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# Soil fertility status and mapping in Gudur Village of Ranga Reddy District of Telangana

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## Abstract
Present study was carried out to assess the fertility status of the adopted village of the College of Agriculture, Rajendranagar, PJTSAU *viz*., Guduru village, Kothur mandal, Ranga Reddy district of Telangana state. Four hundred surface (0-15 cm) soil samples were collected, processed and analyzed by standard procedures for the pH (1:2.5), EC (1:2.5), organic carbon content, available macro nutrient contents and available micronutrient contents. The soils were acidic to alkaline in reaction (pH ranging from 4.04 to 8.87). Soils were non saline and organic carbon content was low to high. Soils varied from low to medium in available nitrogen, low to high in available phosphorous and low to high in available potassium. Of the 400 soil samples analysed, 64.5 % were neutral in reaction, 42.5 % were low in organic carbon content, 97.25 % samples were low in available nitrogen. Thus the major constraints identified in the soils of Gudur village are low organic carbon and low available nitrogen contents. Recommendations were given to the farmers on fertilizer application and amendment requirements based on the analysed data. The soil fertility thematic maps were prepared under GIS environment. The fertility status in Guduru village of Shamshabad district revealed that low organic carbon content, low Nitrogen content high available Phosphorus and Potassium.

**Keywords:** Soil fertility status, Guduru village, GIS, Soil Mapping

## Introduction
Application of fertilizers by the farmers in the fields without prior knowledge of soil fertility status might result in adverse effects on soils as well as crops both in terms of nutrient deficiency and toxicity either by the adequate or over use of fertilizers (Sharma, 2004). It also increases high input cost for crop production. Hence, it is very important to manage the nutrients in the soil. Nutrient management and recommendation processes in India are still based on response data averaged over a large geographic area. Agricultural holdings in India are highly fragmented; with each farmer managing small field plots separately. This pattern of farming increases variability between fields due to individual farmer knowledge, fertilization history, crop sequence, farm management and resource availability. The results of soil testing are not useful for site specific recommendation and subsequent monitoring and also for sustaining the soil health (Patil *et al.* 2016) [12]. Geographic information system (GIS) is a powerful tool for collecting, storing, retrieving, transforming and displaying spatial data from the real world (Burrough and McDonnelli 1998) [1]. In current scenario, the soil fertility is being depilated by excessive and inefficient use of chemical fertilizers for more and more production in order to meet the requirements (Dongarwar *et al.* 2015) [3] and this excessive use of chemical is inducing the rate soil loss and deterioration in major parts of India.
Furthermore, GIS generated soil fertility maps may serve as a decision support tool for nutrient management (Iftikar *et al.* 2010) [5]. The GIS can be used in producing a soil fertility map of an area, which will help in formulating site specific balanced fertilizer recommendation and to understand the status of soil fertility spatially and temporally (Ravi kumar *et al.* 2007) [13]. The integrated use of GPS and GIS makes the results to be used for the recommendation of soil test-based fertilizer recommendation which can effectively reduce the total cost of cultivation for farmers' community (Kashiwar *et al.* 2018) [7]. Soil nutrient status of Rice soils of Guntur district (Sudha Rani and Jayasree 2014) [19] Tarakllu Village (Sashikala *et al*., 2021) [17] nutrient status of Nizamabad (Madhavi *et al*., 2014) [9] were mapped and were utilized for different purpose, Such site-specific recommendations are not available for Guduru village of Ranga Reddy district of Telangana with low rainfall associated with low crop productivity. Hence, the present

investigation was planned and executed with the objective of identifying available nutrient status in the soils of Guduru village of Ranga Reddy district of Telangana.

## Materials and methods

A total of 400 surface composite soil samples (from every farm holding) were collected using global positioning system in the study area. The location of site and sampling points are given in Fig. 1. The soil samples were air-dried, ground and sieved with 2 mm sieve and analyzed for physico-chemical and fertility parameters. The pH (1:2.5) and EC (1:2.5) of soils were measured by standard procedures as described by Jackson (1973) [6]. Organic carbon (OC) was determined using the Walkley-Black method (Nelson and Sommers 1996) [10]. Available potassium (K) was determined using the ammonium acetate method (Helmke and Sparks 1996) [4]. Available phosphorus (Olsen P) was measured using sodium bicarbonate ($NaHCO_3$) as an extractant (Olsen and Sommers 1982) [11]. Available nitrogen (N) was estimated by alkaline permanganate method (Subbiah and Asija 1956) [18]. Thematic maps of soil N, P, K, OC, EC and pH were prepared under GIS environment.

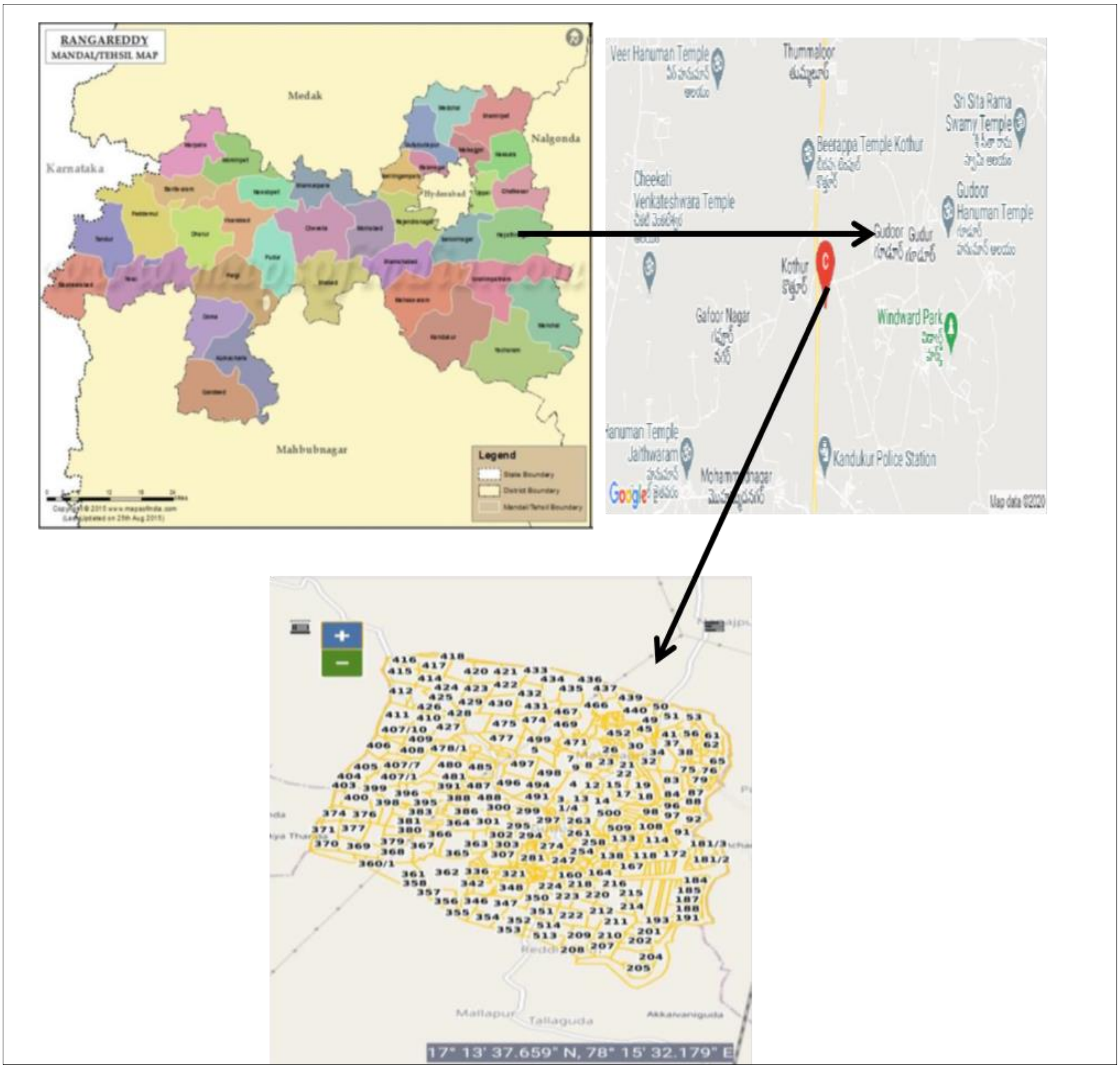



**Fig 1:** Location map of Guduru village

## Results and discussion

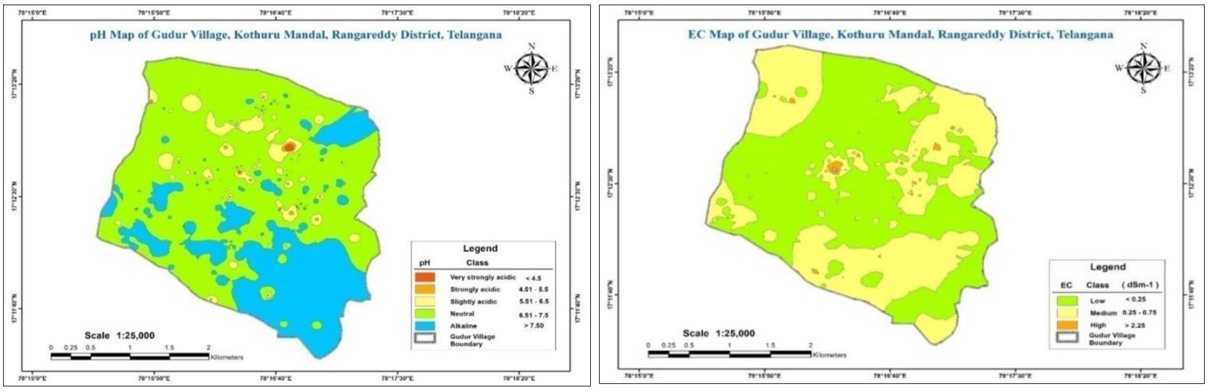
### Soil reaction and electrical conductivity

Soils of the Guduru village were extremely acidic to strongly alkaline (4.04 to 8.07) in reaction with a mean pH of 7.19, standard deviation (SD) of 0.81 and coefficient of variation (CV) of 11.217 % (Table 1). The CV of soil pH indicates that spatially it did not vary significantly. Mapping of soil pH by GIS technique resulted in eight soil reaction classes (Fig. 2, a) *viz.*, Extremely acidic (<4.5), strongly acidic (4.6-5.2), moderately acidic (5.3-5.9) slightly acidic (6.0-6.5), neutral (6.6-7.3), slightly alkaline (7.4-7.8), moderately alkaline (7.9-8.4) and strongly alkaline (8.5-9.0). Major soils of the Guduru village were neutral (63.9%) followed by slightly alkaline (13.7%), moderately alkaline (13.0%), highly alkaline (8.0%) and slightly acidic (1.4%), respectively.

**Table 1:** Physicochemical properties and available major status in Guduru village

| | pH (1:2.5) | EC (dS/m) | OC value (%) | Available N (kg/ha) | Available P (kg/ha) | Available K (kg/ha) |
|---|---|---|---|---|---|---|
| SD | 0.81 | 0.20 | 0.28 | 60.08 | 53.43 | 205.25 |
| Minimum | 4.04 | 0.02 | 0.03 | 4.00 | 4.30 | 40.70 |
| Maximum | 8.87 | 1.26 | 2.98 | 393.9 | 310.10 | 972.90 |
| Average | 7.19 | 0.25 | 0.51 | 155.9 | 78.80 | 323.30 |
| CV % | 11.217 | 81.9403 | 54.808 | 38.452 | 67.792 | 63.487 |

Around 64.5% of soils were neutral in reaction. A total of 142 soil samples of Guduru village are alkaline soils, and remaining soil are neutral in pH. The lowest value of pH under the cultivated soils may be due to depletion of basic cations during crop harvest and drainage to streams through run-off by accelerated erosion. The EC of soils in Guduru village (Fig. 2, b) was in the range of 0.02 to 1.26 dS $m^{-1}$ with a mean of 0.25 dS m-1 and standard deviation of 0.20. The coefficient of variation (81.94%) for EC values indicated that salt content in Guduru village varied spatially. The 77 soil samples of Guduru village were low in salts and remaining samples are medium in salts. Slightly higher level of soluble salts in the study area can be attributed to semi-arid climatic condition. Soluble salt content in the study area revealed that the soils were non-saline**.** Similar views were expressed by Reddy and Naidu (2016) [14] in Chennur mandal of Kadapa district in Andhra Pradesh.




**a) Soil pH** **b) Electrical Conductivity**

**Fig 2:** Spatial variability of soil reaction in Guduru village

**Organic Carbon**

The OC content in soils of Guduru village varied from 0.03 % to 2.28 % with a mean and standard deviation values of 0.51 and 0.28, respectively. The CV of 54.808 % for OC content indicated that in the Guduru village OC content varied spatially (Table 1) & (Fig. 3). Mapping of OC by GIS revealed that 42.5% soils of the village were low in organic carbon content, 30.5 % were medium and only 12 % of the study area was high in OC content. The low OC content in these soils may be attributed to the prevalence of semi-arid condition, where the degradation of organic matter occurs at a faster rate coupled with little or no addition of organic manures and low vegetation cover on the fields, thereby leaving less chances of accumulation of OC in the soils (Vedadri and Naidu 2018; Supriya *et al.* 2019) [21, 20].

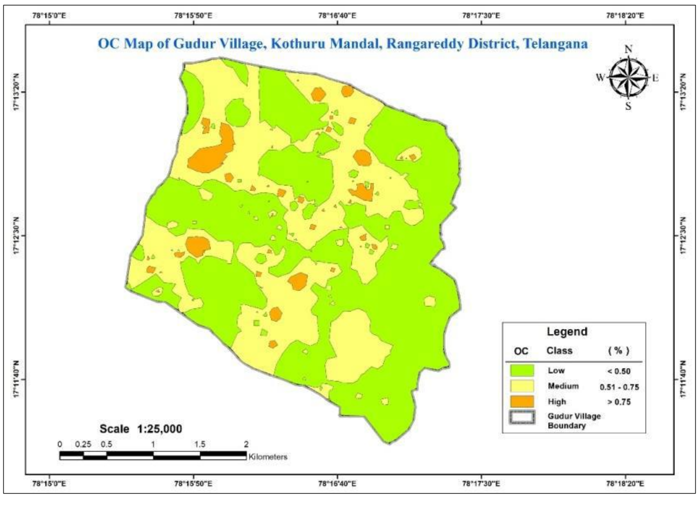



**Fig 3:** Spatial variability of Organic carbon (%) status in Guduru Village

**Available Macronutrients**

The available N in surface soils of the Guduru village varied from 40 to 393.9 kg $ha^{-1}$ with a mean of 155.9 and SD of 60.08. The CV value of 38.45 % indicates that available N in soils varied spatially (Table 1). Mapping of available N by GIS revealed that soils of the village were low in available N (Fig

4). Only 2.75 % of the soils are having medium available N. The low available N could be attributed to soil management, varied application of FYM and fertilizers to previous crops. Another possible reason may be due to low organic matter content in these areas due to low rainfall and high temperature which facilitate faster degradation and removal of organic matter leading to N deficiency (Kumar and Naidu 2012) [8].

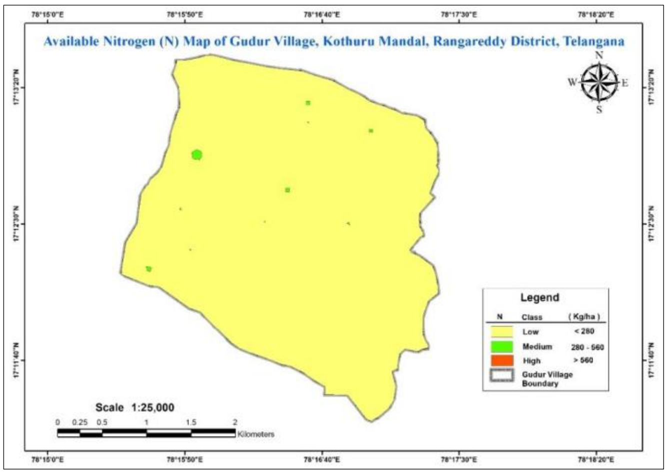



**Fig 4:** Spatial variability of available Nitrogen (kg/ha) of Guduru Village

The available P content in the soils of Guduru village ranged from 4.3 to 310.1 kg $P_2O_5$ $ha^{-1}$with an average and SD values of 78.8 and 53.43, respectively. The CV of 67.79 % for available P distribution in the village indicates that it varied spatially (Table 1). 49.75 % of the soils were high in available P, 35 % of the soils were medium in available P and 4.75 % were high in available P (Fig. 5). Semi-arid environment with low rainfall and continuous use of high analysis fertilizers especially di ammonium phosphate (DAP) without considering the crop requirement resulted in P build-up and high available P status in these soils (Sathish *et al.*, 2018).

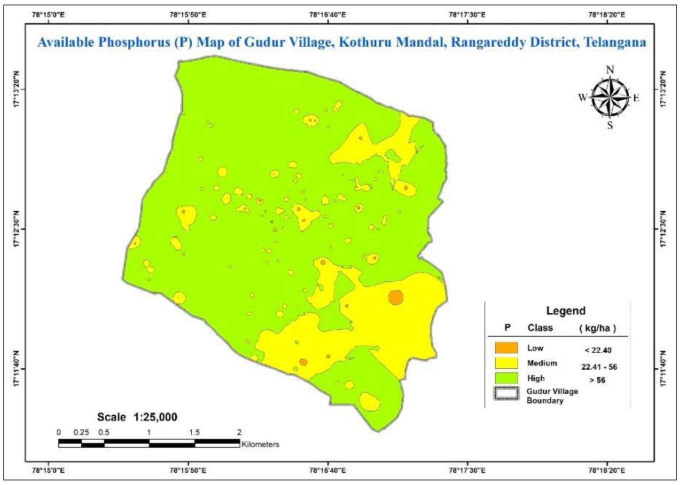



**Fig 5:** Spatial variability of available Phosphorus (kg/ha) in Guduru Village

The available K in surface soil samples ranged from 40.7 to 972.9 kg $K_2O$ $ha^{-1}$ with mean and SD values of 323.3 and 205.25, respectively. The CV of 63.487 for available K indicates that it varied spatially in the study area (Table 1). About 47.25 % samples of the study area was medium in available K, 33.75 % was high and 13.5 % was low in available K (Fig 6). Soils were able to maintain a sufficient or even high level of exchangeable K for supplying K to plants for a long time. The medium to higher content of available K in soils may be due to the predominance of K-rich mica and feldspars in the parent material (Devi *et al*., 2015) [2].

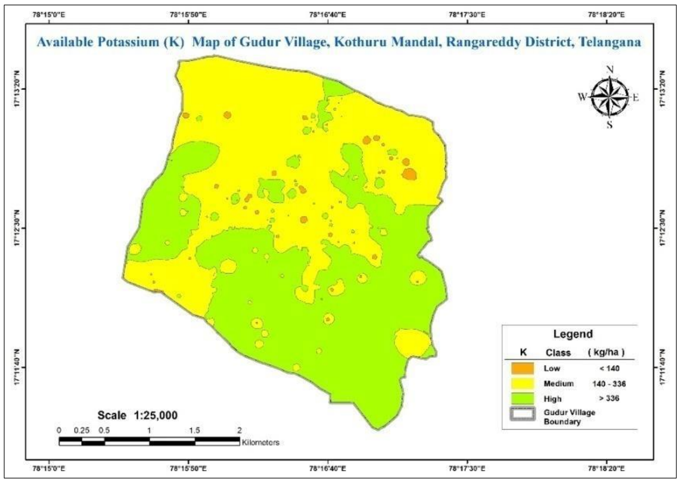



**Fig 6:** Spatial variability of available Potassium (kg/ha) in Guduru Village

## Conclusion

The soils of Guduru village were neutral to alkaline in reaction non-saline, low to medium in organic carbon. The soils were low in available N and low to high in available P, medium to high in available K. The area's of alkalinity requires immediate attention for correct management in order to prevent further degradation. Available N in the soils was low and requires prompt attention. Soil health cards were prepared and were distributed to farmers with due training in interpretation of the results. Hence, judicious application of organic manures in combination with inorganics will not only help to achieve sustainable crop yields, but will also help to maintain soil health. About 49.75 % samples are high in P and 33.75 % samples are high in K

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