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GIS-GPS Based Soil Fertility Maps of Agriculture College Farm, Kadegaon District Sangli: Maharashtra

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Abstract:
The present study was conducted during the year 2017-18 at department of Soil Science and Agricultural Chemistry, Loknete Mohanrao Kadam College of Agriculture, Kadegaon with aim to study the fertility status of college farm and prepare GIS-GPS based fertility map. The soil samples were collected on the basis of GPS gridwith50m^2 spacing on the cadastral map for the study. The 81 grids in the L.M.K. Agriculture College farm covering an area of 60 ha from which soil samples were collected and analysed as per standard procedure for assessing chemical properties and available N, P and K nutrient status. The pH of soil varied from 7.09 to 8.21 while EC varied from 0.200 to 0.980 dSm^{-1}. The organic carbon and calcium carbonate content in soil were varied from 0.13 to 0.91 % and 2.5 to 15.1 % respectively. The available Nitrogen, Phosphorus and Potassium ranged from 91 to 637, 5.2 to 34.7 and 109 to 559 kgha^{-1} respectively. Soils of Agriculture College farm Kadegaon were very low to high in available Nitrogen, very low to high in available Phosphorus and low to very high in available Potassium. The fertility map indicates Soil reaction, salinity, organic carbon, calcium carbonate and primary nutrient content which were prepared by kriging technique in Arc GIS platform. The maps indicate the fertility status of College farm based on which fertilizer recommendation for crops are made leading to economy of fertilizer and balanced applications and serve as the decision making tool for successful raising of field crops and development of orchards .

Key words: GPS, GIS Technique, Soil fertility map, O.C. and EC.

I. INTRODUCTION

The major challenges of in 21st century are food security, environmental quality and soil health. Besides, shrinking land holding and increasing cost of inputs necessitate induction and adoption of scientific use of plant nutrient for sustaining higher growth of crop productivity. Soil is vital resource, can be termed as "Soul of infinite life." The essence of life in the soil is its crop producing capacity i.e. the soil productivity largely depends on soil fertility, management practices and climate. Therefore soil fertility is the major component of productivity which primarily deals with nutrient supplying ability of the soil to the plant. GPS and GIS techniques i.e. (Global Position System and Geographical Information System) are widely utilised for delineating fertility maps of soil available nutrient status of an area. Soil samples collected with GPS data can help in making critical decision on nutrient management. The fertilizer required is to be established, for calculating exact amount of fertilizer. Fertilizer used can be better optimised by utilizing knowledge of fertility maps prepared with the help of GIS-GPS techniques. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soil to realize good crop yield. Therefore an attempt has been made in present investigation to prepare GIS and GPS based soil fertility maps for the L.M.K. Agriculture College farm in order to find out the soil fertility related production constraints of the farm and to suggest remedial measures for optimum production of crops, which might be useful for conducting research trial.

II. MATERIALS AND METHODS: College farm is situated at Kadegaon, District Sangli in lower Maharashtra (Deccan) plateau scarcity zone of western Maharashtra having GPS 17^{0}15'59.607" to 17^{0}16'15.048"North latitude, 74^{0}20'32.935" to 74^{0}20'37.786"East longitude with altitude 600 m. L.M.K. Agriculture College farm, Kadegaon The total geographical area of College farm is 60 ha. The average annual rainfall is 624-685mm. The soil samples were collected with help of GPS. Total 81 surface soil samples (22.5 cm) were collected using Global Positioning System (GPS) at grid of 50 m^2. The data base on the analysis of soil chemical properties and primary nutrient was developed using Microsoft Excel. The data base was exported into Arc GIS software for preparing thematic maps. The details regarding the climatology, geology and physiography of the site are presented in Table 1.

Table.1. Climatology, Geology and Physiography of the study area

1	Average annual rainfall in (mm)	624-685mm
2	Average annual Temp. ^{0}C	24.6 ^{0}C
	(a) Maximum	28.9 ^{0}C
	(b) Minimum	21.6 ^{0}C
3	Average relative humidity	71.0%
	(a) Maximum	41.4%
	(b) Minimum	93.4%
4	Climatic classification	Low rainfall, hot semi-arid
5	Parent material	Weathered basalt
6	Height from M.S.L.(m)	600m
7	Physiography	Lower Maharashtra(Deccan) plateau
8	Type of soil	Black, brown, clay, medium fine loamy, mixed calcareous.

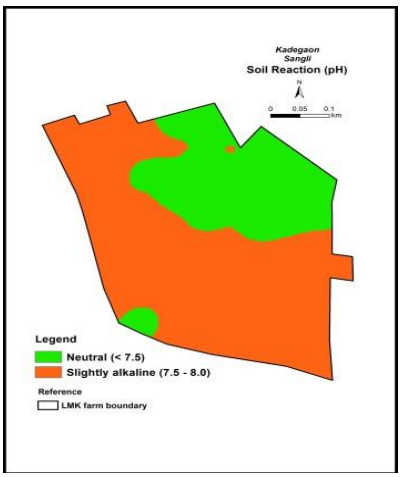
The collected soil samples were processes and analysed for their nutrient status by standard analytical methods at department of Soil Science and Agricultural Chemistry, L.M.K. College of Agriculture, Kadegaon. Soil reaction was determined in 1:2.5 Soil:Water suspension using standard pH meter topotentiometric by Jackson (1973) the electrical conductivity was determined by 1:2.5 Soil:Water suspension using EC meter to conductometry by Jackson (1973). Organic carbon was determined by Walkely and Black wet oxidation method was given by Nelson and Sommer (1982). Calcium carbonate was determined by rapid titration method is given by Piper (1966). The available Nitrogen is given by modified alkaline and permanganate method by Subbiah and Asija(1956). Available Phosphorus was estimated by 0.5 M $NaHCO_3$(pH 8.5) method by Olsen (1965). Available Potassium was estimated by flame photometry method (Neutral Normal NH_4OAcpH 7.0) by Jackson (1973).The soil chemical properties and primary nutrient data were statistically analysed by standard statistical methods given by Panse and Sukhatme (1985).

III. RESULT AND DISCUSSION

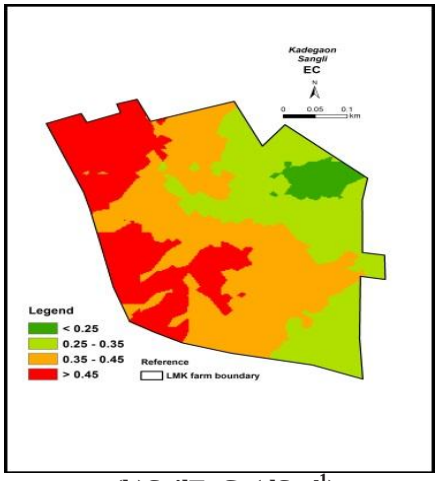
The GIS-GPS based fertility maps of L.M.K. College of Agriculture farm Kadegaon was prepared by Arc-4 software with the help of NBSS- LUP Soil Science research station. The result presented in (Table 2 and Fig. a, b, c &d) that the pH of the Agriculture College farm, Kadegaon ranges from 7.09 to 8.21. The mean pH was7.68. Among the soil sample tested, most of the soils were slightly alkaline (75.30%) followed by moderately alkaline (24.69%) in reaction. Thesimilar types of observation were also recorded by Vivekananda Aich(2017)in soil collected from organic farms at college of Agriculture, Pune. The EC of soil samples were ranged from 0.200 to 0.980 dSm^{-1}, with an average mean was 0.390 dSm^{-1}. It was observed that all 81 soil samples (100%) were non saline nature. The result indicates that all the soils are normal in nature and suitable for all type of crops. The similar results were reported by Shinde and Patil (2016) at Agriculture College farm, Nandurbar, Maharashtra.

Table.2. Soil pH, EC, O.C. and $CaCO_3$ status of L.M.K. Agriculture College farm Kadegaon.

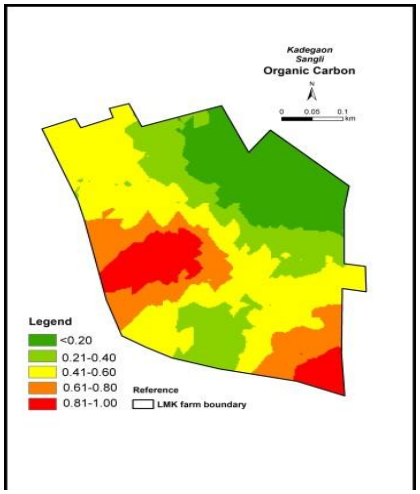
Particulars	pH	EC dSm^{-1}	Organic Carbon %	$CaCO_3$ %
Mean	7.68	0.39	0.47	8.39
Range	7.09-8.21	0.20-0.98	0.13-0.91	2.5-15.1
SE±	0.028	0.17	0.023	0.36
SD±	0.26	0.16	0.21	3.29
C.V. %	3.38%	41.02%	44.68%	39.21%



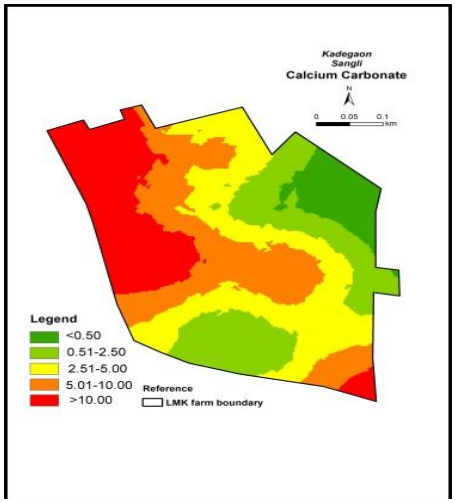
(a) Soil pH



(b)SoilE. C. (dSm^{-1})



(c) Soil Organic Carbon (%)



(d) Soil Calcium carbonate (%)

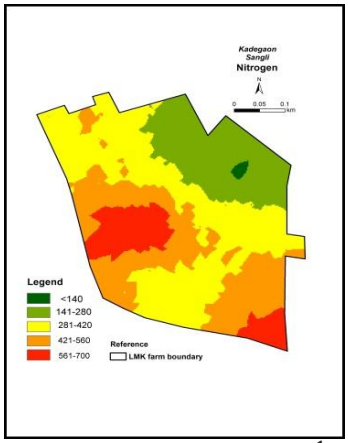
Table.3. Number of sample and per cent distribution of soil chemical properties in different category of L.M.K. Agriculture College farm.

Chemical properties	Category	Value	No. of samples	% Distribution
pH (1:2.5)	Neutral	6.5-7.5	20	24.69
	Slightly alkaline	7.5-8.5	61	75.30
	Moderately alkaline	8.5-9.5	0	-
	Strongly alkaline	>9.5	0	-
EC (1:2.5) dSm^{-1}	Excellent	<0.250	16	19.75
	Good	0.250-0.750	61	75.30
	Permissible	0.750-2.00	4	4.93
	Doubtful	>2.00	0	-
Organic carbon (%)	Very low	<0.20	9	11.11
	Low	0.21-0.40	24	29.62
	Medium	0.41-0.60	25	30.86
	Moderately high	0.61-0.80	17	20.98
	High	0.81-1.00	6	7.40
	Very high	>1.00	0	-
Calcium carbonate (%)	Non calcareous	<0.50	0	-
	Slightly calcareous	0.51-2.50	1	1.2
	Moderately calcareous	2.51-5.00	12	14.81
	Calcareous	5.01-10	17	45.67
	Highly calcareous	>10	31	38.27

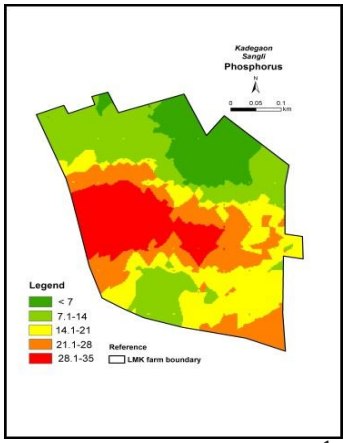
The Organic Carbon content ranged from 0.13 to 0.91 % with the mean of 0.47 % the similar nature of observation were recorded by Chaudhari and Kadu(2007)in soils of Dhule Tehsil of Dhule District. The wide variation in organic carbon content in the tested soil might be because of decomposition rate of substrate and different vegetable crops to be grown in College farm. The calcium carbonate in soil sample was ranged from 2.5 to 15.1 % present with an average of 8.39 %. The similar nature of calcium carbonate in soils by Golhar and Chaudhari (2013) at Tehsil Chalisgaon, District Jalagaon, The calcareousness is high might be due to precipitation of carbonate. The data presented in (Table 4 and fig. e, f, g) revealed that the available Nitrogen content in soil varied from 91 to 637 kg $ha^{-1}$with an average of 330 kg ha^{-1}. The maximum soil sample falling in medium (30.86%) followed by low (29.64%) in categories. The similar results were earlier recorded by Patil and Sakore (2016).The available phosphorus in soil was ranged from 5.2 to 34.7kg $ha^{-1}$with a mean value of 16 kg ha^{-1}. Very low to high status of available P in soils of studiedarea might be due to alkaline soil reaction and high content of CaCO3 in the soil. The range is quite large which might be due to variation in soil properties viz. Calcareous, organic Matter content, texture and various management and Agronomic practices. The similar trends of available Phosphorus were also reported byShinde*et.al.*(2016)in soils of Nandurbar Agriculture college farm. The available Potassium in soil was ranged from 109 to 559 $kgha^{-1}$with mean of 271 $kgha^{-1}$. The low to very high content of available K in the soils of College farm. Almost all the samples were categorised very high (38.27%) followed by moderately high (18.51%). The similar result of available K was also reported by Kadam(2017) in soils of Agriculture College farm, Karad.

Table.4. Soil Available N, P &K status of L.M.K. Agriculture College farm Kadegaon.

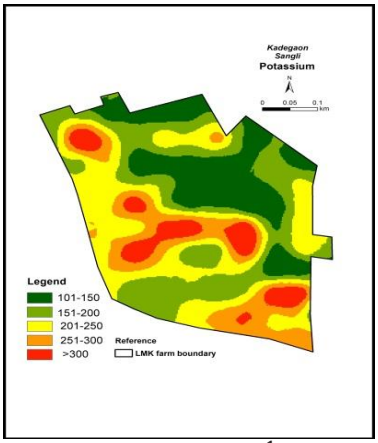
Particulars	Avail. N ($kgha^{-1}$)	Avail. P($kgha^{-1}$)	Avail. K ($kgha^{-1}$)
Mean	330	16	271
Range	91-637	5.2-34.7	109-559
SE±	16.77	0.77	12.11
SD±	151	7	109
CV %	45.75%	43.75 %	40.22 %



(e) Avilable N(kg ha^{-1})



(f) Available P (kg ha^{-1})



(g) Available K (kg ha^{-1})

Table.5. Number of sample and per cent distribution of available nutrient in different category of L.M.K. Agriculture College farm.

Macronutrient	Category	Value	No. of samples	% Distribution
Avail. N kg ha^{-1}	Very low	<140	9	11.11
	Low	141-280	24	29.64
	Medium	281-420	25	30.86
	Moderately high	421-560	17	20.98
	High	561-700	6	7.40
	Very high	<700	0	-
Avail. P kg ha^{-1}	Very low	<7	5	6.17
	Low	7.1-14	30	37.03
	Medium	14.1-21	33	40.74
	Moderately high	21.1-28	5	6.17
	High	28.1-35	6	7.40
	Very high	>35	0	-
Avail. K kg ha^{-1}	Very low	<100	0	-
	Low	101-150	12	14.81
	Medium	151-200	11	13.58
	Moderately high	201-250	15	18.51
	High	251-300	11	13.58
	Very high	>300	31	38.27

IV. CONCLUSION:

The soils collected from L.M.K. Agriculture College farm Kadegaon were neutral to slightly alkaline in reaction. The very less variation in soil pH may be due to inherent homogeneity of soil. The result indicates that all the soils are normal in nature and for healthy plant growth due to the soils are free from salinity. The soils were very low to high in Organic carbon and slightly calcareous to very high calcareous in calcium carbonate. The soils were very low to high in available Nitrogen. The most of the soils were medium (30.86%) a followed by low (29.64%). Very low (6.17%) tohigh (7.40%) in available Phosphorus, and low to very high in available Potassium. Holistic survey and precise use of analytical techniques in this investigation have enabled the investigator to come out with soil fertility maps of the L.M.K. Agriculture College farm Kadegaon. The use of GPS-GIS based technique for soil sampling is new landmark, which will enabled the further researcher and officials to monitors the changes in the soil fertility status for years to come. The soil fertility maps of L.M.K. Agriculture College farm Kadegaon will be of great utility for monitoring the fertilization schedule on sound scientific footing for improving the crop yields of L.M.K. Agriculture College farm Kadegaon. Moreover, the timely monitoring of soil health deterioration can also be maintained by appropriate soil reclamation techniques.

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