dS m^{-1}) (Table 2). The highest electrical conductivity of the soils under irrigated system was recorded in Nemili (0.33 dS m^{-1}) block while the lowest in Gudiyattam block (0.20 dS m^{-1}) (Table 3). The EC of the rainfed soils ranged from 0.10 to 0.82 dS m^{-1} with a mean of 0.28 indicating low in salt concentration (Table 2). The highest mean electrical conductivity is noticed in Kaniymbadi (0.34 dS m^{-1}) and the lowest mean EC is noticed in Arcot, thirupatthur, Madhanur, Anaicut and Walajapet (0.26 dS m^{-1}). The organic carbon content of the soils under irrigated system ranged from 0.18 to 0.70 per cent with a mean of 0.42 per cent revealing low in organic carbon status of the soils (Table 2). The highest mean organic carbon content was recorded in Natrampally and Kaniyambadi block (0.47 per cent) while

the lowest in Alangayan (0.35 per cent) block (Table 3). The mean organic carbon content of the soils under rainfed situation was low (0.43 percent) in fertility and ranged from 0.15 to 0.85 per cent (Table 2). Highest organic carbon status (0.47 per cent) was found in Gudiyattam block and the lowest in Arakkonam (0.35 per cent) block (Table 5). The free $CaCO_3$ (per cent) content of the soils in irrigated system showed a mean of 2.9 per cent indicating non calcareous nature of soils (Table 2). The highest mean free $CaCO_3$ content was noted in the soils of Arcot (4.0 per cent) block and the lowest in Alangayan (1.4 per cent) block (Table 2). The mean free $CaCO_3$ content of the soils in rainfed cultivation system was non calcareous in nature and ranged from 0.13 to 13.9 per cent with a mean of 2.8 per cent (Table 2). The highest mean free $CaCO_3$ registered in the soils of Natrampally block (4.0 per cent) while the lowest in Alangayan and Anaicut (2.20 per cent) block soils (Table 5).

Micronutrient availability in the soils of Vellore district under irrigated situation was observed with mean of 42.6 mg kg^{-1}, 28.4 mg kg^{-1}, 1.8 mg kg^{-1} and 2.4 mg kg^{-1} for available iron, manganese, zinc and copper respectively (Table 2). Considering the critical limits 1.2 mg kg^{-1} for available Zn, 0.2 mg kg^{-1} for available Cu, 4.2 mg kg^{-1} for available Fe, 2.0 mg kg^{-1} for available Mn as proposed by Lindsay and Norvell (1978), the deficient range of Zn noticed under irrigated condition in Jolarpet, Natrampally, Thirupattur and madhanur blocks of vellore district (Table 4).

The DTPA-Zn content in the soils of irrigated system ranged from 0.20 to 11.1 mg kg^{-1} with a mean of 1.8 mg kg^{-1} and the highest mean Zn content was found in walajapet block (3.7 mg kg^{-1}) and the lowest mean Zn content was found in Madhanur (0.7 mg kg^{-1}) block (Table 4). All the blocks had higher DTPA-Fe content and values ranged from 5.5 to 98.1 mg kg^{-1} (Table 4). The soils of vellore block recorded the highest mean Fe availability (80.6 mg kg^{-1}) while the lowest Fe status in Walajapet block (28.5 mg kg^{-1}) under irrigated condition (Table 4). The sufficient range of Cu noticed in all the blocks of Vellore district (Table 4) under irrigated system. The DTPA-Cu content in the soils of irrigated system ranged from 0.3 to 7.4 mg kg-1 with overall mean of 2.4 mg kg^{-1} (Table 4). The highest mean Cu content in the soils was found in Alangayan block (3.9 mg kg^{-1}) and the lowest in Peranambattu (1.4 mg kg^{-1}) blocks (Table 4). The DTPA-Mn content in the soils under irrigated condition ranged from 1.2 to 67.8 mg $kg^{-1}$with a mean of 28.4 mg kg^{-1} and the highest mean Mn availability was noted in the soils of Gudiyattam block (62.5 mg kg^{-1}) whereas the lowest mean Mn content was in Arakkonam block (8.4 mg kg^{-1}) (Table 4). Considering the critical limits of 2.0 mg kg^{-1}, proposed by Lindsay and Norvell (1978), the sufficient range of Mn noticed in all the blocks of Vellore district.

In general, soils under irrigated system, deficient range of Zn noticed in Jolarpet, Natrampally, Thirupattur and Madhanur blocks of Vellore district. The Cu was sufficient in all the blocks except in Vellore block. The Fe and Mn was sufficient in all the blocks. The soils under rainfed condition possessed lesser values of all the nutrients than irrigated soil environment except for Zn which is equal (1.8 mg kg^{-1}). Deficient soil samples were found in all the blocks, for Fe, Zn, Mn and Cu in district (Table 6). The DTPA-Zn content in the soils varied from 0.1 to 11.4 mg kg^{-1} with a mean of 1.80 mg kg^{-1}. The highest mean DTPA Zn content noticed in the soils of Walajapet block (3.5 mg kg^{-1}) and the lowest Zn status in Thiruppathur (0.5 mg kg^{-1}) block soils under rainfed system (Table 6). Considering the critical limit, Arakkonam, Jolarpet, Thiruppathur and Madhanur blocks have deficient range of Zn.

Fig.1 Location map of Vellore district

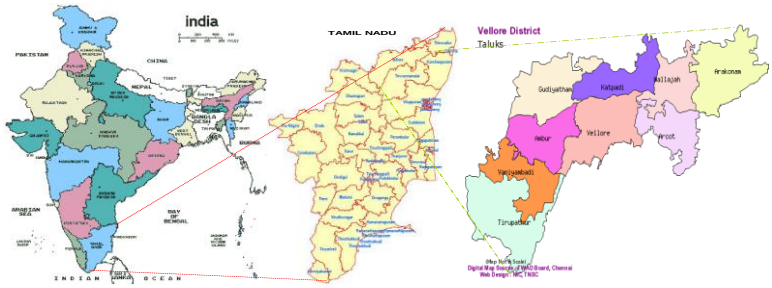

Table.1 Details of geo referenced soil samples

S. No.	Taluk name	Block name	No. of samples
1	Arakkonam	1. Arakkonam	108
		2. Kaveripakkam	224
		3. Nemili	228
2	Arcot	4. Arcot	163
		5. Timiri	260
3	Gudiyattam	6. Gudiyattam	172
		7. Katpadi	82
		8. K.V.Kuppam	152
		9. Peranambattu	196
4	Thiruppathur	10. Jolarpet	148
		11. Kandili	156
		12. Natrampalli	115
		13. Tiruppathur	124
5	Kaniyambadi	14. Alangayan	98
		15. Madhanur	141
6	Vellore	16. Anaicut	152
		17. Kaniyambadi	104
		18. Vellore	76
7	Walajapet	19. Sholinghur	168
		20. Walajapet	143
		TOTAL	3010

Table.2 The data of soil properties and micronutrient status

Parameter	**Irrigated**		**Rainfed**	
	Range	**Mean**	**Range**	**Mean**
No. of samples	714		1319	
pH	6.25-8.82	7.64	6.32-8.81	7.55
EC(dSm^{-1}))	0.11-0.59	0.27	0.10-0.82	0.28
OC ($mg\ kg^{-1}$))	1.80-7.90	4.20	1.50-8.50	4.30
$CaCO_3$ (%)	0.3-13.80	2.90	0.13-13.9	2.80
Micronutrient status ($mg\ kg^{-1}$)				
DTPA-Zn	0.2-11.1	1.80	0.1-11.4	1.80
DTPA-Fe	5.5-98.1	42.6	1.8-71.2	13.8
DTPA-Cu	0.3-7.40	2.40	0.2-12.1	2.20
DTPA-Mn	1.2-67.8	28.4	0.8-59.4	18.0

Table.3 Chemical properties of soil under irrigated condition in different blocks of Vellore district (n=714)

S. no	Name of the block	No. of Samples	Crops grown	pH		EC(dSm^{-1})		OC (mg kg^{-1})		Free $CaCO_3$ (%)	
				Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Arakkonam	80	Rice, Sugarcane	6.25-8.82	7.66	0.11-0.57	0.28	2.1-7.0	4.2	0.9-10.6	3.2
2	Kaveripakkam	115	Rice, Sugarcane	6.29-8.75	7.71	0.11-0.56	0.30	1.9-7.9	4.2	0.3-11.5	3.8
3	Nemili	169	Rice, Lilly	6.46-8.54	7.66	0.12-0.57	0.33	1.7-6.5	3.9	0.9-11.3	3.0
4	Arcot	56	Rice, Sugarcane.	6.31-8.82	7.73	0.15-0.58	0.28	1.8-6.2	4.5	1.1-13.8	4.0
5	Timiri	103	Rice, Sugarcane, Groundnut	6.49-8.82	7.69	0.11-0.24	0.31	1.8-7.2	4.2	0.3-13.5	3.5
6	Gudiyattam	5	Rice, Ragi.	7.08-8.54	7.70	0.11-0.30	0.20	3.8-5.4	4.6	1.3-2.9	1.8
7	Katpadi	14	Rice, Sugarcane.	6.92-8.34	7.68	0.11-0.37	0.26	2.5-5.2	4.0	1.4-6.1	2.4
8	K.V.Kuppam	9	Rice, Sorghum.	6.94-8.54	7.76	0.16-0.35	0.25	1.9-5.8	3.8	1.0-9.0	3.9
9	Peranambattu	8	Rice, Sugarcane.	6.58-8.35	7.47	0.11-0.33	0.24	1.6-5.4	3.9	0.9-10.4	2.8
10	Jolarpet	11	Rice, Ragi.	7.11-8.24	7.67	0.18-0.46	0.27	3.4-5.4	4.0	0.9-2.8	1.8
11	Kandili	12	Rice, Ragi, Coconut.	7.23-8.41	7.68	0.15-0.41	0.28	3.0-5.9	4.3	1.4-8.1	2.8
12	Natrampalli	3	Rice,	6.92-8.24	7.57	0.15-0.35	0.28	3.9-5.9	4.7	1.3-3.5	2.1
13	Tiruppathur	12	Rice, Maize.	6.48-8.56	7.75	0.12-0.59	0.30	2.5-5.6	4.2	1.0-8.6	3.2
14	Alangayan	2	Rice,	7.54-7.98	7.76	0.24-0.31	0.28	2.8-4.2	3.5	1.4 -1.5	1.4
15	Madhanur	7	Rice, Ragi.	6.84-7.91	7.44	0.16-0.29	0.23	3.0-5.5	4.0	1.3-2.9	2.0
16	Anaicut	7	Rice, Sugarcane.	6.99-7.93	7.55	0.15-0.31	0.21	3.4-7.3	4.1	1.1-11.8	2.8
17	Kaniyambadi	10	Rice, Turmeric.	6.94-8.55	7.70	0.16-0.35	0.26	3.8-6.4	4.7	1.1-10.6	3.7
18	Vellore	3	Rice,	7.28-7.68	7.47	0.24-0.31	0.28	2.8-5.4	3.7	3.0-3.8	3.3
19	Sholinghur	40	Rice, Ragi, Sugarcane.	6.57-8.49	7.51	0.13-0.47	0.28	1.9-6.8	4.2	0.9-11.3	3.7
20	Walajapet	48	Rice, Groundnut, Sugarcane	6.48-8.48	7.56	0.11-0.45	0.28	1.9-7.4	4.6	0.3-10.4	2.8
District		714		6.25-8.82	7.64	0.11-0.59	0.27	1.8-7.9	4.2	0.3-13.8	2.9

Table.4 Micronutrient availability in the soil under irrigated condition in different blocks of Vellore district (n=714)

S. No	Name of the block	No. of Sample	Fe ($mgkg^{-1}$)		Mn ($mgkg^{-1}$)		Zn ($mgkg^{-1}$)		Cu ($mgkg^{-1}$)	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Arakkonam	80	10.7-82.9	33.5	1.2-21.0	8.4	0.4-4.9	1.2	0.3-6.6	2.3
2	Kaveripakkam	115	8.8-98.1	52.4	2.2-67.8	33.8	0.2-6.7	1.6	0.4-5.8	1.7
3	Nemili	169	5.5-87.8	33.3	1.2-64.2	20.8	0.4-7.7	1.7	0.4-7.4	1.8
4	Arcot	56	43.5-85.9	63.2	8.9-43.7	29.9	0.3-11.1	1.8	0.4-4.4	2.2
5	Timiri	103	26.0-70.3	40.8	7.9-40.7	30.8	0.4-7.5	1.7	0.6-7.3	2.3
6	Gudiyattam	5	49.2-56.6	53.0	60.5-66.0	62.5	1.2-3.5	2.0	1.2-1.9	1.6
7	Katpadi	14	28.0-49.5	34.3	10.1-23.5	14.4	0.8-3.3	1.7	1.8-6.8	3.2
8	K.V.Kuppam	9	24.4-41.1	29.9	27.5-38.3	31.2	1.1-7.5	2.9	1.1-7.1	3.8
9	Peranambattu	8	32.8-56.5	39.7	45.7-49.4	47.4	0.5-8.0	2.5	0.7-2.62	1.4
10	Jolarpet	11	33.6-63.2	48.1	13.3-26.8	18.3	0.4-1.4	0.9	2.6-5.8	3.4
11	Kandili	12	22.0-44.0	34.0	17.3-29.7	21.0	1.1-9.6	3.2	1.2-5.2	3.0
12	Natrampalli	3	29.2-64.7	41.4	15.9-16.9	16.3	0.6-1.1	1.0	0.9-2.8	1.8
13	Tiruppathur	12	26.4-47.4	39.4	24.8-46.6	30.5	0.2-1.7	0.6	0.7-6.5	3.5
14	Alangayan	2	32.7-37.6	35.2	19.1-20.3	19. 7	1.3-2.7	2.0	3.1-4.8	3.9
15	Madhanur	7	31.2-36.2	33.8	51.3-54.4	52.9	0.4-1.3	0.7	1.3-2.9	2.0
16	Anaicut	7	28.8-44.2	38.0	39.4-50.8	45. 8	0.9-1.9	1.4	0.8-3.2	1.9
17	Kaniyambadi	10	38.6-54.4	42.7	8.2-38.3	22.5	0.7-4.4	2.1	1.6-5.8	3.2
18	Vellore	3	74.4-89.2	80.6	6.8-33.0	22.5	0.8-1.9	1.2	0.6-1.1	0.9
19	Sholinghur	40	25.9-75.0	50.5	2.3-40.5	24.5	0.3-4.4	1.3	0.4-5.7	2.1
20	Walajapet	48	18.8-57.4	28.5	7.4-35.8	13.9	0.2-9.7	3.7	0.4-4.0	1.8
District		714	5.5-98.1	42.6	1.2-67.8	28.4	0.2-11.1	1.8	0.3-7.4	2.4

Table.5 Chemical properties of soil under rainfed condition in different blocks of Vellore district (n=1319)

S. No	Name of the block	No. of samples	Crops Grown	pH		EC(dSm^{-1})		OC (mg kg^{-1})		Free $CaCO_3$ (%)	
				Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Arakkonam	5	Groundnut	7.28-7.64	7.43	0.23-0.41	0.32	2.7-4.3	3.5	1.1-3.1	2.3
2	Kaveripakkam	45	Cowpea, Groundnut	6.61-8.54	7.66	0.11-0.50	0.27	2.4-7.1	4.3	1.0-9.5	2.7
3	Nemili	13	Cowpea, Groundnut	6.52-7.91	7.47	0.16-0.42	0.27	2.4-6.2	4.4	1.3-10.4	3.5
4	Arcot	50	Redgram, Groundnut	6.89-8.66	7.73	0.11-0.55	0.26	2.2-6.2	4.1	0.3-11.8	3.3
5	Timiri	63	Groundnut, Red gram, Sorghum	6.57-8.57	7.63	0.11-0.61	0.30	2.4-7.1	4.4	0.3-11.5	2.9
6	Gudiyattam	112	Ragi, Redgram, Horsegram, Sorghum	6.48-8.56	7.39	0.10-0.58	0.28	2.2-7.8	4.7	0.1-12.5	2.5
7	Katpadi	41	Redgram, Sorghum, Horsegram	6.36-8.46	7.59	0.16-0.56	0.30	2.1-5.9	4.1	0.3-10.6	2.8
8	K.V.Kuppam	100	Ragi, Horsegram, Sorghum	6.54-8.56	7.51	0.11-0.59	0.28	1.6-7.7	4.3	0.9-10.3	3.0
9	Peranambattu	140	Ragi, Sorghum	6.32-8.58	7.43	0.11-0.54	0.27	2.3-7.8	4.6	0.9-10.4	2.3
10	Jolarpet	93	Cotton, Ragi, Sorghum	6.34-8.54	7.6	0.1-0.24	0.27	1.6-7.7	4.6	0.4-10.8	3.0
11	Kandili	114	Cotton, Ragi, Redgram, Sorghum	6.79-8.53	7.61	0.11-0.19	0.27	2.4-6.5	4.2	0.4-13.4	2.9
12	Natrampalli	93	Cotton, Ragi, Sorghum	6.78-8.59	7.74	0.11-0.57	0.31	1.8-6.2	3.8	0.9-10.8	4.0
13	Tiruppathur	58	Cotton, Redgram, Ragi.	6.33-8.63	7.55	0.11-0.82	0.26	1.9-7.4	4.2	0.9-13.9	3.3
14	Alangayan	57	Cotton, Ragi, Sorghum	6.36-8.48	7.54	0.11-0.45	0.27	2.5-8.5	4.3	0.9-7.9	2.2
15	Madhanur	62	Groundnut, Sorghum	6.49-8.48	7.45	0.11-0.53	0.26	1.9-8.3	4.3	1.0-13.3	2.6
16	Anaicut	70	Ragi, Sorghum	6.35-8.48	7.43	0.12-0.45	0.26	1.5-6.2	4.0	0.1-12.4	2.2
17	Kaniyambadi	56	Groundnut, Redgram, Sorghum	6.37-8.48	7.67	0.12-0.26	0.34	1.9-7.4	4.3	0.6-10.9	2.9
18	Vellore	62	Groundnut, Sorghum	6.54-8.53	7.60	0.13-0.60	0.3	1.6-6.2	4.1	1.0-10.6	2.7
19	Sholinghur	47	Groundnut, Redgram, Sorghum	6.54-8.81	7.53	0.11-0.43	0.28	1.9-7.4	4.5	0.9-13.4	3.2
20	Walajapet	38	Groundnut, Redgram, Sorghum	6.54-8.48	7.52	0.14-0.54	0.26	2.5-7.4	4.4	0.5-10.9	2.8
	District	1319		6.32-8.81	7.55	0.10-0.82	0.28	1.5-8.5	4.3	0.1-13.9	2.8

Table.6 Micronutrient availability in the soil under rainfed condition in different blocks of Vellore district (n=1319)

S. No	Name of the block	No. of sample	Fe (mgkg^{-1})		Mn (mgkg^{-1})		Zn (mgkg^{-1})		Cu (mgkg^{-1})	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
1	Arakkonam	5	6.9-9.0	8.0	3.1-17.9	7.1	0.3-1.2	0.7	0.9-4.9	2.1
2	Kaveripakkam	45	3.0-25.0	13.0	2.2-45.5	19.5	0.3-4.4	1.4	0.2-2.7	1.2
3	Nemili	13	6.0-13.8	9.1	2.0-25.1	13.2	0.8-6.9	2.2	0.4-3.9	1.4
4	Arcot	50	4.8-44.0	28.6	8.4-41.5	29.1	0.4-7.1	1.8	0.4-4.0	2.0
5	Timiri	63	2.6-27.5	13.8	0.8-39.5	25.3	0.3-4.5	1.3	0.6-4.8	1.9
6	Gudiyattam	112	1.8-20.5	11.2	0.9-59.4	30.8	0.4-8.0	2.8	0.9-4.0	1.8
7	Katpadi	41	4.3-27.8	13.1	1.5-9.6	4.1	0.5-5.8	1.6	1.1-6.6	2.7
8	K.V.Kuppam	100	4.6-19.2	9.8	3.5-26.5	12.2	0.7-9.4	2.0	0.8-8.1	2.8
9	Peranambattu	140	3.3-22.4	10.5	7.5-47.1	26.6	0.1-7.6	2.1	0.5-3.7	1.3
10	Jolarpet	93	5.4-21.6	14.5	1.5-13.2	6.0	0.2-3.9	1.0	0.8-12.1	3.0
11	Kandili	114	6.4-21.9	15.0	1.7-19.1	10.2	0.6-6.5	2.1	0.4-9.8	3.3
12	Natrampalli	93	4.4-20.6	13.0	0.6-16.2	13.7	0.2-7.0	2.1	0.7-5.6	2.7
13	Tiruppathur	58	3.5-14.1	8.7	5.1-19.9	13.8	0.2-1.2	0.5	0.4-5.2	2.2
14	Alangayan	57	5.1-16.8	12.8	1.6-19.0	13.1	0.7-11.4	2.1	1.4-5.7	3.4
15	Madhanur	62	2.3-13.4	6.9	2.5-58.7	37.6	0.3-4.1	0.9	0.9-4.4	2.1
16	Anaicut	70	4.3-26.7	17.4	11.0-52.5	45.2	0.4-3.9	1.2	1.0-4.8	2.2
17	Kaniyambadi	56	3.6-37.6	19.7	2.6-39.0	20.6	0.6-4.6	1.9	0.3-4.9	2.4
18	Vellore	62	6.9-71.2	31.3	1.8-33.2	9.4	0.1-7.9	2.4	0.5-8.0	1.7
19	Sholinghur	47	3.3-23.1	10.2	2.8-39.4	18.1	0.4-5.4	1.6	0.4-5.1	1.4
20	Walajapet	38	3.5-18.1	10.1	0.8-8.4	3.9	0.1-9.3	3.5	0.6-3.7	1.6
	District	1319	1.8-71.2	13.8	0.8-59.4	18.0	0.1-11.4	1.8	0.2-12.1	2.2

The overall mean DTPA-Fe availability in the soils of rainfed system was 13.8 mg kg-1 with a range of 1.8 to 71.2 mg kg-1revealing very high availability of Fe. The highest mean Fe availability recorded in Vellore (31.3 mg kg^{-1}) block while the lowest was in Madhanur (6.9

mg kg^{-1}) block under rainfed system (Table 6). The DTPA Cu content in the soils of rainfed system varied from 0.2 to 12.1 mg $kg^{-1}$and the highest mean Cu content found in Alangayan (3.4 mg kg^{-1}). The lesser DTPA Cu status, noticed in Kaveripakkam (1.2 mg kg^{-1}) block (Table 6). The DTPA-Mn in the rainfed soils ranged from 0.8 to 59.4 mg kg^{-1} with a mean value of 18.0 mg kg^{-1}. The highest mean Mn status registered in Anaicut block (45.2 mg kg^{-1}) whereas the lowest in Walajapet (3.9 mg kg^{-1}) (Table 6).

To conclude that, there is no wide variation in the soil properties under both irrigated and rainfed systems (Table 1). However the higher soil pH and Free $CaCO_3$ was noticed in Irrigated system. The rainfed system had higher amount of electrical conductivity than irrigated system. With regard to mean viability of micronutrient content, the irrigated environment registered the highest availability of all nutrients except Zn content, which was equal with rainfed condition.

Moisture plays an important role in soil nutrient availability by influencing the soil chemical characteristics. "slightly acidic to alkaline" soil reaction was observed in both irrigated and rainfed situations and neutral pH under irrigated situations might be due to reduced condition prevailing under wetting (Ponnamperuma, 1972). The overall mean values of the soils indicated alkaline soil reaction, low salinity, low organic carbon and non-calcareous nature. However the range values showed a variation in organic carbon, EC and free $CaCO_3$. Alkaline soil reaction, the higher EC values, $CaCO_3$ (2.8 %) were noticed in soils under rainfed system than irrigated system which were similar with the results from the studies done by Sharma *et al.*, (2011) The soils under rainfed conditions had higher organic carbon which can be explained by increased C input through root biomass and similar results were reported by Singh *et al.*, (2009). Lesser free $CaCO_3$ content was observed under rainfed situation which might be due to deficit moisture availability and faster decomposition and loss (Datta *et al.*, 1989). Although the nutrient availability was lesser in soils under rainfed situation, the mean values indicated sufficient nutrients availability in the soils of Vellore district except Zn which showed medium status under rainfed and irrigated conditions. Comparing the irrigated and rainfed situations, more than 65 per cent reduction in Fe and 37 per cent reduction in Mn and 8 per cent reduction in Cu availability was noted in rainfed soils and the order of reduction was higher Fe > Mn > Cu. Reduced water availability under rainfed situation leads to reduced solubilisation of nutrients to the available pool thus leads to reduced nutrient availability. Similar results were reported by Paramasivam *et al.*, (1994). Higher availability of nutrients viz., Fe, Cu and Mn in irrigated situation might be primarily attributed to the higher amount of organic residues produced and returned to the soil, increased nutrient solubilisation in the presence of moisture and reduced rate of organic matter decomposition in cultivated soils (Bayala *et al.*, 2007; Mages and Nicholas 2008; Hundal *et al.*, 2009). Reduced water availability under rainfed situation leads to reduced solubilisation of nutrients to the available pool thus leads to reduced nutrient availability. Similar results were reported by Pal *et al.*, (2000) and Ajit Kumar *et al.*, (2009).

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