



## **Physico-chemical Properties and Major Nutrient Status in Some Soils of Krishna Eastern Delta, Andhra Pradesh**

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### **ABSTRACT**

A reconnaissance survey was conducted to study the physico-chemical properties and available nutrient status of some of the soils of Krishna Eastern Delta, Andhra Pradesh. Soil samples were collected from representative areas in the delta and analyzed for soil reaction, electrical conductivity, organic carbon and major nutrients. The results revealed that texture of the soils varied from sandy loam to clay. Majority of the soils have neutral pH. About 53 per cent of soils have low organic carbon content while rest of them were medium status. The available nitrogen in the soils was low to medium while the phosphorus and potassium were medium to high. Significant positive correlations were found between organic carbon and available N, P and K. The saturation extract of the soil samples pertaining to Villages of Deendayalapuram, Akanuru, Soralgondi, Chintalamada, Utukuru, Chinaogirala, Chilakalapudi and Mangalapuram were found to be strongly saline and need proper reclamation measures for growing a good crop during monsoon.

**Key words :** Physico-chemical properties, Krishna eastern delta, Major nutrients.

The Krishna eastern delta is located south of Andhra Pradesh. The area of the Krishna Eastern delta enclosed between Latitude 15°42'N – 16°42' N and Longitude 80°42' E – 81°36' E. The predominant crop in the delta area is paddy and the other prominent crops are sugarcane, fruits and vegetables. The total geographical area of the delta is 6200 sq.km of which the Krishna eastern delta occupies an aerial extent of 3980 sq.km. The major part of the Krishna delta is a flat area with gentle slope towards Bay of Bengal. It has some undulations in the middle in the form of deltaic lobes, beach ridges and flood plains.

The highest elevation was about 16 meter above mean sea level near Vijayawada city and minimum was 3.50 m at Machilipatnam. The general climatic conditions of the delta are hot summer and cold winter. The delta area receives precipitation from South-West monsoon and North-East monsoon, of which the South-West contributes 89 per cent of the rainfall, remaining is from North-East monsoon. Keeping the above facts in view, the present investigation was carried out to study the physico-chemical properties and nutrient status of some of the soils of Krishna Eastern Delta to assess their suitability for growing a better crop during the monsoon period.

### **MATERIAL AND METHODS**

The study area covers a part of Krishna eastern delta in Krishna District, Andhra Pradesh which includes major cropping areas with different soil types. Soil samples from nineteen villages (3 representative soil samples from each village) were selected and the composite soil samples (0-15 cm) were prepared to determine the status of available nitrogen, phosphorus and potassium. Organic carbon was estimated by Walkley and Black (1934) method. Available nitrogen was determined by alkaline permanganate method (Subbiah and Asija (1956). Available phosphorus was extracted by Olsen's method (Olsen et.al. 1954). Available potassium (neutral normal ammonium acetate extractable) was determined by flame photometer method (Jackson, 1973). Simple correlation analysis was carried out between available nutrient contents and physico-chemical properties of soils. The water-soluble salts present in saturation extract of some soils of Krishna eastern delta, Andhra Pradesh were also determined as they are responsible for development of salinity and alkalinity in the study area.

Table 1. Physico-chemical properties of soil samples of Krishna eastern delta

S.No	Location*	pH (1:2)	EC (dSm <sup>-1</sup> )	O.C. (%)	Soil Texture	Sand (%)	Silt (%)	Clay (%)	CEC C mol (p+) kg <sup>-1</sup>	Exchangeable cations (m.eq/100 g soil)			ESP (%)	
										Ca <sup>2+</sup>	Mg <sup>2+</sup>	Na <sup>+</sup> K <sup>+</sup>		
1	Gandigunta	7.58	2.80	0.48	Clay	40.5	12	47.5	39.6	16.40	14.50	0.77	5.00	1.94
2	Akanuru	7.36	15.82	0.43	Clay	41.3	18	42.7	32.5	16.43	8.45	0.60	4.11	1.85
3	Viveka	7.59	2.46	0.46	Clay	42.0	17	41.0	31.6	13.35	9.20	1.09	4.25	3.45
4	Utukuru	7.90	7.21	0.36	Clay Loam	46.8	18	35.2	24.0	9.20	6.80	0.86	3.42	3.58
5	Pathamajeru	8.01	2.44	0.46	Clay	34.8	30	45.2	32.7	13.45	12.26	0.98	4.12	3.00
6	Ullipalem	8.10	0.75	0.22	Sandy Loam	74.6	6	19.2	11.7	5.50	2.50	0.41	1.29	3.50
7	Soralagondi	8.03	8.50	0.28	Sandy Clay Loam	66.8	8	25.2	18.0	8.40	4.00	0.94	1.67	5.22
8	Deendayalapuram	7.52	18.45	0.35	Sandy Clay Loam	58.8	10	31.2	24.7	9.45	6.54	1.19	3.02	4.82
9	Pedaogirala	7.36	6.15	0.66	Clay	14.8	27	58.2	47.5	22.00	14.00	5.78	0.58	12.17
10	Chinaogirala	7.54	4.38	0.62	Clay	16.8	28	55.2	44.7	20.20	16.50	0.78	0.81	1.74
11	Chintalamada	7.60	6.40	0.58	Clay	14.8	34	51.2	40.3	20.00	10.50	0.76	0.89	1.89
12	Mangalapuram	7.50	2.53	0.64	Clay	14.8	28	57.2	48.5	20.50	14.50	5.88	0.97	12.12
13	Devarakota	7.61	1.91	0.62	Clay	10.8	28	61.2	48.7	21.50	18.00	5.96	0.82	12.24
14	Pedakallepalli-I	7.86	0.92	0.69	Clay	14.8	24	61.2	47.7	23.00	14.00	5.33	0.72	11.17
15	Kummarapalem	8.10	0.85	0.6	Clay	10.8	32	57.2	42.7	18.50	14.00	5.98	0.87	14.00
16	Ghantasala	7.90	0.71	0.64	Clay	16.8	26	57.2	46.7	19.00	15.50	5.94	0.81	12.72
17	Chilakapudi	7.28	3.84	0.62	Clay	10.8	34	55.2	45.3	22.00	12.50	5.44	0.70	12.01
18	Kokkilagadda	7.63	0.59	0.56	Clay	14.8	32	55.2	48.0	22.50	16.50	4.56	0.58	9.50
19	Pedakallepalli	7.90	0.79	0.67	Clay	16.8	28	55.2	45.6	19.50	16.50	5.25	0.87	11.51
	<b>Mean</b>	<b>7.70</b>	<b>4.61</b>	<b>0.52</b>		<b>29.6</b>	<b>23</b>	<b>48.0</b>	<b>37.9</b>	<b>16.89</b>	<b>11.93</b>	<b>3.28</b>	<b>1.87</b>	<b>12.83</b>

\* Three representative soil samples from each village were taken and mean of the data is presented

Table 4. Ionic composition and other characters of saturation extract of the soil samples of Krishna Eastern Delta.

S.No	Location*	pH <sub>s</sub>	ECe (dSm <sup>-1</sup> )	Cations (m.eq l <sup>-1</sup> )			Anions (m.eq l <sup>-1</sup> )			SAR (m mol/l) <sup>1/2</sup>	
				Ca <sup>+2</sup>	Mg <sup>+2</sup>	Na <sup>+</sup>	K <sup>+</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>		SO <sub>4</sub> <sup>-2</sup>
1	Gandigunta	6.80	4.50	14.8	14.0	24	0.41	6.0	40	1.80	6.32
2	Akanuru	6.38	40.68	187.2	224.0	144	0.59	4.1	480	1.90	10.04
3	Viveka	8.10	4.72	10.2	19.0	26	0.59	2.1	48	1.00	6.80
4	Utukuru	8.21	18.68	48.0	82.0	83	0.98	9.0	192	2.60	10.29
5	Pathamajeru	8.03	4.73	8.8	11.0	31	0.51	13.0	40	0.90	9.85
6	Ullipalem	7.83	2.19	23.0	6.0	14	0.35	8.0	16	0.60	3.68
7	Soralagondi	7.66	28.54	72.7	55.0	95	1.64	9.0	312	2.50	11.89
8	Deendayalpuram	7.58	49.50	77.7	75.0	106	1.90	5.0	558	0.90	12.13
9	Pedaogirala	8.10	5.10	16.0	12.0	26	0.14	2.5	42	6.19	6.95
10	Chinaogirala	7.70	14.10	54.0	22.0	74	0.35	1.5	138	10.13	12.00
11	Chintalamada	7.10	25.60	96.0	58.0	98	0.70	1.5	256	9.86	11.17
12	Mangalpuram	7.90	6.90	20.0	15.5	33	0.19	1.5	62	5.74	7.83
13	Devarakota	8.00	4.80	17.0	11.5	21	0.11	1.2	44	5.70	5.56
14	Pedakallepalli-I	7.80	2.20	9.0	4.5	7	0.06	2.0	15	4.06	2.69
15	Kummarapalem	8.10	2.30	10.0	4.5	9	0.08	2.0	19	1.74	3.34
16	Ghantasala	8.30	1.50	4.0	2.0	9	0.08	2.5	8	5.16	5.20
17	Chilakalpudi	7.10	12.90	72.0	18.0	36	0.11	1.5	130	3.87	5.37
18	Kokkilagadda	8.00	1.20	6.0	4.5	3	0.03	1.0	10	2.46	1.31
19	Pedakallepalli	8.10	1.80	6.0	1.0	12	0.08	6.5	8	3.33	6.41
	<b>Mean</b>	<b>7.73</b>	<b>12.21</b>	<b>39.6</b>	<b>33.66</b>	<b>44.79</b>	<b>0.47</b>	<b>4.2</b>	<b>127.26</b>	<b>3.71</b>	<b>7.31</b>

\* Three representative soil samples from each village were taken and mean of the data is presented

Table 3. Correlation coefficient (r) values of pH, organic carbon and clay content with available nutrients.

Soil properties	Available nutrients (r values)		
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
pH	-0.140	-0.362	-0.332
Organic carbon	0.636*	0.686*	0.551*
Clay	0.977*	0.577*	0.514*

\*Significant at 1% level

Table 4. Status of available major nutrients in soils of krishna eastern delta

S.No.	Village*	Available major nutrients (kg ha <sup>-1</sup> )		
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
1	Gandigunta	352	48.6	391
2	Akanuru	272	51.2	360
3	Viveka	298	56.3	547
4	Utukuru	298	46.3	326
5	Pathamajeru	298	42.5	313
6	Ullipalem	216	29.5	242
7	Soralagondi	244	32.7	284
8	Deendayalpuram	244	38.4	353
9	Pedaogirala	406	56.4	578
10	Chinaogirala	376	48.4	411
11	Chintalamada	272	40.3	538
12	Mangalpuram	272	62.5	524
13	Devarakota	272	40.3	452
14	Pedakallepalli-I	313	65.8	635
15	Kummarapalem	298	48.4	395
16	Ghantasala	373	51.8	290
17	Chilakalpudi	295	50.4	290
18	Kokkilagadda	272	42.4	315
19	Pedakallepalli	406	49.3	394
	Mean	304	47.4	402

\* Three representative soil samples from each village were taken and mean of the data is presented

## RESULTS AND DISCUSSION

### Physicochemical properties of the soils of Krishna eastern delta

#### Soil pH and EC

Soil reaction (pH) varied from 7.28 to 8.10 with a mean of 7.70 (Table 1). Among the 19 soil samples, 3 soil samples have neutral pH (6.6 to 7.3) and 16 samples have alkaline pH (7.4- 7.8). The lowest pH was observed in Chilakalapudi village whereas highest value was noticed in Ullipalem and Kummaripalem. The relatively higher pH values of

the soils might be due to the high amount of base saturation. The electrical conductivity (EC) of the soils ranged from 0.59 to 18.45 with a mean of 4.61 dSm<sup>-1</sup>. The highest values of EC were noticed in the villages of Deendayalpuram (18.45 dSm<sup>-1</sup>) followed by Akanuru (15.82 dSm<sup>-1</sup>), Soralagondi (8.50 dSm<sup>-1</sup>), Utukuru (7.21 dSm<sup>-1</sup>), Chintalamada (6.40 dSm<sup>-1</sup>), Pedaogirala (6.15 dSm<sup>-1</sup>) whereas the lowest values were noticed in Kokkilagadda (0.59 dSm<sup>-1</sup>) and Ghantasala (0.71 dSm<sup>-1</sup>) villages.

### Organic carbon (%)

The organic carbon content of the soils (Table 1) varied from 0.22 to 0.69 per cent with a mean of 0.52 g kg<sup>-1</sup>. The organic carbon was low (<0.5 per cent) in 8 samples (42%) while 11 soil samples (58%) were medium in status (0.5-0.75 per cent). Low organic carbon in soils is possibly due to high temperature and good aeration in the soil which increases the rate of oxidation of organic matter.

### Soil Texture and Exchangeable Sodium Percentage (ESP)

The texture of the soils ranged from sandy loam, sandy clay loam, clay loam and clay and the ESP values were low in all the soil samples under study (Table 1).

### Cation Exchange capacity

The CEC of the soils (Table 1) ranged from 11.7 to 48.7 received with a mean of 37.92 C mol (p+) kg<sup>-1</sup>. Clay textured soils higher CEC as compared to the soils with clay loam and sandy clay loam texture.

### Available N

Available N in soil samples ranged from 216 to 406 kg ha<sup>-1</sup> with a mean of 304 kg ha<sup>-1</sup> (Table 2). On the basis of ratings suggested by Subbiah and Asija ((1956), about 8 soil samples were in low category (< 280 kg ha<sup>-1</sup>) and 11 were in medium category (280-560 kg ha<sup>-1</sup>). A significant positive correlation (r=0.636\*) was found between organic carbon and available nitrogen (Table 3). Similar results were also reported by Verma et. al. (1980).

### Available P<sub>2</sub>O<sub>5</sub>

The available P<sub>2</sub>O<sub>5</sub> in the soil samples (Table 2) ranged from 29.5 to 65.8 kg ha<sup>-1</sup> with a mean of 47.4 kg ha<sup>-1</sup>. On the basis of ratings suggested by Muhr et. al. (1963), about 12 soil samples were in medium category (22-56 kg ha<sup>-1</sup>) and 7 samples were high in status (above 56 kg ha<sup>-1</sup>). A significant positive correlation (r=0.548\*) was observed between the available phosphorus and organic carbon. This indicates that presence of organic matter increases the availability of phosphorus in soil. According to Tisdale et.al. (1997) about 50% of phosphorus is in the organic form and decomposition of organic matter produces humus which forms complex with Al and Fe and protects the P fixation by reducing adsorption/phosphate fixation. Available phosphorus and clay content were found to be positively correlated (r=0.686\*). Available phosphorus was negatively correlated (r= -0.362) with pH, because at higher pH calcium precipitate with phosphorus as Ca-phosphate and reduced the phosphorus

availability. Similar results were reported by Singh (1988).

### Available K<sub>2</sub>O

The available K<sub>2</sub>O in the soil samples (Table 2) ranged from 242 to 635 kg ha<sup>-1</sup> with a mean of 402 kg ha<sup>-1</sup>. According to Muhr et.al. (1963), about 4 soil samples were in medium category (145-300 kg ha<sup>-1</sup>) and 15 samples were in high status (above 300 kg ha<sup>-1</sup>). A positive correlation (r=0.551\*) was observed between organic carbon and available K content in the soils (Table 3). This might be due to the creation of favourable soil environment with presence of high organic matter.

The saturation extract of the soil samples of Krishna eastern delta were analyzed for pHs, EC<sub>e</sub>, cations, anions and SAR (Table 4). The values of pHs varied from 6.38 to 8.29 with a mean of 7.73. The EC<sub>e</sub> varied from 1.2 to 49.5 with a mean of 12.21 dS m<sup>-1</sup> while the values of SAR (Sodium Adsorption Ratio) ranged from 1.31 to 12.13 with an average value of 7.31 (mmol/l)<sup>1/2</sup>. Based on the ratings of Richards (1954), it was found that about 6 samples (Kokkilagadda, Ghantasala, Pedakallepalli, Pedakallepalli-I, Ullipalem and Kummrapalem) were in safe limits of salinity (EC<sub>e</sub> < 4 dS m<sup>-1</sup>). About 4 samples (Viveka, Pathamaraju, Devarakota, Pedaogirala) were found to be slightly saline (EC<sub>e</sub> between 4-8 dS m<sup>-1</sup>) and 2 samples (Chilakalpudi and Chinaogirala) were moderately saline (EC<sub>e</sub> between 8-15 dS m<sup>-1</sup>). Six soil samples from the villages of Deendayalapuram, Akanuru, Soralgondi, Chintalamada, Utukuru, Chinaogirala, Chilakalpudi and Mangalapuram were found to be strongly saline (EC<sub>e</sub> > 15 dS m<sup>-1</sup>) and need proper reclamation measures during monsoon for growing a good crop.

### ACKNOWLEDGEMENTS

The author is indebted to the A.P. Water Management Project, Bapatla and also the Acharya N.G.Ranga Agricultural University for providing the financial assistance and other logistics to carry out this study.

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(Received on 04.01.2011 and revised on 16.01.2011)