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Soil Macro and Secondary Nutrients Status of Pathardi Tehsil of Ahmednagar District. (M.S.)

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Abstract

A survey was conducted to know available macro and secondary nutrient status of soils of Pathardi Tehsil of Ahmednagar District by GIS technique. 199 soil samples (0-22.5 cm) drawn during 2014 from the 70 villages were analyzed for their fertility status and mapped by geographic information system (GIS) technique. The exact locations of soil samples were recorded with the help of GPS.

The results indicated that all samples were slightly alkaline to moderately alkaline in soil reaction (7.09-8.39), non-saline (0.11 -0.58 dS m⁻¹), low to moderately high in organic carbon (0.22-0.74 %) and Calcium Carbonates ranged from (5.75-13.0 %). Regarding to macro and secondary nutrients, the available N, P and K which ranged between (62.72.-338.68 kg ha⁻¹), (3.31-19.64 kg ha⁻¹) and (302.4-571.2 kg ha⁻¹), respectively, whereas exchangeable Ca and Mg was sufficient in soils and available S is ranged between (8.4- 20.4 mg kg⁻¹) was slightly deficient to sufficient in soil.

Keywords: GPS, GIS, Nutrient mapping, Soil fertility status.

Introduction

Soils are considered as the integral part of the landscape and their characteristics are largely governed by the landforms in which they are developed. Topographic maps, aerial photographs and remote sensing data provide useful tools for geomorphic analysis of the region and help in the soil survey and mapping (Pandey and Pofali, 1982) [12].

The growing population in the country is an acute problem that demands maximum possible output of food, fibre and fuel from each unit of cultivated land area per unit time. Soil test results of one farm need to have scope to be connected with the broader population of all farms in a given area. The ideal situation would be to sample every farm to get soil fertility status of all the farms, but we are not be able to sample each farm in the population, because it is too costly, troublesome and time consuming, especially with the multiple small farm holding in many developing countries. We thus, need to generalize results of sample farms to get information of entire area.

Global Positioning System and Geographical Information System are advanced tool for studying on site specific nutrient management which can be efficiently used for monitoring soil fertility changes. The geo-referenced nutrient status of soils in Pathardi Tehsil, Dist-Ahmednagar, would be useful for ensuring balanced fertilization to crops which demands the systematic study of macronutrients including assessment of macronutrient status of different soils with delineation of nutrient deficiency or sufficiency. Farmers can use GPS to locate the nutrient deficiencies and can manage the accurate distribution of fertilizer chemicals. Many would argue that GPS has found its greatest utility in the field of Geographic Information System (GIS) with some consideration for error.

Material and Methods

Study area

Pathardi Tehsil is located in between 19°17'19.316 North latitude and 75°17'00.62 East longitude. The total geographical area of Pathardi Tehsil is 1214.10 ha. The elevation in between 504-676 Meter above mean sea level. The "Pathardi-Tehsil, is situated about 52 km away from Ahmednagar city, towards north-east.

Soil characteristics

Soils are derived from the igneous rocks *viz.* Basalt (Deccan trap) which is basic in nature

mainly feldspars (plagioclase), augite and small amount of titaniferous magnetite mineral. In the vesicular rocks the any of daloidal cavities are filled with mineral like zeolite and quartz.

Climate

The climate is usually hot and potential evapo-transpiration (PET) is far excess of the precipitation and is classified as semi-arid tropical. Pathardi Tehsil area experience a cool season from the month of November to February and hot spell from the month of March to May. The annual rainfall received in 17 rainy days was 359.5 mm. The mean annual maximum and minimum temperatures were ranged from 32.5 °C and 18.46 °C respectively.

Land use and natural vegetation

The dominant cropping pattern of Pathardi Tehsil is Gram, Sorghum, Soybean and Cotton. The dominant tree species are *Acacia arabica*, *Azadirachta indica*, *Zizyphus jujuba*, *Mangifera indica*, etc.

Methodology

Soil sample collection and analysis

A geo-referenced surface (0-22.5 cm depth) soil samples were collected from 119 sites of 70 villages. Three soil samples of soil order shallow, medium and deep (Entisols, Inceptisols and Vertisols) from each village following the standard procedures of soil sample collection with stainless steel auger to avoid iron contamination. The exact sample location was recorded using a GPS.

Soil samples were analyzed for chemical characteristics by following standard analytical techniques. Soil reaction was determined in 1:2.5 suspension using standard pH meter by potentiometry (Jackson, 1973) [6]. The electrical conductivity was determined by 1:2.5 suspension using EC meter by Conductometry (Jackson, 1973) [6]. Soil organic carbon was estimated using the wet oxidation method (Nelson and Sommer, 1982) [10] and CaCO₃ is determined by Acid neutralization method by Alison and Moodie (1965) [11].

Soil available N determined by Modified alkaline permanganate Subbiah and Asija (1956) [17], available P by 0.5M NaHCO₃ (Watanabe and Olsen, 1965) [19] and available K by Flame Photometer (NMNH₄OAc pH (7.0), (Jackson, 1973) [6]. Available S determined by 0.15% CaCl₂ extractable method by William and Steinberg (1969) and exchangeable Ca and Mg determined by Versenate titration method given by Hoffman and Shapiro (1954) [5].

Generation of maps

The delineation of the area for different nutrient levels of soils and their extent of area were calculated and mapping was carried out by using Arc-GIS 9, version 9.3 software.

Statistical analysis

The soil chemical properties data were statistically analyzed by using standard statistical methods given by Panse and Sukhatme (1985) [14].

Result and Discussion

Chemical characteristics of soil

The pH of the soils ranged from 7.09 to 8.39. Among the soil samples tested, were slightly alkaline (57.79 per cent) to moderately alkaline (42.21 per cent) in reaction. The similar results were recorded by katariya (2011) [7] in soil collected from the Water Management Project-Block A, Central

Campus, M.P.K.V, Rahuri, and the result recorded by Nalawade (2013) [8] in soils of Savlivihir Farm of Kopergaon Tehsil, Dist-Ahmednagar. The Moderately alkaline reaction might be due to deep to medium black soils being under irrigation since long have shifted to alkaline condition. The EC of various soil samples were ranged from 0.11 to 0.58 dSm⁻¹. The EC indicated that all the soils were normal in salt content (100 per cent) and suitable for healthy plant growth. The similar results were reviewed by Padole and Mahajan (2003) [11] in swell-shrink soils of Vidharbha region. The organic carbon content in soils are ranged from 0.22 to 0.74 per cent with the mean of 0.45 per cent. The similar results were reported by Yeresheemi *et al.* (1997) [21] in salt affected soils of Krishna Command of Karnataka. The calcium carbonate content in soils were ranged from 5.75 to 13.0 per cent with an average of 9.23 per cent. The calcareousness is common in soils of arid and semiarid climate particularly in Vertisols (Black soils) due to precipitation of carbonates and bicarbonates due to acidity. The similar trend of CaCO₃ in Block C Central Campus M.P.K.V., Rahuri was reported by Durgude (1999) [4]. (Table 1 and Fig1, 2, 3 and 4).

Table 1: Soil pH, EC, Organic Carbon and CaCO₃ status of Pathardi Tehsil

Particulars	pH	EC (dSm ⁻¹)	Organic Carbon (%)	CaCO ₃ (%)
Mean	7.92	0.27	0.45	9.23
Range	7.09-8.39	0.11-0.58	0.22-0.74	5.75-13.0
SE±	0.020	0.006	0.008	0.156

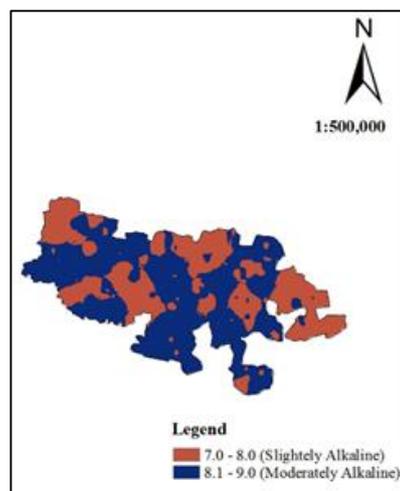


Fig 1: Soil pH status of Pathardi Tehsil

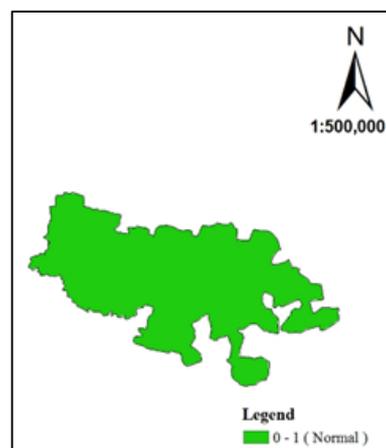


Fig 2: Soil Electrical Conductivity (dSm⁻¹) status of Pathardi Tehsil

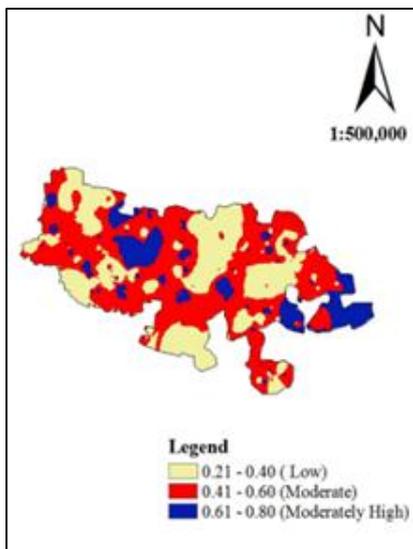


Fig 3: Soil Organic Carbon (%) Status of Pathardi Tehsil

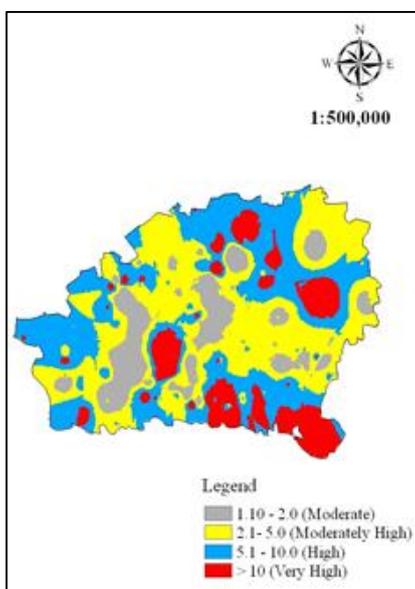


Fig 4: Soil Calcium Carbonate (%) Status of Pathardi Tehsil

Primary nutrients

The available nitrogen in soils are ranged from 62.72 to 338.68 kg ha⁻¹ with an average of 216.57 kg ha⁻¹. Higher pH declined the organic matter status by faster degradation which reflected low status of available nitrogen. The available phosphorus in soils were ranged from 3.31 to 19.64 kg ha⁻¹ with an average of 11.07 kg ha⁻¹. Low status of available P in soil might be due to alkaline condition and high content of CaCO₃ in the soil. The available potassium in soils ranged from 302.4 to 571.2 kg ha⁻¹ with an average of 382.76 kg ha⁻¹. The very high content of available K in the soil could be attributed to the dissolution and diffusion of K from internal crystal lattice of silicate clay minerals and may be due to high clay content and montmorillonitic clay minerals present (Durgude, 1999) [4].

The similar trends of available N, P and K were reported Waikar *et al.* (2004) [18], Bhalerao and Pharande (2003) [2] also recorded the very high available K content in Marathwada region. The observation recorded with respect to available Nitrogen by Dhage *et al.* (2000) [13] from Shevgaon Tehsil of Ahmednagar District and by Pandey *et al.* (2000) [13] with respect of available Phosphorus in Inceptisols of Central Uttar Pradesh were conformed this findings.

Table 2: Soil available N, P and K status of Pathardi Tehsil

Particulars	Available Nutrients (kg ha ⁻¹)		
	N	P	K
Mean	216.57	11.07	382.76
Range	62.72-338.60	3.31-19.64	302.4-571.2
SE±	4.006	0.348	3.964

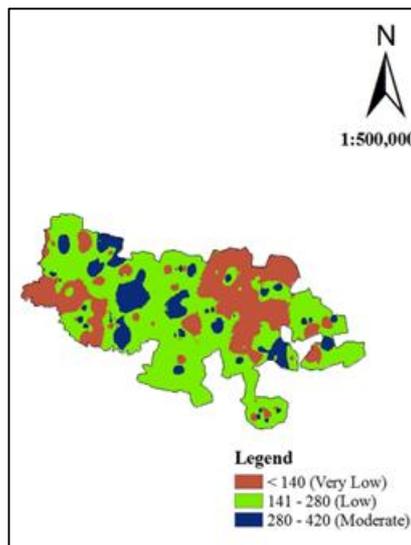


Fig 5: Soil available Nitrogen (kg ha⁻¹) status of Pathardi Tehsil

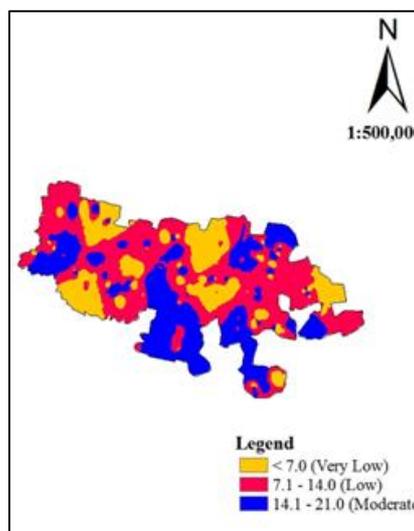


Fig 6: Soil available Phosphorus (kg ha⁻¹) status of Pathardi Tehsil

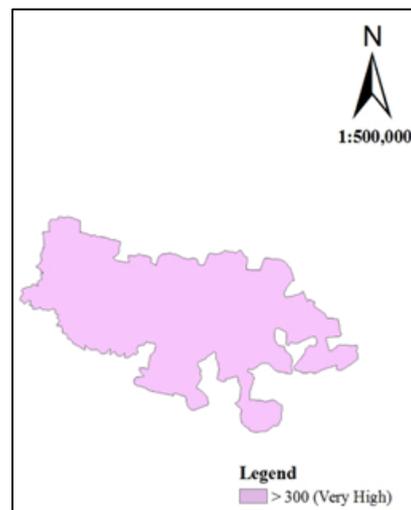


Fig 7: Soil available Potassium (kg ha⁻¹) status of Pathardi Tehsil

Secondary nutrients

The exchangeable calcium in soils ranged from 16.5 to 31.4 cmol (p+) kg⁻¹ with an average of 24.73 cmol (p+) kg⁻¹, exchangeable magnesium in soils were ranged from 9.80 to 18.06 cmol (p+) kg⁻¹ with an average of 14.45 cmol (p+) kg⁻¹ and available sulphur in soils ranged from 8.4 to 20.4 mg kg⁻¹ with an average of 14.88 mg kg⁻¹. The soils of Pathardi Tehsil were sufficient in exchangeable calcium and magnesium. However, out of all soil samples 91.96 per cent soils were sufficient and 8.04 per cent were deficient in available sulphur. (Table 3. Fig. 8, 9 and 10). The similar results were observed by Prasad *et al.* (2006) [16] in swell-shrink orange cropped soils of Nagpur District, Nayak *et al.* (2006) [9] in swell and shrink soils of Vertisol order in Vidarbha and Patel *et al.* (2014) [15] at different villages of Kutch District of Gujrat.

Table 3: Exchangeable Ca and Mg and available S status of soils of Pathardi Tehsil

Particular	Exchangeable Ca [cmol (p+) kg ⁻¹]	Exchangeable Mg [cmol(p+) kg ⁻¹]	Available S (mg kg ⁻¹)
Mean	24.73	14.45	14.88
Range	16.5-31.4	9.80-18.6	8.4-20.4
Critical limit	20	10	10
Deficient (%)	6.03	0.50	8.04
Sufficient (%)	93.97	99.50	91.96
SE ±	0.246	0.146	0.218

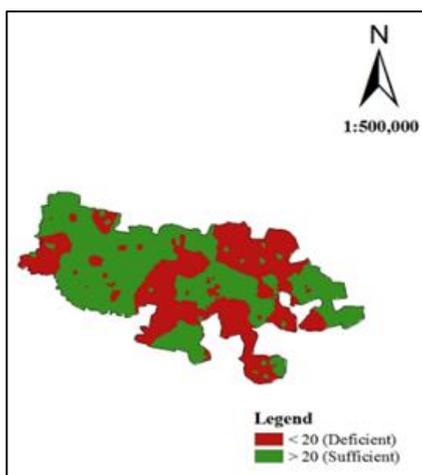


Fig 8: Soil Exchangeable Calcium [cmole (p+) kg⁻¹] status of Pathardi Tehsil

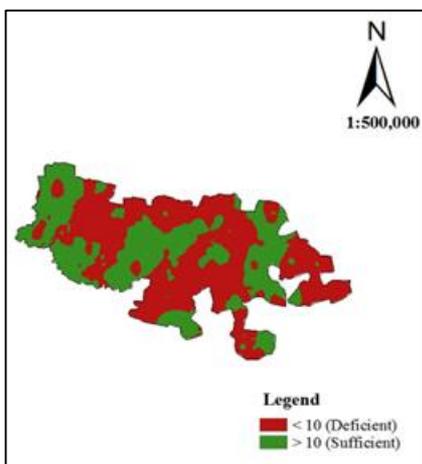


Fig 9: Soil Exchangeable Magnesium [cmole (p+) kg⁻¹] status of Pathardi Tehsil

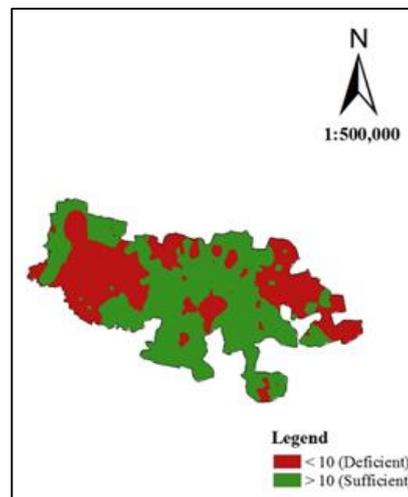


Fig 10: Soil available Sulphur (mg kg⁻¹) status of Pathardi Tehsil

Conclusion

From the study, it can be concluded that, soils of Pathardi Tehsil area slightly alkaline to moderately alkaline in soil reaction, non-saline in nature, low to moderately high in organic carbon and moderate to high in calcium carbonate. The soils were categorized as very low to moderate in available nitrogen and phosphorus, very high in available potassium, slightly deficient to sufficient in available S and sufficient in exchangeable calcium and magnesium.

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