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GPS Based Soil Fertility Maps Of Secondary And Micro Nutrients Of Village Baragaon Nandur, Dist- Ahmednagar Of State-Maharashtra

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ABSTRACT

The present study entitled, "GPS based soil fertility map of Village BaragaonNandur, Taluka Rahuri, Dist-Ahmednagar (M.S)", was carried out during the year 2015-16 at the Department of Soil Science and Agricultural Chemistry, Post Graduate Institute M.P.K.V. Rahuri. The soil fertility maps were prepared by using Global Positioning System (GPS) to make awareness among the farmers regarding use of balanced fertilization according to soil test based recommendation and integrated nutrient management for higher and sustainable crop production. The geo-referenced surface soil (0-22.5 cm) samples were collected from Village Baragaon Nandur by using Differential Global Positioning System (D-GPS).The grid soil sample at 200m apart were carried out and the soil samples from each point was collected.Total 104 soil samples were collected from every grid spot located on cadastral map. The exchangeable calcium and magnesium content in soils ranged from 22.21 to 37.30 and 9.03 to 19.60 [cmol (p+) kg^{1}]; respectively. The exchangeable calcium was 100 per cent sufficient and only 5.77 per cent area found deficient in exchangeable Magnesium. The available Sulphur in soils were ranged from 6.5 to 29.75 mg kg^{-1}. Only 41.34 percent area were found deficient. The available iron, manganese, zinc and copper were ranged from 2.00 to 6.08, 1.22 to 3.87, 0.24 to 1.86 and 1.09 to 4.42 mg kg^{-1}; respectively. All the soils samples were sufficient in available copper whereas, 67.30, 3.85 and 64.42 percent area were deficient in available iron, manganese and zinc respectively, in soils of Village BaragaonNandur. These maps will be helpful for the farming community of the study zone to use properly the secondary nutrients and micro nutrients for different crops thereby saving costly inputs with increase in production, productivity, crop quality.

Key words : GPS, GIS, Ca, Mg, S, Fe, Mn, Zn and Cu

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INTRODUCTION

Soils are considered as the integral part of the landscape and their characteristics are largely governed by the landforms in which they are developed. Topographic maps, aerial photographs and remote sensing data provide useful tools for geomorphic analysis of the region and help in the soil survey and mapping (Pandey and Pofali, 1982). The remote sensing techniques in conjugation with conventional methods have been employed successfully in India and different parts of the world (Sehgal *et al*., 1988).

The life supporting systems of a country and socio-economic development of its people depends on the soils. More than ever before, a renewed attention is being given to soils due to rapidly declining land area for agriculture, declining in soil fertility and increasing soil degradation, land use policies and irrational and imbalanced use of inputs (Kanwar, 2004). All the above factors call for a paradigm shift in research away from the maximum crop production to the sustainability of the crop production system without degradation of soil health and environmental quality. Systematic study of morphology and taxonomy of soils provides information on nature and type of soil, their constraints, potential, capabilities and their suitability for various uses (Sehgal, 1996).

Soils of Maharashtra State have been broadly classified as 1) The laterites and lateritic soils 2) The costal saline and costal alluvium soils 3) Shallow medium and deep black soil 4) Gray and red soils of mixed parent materials and 5) Saline, saline-alkaline and non-saline-alkaline soils (Raychaudhari and Chakravarty, 1943).

Soil is a vital natural resource and should be used judiciously according to its potential to meet the increasing demands of ever growing population. To ensure optimum agricultural production, it is imperative to know best fact about our soils and their management to achieve sustainable production. The quality of soil needs to be looked into because presently the natural resources are being over exploited. Soils of Maharashtra State are categorized as poor in fertility and vary widely in genetic, morphological, physical, chemical and biological characteristics (Challa*et al*., 1995). The nutrient deficiencies started appearing in different areas due to introduction of intensive production systems after green revolution period. It is due to net removal rates of micronutrients by crops being higher under intensive productivity regimes (Kanwar, 2004). The nutrient deficiencies situation was further increased by the discontinuous and diversified use of organic manures and chemical fertilizers.

Availability of micronutrients in soil depends upon various factors like soil, environment, crop situations and their management. Soil reaction, texture, calcium carbonate, parent material, organic matter and mineralogical make up have profound influence on their availability to crops. Micronutrient deficiencies are more encountered on calcareous soils with high pH and low organic matter (Nayyar*et al.,* 1999). The fine textured as well as coarse calcareous black soils are more prone to deficiency of zinc. The availability of micronutrients are generally low and they are likely to be exhausted soon under exploitative agriculture. It is, therefore, imperative that these nutrients should be timely replenished in order to obtain sustainable agricultural production.

Global positioning system (GPS) and geographical information system (GIS) are advanced tools for studying on site specific nutrient management which can be efficiently used for monitoring soil fertility changes. The geo-referenced nutrient status of soils in Village BaragaonNandur, Taluka Rahuri, Dist-Ahmednagar would be useful for ensuring balanced fertilization to crops that demands the systematic study of macro as well as micronutrients status for assessment of nutrient status of soils to delineation of nutrient deficiency or sufficiency.

STUDY AREA

The Village BaragaonNanduris boundary between region located in between 19° - 21'N latitude and 74°-35' E longitude and covers total geographical area of 3845 ha. The elevation is 500m above mean sea level. The Village BaragaonNandur, is situated about 38 km away from Ahmednagar city.

Soils of VillageBaragaonNanduris derived from the igneous rocks *viz*. Basalt (Deccan trap) which is basic in nature containing mainly feldspars, augite and small amount of titaniferrous magnetite mineral. In the vesicular rocks the any of daloidal cavities are filled with mineral like zeolite and quartz.

The soils of Village BaragaonNandurare under the cultivation of Jowar, Bajara, Wheat, Gram, Pigeon Pea, Soybean, Black Gram, Safflower, Sugarcane and Cotton crops. The natural vegetation grown comprises of dry deciduous tree species and some grasses. The dominant tree species are *Acasiaarabica, Azadirachtaindica, Zizyphusjujuba, Mangiferaindica, Prosopisjuliflora, Typhaangustata.*

The climate is usually hot and potential evapo-transpiration (PET) is far excess of the precipitation and is classified as semi-aired tropical. Village BaragaonNandur, Taluka Rahuri, Dist- Ahmednagar experience a hot spell from the month of March and May, with rains from June to September. The mean annual maximum and minimum temperatures were ranged from 32.9^{0}C and 18.8^{0}C, respectively. The VillageBaragaonNandur has annual precipitation of 517.8 mm. The rainfall is torrential, erratic, scanty and ill distributed.

MATERIALS AND METHODS

Geo-referenced surface (0-22.5cm) soil samples representing different survey numbers were collected from Village BaragaonNandur. The latitude, longitude and altitude of sampling sites were recorded with the help of Differential Global Position System, while sampling from each site following procedure were taken into account-

1. The grid soil sample at 200m apart were carried out and the soil samples from each point was collected.
2. Total 104 soil samples were collected from every grid spot located on cadastral map.
3. Recorded of surveyed fields, latitude, longitude and altitude was maintained.
4. The data on crops and use of fertilizers and manures were also recorded.
5. The soil samples from selected site were collected by using stainless steel auger to avoid iron contamination.

Soil samples were brought to the laboratory and air dried under shade avoiding contamination with foreign materials and then crushed with a wooden pestle. The sample is then screened through a 2mm sieve and the pebbles, stones and roots were rejected. About 0.5 to 1kg of air dried crushed soil sample was put in the plastic sample bottle, lebelled and stacked on the open sample racks for analysis. The analysis of soil samples have been done by using standard methods i.e.Ca and Mg (Versanate titration method), Available Sulphur (0.15% $CaCl_2$ extractable) Micronutrients (Atomic Absorption

Spectrophotometer),. Polygons were superimposed on the geo-referred map. Latitude, longitude and analysis data were entered into attributed table and linked to Arc GIS software for making thematic soil fertility maps.

Standard analytical methods used for chemical properties of soil

Sr. No.	Parameters	Method used	Reference
Soil analysis			
1.	Exchangeable Ca^{2+}, Mg^{2+}	Versenate titration	Page (1982)
2.	Available S	0.15% $CaCl_2$ extractable	Williams and Steinbergs (1969)
3.	Available (Fe,Mn,Zn and Cu)	Atomic Absorption Spectrophotometer	Lindsay and Norvell (1978)

RESULTS AND DISCUSSION

The results of the present investigation entitled, "GPS based soil fertility maps of Village BaragaonNandur, Taluka Rahuri, Dist- Ahmednagar (M.S)", carried out during the year 2015-2016 with the view to study the nutrient status of soils of Village BaragaonNandur are presented and discussed in this chapter under following subheads.The 104 soil samples collected were analyzed and the data pertaining to different parameters are categorized as per the critical limit .The chemical properties and the status from 104 soil sample are presented and discussed under following subheads.

Table 1:Status of exchangeable Ca, Mg, and available S in soils of VillageBaragaonNandur

Particular	Exchangeable Ca [Cmol (p^+) kg^{-1}	Exchangeable Mg [Cmol (p^+) $kg^{-1]}$	Available Nutrients (mg kg^{-1}) S (mg kg^{-1})
Mean	28.08	13.98	14.20
Range	22.21-37.30	9.03-19.60	6.5-29.75
Category	Sufficient (100%)	Deficient (5.77%)	Deficient (41.34%)
		Sufficient (94.23%)	Sufficient (58.66%)

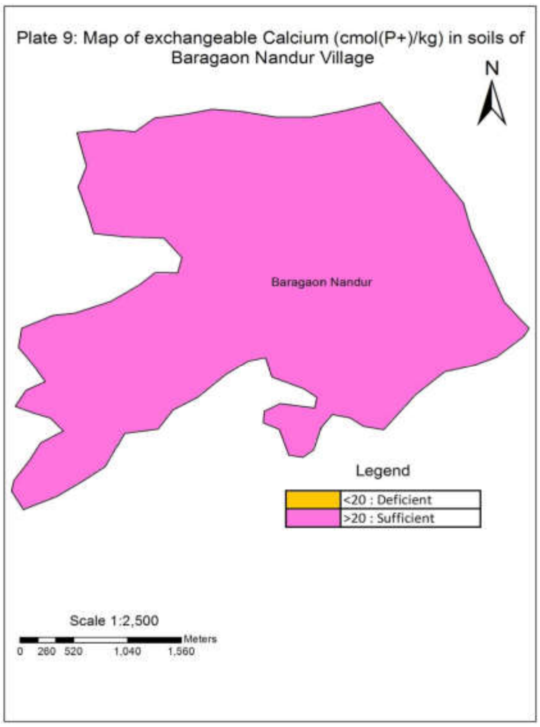


Plate 9: Map of exchangeable Calcium (cmol(P+)/kg) in soils of Baragaon Nandur Village

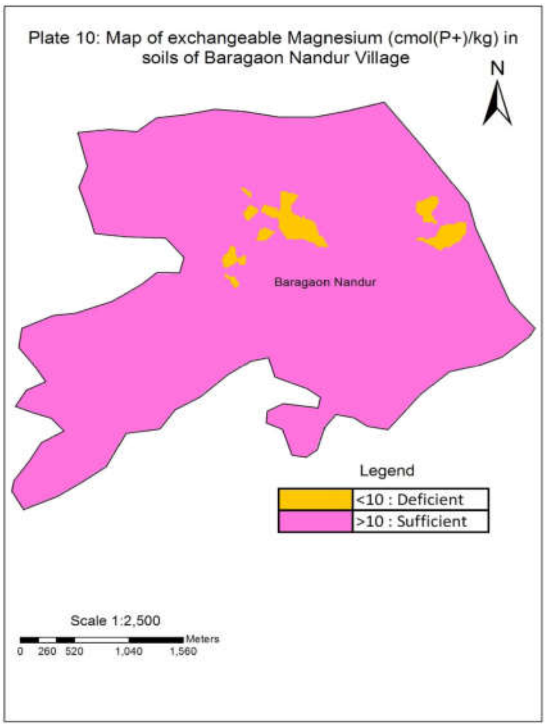
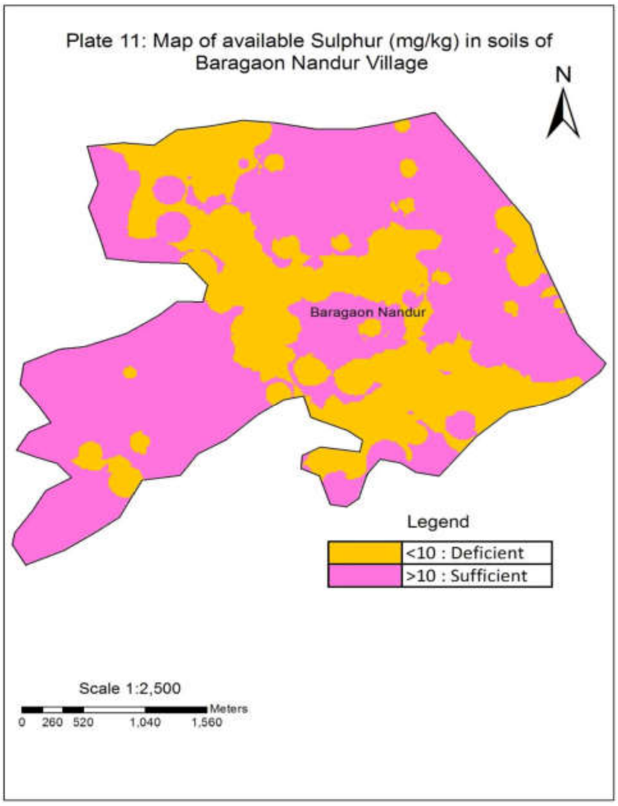


Plate 10: Map of exchangeable Magnesium (cmol(P+)/kg) in soils of Baragaon Nandur Village



Exchangeable calcium

The data in respect of exchangeable calcium status in soils of Village BaragaonNandur are presented in table 1 and depicted on map (Plate 9). The exchangeable calcium in soils of Village BaragaonNandur was ranged from 22.21 to 37.30 [cmol (p+) kg^{-1}] with an average of 28.08 [cmol (p+) kg^{-1}]. The highest exchangeable calcium was 37.30 [cmol (p+) kg^{-1}] (19°21.696N-0.74°37.468E) and the lowest was 22.21 [cmol (p+) kg^{-1}] (19°22.978N-0.74°37.080E). All the 104 soil samples collected were sufficient in exchangeable calcium, as the critical limit of exchangeable calcium is 20 [cmol (p+) kg^{-1}] (Durgude, 1999). The calcareous nature of study soils may explain the sufficiency in the exchangeable calcium (>20 cmol (p+) kg^{-1}). Chinchmalatpure*et al*. (1998) reported similar explanation for exchangeable calcium content in soils of North Western part of Nagpur District and also by Mandal *et al*. (2005) in soils of Nagpur District.

Exchangeable magnesium

The data in respect of exchangeable magnesium status are presented in table 1 and depicted on map (Plate 10). The exchangeable magnesium in soils of Village BaragaonNandur was ranged from 9.03 to 19.60 [cmol (p+) kg^{-1}] with an average of 13.98 [cmol (p+) kg^{-1}]. The highest exchangeable magnesium was 19.60 [cmol (p+) kg^{-1}] (19°21.369N-0.74°36.375E) and the lowest was 9.03 [cmol (p+) kg^{-1}] (19°22.605N-0.74°36.645E). Out of total soil samples collected, 94.23 per cent soil samples were found in sufficient range and 5.77 per cent samples were in deficient range. The critical limit of exchangeable magnesium is 10 [cmol (p+) kg^{-1}] (Durgude, 1999).

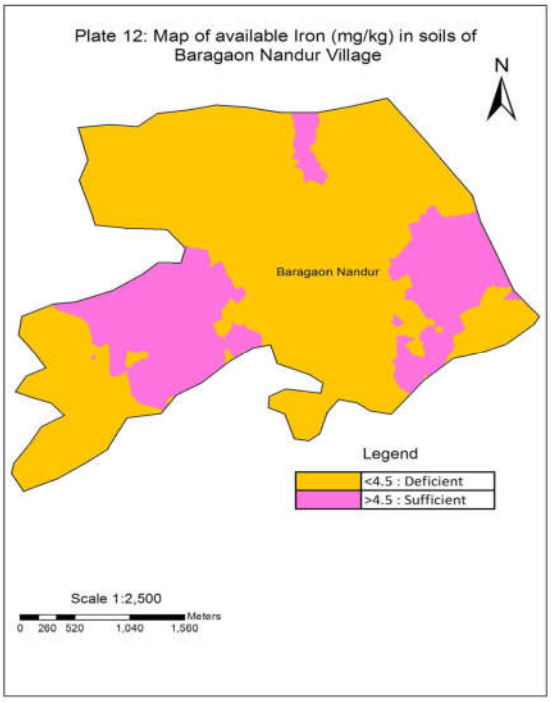
In generalthe exchangeable Mg in soils of Village BaragaonNandurwere sufficient in status however, deficient in only 5.77 per cent, this might be due to antagonistic effect of high status of exchangeable Ca in soil. Similar results were recorded by Mandal *et al*. (2005) in soils of Nagpur District and by Nayak*et al*. (2006) in swell and shrink soils of Vidarbha region.

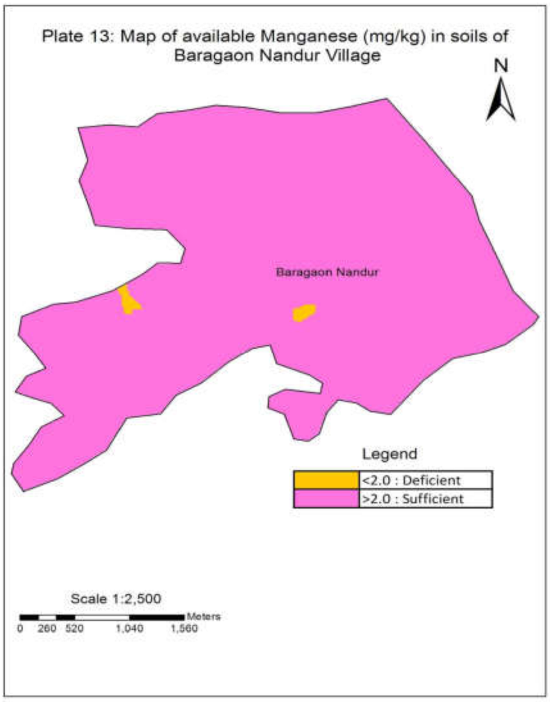
Available sulphur

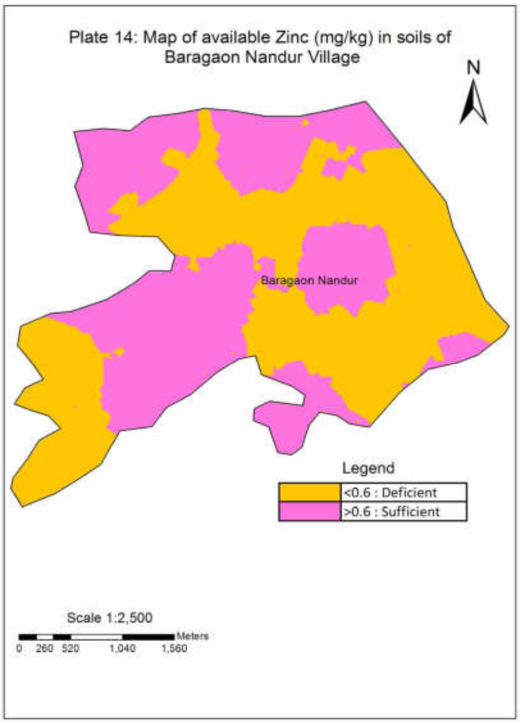
The data on available sulphur are presented in table 1 and depicted on map (Plate 11). The available sulphur in soils of Village Baragaon Nandur ranges from 6.5 to 29.75 mg kg^{-1} with an average of 14.20 mg kg^{-1}. The highest available sulphur was 29.75 mg kg^{-1} (19°22.611N-0.74°36.405E) and the lowest was 6.5 mg kg^{-1} (19°21.696N-0.74°37.468E). In general, the available sulphar status in soils of Village Baragaon Nandur were 58.66 per cent soil samples in sufficient status which might be due to present of sufficient amount of sulphate anions in irrigation water. However 41.34 per cent sample were in deficient status in available sulphur which might be due to high $CaCO_3$ content in soils. The Kanwar (1976) in his studies of relation between organic matter and available sulphur reported sufficiency of available sulphur in soil of moderate to high content of organic matter.

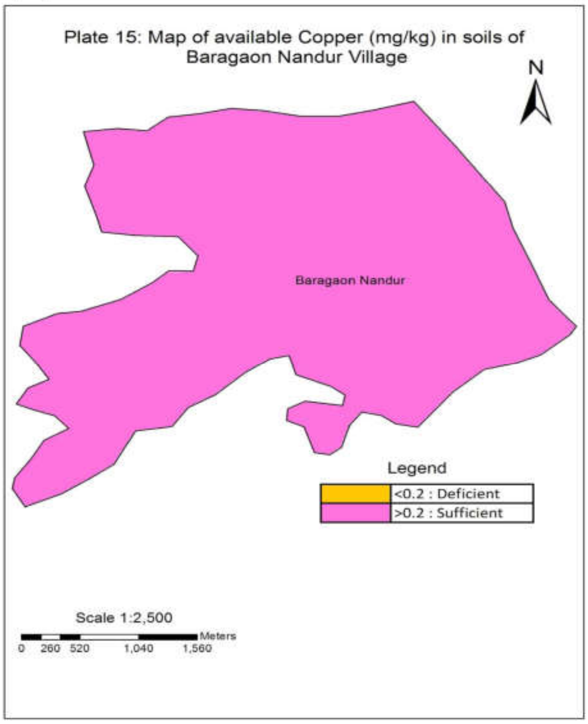
Table 2 Status of DTPA micronutrients in soils of Village Baragaon Nandur

Particular	Available micronutrients (mg kg^{-1})			
	Fe	Mn	Zn	Cu
Mean	4.17	3.10	0.62	2.56
Range	2.00-6.08	1.22-3.87	0.24-1.86	1.09-4.42
Category	Sufficient (32.70%)	Sufficient (96.15%)	Sufficient (35.58%)	Sufficient (100%)
	Deficient (67.30%)	Deficient (3.85%)	Deficient (64.42%)	









Available iron

The DTPA iron values of soils in Village BaragaonNandur are presented in table 2 and depicted on map (Plate 12). The available iron content in soils ranged from 2.00 to 6.08 mg kg^{-1} with an average of 4.17 mg

kg^{-1}. The highest available iron content was6.08 mg kg^{-1} (19°22.330N-0.74°37.223E) and the lowest was 4.17 mg kg^{-1} (19°21.158N-0.74°35.411E).

In general, the available Fe content in soils ofVillage BaragaonNandur, Taluka Rahuri, Dist- Ahmednagar were (32.70) per cent sufficient. The sufficiency of available Fe might be due to high Organic matter content where as deficiency might be due to excess of $CaCO_3$ content in soil.

The similar observation on Fe content was noted by Meena (2009) in soils of Central Research Farm M.P.K.V, Rahuri. Dhage*et al*. (2000) also reported the similar results in soils Shevgaon Tehsil of Ahmednagar District.

Available manganese

The available Mn status of present study soils are presented in table 2 and depicted on map (Plate 13). The available manganese in soils of Village BaragaonNandur was ranged from 1.22 to 3.87 mg kg^{-1} with an average of 3.10 mg kg^{-1}. The highest available manganese was 3.87 mg kg^{-1} (19°22.354N-0.74°35.825E) and the lowest was 1.22 mg kg^{-1} (19°21.620N-0.74°36.532E). Among the 104 soil samples collected in Village Baragaon Nandur (96.15 per cent) were sufficient and (3.85 per cent) deficient in available manganese on the basis of the critical limit of available manganese is 2 mg kg^{-1} (Takkar*et al*., 1989). The sufficiency of available Mn in soils might be due to moderate organic matter content and also due to sufficient amount of carbonates and bicarbonates. The similar observations have been reported by Meena (2009) in soils of Central Research Farm, Central Campus, M.P.K.V, Rahuri andShinde (2007) in soils of Udgir and Deoni Tehsil of Latur District.

Available zinc

The data on available zinc status of soils are presented in table 10 and depicted on map (Plate 14). The available zinc in soils of Village BaragaonNandur was ranged from 0.24 to 1.86 mg kg^{-1} with an average of 0.62 mg kg^{-1}. The highest available zinc was 1.86 mg kg^{-1} (19°21.561N-0.74°35.694E) and the lowest was 0.24 mg kg^{-1} (19°21.745N-0.74°36.940E). Out of 104 soil samples collected, 64.42 per cent soil samples were in deficient category and 35.58 per cent soil sample were sufficient in available zinc, as the critical limit of available zinc is 0.6 mg kg^{-1} (Katyal, 1985). Most of the soils found deficient in available Zn is might be due to continous cultivation of crops and generally deep black soils are deficient Zn in village BaragaonNandurand similarily farmer in this region not practice the regular application of zinc containing fertilizer. This difference between removal of zinc by crops and addition of zinc by the farmer may explain the deficiency of zinc by 64.42 per cent soils of BaragaonNandur Village. Kharche*et al.* (2001) and Waghmare*et al.* (2007) recorded the similar observation on DTPA Zn status in soils of Nashik District and soils of Ausa Tehsil of Latur District of Maharashtra; respectively.

Available copper

The values of available copper are reported in Table 2 and depicted on map (Plate No 15). The available copper in soils of Village BaragaonNandur ranged from 1.09 to 4.42 mg kg^{-1} with average value of 2.56 mg kg^{-1}. The highest available copper was 4.42 mg kg^{-1} (19°21.799N-0.74°37.334E) and the lowest was 1.09 mg kg^{-1}(19°22.330N-0.74°37.223E). All the 104 soil samples collected from Village BaragaonNandur were 100 per cent sufficient in available copper, as the critical limit of available copper is 0.2 mg kg^{-1} (Katyal and Randhawa, 1983). The sufficiency of available copper in present study soils might be due to the high organic matter content and optimum soil moisture content in soils of BaragaonNandur Village.

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