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MICRO AND SECONDARY NUTRIENT STATUS OF GEOREFERENCED SOILS OF BHADRAK, ANGUL, SONEPUR AND DHENKANAL DISTRICTS OF ODISHA

A. K. Pal[1], B. Jena[2], Bitish K. Nayak[1] and D. Jena[1]

[1]Department of soil science and Agril. Chemistry, IAS, SOAU, Bhubaneswar-751029

[2]Department of soil science and Agril. Chemistry, OUAT, Bhubaneswar-751003

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ABSTRACT

Soil fertility maps of Dhenkanal, Sonpur, Bhadrak and Angul district of Odisha were prepared by using Global positioning system (GPS) and Geographical Information system (GIS) .soils of each blocks (total 29 blocks) of above districts were collected by Gramin 76 MAPCS x MAKE GPS instruments. Total number of soil samples were collected was 1024 and 124 plant samples. The soil and plant samples were processed and analysed in the laboratory using standard methods. The data were entered in attributed table and linked with GIS software to develop a rational data base. The analogue soil fertility map was georeferenced and digitized by using Arc-GIS software. Thematic layers were developed for block boundaries to prepare base map. Superimposing polygons (spatial coverage) of block unit and base map, soil fertility maps for secondary and micronutrient were prepared. Base on fertility maps, the status of organic carbon, DTPA-extractable Fe, Mn, Zn, Cu and Hot water soluble Boron and secondary nutrient like Sulphur were assessed for suitability of crops. The overall conclusion was that these four districts of Odisha were deficient in Sulphur, Zinc and Boron in soil as well as plants whereas Fe, Mn and Cu in soil were found abundant. However, Cu in soil was an emerging issue now-a-days and should take care of. It is advocated that the need for fertilization with Sulphur, Zinc and Boron fertilizer to enhance better crop growth and productivity.

Keywords: Secondary Nutrient, Micro Nutrient, PSD, GIS, GPS

INTRODUCTION

Soil micro and secondary nutrient constraint to productivity and other related aspects are being studied since long because of their widespread deficiencies in soils of the country. The need for soil information is becoming more important in terms of sustainable land management, ecosystem health and cycling of biogeochemicals. The modern geo-spatial 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 resource development management (Das, 2004). GIS is a potential tool used for manipulation of handling voluminous data of diverse origin (Mandal and Sharma, 2010; Mishra et.al., 2013 and Pal et al., 2015). Collection of soil samples by using GPS is very important for preparing GPS and GIS based thematic soil fertility maps. GPS is used to know the latitude and longitude of that particular place and it has great significance in agriculture for future monitoring of soil nutrient status of that particular location. Keeping these in mind, a delineation study was made covering all blocks of four districts and prepares thematic maps for micro and secondary nutrients of those districts.

MATERIALS AND METHODS

The total soil samples (1024 nos.) and plant samples (124 nos.) were collected from four districts with the help of GPS to record the longtitude and latitude of that area. A soil fertility map was prepared by using GPS and GIS.

The samples were collected covering eight blocks in Dhenkanal district (301 nos.), comes under agroclimatic zone of mid central table land with hot and dry subhumid climate and the soils are alluvial, red and light textured lateritic soil. six blocks of Sonepur district (140 nos.) comes under agroclimatic zone of western central table land with hot and moist sub-humid climate and the soils are mixed red and black. Seven blocks of Bhadrak district (358 no.) comes under agroclimatic zone of eastern Coastal plain land and the soils are saline, sandy and alluvial .Eight blocks of Angul district (225 nos.) comes under agroclimatic zone of region Eastern and part of Eastern plateau sub land with hot and dry sub-humid climate and the soils are red and black. The collected soil samples were air dried and screened through 2 mm sieve and kept in plastic container for further analysis following the method by Jackson, 1973. The plant samples were kept in oven at 70^0C, then grinded and ground samples were digested in diacid mixture, analysed with the help of Atomic absorption spectrophotometer for Fe, Mn, Cu and Zn (Linsay and Norvel, 1978) and sulphur by spectrophotometer (Tabatabai, 1982).

RESULT AND DISCUSSION

The soil pH of the four districts ranged from 4.0 to 9.95 (Table 1). The soils of these districts were strongly acidic to slightly alkaline in reaction. The electrical conductivity ranged from 0.01 to 0.96 dSm-1 indicating non-saline to slightly saline in nature. The organic carbon varied from 0.06 to 3.21 percent. The mean value of organic carbon of four districts was medium to high. Similar findings reported by Mitra et al., 2006 and Mishra et al., 2014.

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Table 1: Range, Mean of pH, EC and O.C of the districts

District	Sample size	pH		EC (dSm-1)		OC(%)	
		range	Mean	range	Mean	range	mean
Dhenkanal	**301**	**4.0-8.57**	**5.42**	**0.01-0.95**	**0.12**	**0.06-3.21**	**0.89**
Sonepur	**140**	**4.2-8.4**	**6.17**	**0.01-0.66**	**0.12**	**0.11-1.47**	**0.63**
Bhadrak	**358**	**4.4-7.02**	**5.04**	**0.01-0.47**	**0.38**	**0.1-1.73**	**0.74**
Angul	**225**	**4.01-9.95**	**6.15**	**0.01-0.54**	**0.12**	**0.15-2.26**	**0.76**

Out of 301 soil samples of Dhenkanal district, sixty percent soils were deficient in sulphur (Table 2). It ranged from 0.39 to 54.61 ppm with a mean value of 10 ppm. The sulphur deficiency in the soils of Sonepur, Bhadrak and Angul districts were 32.4, 31.5 and 14.22 percent, respectively (Fig. 1). The plant samples (124 nos.) from above three districts showed samples highly deficient in sulphur in the order of 82, 76 and 95 percent, respectively. The overall data showed that all the districts were deficient in sulphur, need to apply sulphur fertilizer, because of now-a-days major fertilizers like the phosphatic fertilizer was applied without sulphur composition. Similar findings were reported by Jena et al. 2008 and Pal et al., 2015.

Table 2: Range, Mean and percent sample deficient (PSD) of sulphur in soil (mgkg-1) and (%) in plants of the districts

Districts	Sample size (soil)	Range (mgkg-1)	Mean (mgkg-1)	PSD
Dhenkanal	**301**	**0.39- 54.61**	**10.0**	**60.0**
Sonepur	**140**	**0.70- 84.45**	**20.02**	**31.4**
Bhadrak	**358**	**1.03- 265.03**	**33.69**	**31.5**
Angul	**225**	**1.16- 118.61**	**28.53**	**14.2**
Plant sulphur (%)				
Onepur	**33**	**0.02- 0.43**	**0.13**	**82.0**
Bhadrak	**50**	**0.03- 0.22**	**0.13**	**76.0**
Angul	**41**	**0.03- 0.30**	**0.12**	**95.0**

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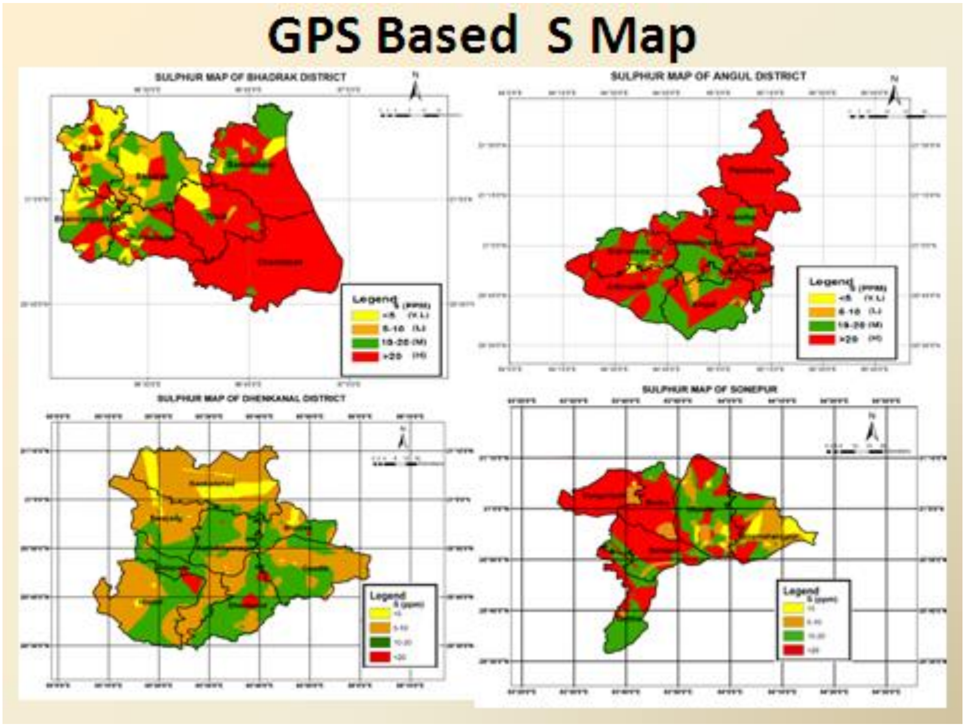
Figure 1: GPS based sulphur map of Four Districts



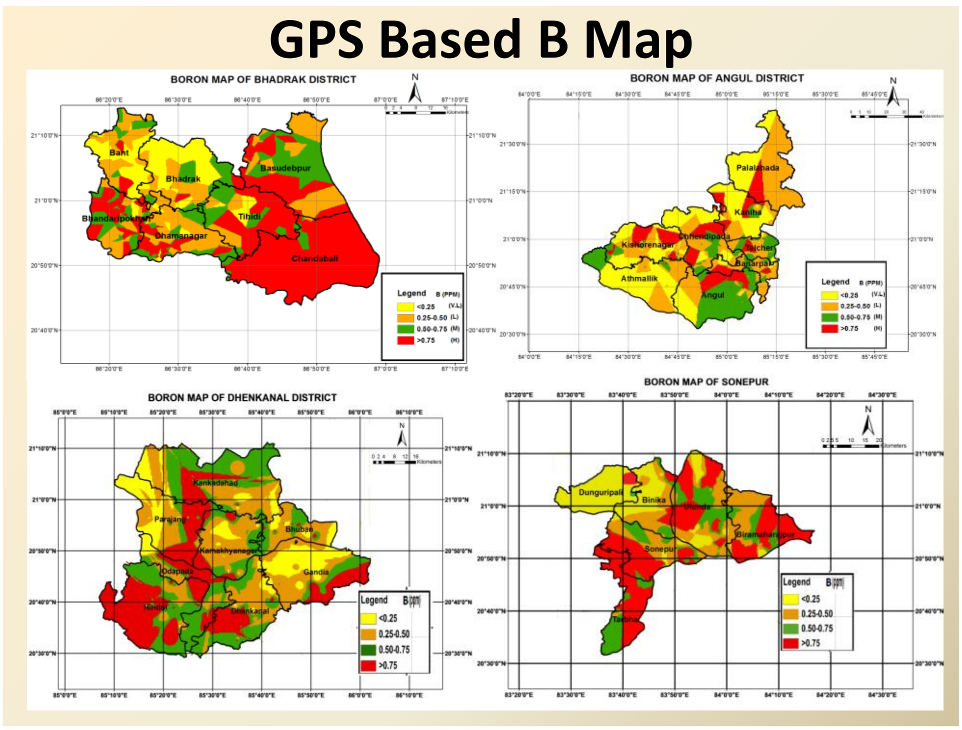
The hot water soluble boron status of four districts varied from 0.02 to 5.47 ppm (Table 3). Maximum sample boron deficient in soil was observed in Dhenkanal district (63 %) followed by Angul (59.6 %), Sonepur (49.3%) and Bhadrak (44.7%) (Fig. 2) whereas in plant samples, maximum sample deficient was observed in Angul (97.6%) followed by Bhadrak (92%) and Sonepur (63.6%). The overall data of four districts showed that all the districts were deficient in boron; need to apply boron fertilizer or foliar application of boron for better growth and grain formation of the crop. Similar observations were reported by Jena et al., 2008 and Pal et al., 2015.

Table 3: Range, Mean and percent sample deficient (PSD) of Boron status (mgkg-1) in soil and (%) in plants of the districts

Districts	Sample size (soil)	Range (mgkg-1)	Mean (mgkg-1)	PSD
Dhenkanal	301	0.03- 4.73	0.61	63.0
Sonepur	140	0.02- 5.33	0.87	49.3
Bhadrak	358	0.03- 3.46	0.68	44.7
Angul	225	0.03- 5.47	0.66	59.6

Plant boron (mgkg-1))				
Sonepur	**33**	**5.27- 70.23**	**24.16**	**63.6**
Bhadrak	**50**	**1.88- 23.74**	**6.34**	**92.0**
Angul	**41**	**1.64- 18.04**	**5.48**	**97.6**

Figure 2: GPS based Boron map of Four Districts



Crop needs zinc for carbohydrate metabolism, photosynthesis and resistance to infection by certain pathogens. The zinc status of four districts varied from 0.06 to 4.06 ppm with a mean value of 0.85 ppm (Table 4). Maximum deficiency in soil was observed in Angul district (64.9 %) followed by Bhadrak (51.9%), Sonepur (31.4%) and Dhenkanal (14.5%), respectively (Fig. 3). The overall mean deficiency was 40.7%. Similar findings by Jena et al., 2008 and Pal et al., 2015. In case of plant, maximum sample deficiency was observed in Angul (31.7%) followed by Bhadrak (20.0%) and did not find any deficiency in Sonepur. Earliar Jena et al. 2008 reported that 19% soils were deficient in Zinc, now it increased to 40.7% due to intensive high yielding varieties of crop or cropping system and non use of zinc fertilizer. So, there was urgent need for zinc fertilization to crops.

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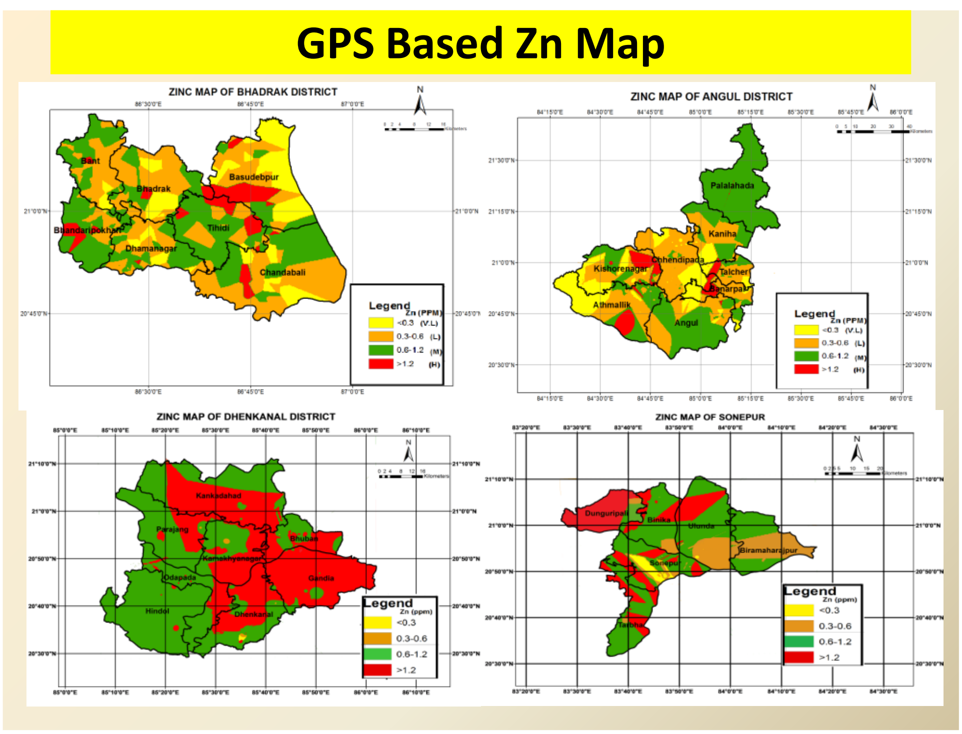
Table 4: Range, Mean and percent sample deficient (PSD) of Zinc status (mgkg-1) in soil and (mgkg-1) in plants of the districts

Districts	Sample size (soil)	Range (mgkg-1)	Mean (mgkg-1)	PSD
Dhenkanal	**301**	**0.16- 4.06**	**1.19**	**14.5**
Sonepur	**140**	**0.09- 3.88**	**0.94**	**31.4**
Bhadrak	**358**	**0.11- 2.61**	**0.64**	**51.9**
Angul	**225**	**0.62- 3.29**	**0.63**	**64.9**
Plant sulphur (mgkg-1)				
Sonepur	**33**	**19.5- 54.1**	**33.75**	**Nil**
Bhadrak	**50**	**16.1- 92.9**	**31.50**	**20.0**
Angul	**41**	**1.8-69.8**	**25.03**	**31.7**

Figure 3: GPS based Zinc map of Four Districts



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The results (Table 5) showed that no samples deficiency of Fe, Mn and Cu were found in four districts except in Sonepur and Angul, only 6.5 and 4.0 percent deficient in Cu and now-a-days it was an emerging issues.

Table 5: Range, Mean and PSD ()*of Cu, Mn and Fe (mgkg-1) in soils of the districts

District	Sample size	Cu		Mn		Fe	
		range	mean	range	Mean	Range	mean
Dhenkanal	**301**	***0.29-4.32*** **(6.5)***	**1.49**	**7.02-120.4**	**39.03**	**4.32- 195.9**	**46.8**
Sonepur	**140**	**0.36-7.62**	**3.07**	**9.1-421.0**	**102.2**	**8.7-374.4**	**121.1**
Bhadrak	**358**	**0.55-5.65**	**3.09**	**2.7-522.5**	**113.55**	**2.0-255.0**	**77.11**
Angul	**225**	**0.14-4.94 (4.0)***	**1.86**	**2.1-203.3 (3.1)***	**31.1**	**4.6-214.1**	**56.66**

***PSD (percent sample deficient)**

CONCLUSION

It was concluded that GPS and GIS based secondary and micronutrient soil fertility map for intensive cultivation for these districts helps the farmers, planner and scientists for site specific nutrient management and monitoring of soil health for present and future agriculture. The overall observations regarding these four districts were deficient mainly in sulphur, zinc and boron. Therefore there was urgent need to for fertilization with these nutrients for better crop growth and production. However, Cu was an emerging issue, need to be taken care of.

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