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Spatial variability of soil physical and Physico-chemical properties of Kurnool division of Andhra Pradesh

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Abstract
A study was undertaken to assess the physical, physico-chemical properties of soil in Kurnool revenue division in Kurnool district of Andhra Pradesh state using geospatial techniques. Soil analysis of the study area during 2016-17 and 2017-18 indicated that the soils are neutral to strongly alkaline in reaction with low electrical conductivity. The organic carbon was low to medium in range. The bulk density and water holding capacity was varied in different mandals.

Keywords: Bulk density, water holding capacity, physical properties of soil

Introduction

Crops like rice, cotton, sorghum, chickpea and blackgram are largely grown in Kurnool district of Andhra Pradesh. It is also one of the dominant seed producing districts of Andhra Pradesh. Farmers follow intensive management practices which include use of excessive inorganic/chemical fertilizers and pesticides beyond recommended doses resulting in high cost of cultivation coupled with decreased net returns. Hence, an attempt was made to delineate the soil physical and physic- chemical studies in Kurnool division by using Remote sensing (RS) and Geographic Information System (GIS) techniques. The application of RS and GIS would be helpful for creating systematic and sharable database on soil fertility related issues and to answer the unanswered questions of different stakeholders in the field of agriculture (Aggarwal *et al.* 2004).

Material and Methods

The study area comprised of five mandals of Kurnool Agricultural Revenue Division, Kurnool District, Andhra Pradesh state, is strategically located on National Highway 44. Kurnool Agricultural Revenue Division sprawls cover 1.29 Lakh ha and surrounded by Adoni Agricultural Division in the west, Telangana state in the north, Nandyal Agricultural Division in the south and Nandikotkur Agricultural Division in the east. Its geographic limits are from 15°54′18″ to 15°33′15″ N latitudes and 77°36′18″ to 78°12′21″ E longitudes. Considering the uniformity of soil sample distribution in the study area, eight hundred and thirty five (835) surface soil samples were collected at a depth of 0-15 cm in a systematic pattern from different locations during *rabi*, 2016-17 (383 samples) and *rabi* 2017-18 (452 samples) seasons using Global Positioning System (GPS). These surface soil samples were collected by adopting the procedure given by Jackson (1973) [2]. The soil samples were air-dried, ground (< 2 mm) and analyzed for physical and physico-chemical parameters. The pH (1:2.5) and electrical conductivity (EC) (1:2.5) of soils were measured using standard procedures as described by Jackson (1973) [2]. Organic carbon (OC) was determined using the Walkley-Black method (Nelson and Sommers 1996) [3]. The bulk density and water holding capacity of soil samples was determined by following Keen Raczkowski's method as described by Sankaram (1966) [4]

Results and Discussion

Soil sample analysis of study area for pH indicates that 74.75 per cent of soils was moderately alkaline, 13.02 per cent is slightly alkaline and 10.96 per cent is strongly alkaline during 2016-17 (Table 1.). During 2017-18, 65.84 per cent of soils in the study area were moderately alkaline (pH 7.9 to 8.4) and 29.75 per cent of soils were found strongly alkaline (pH 8.5 to 9.0) and 2.6 per cent of area was slightly alkaline (pH 7.3 to 7.8) and 1.55 per cent of area was very strongly alkaline (pH>9.0). The variation in pH might be attributed to the nature of the parent material, leaching, presence of calcium carbonate and exchangeable sodium.

These results are in conformity with the findings of Shalimadevi and Anilkumar (2010) [6]. In almost all the mandals, electrical conductivity of the soil was within the normal range and soils were non-saline in nature. There was not much variation in electrical conductivity of the soils during 2017-18 as compared to 2016-17 (Table 2.). During 2016-17, 97.08 per cent (125571.25 ha) of the study area was low in organic carbon (< 0.5%) and 2.3 per cent (3776.38 ha) was medium (0.5 to 0.75%) in soil organic carbon (Table 3.). During 2017-18 also, similar observations were recorded where in 12629.04 ha (97.04%) of area was low in organic carbon and very little area (2.36%) was medium in organic carbon. The variation in the organic carbon content in soils might be due to variation in rates of application of organic manures like farm yard manure and/ or crop residues by the farmers. The low organic carbon in surface soils might be due to low input of farm yard manure and crop residues as well as their rapid rate of decomposition under high temperature. Similar findings was reported by Vijayakumar *et al.* (2011) [8].

The bulk density of soils under the study area of Kurnool, Gudur, Kallur, C. Belagal and Kodumur mandals during 2016-17, ranged from 1.11 to 1.55, 1.15 to 1.51, 1.12 to 1.53, 1.14 to 1.56 and 1.12 to 1.53 Mg m^{-3} (Table 4). The mean bulk density was 1.31, 1.29, 1.33, 1.35 and 1.31 Mg m^{-3}, respectively. The bulk density of soils recorded in the study area during 2017-18 varied from 1.09 to 1.53, 1.10 to 1.55, 1.0 to 1.50, 1.12 to 1.57 and 1.14 to 1.55 Mg $m^{-3}$with a mean of 1.29, 1.33, 1.30, 1.34 and 1.34Mg m^{-3} in Kurnool, Gudur, Kallur, C. Belagal and Kodumur mandals, respectively. The higher bulk density values of soils were due to their coarse texture and in some cases due to the presence of calcium carbonate and low organic carbon content. Similar results were reported by Sharma *et al.* (1994) [7].

The values of water holding capacity in study area during 2016-17 varied from 30.9 to 54.1, 31.0 to 54.4, 25.0 to 54.1, 33.0 to 55.6 and 30.0 to 55.7 per cent and mean values of water holding capacity were 43.7, 45.2, 43.6, 45.8 and 45.8 per cent in Kurnool, Gudur, Kallur, C. Belagal and Kodumur mandals, respectively(Table 4.). During 2017-18, per cent of water holding capacity of soils in Kurnool, Gudur, Kallur, C. Belagal and Kodumur mandals ranged from 24.7 to 53.8, 21.6 to 52.1, 28.1 to 50.9, 31.4 to 52.9 and 30.1 to 54.6 with mean value of 43.2, 43.92, 44.5, 45.5 and 46.5 per cent, respectively. Satyavathi and Surya Narayana reddy (2003) [5] reported high water holding capacity values in black soils, which might be due to high clay content, more CEC and more exchangeable calcium and magnesium.

Table 1: Spatial distribution of soil reaction (pH) in the soils of study area

Category	2016-17		2017-18	
	Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**
Neutral (6.6 – 7.3)	1606.95	1.242	271.90	0.210
Slightly alkaline (7.3 – 7.8)	16838.49	13.018	3411.16	2.637
Moderately alkaline (7.9 – 8.4)	96688.50	74.751	85161.65	65.84
Strongly alkaline (8.5 – 9.0)	14179.31	10.963	38479.36	29.749

Table 2: Spatial distribution of EC (dSm^{-1}) in the soils of study area

Category	2016-17		2017-18	
	Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**
Non saline (0 – 2)	128362.26	99.23	128198.81	99.11
Very slightly saline (2 – 4)	815.49	0.63	1146.52	0.87
Slightly alkaline (4 – 8)	169.88	0.131	2.32	0.002

Table 3: Spatial distribution of Soil Organic Carbon (%) in the soils of study area

Category	2016-17		2017-18	
	Area (ha)	**Area (%)**	**Area (ha)**	**Area (%)**
Low (< 0.5%)	125571.25	97.08	126292.04	97.64
Medium (0.5 – 0.75%)	3776.38	2.3	3055.60	2.36

Table 4: Physical and physico–chemical properties of soils of Kurnool division

Year		pH	EC (dSm^{-1})	OC (%)	BD (Mg m^{-3})	WHC (%)
Kurnool mandal						
2016-17	Range	6.51-9.12	0.11-4.01	0.09-0.62	1.11-1.55	30.9-54.1
	Mean	8.12	0.27	0.34	1.31	43.7
2017-18	Range	6.66-9.23	0.06-2.36	0.09-0.61	1.09-1.53	24.7-53.8
	Mean	8.22	0.41	0.31	1.29	43.2
Gudur mandal						
2016-17	Range	6.28-8.78	0.09-0.57	0.15-0.58	1.15-1.51	31.0-54.4
	Mean	8.02	0.25	0.32	1.29	45.18
2017-18	Range	6.10-9.46	0.05-4.10	0.09-0.61	1.10-1.55	21.6-52.1
	Mean	8.15	0.46	0.33	1.33	43.92
Kallur mandal						
2016-17	Range	7.21-8.91	0.06-0.79	0.09-0.66	1.12-1.53	25.0-54.1
	Mean	8.04	0.27	0.33	1.33	43.6
2017-18	Range	7.47-9.40	0.05-1.80	0.06-0.58	1.0-1.50	28.1-50.9
	Mean	8.30	0.28	0.31	1.30	44.5
C. Belagal mandal						
2016-17	Range	6.69-8.99	0.10-2.21	0.17-0.62	1.14-1.56	33.0-55.6
	Mean	8.10	0.42	0.34	1.35	45.8
2017-18	Range	7.08-9.32	0.09-2.10	0.14-0.57	1.12-1.57	31.4-52.9
	Mean	8.47	0.36	0.33	1.34	45.5
Kodumur mandal						
2016-17	Range	6.48-9.06	0.07-0.71	0.12-0.56	1.12-1.53	30.0-55.7
	Mean	8.15	0.24	0.34	1.31	45.85
2017-18	Range	6.84-9.81	0.08-2.31	0.13-0.56	1.14-1.55	30.1-54.6
	Mean	8.32	0.43	0.35	1.34	46.5

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