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# GPS-GIS based soil fertility maps of micronutrient status of Chandgad tehsil of Kolhapur district (M.S.)

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**Abstract**
The present study was conducted during the year 2015-2016 with an objectives to assess the micro nutrients status of soils of Chandgad tehsil of Kolhapur district and delineate GPS - GIS based soil fertility maps and to correlate soil properties with available nutrients. One hundred and fifty four geo-referenced soil samples were collected from study area using GPS. The DTPA extractable iron, manganese, zinc and copper in soils ranged from 4.58 to 33.74, 2.32 to 30.92, 0.66 to 3.52 and 0.27 to 8.39 mg $kg^{-1}$, respectively. Soils were sufficient in available iron, manganese, copper and zinc. The pH, EC and $CaCO_3$ showed significant negative correlation with zinc, manganese and copper. Organic carbon was positively correlated with iron, zinc and manganese.

**Keywords:** Soil fertility maps, geographical information system, global positioning system

## Introduction
Generally, quantity and distribution of micro nutrients in soils depends upon the parent materials, organic matter, pH, mineralogy, soil forming processes, drainage, vegetation, anthropogenic and natural processes Micronutrients though required in small quantities are very important in crop production. The deficiencies of some micronutrients are emerging fast with increase in area under intensive cropping and imbalance use of high analysis fertilizers. The information on micro nutrient status of Chandgad tehsil based on "GPS-GIS" studies is very limited, therefore the present study was undertaken for delineating the micronutrient status of tehsil which can be used for ensuring balanced fertilization to crops by the farmers and planners.

## Material Method
Chandgad tehsil of Kolhapur district was selected to assess the soil macro and micro nutrient status and delineate the fertility map, 77 villages were selected randomly in such a way that it covers the whole area of the tehsil. One hundred and fifty four representative soil samples were collected from sixty six villages of Chandgad tehsil along with GPS reading.

### Collection and processing of soil samples
Seventy seven villages from Chandgad tehsil were selected for sampling keeping in mind to avoid overcrowding of sampling site on GPS based soil fertility map. Geo-referenced surface (0-22.5) cm soil samples from each selected villages representing different soils were collected. The latitude and longitude of sampling sites were recorded with the help of differential Global Positioning system with detailed observation on cropping pattern and fertilizer use. The soil samples were collected with the help of wooden peg. The samples were air dried and ground using wooden mortar and pestle and passed through 2.0 and 0.5 mm sieves. The sieved soil samples were stored in cloth bags with proper labeling for subsequent analysis. The samples were analysed for pH, EC, $CaCO_3$, and OC were estimated by adopting standard procedure. The DPTA extractable micronutrients (Fe, Mn, Zn and Cu) were analysed by adopting Spectrophotometry (Lindsay and Norvell, 1978). Soil fertility maps were prepared by using GPS reading and fertility maps of soils were prepared by employing Arc GIS 9.3 software.

## Result and Discussion

The results of the study area are presented and discussed as follows.

### Soil reaction (pH), EC (Electrical conductivity) and per cent $CaCO_3$ eq.

The soils of Chandgad tehsil were found strongly acidic to slightly alkaline in reaction, pH ranged from 5.01 to 7.21. The EC of the soil ranged from 0.04 to 0.70 dS $m^{-1}$.

The Organic carbon content in the soils were categorized as low (24.02%), moderate (24.03 %) moderately high (21.42%) high (19.50 %) and very high (11.03 %) which ranged from 0.31-1.12 per cent.

The per cent calcium carbonate eq. content in soils ranged from 0.51 to 3.07 and soils were categorized as 33.77 per cent samples were barely calcareous, 50 per cent samples were slightly calcareous and 16.23 per cent samples were moderately calcareous. The low calcium carbonate content was may be due to low temperature, porous nature of soil, heavy rainfall, erosion, rapid leaching down of soluble salts and soils basic cations.

**Table 1:** Overall mean, range of soil properties and nutrient status in soil samples of Chandgad tehsil

| Particulars | Range | Mean |
|---|---|---|
| pH | 6.02 | 5.01 – 7.21 |
| EC (dS $m^{-1}$) | 0.14 | 0.04-0.70 |
| $CaCO_3$ (%) | 1.38 | 0.51 -3.07 |
| O.C. (%) | 0.64 | 0.31-1.12 |
| Fe (mg $kg^{-1}$) | 18.49 | 4.58 – 33.74 |
| Mn (mg $kg^{-1}$) | 25.06 | 2.32 – 30.92 |
| Zn (mg $kg^{-1}$) | 1.69 | 0.66 – 3.52 |
| Cu (mg $kg^{-1}$) | 2.84 | 0.27 - 8.39 |

### DTPA extractable zinc

The DTPA extractable Zn ranged from 0.66 to 3.52 mg $kg^{-1}$ with the mean value of 1.69 mg $kg^{-1}$. All the soils showed sufficient amount of Zn content, which is above critical level 0.6 mg $kg^{-1}$ (Katyal, 1985) [3]. It might be due to the good cultivation practices, addition of micronutrients in soils and low pH of soil and parent material might be containing zinc bearing minerals. Similar results were recorded by Haribhushan (2013) [2].

### DTPA extractable iron

The DTPA extractable Fe ranged from 4.58 to 33.74 mg $kg^{-1}$ with the mean value of 18.49 mg $kg^{-1}$(sufficient). All the soils showed sufficiency in iron content, that is above critical level (4.5 mg $kg^{-1}$) Takkar *et al* (1989) [8]. The sufficiency of available iron might be due to high organic matter content and leaching of base where as deficiency might be due to excess of phosphorus in soil. Gupta *et al*, (2003) [1] also reported the similar results in some soil series of Northern Madhya Pradesh.

### DTPA extractable manganese

The data reported in table 1 showed that, DTPA extractable Mn ranged from 2.32 to 30.92 mg $kg^{-1}$ with the mean value of 25.06 mg $kg^{-1}$(sufficient). All the soils showed sufficiency in Mn content above critical level (2.0 mg $kg^{-1}$) (Takkar *et al*, 1989) [8]. The sufficiency of manganese in soils might be due to the higher amount of ferro magnesium content and optimum soil moisture content. Similar results were also recorded by Thakre *et al* (2013) [9].

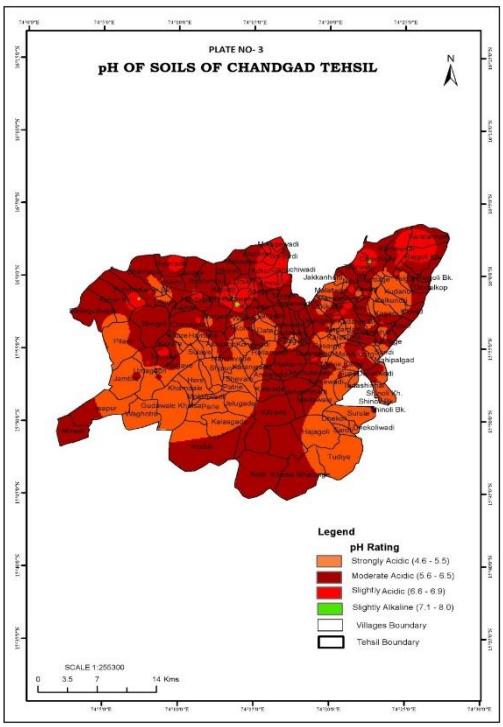
### DTPA extractable copper

The data presented in table 1 showed that, DTPA extractable Cu ranged from 0.27 to 8.39 mg $kg^{-1}$ with the mean value of 2.84 mg $kg^{-1}$ and all soil samples are sufficient in copper in soil. Cu content of soil is above critical level i.e. 0.2 mg $kg^{-1}$ (Katyal and Randhva, 1983) [4]. The DTPA extractable copper were above critical level in Jintur tehsil soils of parbhani district was reported by Mandavgade (2015) [6].

**Correlation:** The negative correlation of available Fe with soil pH and $CaCO_3$ indicated that there was a precipitation of available iron into insoluble products which supports the classical phenomenon of lime induced iron deficiency. A negative correlation of available zinc with pH, organic carbon and $CaCO_3$ but it was positively correlated with EC (r = 0.119). The available Mn and Cu was significantly negatively correlated with pH, Organic carbon and $CaCO_3$. Similar results were also reported by Sharma *et al* (2003) [7].

**Table 2:** Correlation of DTPA Extractable micronutrients content in soils of Chandgad tehsil

| Available nutrients | Physico - chemical properties | | | |
|---|---|---|---|---|
| | pH | EC | OC | $CaCO_3$ |
| Fe | -0.120 | -0.163* | -0.129 | -0.069 |
| Zn | -0.022 | 0.119 | -0.001 | -0.006 |
| Mn | -0.030 | -0.020 | -0.015 | -0.067 |
| Cu | -0.042 | 0.033 | -0.086 | -0.066 |



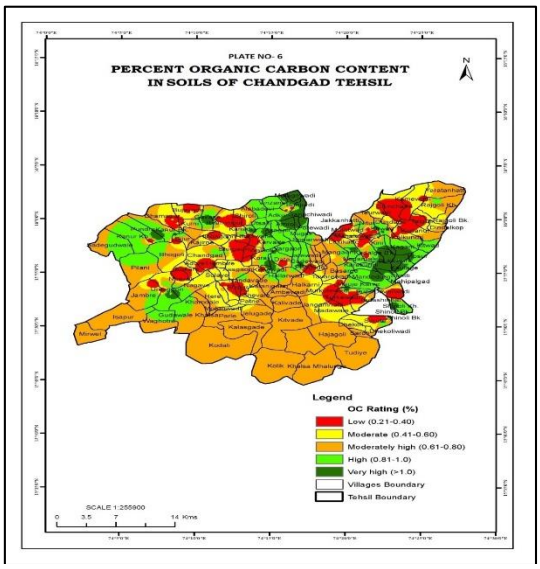


PLATE NO- 6
PERCENT ORGANIC CARBON CONTENT
IN SOILS OF CHANDGAD TEHSIL
N
Legend
OC Rating (%)
Low (0.21-0.40)
Moderate (0.41-0.60)
Moderately high (0.61-0.80)
High (0.81-1.0)
Very high (>1.0)
Villages Boundary
Tehsil Boundary
SCALE 1:255900
0 3.5 7 14 Kms

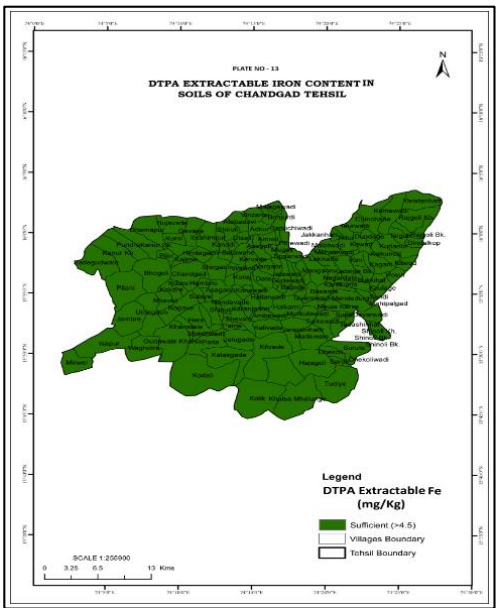


PLATE NO - 13
DTPA EXTRACTABLE IRON CONTENT IN
SOILS OF CHANDGAD TEHSIL
N
Legend
DTPA Extractable Fe
(mg/Kg)
Sufficient (>4.5)
Villages Boundary
Tehsil Boundary
SCALE 1:255900
0 3.25 6.5 13 Kms

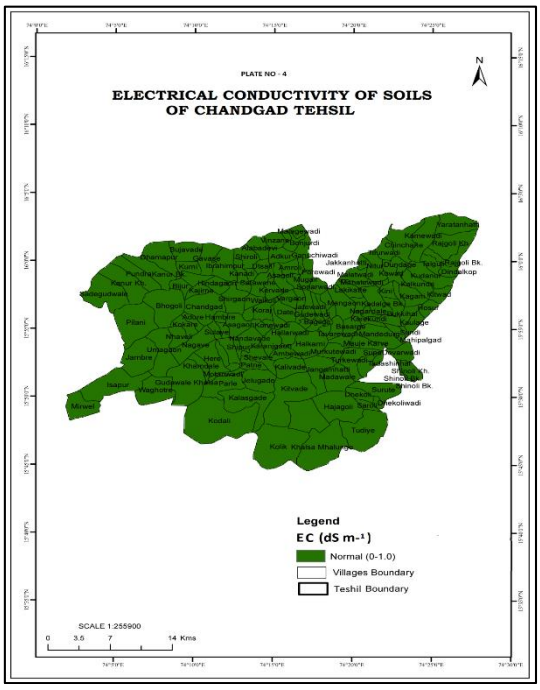


PLATE NO - 4
ELECTRICAL CONDUCTIVITY OF SOILS
OF CHANDGAD TEHSIL
N
Legend
EC (dS m-1)
Normal (0-1.0)
Villages Boundary
Teshil Boundary
SCALE 1:255900
0 3.5 7 14 Kms

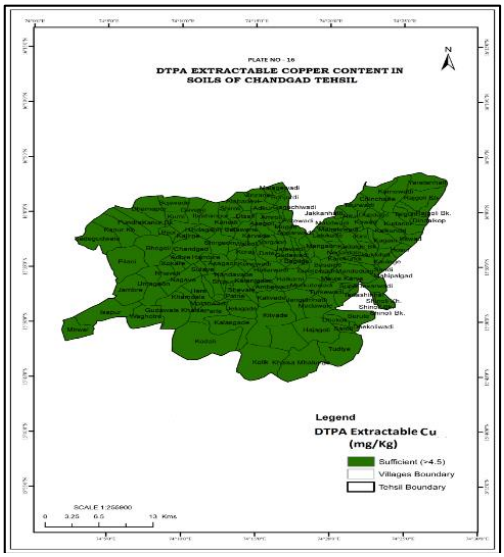


PLATE NO - 16
DTPA EXTRACTABLE COPPER CONTENT IN
SOILS OF CHANDGAD TEHSIL
N
Legend
DTPA Extractable Cu
(mg/Kg)
Sufficient (>4.5)
Villages Boundary
Tehsil Boundary
SCALE 1:255900
0 3.25 6.5 13 Kms

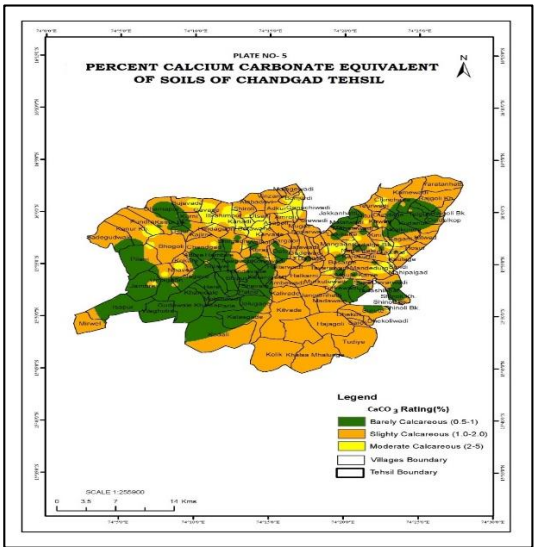


PLATE NO- 5
PERCENT CALCIUM CARBONATE EQUIVALENT
OF SOILS OF CHANDGAD TEHSIL
N
Legend
CaCO3 Rating(%)
Barely Calcareous (0.5-1)
Slighty Calcareous (1.0-2.0)
Moderate Calcareous (2-5)
Villages Boundary
Tehsil Boundary
SCALE 1:255900
0 3.5 7 14 Kms

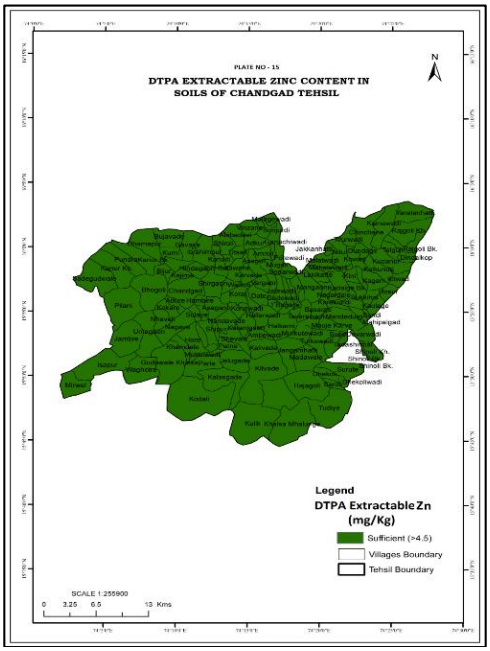
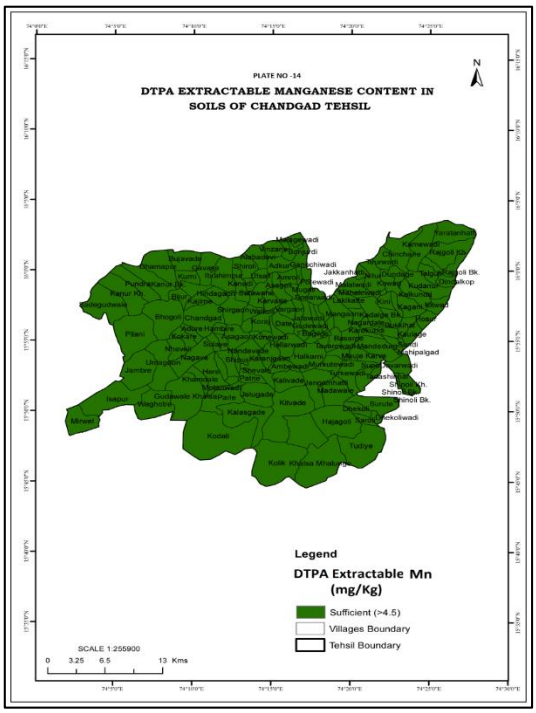


PLATE NO - 15
DTPA EXTRACTABLE ZINC CONTENT IN
SOILS OF CHANDGAD TEHSIL
N
Legend
DTPA Extractable Zn
(mg/Kg)
Sufficient (>4.5)
Villages Boundary
Tehsil Boundary
SCALE 1:255900
0 3.25 6.5 13 Kms



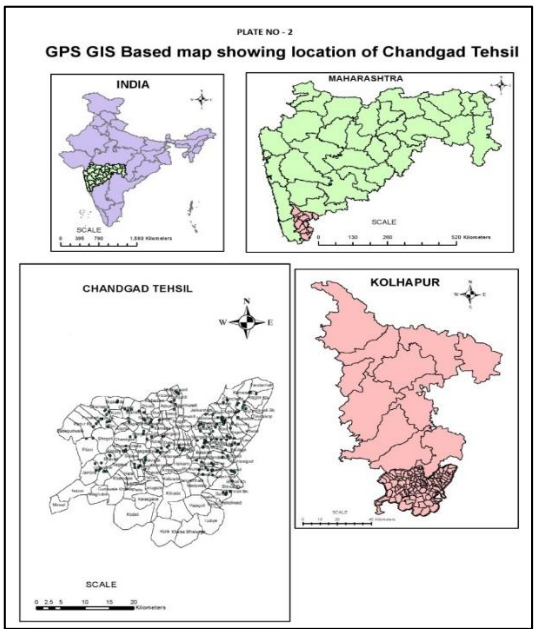




**Fig 1:** GPS-GIS based soil fertility maps of Chandgad tehsil of Kolhapur district of Maharashtra state.

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