



Research Article

GIS BASED SOIL FERTILITY MAPS AND IDENTIFICATION OF SOIL RELATED PRODUCTION CONSTRAINTS OF AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE, VAZHAVAACHANUR FARM

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Abstract: Geographical Information System (GIS) based soil fertility maps for the Agriculture College and Research Institute, Vazhavachanur farm in order to find out the soil fertility related production constraints of the farm and to suggest corrective measures for optimum production of crops. Totally 35 numbers of soil samples were collected from the Agriculture College and Research Institute, Vazhavachanur farm. The synchronization points were recorded by the help of GPS instrument (Garmin). Base map of the Agriculture College and Research Institute, Vazhavachanur farm was digitized and geo-referenced. Polygons were overlaid on the geo-referenced map. The average value of the pH and EC is the 6.95 and 0.34 dS m⁻¹. The organic carbon content of the soil is very much low 0.31. The available nitrogen, phosphorus and potassium content of the soil is 190 kg ha⁻¹ (low), 18 kg ha⁻¹ (medium) and 203 kg ha⁻¹ (medium) respectively. The available Iron, zinc, Manganese and Copper in the soil 7.28 ppm (high), 0.70 ppm (low), 1.24 ppm (low), 1.02 ppm (low) respectively.

Keywords: GIS and GPS, Available N, P, K, Micronutrients, Soil Fertility Map

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Introduction

The food security, environmental quality and soil health are the major challenges in 21st century. 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 soil fertility is the major component of productivity which primarily deals with nutrient supplying ability of the soil to the plant. The Global Positioning System (GPS) has very wide adaptability in Agriculture in preparation of thematic maps like land use, land cover, soil fertility maps etc. Site specific nutrients management formulation has achieved by the soil available nutrients status of an area using GPS. 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 optimized by utilizing knowledge of fertility maps prepared with the help of GIS techniques [1-2]. Soil fertility maps are meant for highlighting the nutrient needs, based on fertility status of soil to realize good crop yield. Soil fertility-based mapping using GIS coordinating points is mainly useful for the precision agricultural farming because it meets production and ecological goals [3-8]. Therefore an attempt has been made in present investigation to prepare GIS and GPS based soil fertility maps for the Agriculture College and Research Institute, Vazhavachanur 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 [9-16].

Experimental site

Total area of 110 acres from the State Seed Farm (SSF), Vazhavachanur has been allotted to this new college, Agricultural College and Research Institute during 2014 which includes wet land and garden land ecosystems with bore well irrigation facility and canal irrigation system.

Thenpennai river running south of the location is the main source of water for the irrigated crops. Name of the village, block, taluk and District viz., Vazhavachanur, Thandampattu, Thandampattu and Thiruvannamalai respectively. The farm is located at 12°4'22" N and 78°59'21" E and an altitude of 160MSL. The soil type is Yellowish brown / red sandy loam, Gravelly sandy loam. The pH of the soil 6.7 and soil series is Kurumbalur (Kbr). The soil taxonomy is Fine Loamy mixed with hyperthermic Typic Haplustalf. The average rainfall is 1074.70 mm.

Materials and Methods

Totally 35 numbers of soil samples were collected from the Agriculture College and Research Institute, Vazhavachanur farm. The synchronization points were recorded by GPS instrument (Garmin). Soil samples were analyzed for texture [3], pH (1:2), EC (1:2) [4], organic carbon [5], available N [6], available phosphorus [7], available potassium [8], DTPA extractable Fe, Mn, Cu and Zinc [9]. Base map of the Agriculture College and Research Institute, Vazhavachanur farm was digitized and geo-referenced. Polygons were superimposed on the geo-referenced map. The nutrient index value has calculated for the all the nutrients [10].

$$\text{Nutrient Index} = [(NLx1) + (NMx2) + (NHx3)] / NT$$

Where NL, NM and NH are the number of soil samples falling in low, medium and high categories, respectively and NT is the total number of soil samples analyzed. If the nutrient index is < 1.5, the fertility status is low in that area, a value between 1.5 and 2.5 indicates medium and > 2.5 as high fertility status.

Results and Discussion

The average value of the pH and EC is the 6.95 and 0.34 dS m⁻¹. It shows that the soils are very suitable for all the crop production. It includes agricultural, horticultural and forest tree crops. The average organic carbon content of the soil is very much low 0.31. The role of organic matter plays a vital role to improve the soil fertility and productivity.

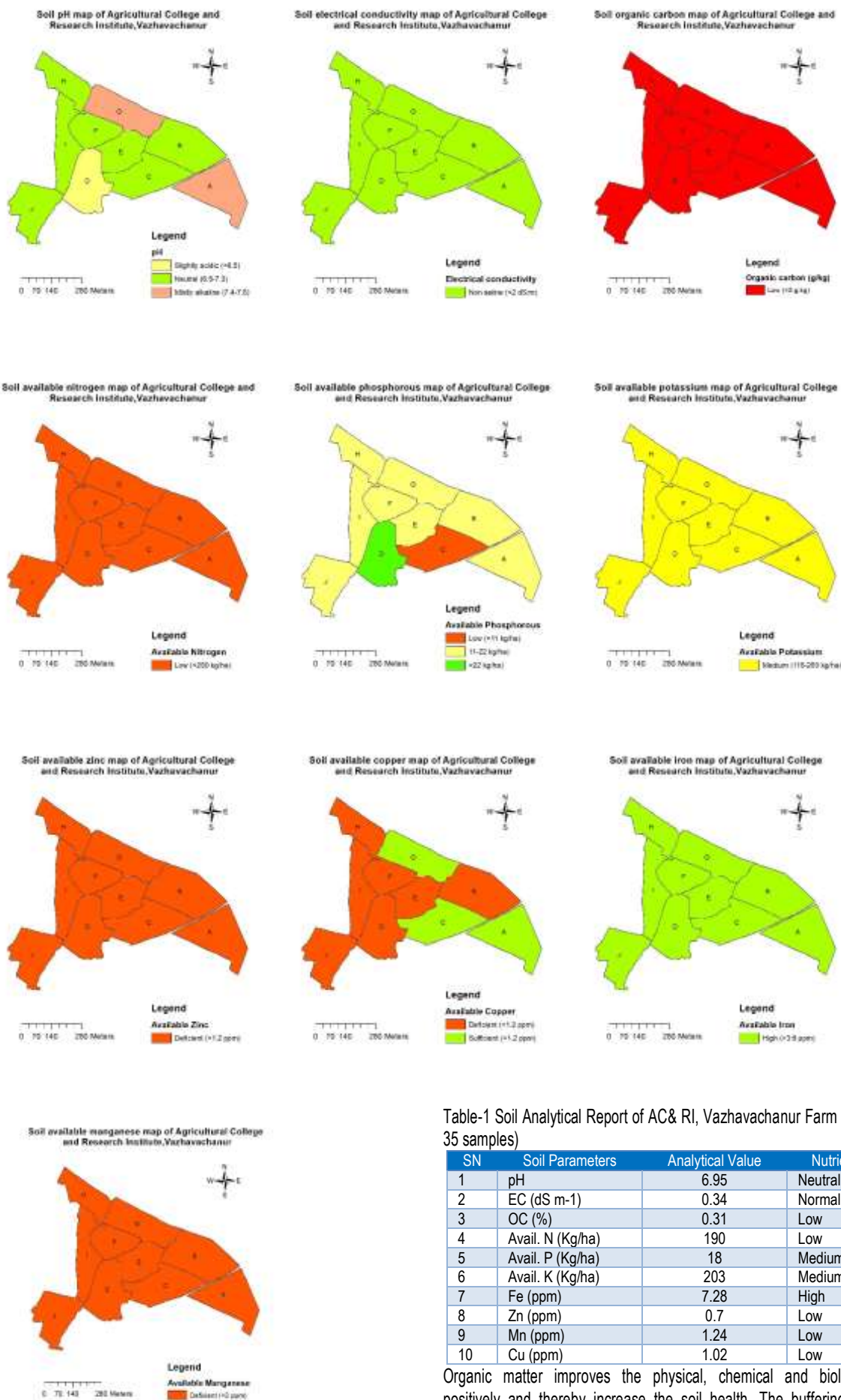


Table-1 Soil Analytical Report of AC& RI, Vazhavaachanur Farm (Average value of 35 samples)

SN	Soil Parameters	Analytical Value	Nutrient Index
1	pH	6.95	Neutral
2	EC (dS m ⁻¹)	0.34	Normal
3	OC (%)	0.31	Low
4	Avail. N (Kg/ha)	190	Low
5	Avail. P (Kg/ha)	18	Medium
6	Avail. K (Kg/ha)	203	Medium
7	Fe (ppm)	7.28	High
8	Zn (ppm)	0.7	Low
9	Mn (ppm)	1.24	Low
10	Cu (ppm)	1.02	Low

Organic matter improves the physical, chemical and biological properties positively and thereby increase the soil health. The buffering capacity of the organic matter is considered to be advantageous in the residue management of pesticides, herbicides and other heavy metals.

Add subsequent amount of farmyard manure, green manures, green leaf manures and vermi-compost to the soil to increase the organic carbon content. The available nitrogen, phosphorus and potassium content of the soils are 190 kg ha⁻¹ (low), 18 kg ha⁻¹ (medium) and 203 kg ha⁻¹ (medium) respectively. The available Iron, zinc, Manganese and Copper in the soil 7.28 ppm (high), 0.70 ppm (low), 1.24 ppm (low), 1.02 ppm (low) respectively [Table-1]. Integrated Nutrient Management (INM) is the best practice to improve the nutrient status of the soil and thereby sustainable crop production could achieve. Integrated Nutrient Management (mineral fertilizers + organic manures + biofertilizers) the best option through management of all-natural resources available in the farm to maintain the soil fertility for sustainable crop production.

Conclusion

Soil properties are varied within the farm area. It prioritizes the significance of mapping of different soil fertility parameters over the usual practice of assessing soil fertility on the basis of mean values of the concerned parameters. The use of GIS instrument for collection of soil samples and preparation of soil fertility maps will be helpful for the local farming community in many aspects. It will help in monitoring soil health from time to time by bringing soil samples from the same spots from which the samples are drawn in present study.

Application of research: Collecting and analyzing the geo-referenced soil samples at intervals, the change in soil fertility status can be regularly monitored and corrective measures can also be suggested to maintain soil health for sustainable crop production.

Research Category: Soil Fertility

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Study area / Sample Collection: Vazhavaachanur Farm

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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