



Research Article

SOIL FERTILITY STATUS OF DIFFERENT BLOCKS IN PURI DISTRICT OF COASTAL ODISHA

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Abstract: Geo-referenced soil samples were collected from different villages of different blocks in Puri district and analyzed for physico-chemical properties. Total 954 numbers of geo-referenced soil samples were collected and analyzed. The soils pH varied from 4.97 to 7.63, EC content (0.01 to 4.74 dS m^{-1}) and organic carbon content (2.70 to 14.80 g kg^{-1}). Further, available nitrogen (108.00 to $388.00 \text{ kg N ha}^{-1}$) and phosphorus content (1.24 to $69.85 \text{ kg P ha}^{-1}$) ranges from low to medium but available potassium ranges from low to high (40.70 to $586.00 \text{ kg K ha}^{-1}$). Available sulphur content ranges from very low to very high (3.18 to $150.00 \text{ mg kg}^{-1}$). Available zinc content ranges from very low to very high (0.25 to 4.89 mg kg^{-1}) and hot water extractable boron content ranges from 0.08 to 1.67 mg kg^{-1} . The fertility database would be very useful for extension functionaries, agricultural officers, scientists, NGOs and above all, the farmers, for a sustainable crop production in the Puri district of coastal Odisha.

Keywords: Soil fertility status, Puri district, Coastal Odisha

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Introduction

Puri, a coastal district of Odisha, is famous for its historic antiquities, religious sanctuaries, architectural grandeur, sea-scape beauty and moderate climate and also has got the largest brackish water Chilika lake in India. Soil, land and water are essential resources for the sustained quality of human life and the foundation of agricultural development [11]. Efficient management of soil and water resources is a major challenge for the scientists, planners and farmers to ensure food, water and environmental security for the present and future generations [3,7]. The modern geospatial technologies such as Remote Sensing (RS), Geographical Information System (GIS), Global Positioning System (GPS) and Information Technology (IT) offer immense potential for soil and water resources development and management [4,15]. Geographical Information System (GIS) is a potential tool used for easy access, retrieval and manipulation of voluminous data of natural resources often difficult to handle manually. It facilitates manipulation of spatial and attributes data useful for handling multiple data of diverse origin [9]. Collection of soil samples by using Global Positioning System (GPS) is very important for preparing the GPS based soil fertility map. It has got great impact in agriculture for future monitoring of soil nutrient status. Therefore, a study on soil fertility status was analyzed the different blocks in Puri district of Odisha.

Material and Methods

Puri district of Odisha was selected for carrying out the study to prepare GPS based thematic soil fertility maps. It is located between $19^{\circ}28' \text{ N}$ to $26^{\circ}28' \text{ N}$ latitude and $84^{\circ}25' \text{ E}$ to $86^{\circ}29' \text{ E}$ longitude. Six composite GPS based soil samples were collected from selected villages of each block during 2017-18. Total 954 numbers of GPS based soil samples from Pipili (92), Nimapada (85), Gop (47), Delang (62), Kanas (75), Satyabadi (158), Kakatpur (65), Astarang (59), Puri Sadar (36), Bramhagiri (135) and Krishna Prasad (140) blocks were collected and analysed for physico-chemical properties. The method involved in analysis of soil samples is depicted in [Table-1].

Results and Discussion

Coastal soil occurs within a very narrow strip of land adjacent to the coast with a width of 20 to 30 km. The salinity of the coastal soils is at its maximum in May and decreases with onset of monsoon and is generally the lowest during September. Soils are rich in soluble salts of chloride and sulphate in conjunction with sodium and magnesium [16].

Soil reaction

The pH of soils for all the blocks in Puri district is moderately acidic to alkaline which ranged from 4.64 to 7.72 [Table-2]. The data also revealed that soil pH of Pipili, Delang, Kanas, Nimapada, Kakatpur, Puri Sadar, Krishna Prasad and Bramhagiri varies from moderately acidic to neutral and whereas in Astarang, Gop and Satyabadi varies between moderately acidic to slightly alkaline. The mean value of all the blocks varies between 5.27 to 5.78. Similar findings were also recorded by Mishra, *et al.*, (2015) and Sahu, (2006) [10, 16].

Electrical conductivity (EC)

The electrical conductivity (EC) of soils of Pipili block ranged from 0.01 to 0.45 dS m^{-1} with the mean value of 0.14 dS m^{-1} [Table-2]. The lowest electrical conductivity of soils was found in Pipili block (0.01 dS m^{-1}) and the highest in Krishna Prasad block (4.74 dS m^{-1}). The mean value of all the blocks varies between 0.14 to 0.86 dS m^{-1} . Comparatively higher average soil electrical conductivity of Krishna Prasad block (0.86 dS m^{-1}) is due to its proximity to Chilika lake and Bay of Bengal. Similar findings were also recorded by Mishra, *et al.*, (2015) [10].

Soil Organic Carbon

The soil organic carbon content for all the blocks varied between low to very high. The highest soil organic carbon content was observed in Bramhagiri block (14.8 g kg^{-1}) and lowest in Krishna Prasad block (2.7 g kg^{-1}). The highest average soil organic carbon content (7.9 g kg^{-1}) was found in Astarang block [Table-2].

Table-1 Analytical methodologies.

Parameter	Methodology	Citation
Soil analysis		
pH	(in 1:2.5:: Soil : Water)	Jackson, (1967) [5]
EC	(in 1:2.5:: Soil : Water)	Jackson, (1967) [5]
Organic carbon	Wet oxidation method	Jackson, (1973) [6]
Available N	Hot alkaline KMnO ₄ Method	Subbiah and Asija, (1956) [17]
Available P	0.03 N NH ₄ F + 0.025 N HCL (pH 3.5) and 0.5 M NaHCO ₃ at pH 8.5	Bray and Kurtz, (1945) [2] and Olsen, <i>et al.</i> (1954) [14]
Available K	Neutral N NH ₄ OAc extraction	Jackson, (1973) [6]
Available S	Extraction with 0.15% CaCl ₂	Massoumi and Cornfield, (1963) [10]
Available Zn	DTPA extractant	Lindsay & Norvel, (1978) [8]
Available B	Hot water extraction	Berger and Truog, (1939) [1]

Table-2 Range and mean of pH, EC and Soil Organic Carbon of different Blocks in Puri district

SN	Name of the Block	No. of Soil Samples analysis	pH (1:2)		EC (dSm ⁻¹)		Organic C (g kg ⁻¹)	
			Range	Mean	Range	Mean	Range	Mean
1	Astarang	59	4.97-7.63	5.47	0.07-4.48	0.72	4.6-12.5	7.9
2	Bramhagiri	135	4.76-7.37	5.33	0.04-3.17	0.67	3.8-12.7	7.6
3	Delanga	62	4.82-6.83	5.61	0.01-0.82	0.23	3.9-11.9	5.7
4	Gop	47	4.88-7.55	5.66	0.01-1.18	0.26	3.5-9.3	5.2
5	Kanasa	75	5.02-6.96	5.72	0.02-2.79	0.49	3.9-11.8	5.9
6	Krishna Prasad	140	4.91-7.28	5.78	0.03-4.74	0.86	2.7-14.1	6.3
7	Kakatapur	65	5.14-6.67	5.39	0.02-2.25	0.44	3.5-12.5	6.8
8	Nimapada	85	4.65-6.91	5.27	0.01-0.72	0.16	3.1-9.5	5.7
9	Pipili	92	4.64-7.20	5.36	0.01-0.45	0.14	3.7-10.9	6.6
10	PuriSadar	36	4.75-6.83	5.47	0.06-1.25	0.36	4.2-14.8	7.4
11	Satyabadi	158	4.79-7.72	5.55	0.04-0.82	0.24	3.5-12.4	6.1

Table-3 Range and mean of Available N, P and K of different blocks in Puri district

SN	Name of the Block	No. of Soil Samples analysis	Available N (kg ha ⁻¹)		Available P (kg ha ⁻¹)		Available K (kg ha ⁻¹)	
			Range	Mean	Range	Mean	Range	Mean
1	Astarang	59	126-275	186.15	3.58-53.85	16.74	108-586	218.35
2	Bramhagiri	135	145-293	193.09	2.47-45.47	12.25	112-527	216.17
3	Delanga	62	162-280	189.32	2.88-22.50	9.70	89.66-319	183.58
4	Gop	47	147-245	157.04	1.69-23.49	8.24	104-410	209.08
5	Kanas	75	155-388	212.11	3.85-35.73	10.08	87.69-546	207.12
6	Krishna Prasad	140	108-221	144.32	2.07-45.67	11.68	40.70-375	162.40
7	Kakatapur	65	156-312	218.05	3.87-49.70	8.72	112-498	219.05
8	Nimapada	85	147-314	193.08	3.54-30.55	9.84	98.27-347	135.69
9	Pipili	92	139-231	188.49	2.76-29.83	9.86	58.15-353	116.93
10	PuriSadar	36	197-285	201.13	2.85-47.42	10.09	114-519	238.16
11	Satyabadi	158	173-305	218.27	1.24-24.14	8.26	96.17-283	133.19

Table-4 Range and mean of some Secondary and Micronutrients of different blocks in Puri district

SN	Name of the Block	No. of Soil Samples analysis	Available S (mg kg ⁻¹)		Available Zn (mg kg ⁻¹)		Available B (mg kg ⁻¹)	
			Range	Mean	Range	Mean	Range	Mean
1	Astarang	59	9.23-54.62	24.74	0.51-1.62	0.95	0.15-1.59	0.58
2	Bramhagiri	135	5.70-98.32	32.17	0.45-4.89	1.45	0.19-1.67	0.53
3	Delanga	62	8.38-39.48	15.37	0.32-2.97	1.17	0.29-1.58	0.48
4	Gop	47	4.95-33.17	13.48	0.41-2.73	1.19	0.14-1.48	0.54
5	Kanasa	75	7.22-54.96	28.37	0.54-2.77	1.08	0.13-0.83	0.43
6	Krishna Prasad	140	5.39-125.27	35.16	0.47-3.37	1.15	0.29-1.27	0.63
7	Kakatapur	65	3.44-49.52	12.15	0.58-2.49	0.85	0.35-0.98	0.49
8	Nimapada	85	3.38-33.16	10.26	0.25-2.68	0.70	0.19-0.95	0.47
9	Pipili	92	3.18-57.83	15.37	0.27-2.69	0.64	0.08-0.98	0.45
10	PuriSadar	36	16.37-32.18	12.47	0.47-2.35	1.07	0.41-1.32	0.56
11	Satyabadi	158	7.47-150.00	30.27	0.36-2.17	0.76	0.32-1.27	0.48

Similar result was also reported by Mitra, *et al.* (2006) [12].

Available Nitrogen content

The soil available nitrogen content for all the blocks in Puri district varied between low to medium except Gop (147 to 245 kg ha⁻¹), Krishna Prasad (108 to 221 kg ha⁻¹) and Pipili (139 to 231 kg ha⁻¹) blocks which are low [Table-3]. The lowest soil available nitrogen content was found in Krishna Prasad block (108 kg ha⁻¹) and the highest in Kanas block (388 kg ha⁻¹). The highest average available nitrogen (218.27 kg ha⁻¹) was recorded in Satyabadi block. Similar result was also revealed by Mitra, *et al.* (2002) and Mitra, *et al.* (2006) [11, 12].

Available Phosphorus content

The available phosphorus content of the soils of Pipili, Nimapada, Satyabadi, Gop, Kanas and Delang ranged from low to medium whereas that of Kakatapur, Astarang, Puri Sadar, Bramhagiri and Krishna Prasad varies between low to high. The data revealed that the mean available phosphorus content of all the blocks are low except Astarang which varies between 3.58 to 53.85 kg P ha⁻¹ with the mean value of 16.74 kg P ha⁻¹ [Table-3]. The highest available phosphorus was observed in Astarang block (53.85 kg P ha⁻¹) and lowest in Satyabadi block (1.24 kg P ha⁻¹). Similar result was also reported by Mitra, *et al.* (2002) and Mitra, *et al.* (2006) [11, 12].

Available Potassium content

The soil available potassium content for all the blocks in Puri district ranged from low to high [Table-3]. The lowest mean available potassium content was obtained only in Pipili block whereas, in other blocks in Puri district it was found to be medium (133.19-238.16 kg K ha⁻¹). The highest available potassium was recorded in Astarang block (586 kg K ha⁻¹) and lowest in Krishna Prasad block (40.70 kg K ha⁻¹). Similar result was also found by Mitra, *et al.* (2002) and Mitra, *et al.* (2006) [11, 12].

Sulphur, Zinc and Boron

The status of available sulphur, zinc and hot water extractable boron content are presented in [Table-4]. Mean available sulphur (0.15% CaCl₂ extractable) content of the soils of Delang, Gop, Kakatpur, Nimapada and Pipili blocks are observed to be below 20 ppm whereas that of Astarang, Bramhagiri, Kanas, Krishna Prasad, Puri Sadar and Satyabadi blocks remain above 20 ppm. Highest mean available sulphur content (35.16 mg kg⁻¹) is observed in Krishna Prasad block and lowest (10.26 mg kg⁻¹) in Nimapada block. The mean value of DTPA extractable zinc content in the soils of all the blocks in Puri district remains above the critical limit (*i.e.* 0.60 ppm). Highest average DTPA extractable Zinc content is observed in Bramhagiri block (1.45 mg kg⁻¹) and lowest in Nimapada block (0.70 mg kg⁻¹). Mean hot water extractable boron content of the soils of Delang, Kanas, Kakatpur, Nimapada, Satyabadi and Pipili blocks are observed to be below 0.50 ppm whereas that of Astarang, Bramhagiri, Gop, Krishna Prasad and Puri Sadar blocks remain above 0.50 ppm. Highest average hot water-soluble boron content is observed in Krishna Prasad block (0.63 mg kg⁻¹) and lowest in Kanas block (0.43 mg kg⁻¹). Similar finding was reported by Mitra, *et al.* (2002) and Mitra, *et al.* (2006) [11, 12].

Conclusion

The soil fertility status of different blocks in Puri district of Coastal Odisha were found to be acidic to alkaline in pH with low to high in organic carbon. Available nitrogen content was found low and phosphorus was observed in low to medium range whereas, available potassium and sulphur fall in medium to high category. The mean value of DTPA extractable available zinc and the average value of hot water extractable boron content in soil remains above the critical limit in some blocks in Puri district, Odisha. The informed data definitely would be useful in management of problematic soils and soil health for better crop production.

Application of research: Soil fertility status of different blocks in Puri district of coastal Odisha was done by using Global Positioning System (GPS) to generate awareness among the farmers and scientists regarding use of balanced fertilizer, soil test-based recommendation and integrated management of nutrients for sustainable crop production.

Research Category: Soil fertility

Abbreviations: N- Nitrogen; P- Phosphorus; K- Potassium; S- Sulphur; B- Boron

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