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GPS-GIS based soil fertility maps of Sangamner tahsil of Ahmednagar district (M.S.)

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Abstract

Plant nutrients supply from chemical fertilizers plays a vital role in increasing agricultural production by enhancing the soil quality and productivity. The GPS and GIS techniques i.e. (Global Position System and Geographical Information System) are widely utilized for delineating fertility maps of macro and micronutrients. The study entitled GPS-GIS based soil fertility maps of Sangamner tahsil of Ahmednagar District (M.S) was conducted during the year 2013-2014 and 2014-2015 at Department Soil Science and Agriculture Chemistry, Post Graduate Institute MPKV, Rahuri to assess the macro nutrient status of Sangamner tahsils of Ahmednagar district based on GPS and delineation of fertility maps.

Keywords: sangamner tehsil, GIS, GPS and soil fertility maps

Introduction

The GPS and GIS techniques i.e. (Global Position System and Geographical Information System) are widely utilized for delineating fertility maps of macro. Global Position System is used in agriculture for land survey, development of dams and canal, animal behavior study and marine organism. It is also used for obtaining digital road maps in vehicles when GPS and GIS are integrated. Soil samples collected with GPS data can help in making critical decisions on nutrients management. The fertilizer required is to be established, for calculating exact amount of straight fertilizer rather than a ready mixed complex, compound fertilizer. Fertilizer used can be better optimized by utilizing knowledge of fertility maps prepared with the help of GPS-GIS techniques. Money spends on fertilizers can be modified to the amount actually needed to supply nutrients in soil for cropping systems. Fertilizer use can be customized to area and quantities needed on various parts of fields for better nutrients management. Collection of soil samples by using GPS is very important for preparing thematic soil fertility maps. This instrument helps to know latitude and longitude of that particular place. It has got great significance in agriculture for future monitoring of soil nutrient status of different locations/villages. It also helps to know elevation, road map, nearest city/town and speed of movement.

Ahmednagar district is located between 18.20 to 19.90 North Latitude and 73.30 to 75.50 East Longitudes. The geographical area of the district is 17, 41, 271 ha. Its annual rainfall is 769 mm. The maximum and minimum temperature of this district is 43.3°C and 11.9°C, respectively. Ahmednagar district comprises 14 tahsils out of this Sangamner is considered for the study. Global positioning system (GPS) is a space based navigation and positioning system administered by U.S. military, which helps to determine the exact position of an object on the earth surface in terms of geographical coordinates (French, 1996) [2]. Geographical information system (GIS) is a computer system for capturing, storing, querying and displaying geographical data, Chang (2002) [1]. Once the soil fertility maps are created, it is possible to transform the information about the fertility status of the area. Such maps provide site specific recommendation and validation for soil fertility over the following years. Adoption of high yielding varieties and intensive cropping together with shift towards use of high NPK fertilizers has caused decline in the level of micronutrients in soil below normal at which productivity of crop cannot be sustained. The deficiency of micronutrients has become major constraint for productivity and sustainability of soil (Yadav and Meena, 2009) [8]. The average rainfall of Sangamner tahsil is 416 mm. Main crops grown in Sangamner tahsil are sorghum, pearl millet, Vegetables, wheat, onion, pomegranate, tomato and sugarcane.

Materials and Methods

Sangamner is located between 74°14'23.654"E and 19°26'43.180"N and covers total area 1705.06 ha. It is situated 100 km away in the South-East direction of Ahmednagar district place. It is spread over the banks of Pravara, Adhala and Mhalungi confluence. The town has been famous for Vegetable market, co-operative dairy farming, sugar industry, tobacco industry (*Gai chhap Jarda*), cloth market etc. There are 172 villages and four Revenue Circles - Talegaon, Sakur, Sangamner and Sangamner (Municipal Corporation). The total population is 439806 according to Census 2001 (No. of Male 226022 and No. of Female 213784) and literacy is 65.21 per cent. The Sangamner tahsil of Ahmednagar districts was selected for carrying out the study to prepare GPS and GIS based thematic soil fertility maps. Latitude (Lat) and Longitude (Long) were recorded by GPS instrument from soil sampling places of Sangamner areas. The soils were collected at a depth of 0-22.5 cm from farmer's fields. The samples collected from Sangamner tahsil were 335. Soil samples collected from Sangamner tahsil of Ahmednagar district were brought to the laboratory, thoroughly mixed, air dried in shade, ground with wooden mortar and pestle and passed through two mm sieve for analysis. The sieved soil samples were stored in cloth bags with proper labeling for subsequent analysis. All the precautions were followed while processing the soil samples in the laboratory. The analysis of soil samples have been done by using standard methods i.e. Soil available nitrogen

(Alkaline permanganate), Soil available phosphorus (NaHCO₃ 0.5 M pH 8.5 ascorbic acid) and Soil available potassium (Flame photometer).

Results and Discussion

The GPS-GIS based fertility maps of Sangamner tahsil of Ahmednagar district (M.S.) was prepared by using Arc-4 software. The data on available N revealed that major portion of the study area in Sangamner tahsil of Maharashtra registered low status of available nitrogen as per the three tier system. A large variation in the results of available phosphorus from 2.43 to 23.70 kg ha⁻¹ was found in the soils of Sangamner tahsil whereas, In general, the values of available K in the cultivated soils of Sangamner was higher.

Table 1: Range and average values of Available nutrients of Sangamner tehsil

Available Nutrients		Sangamner
Nitrogen (kg ha ⁻¹)	Range	80.64 to 443.52
	Average	217.10
	SD ±	74.64
Phosphorus (kg ha ⁻¹)	Range	2.42 to 23.70
	Average	11.92
	SD ±	5.04
Potassium (kg ha ⁻¹)	Range	119.40 to 1496.3
	Average	525.46
	SD ±	274.94

Table 2: Per cent distribution of available nutrients in different category

Available Nutrients	Category	Value	Sangamner	
			No. of Samples	Per cent distribution
Nitrogen (kg ha ⁻¹)	Low	<280	242	72.2
	Medium	280 to 560	93	27.8
	High	>560	00	00
Phosphorus (kg ha ⁻¹)	Low	<10	144	43
	Medium	10 to 24.5	191	57
	High	>24.5	00	00
Potassium (kg ha ⁻¹)	Low	<108	00	00
	Medium	108 to 280	56	16.7
	High	>280	279	83.3

Muhr (1965)

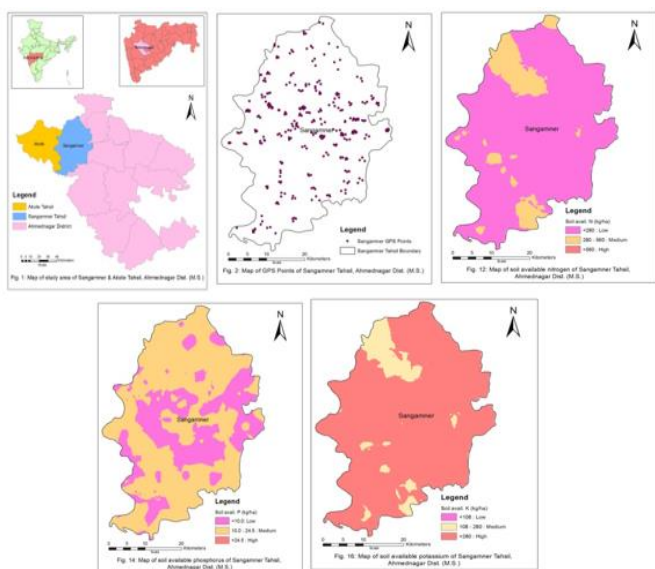


Fig 1: The GPS-GIS based fertility maps of Sangamner tahsil of Ahmednagar district (M.S.)

Conclusion

It was observed from the maps that from all the soil samples collected from Sangamner tahsil 72.2 per cent were found to be low in available N (<280 kg ha⁻¹) and remaining in the category of the medium (280-560 kg ha⁻¹). The highest value of 443.5 kg ha⁻¹ of available N was registered in Jawale Baleshwar village which is because of intensive cropping programme which received continuous addition of organic manures and N fertilizers.

The available phosphorus of various soil samples of Sangamner tahsil range from 2.42 to 23.70 kg ha⁻¹ with an average of 11.92 kg ha⁻¹. The 43 per cent samples were in low category and 57 per cent were in medium category as per the three tier system. The highest value of available P was recorded (23.70 kg ha⁻¹) in Jawale Baleshwar and the lowest (2.42 kg ha⁻¹) in Khandgaon.

The available potassium in cultivated soils of Sangamner tahsil ranged from 119.40 to 1496.3 kg ha⁻¹ with an average of 525.46 kg ha⁻¹. The large variation in the status of available potassium was noticed. All the soil samples were in medium to high category of available potassium. This approach is proposed as a method for the evaluation of sustainable soil

management. The fertility maps could be used to predict potentials and constraints of land for specific crop production. The soil test values have further been utilized for prescribing fertilizer recommendations for optimum crop production in order to maintain the soil fertility, productivity, sustainability and better crop quality in the studied area. This data and fertility maps will be helped in planning, maintaining the fertility, productivity and quality of growing crops viz., pomegranate, sugarcane, onion, cabbage, tomato, cauliflower, *chilli*, *brinjal* and particularly in forage crop *Lucerne* etc. in the soils of Sangamner tahsil.

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