Int.J.Curr.Microbiol.App.Sci (2020) *9*(4): 2896-2904

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 4 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.904.339

Soil Physico Chemical Properties, N, P, K and Soil Micro Nutrient Status of the Janpad Major Command Area of Nagarjuna Sagar Project

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Keywords

GIS krigging technique, Global Positioning System (GPS), Micronutrients, NPK content of soils, Soil physico chemical properties

Article Info

Accepted:
22 March 2020
Available Online:
10 April 2020

A B S T R A C T

An Investigation on physico-chemical properties, NPK and micro nutrient status of soils of Janpad major, Left bank canal, Nagarjuna Sagar Project (NSP), Telangana, India was carried. The soils are having clay content ranging from 6 to 24 per cent, silt content from 4 to 20 per cent and sand content from 69 to 87 per cent. The Hydraulic conductivity varied from 15 to 20 cm day^{-1} with a mean value of 17.5 cm day^{-1}. Mostly the soils under the command area are slightly acidic to slightly alkaline and non-saline in nature. Of the total soil samples, 69 per cent of samples were low and 26 percent samples were medium in organic carbon. The available nitrogen was low in all soil samples (61), the available phosphorus was high in 87 % samples and the potassium content in 43 per cent samples was low, 46 per cent samples medium. All soil samples (61) under command area were above the critical level in Iron, Copper and Manganese. On the other hand, 15 per cent samples were found to be deficient in DTPA-extractable Zn and require Zn application for optimum production and to get full benefit from NPK fertilization.

Introduction

Janpad major distributor command area located at 90.5 km (16^0 56' 12.8" E& 79^0 42' 0.7" N) on Left Bank canal of Nagarjuna Sagar project with the length of 24 km and designed discharge of 555.13 cusecs in Nalgonda district of Telangana, India. The ayacut area spreads in Nereducherla, Garidepally and part of Mattampally mandals

of the Nalgonda district. It has a total geographical area of 13216 ha with paddy cropped area of 11,750 ha. It comes under Agro-Eco region 7-Hot Semi-arid eco region with red and black soils (K_6 D_2) (NBSS&LUP, 1997). The major crops grown in the district are paddy, cotton, greengram, redgram, groundnut and jowar.

The study area comprises of physiographic units like denundational hills, residual hills, dykes, ingelbergs pediment, pedi plain and valley. The hills and dykes have steep to moderately steep, pediment is moderately sloping and Pedi plains are moderately to very gently sloping. Valleys are broad in nature with gentle to very gentle slopes with good water potential .In Pediplain the ground water potential is moderate. The study area is characterized by typical semi –arid drainage with seasonal streams and depression tanks.

The soils of the study area were formed from the granite- gneissic parent material. These soils are generally shallow in the pediplains and deep to very deep in the valley portions. These soils are generally red sandy loams and characterized by low organic carbon status. Despite the importance of the region in the agriculture sector, meager data is available on detailed spatial information showing the physico chemical properties and nutrient status of soil. An attempt was made to study the physical, physico-chemical properties and macro and micro nutrient status of Janpad major distributary command area and to generate maps by using Arc GIS Krigging technique.

Materials and Methods

The available physiographic and soil maps of Janpad major command area of left Bank canal, Nagarjuna Sagar Project on 1:50,000 scales were overlaid in Arc Info GIS to delineate homogenous units (soils developed under similar physiographic conditions) and were taken as basis for collecting soil samples in the field. Geo-referenced surface soil samples (0-15 cm) (Global Positioning System (GPS) make-garmin, model-etrex) for representing different soils was used for noting down the position in Janpad major command area. In all totaling 61 soil samples were collected at harvesting stage of kharif paddy (*Oryza sativa* L.) in Febraury 2009 using GPS (to mark the location of soil samples i.e. x, y coordinates).

In the present study, De-scan scanner was used for scanning toposheets which are covering the study area. Image analysis software ERDAS Imagine version 9.3 was used to process the satellite data, and in developing FCC of the satellite data.

Geographic Information System (GIS) software, ARC GIS version 9.3 was used for the analysis of data and creation of digital database. Tektronix phaser 560" type printer was used for getting the prints of different maps. Study area was delineated with the help of command area boundaries from topographic maps. The data pertaining to the command area was extracted as a subset for further processing.

The soil samples were air-dried, ground and sieved through 2 mm plastic sieve. The samples were analyzed for pH, electric conductivity (EC) and organic carbon (OC). The pH was determined by potentiometric method (Jackson 1973), EC with solution bridge method (Chopra and Kanwar, 1976) and OC by wet digestion method. The texture of the soil was estimated by hydrometer method. The available Zn, Fe, Cu and Mn were extracted using DTPA (Lindsay and Norvell, 1978) and their concentration was determined using atomic absorption spectrophotometer.

Generation of maps

The location of sampling sites was fed into the GIS environment. After analyzing the samples for the DTPA-extractable micronutrients (Zn, Fe, Cu and Mn) were categorized into groups as per the critical limits. The values of the points were tagged with each Geo-reference point and hard print of the maps was taken out.

The points having similar values were grouped and marked as a polygon manually and the maps for individual micronutrients were digitized using Arc GIS (Sharma *et al*., 2006).

The step by step methodology followed for generation of maps has been explained in figure 1.

Results and Discussion

Texture

The texture of Janpad command area soils varied from sandy loam to sandy clay loam. The clay content ranged from 6 to 24 per cent, silt content was ranged from 4 to 20 per cent and sand content was ranged from 69 to 87 per cent (Map 2A) (Table 1).

Hydraulic conductivity

Hydraulic conductivity of Janpad command area soils varied from 15 to 20 cm day^{-1} with a mean value of 17.5 cm day^{-1} (Map2B)

Soil reaction

The pH of the surface (0-30cm) soil samples of Janpad command area was 4.7 to 8.3 with a mean pH of 6.8. Mostly the soils under Janpad command area are slightly acidic to slightly alkaline in nature (Map 2C).

Electric conductivity

The EC of the surface (0-30cm) soil samples of Janpad Command area were non-saline and its EC ranged from 0.098 to 1.63 dS m^{-1} with a mean of 0.57 dS m^{-1}(Map 2D).

Organic carbon

The organic carbon content of soil samples varied from 0.1 to 0.9 per cent with a mean value of 0.4 percent showing that soils in general are low to medium in organic carbon content (Map 2E). Of the total, 69 per cent of samples were low in organic carbon, 26 percent samples were medium in organic carbon and 5 per cent samples were under high range.

Nitrogen, phosphorus and potassium

Available nitrogen of soils of Janpad command ranged from 109 to 189 kg N ha^{-1} with a mean value of 142 kg N ha^{-1} (Map 3A). The available nitrogen was low in all soil samples (61).

Available phosphorus

Available phosphorus of soils of Janpad command varied from 34.9 to 454 kg P_2O_5 ha^{-1} with a mean value of 169 kg ha^{-1}(Map 3B). The available phosphorus was medium to high in Janpad major command area. Of the total (61), 87 per cent samples were high in phosphorus in Janpad command area.

Available potassium

Available potassium varied from 51 to 551 kg K_2O ha^{-1} with a mean value of 189 kg K_2o ha^{-1} showing that the available potassium is low to high.

Of the total (61 samples), 43 per cent samples were recorded low potassium, 46 per cent

samples were medium in potassium and 7 per cent samples were high in potassium (Map 3C).

Micronutrients

Zinc

The available Zn content in the soil of Janpad command area varied from 0.37 to 8.37 ppm with a mean value of 2.46 ppm ((Map 4A). Considering 0.60 ppm as the critical limit for Zn deficiency (Nayyar *et al.,* 1990), 15 per cent samples were found to be deficient in DTPA-extractable Zn and require Zn application for optimum production and to get full benefit from NPK fertilization.

Iron

The available Fe content in the soil of Janpad command area varied from 0.45 to 4.05 ppm with a mean value of 1.81 ppm (Map 4B). Considering 4.5 ppm DTPA-extractable Fe as the critical limit (Lindsay and Norvell 1978). All soil samples (61) under Janpad command area were above the critical level in Iron.

Copper

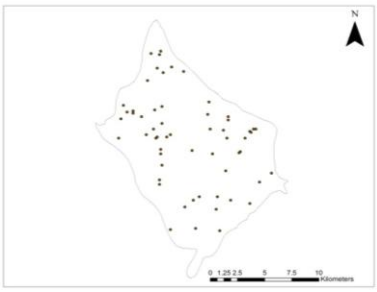
The content of DTPA available Cu in the soil of Janpad command area varied from 1.31 to 60.49 ppm with a mean value of 17.22 ppm (Map 4C). The mean value of Cu was much higher than the critical limit of 0.2 ppm DTPA-extractable Cu (Follett and Lindsay 1970). All soil samples (61) under Janpad command area were above the critical level in Copper.

Manganese

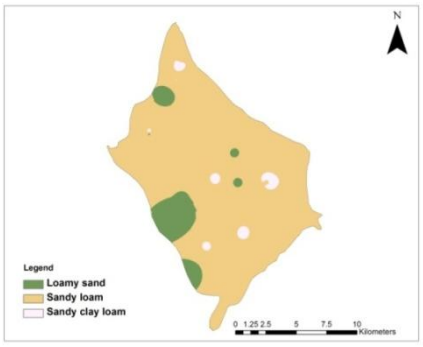
The content of DTPA available Mn in the soil of Janpad command area varied from 2.2 to 88.86 ppm with a mean value of 49.79 ppm (Map 4D). The mean value of Mn was much higher than the critical limit of 0.2 ppm DTPA-extractable cu (Follett and Lindsay 1970). On the whole, all soil samples (61) under Janpad command area were above the critical level in Manganese.

Table.1 Methods followed for analysis of soil samples

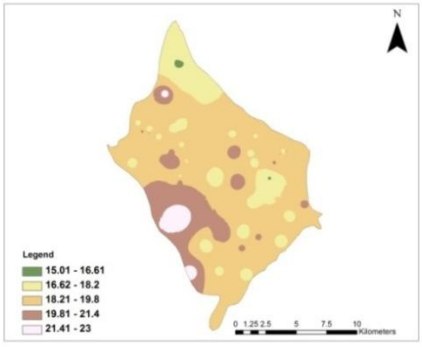
Soil characteristics	Method followed	Reference
Physical Properties		
1) Particle size Analysis (%) **2) Hydraulic conductivity (Cm day^{-1}) C**	Boucouse hydrometer metho Constant head method	Piper, 1966 Bouma and Dekker, (1981)
Physico-Chemical Properties **a) Soil reaction (pH)** **b) Electric conductivity (d S m^{-1})**	 1:2.5 soil water suspension Saturation extract	 Jackson, 1973 Jackson, 1973
c) Organic carbon (%)	Modified Walkley and Black's method (1935)	Piper, 1966
Soil chemical analysis		
Nitrogen	Modified alkaline permanganate method	Sharawat and Burford 1982
Phosphorus	Olsen's method	Olsen *et al.,* 1954
Potassium	Using 1N neutral ammonium acetate Extract	Jackson, 1973



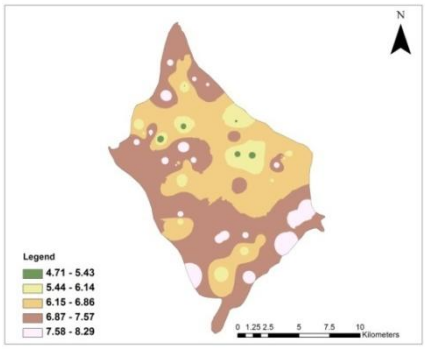
Map.1 Distribution of soil sample collection sites in Janpad command area



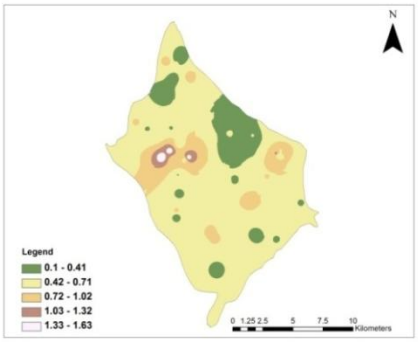
(A)



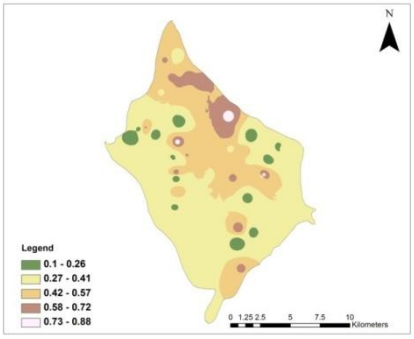
(B)



(C)

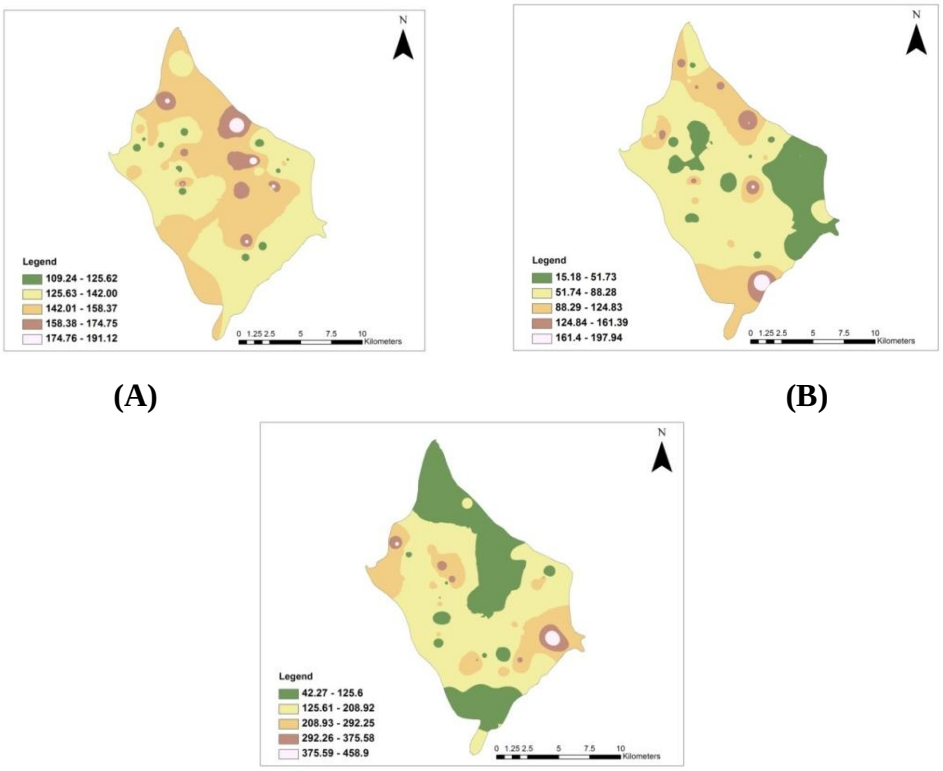


(D)

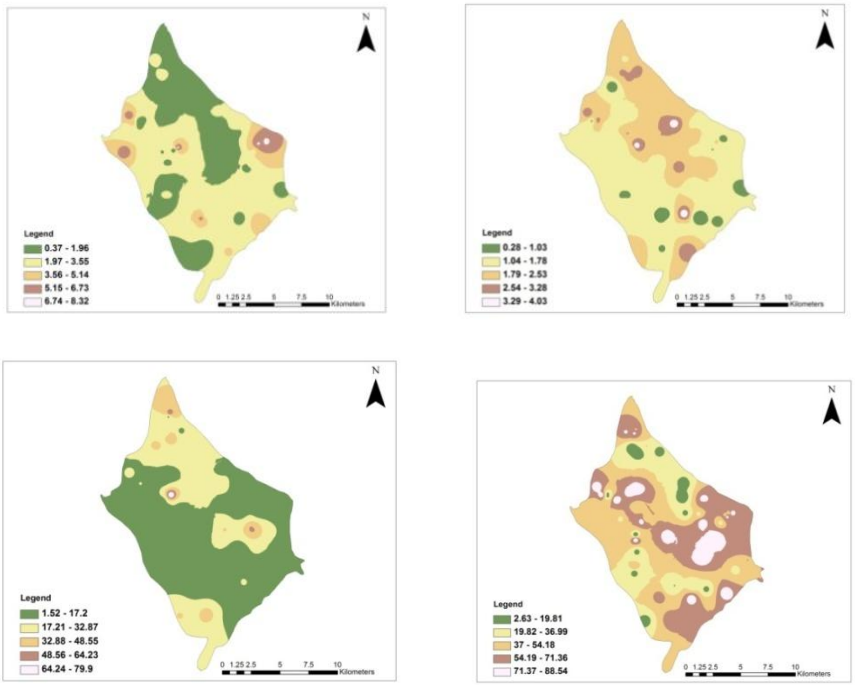


(E)

Map.2 (A) Textural distribution, (B) Hydraulic conductivity, (C) pH, (D) EC and (E) OC status in the soils of Janpad major command area



Map.3 (A) Nitrogen, (B) phosphorus and (C) Potassium in the soils of Janpad major command area



Map.4 (A) Zinc, (B) Cu, (C) Mn and (D) Fe in the soils of Janpad major command area

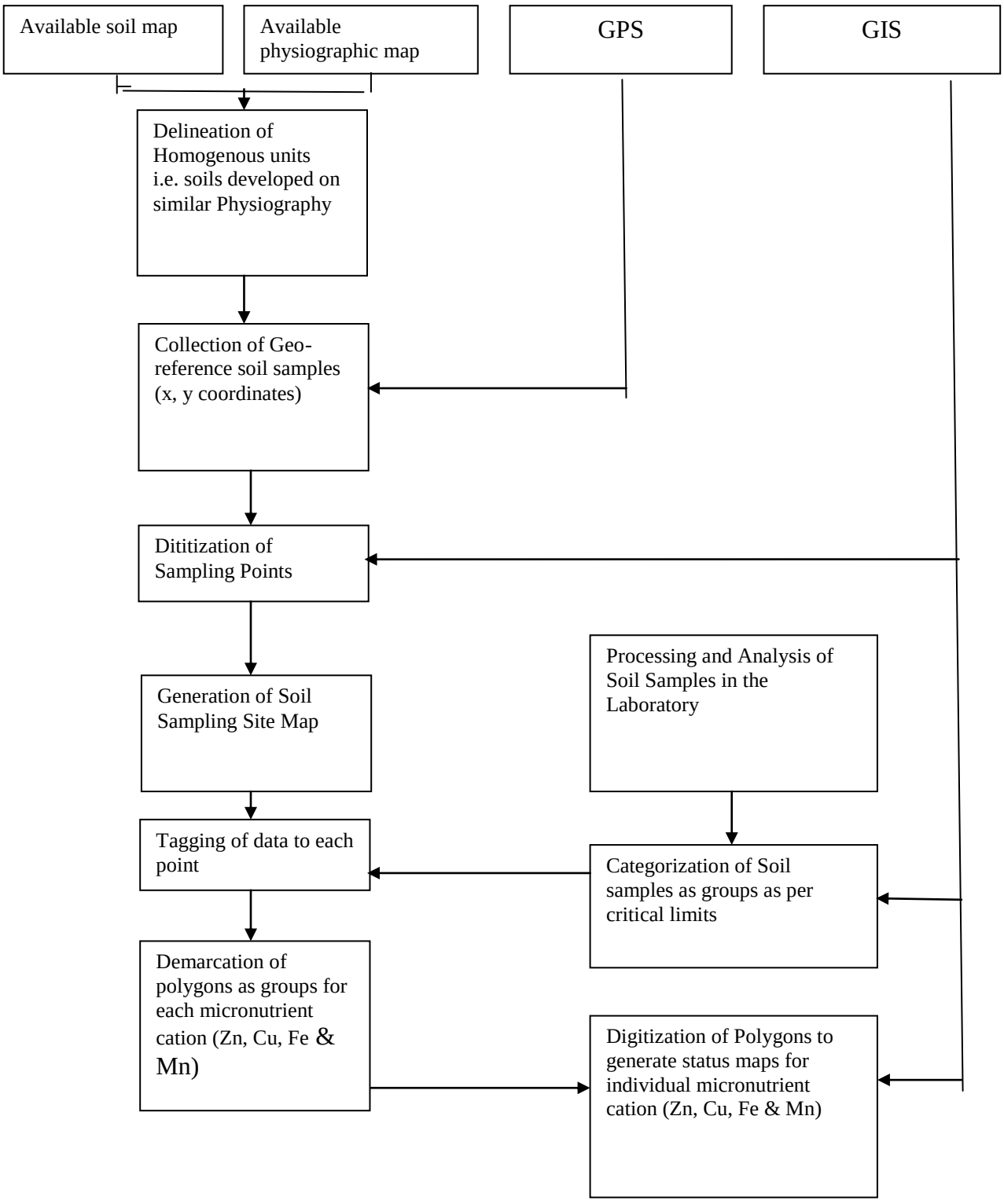


Fig.1 Flow diagram showing the various steps followed in preparation of maps

The available N was low in 100% of samples and in 87% samples the Phosphorus was high and 43 and 47% of samples were low and medium respectively in potassium. The NPK status of the soils indicates that the crop responds more to application of N and K.

It can be concluded that the spatial maps generated under the study will be useful for generating homogenous units and guiding the farmer to decide the amount and kind of micronutrients to be applied for optimizing economic returns based on site-specific nutrient management.

The present study of Geo-referenced sampling sites helps in revisit with the help of GPS and in monitoring the nutrients over a period of time can be done.

Further, by overlaying the boundaries of Village / Tehsil over the individual nutrient maps, it is possible to prioritize the villages which need immediate attention in respect of application of required amount of nutrient deficiencies for achieving the optimum crop yields.

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How to cite this article:

Ch. Koti Reddy, M. Devender Reddy, T. L. Neelima, K. Avil Kumar, A. Mani and Ramana, K. V. 2020. Soil physic-Chemical Properties, N, P, K and Soil Micro Nutrient Status of the Janpad Major Command Area of Nagarjuna Sagar Project. *Int.J.Curr.Microbiol.App.Sci.* 9(04): 2896-2904. doi: https://doi.org/10.20546/ijcmas.2020.904.339