International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 541-549
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Received: 15-09-2018
Accepted: 19-10-2018

Assessment of secondary and micro nutrient status in Hebbalagere micro watershed of Channagiri Taluk, Davanagere district of Karnataka

Harshitha S, Ganapathi, Gurumurthy KT, Mavarkar NS and Soumya TM

Harshitha S
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga, Karnataka, India

Ganapathi
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga, Karnataka, India

Gurumurthy KT
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga, Karnataka, India

Mavarkar NS
Department of Agronomy, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Soumya TM
Department of Agronomy, College of Agriculture, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Correspondence
Harshitha S
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Shivamogga, Karnataka, India

Abstract

An investigation was carried out to study the secondary and micro nutrient status of Hebbalagere micro watershed in Channagiri taluk, Davanagere district of Karnataka during 2017-18. Grid wise one hundred surface soil samples of Hebbalagere micro-watershed were collected, assessed and mapped using GIS technique. Nutrient status maps developed revealed that the exchangeable Ca and Mg were sufficient in the entire study area (1017 ha). Available sulphur content was high in 861 ha (76.20%) and medium in 156 ha (13.74%). Entire micro watershed area (1017 ha) was sufficient in DTPA extractable micronutrients like copper, iron, manganese, while the available zinc was sufficient in 721 ha (63.74%) and deficient in 296 ha (26.21%) area. Available boron was sufficient in entire micro watershed.

Keywords: Micro watershed, assessment, remote sensing, mapping, global information system

1. Introduction

Soil surveys often provide a basis for decisions about the kind and intensity of land management needed, including those operations that should combine for satisfactory soil performance. The kind of soil and its associated characteristics help in determining the length of run, water application rate, soil amendment needs, leaching requirements, general drainage requirements and field practices for maintaining optimum soil conditions for plant growth (Soil survey staff, 2014) [14]. Intensively cultivated soils being depleted with available nutrients especially secondary and micronutrients. Therefore assessment of fertility status of soils that are intensively cultivated with high yielding crops needs to be carried out. Rational utilization of land resources can be achieved by optimizing its use which will demand evaluation of land for alternative land use thus ensuring its sustainable use. Therefore, increased emphasis is given for characterization of soils in their evaluation and precise mapping using remote sensing and GIS.

2. Material and methods

The Hebbalagere micro watershed lies in Channagiri taluk, Davangere district of Karnataka with latitude and longitude extending from 13°59'53.34"N to 14°2'31.20"N and 76°0'23.62"E to 76°1'26.83"E respectively. Total area of Hebbalagere micro-watershed was found to be 1131 ha out of which 1017 ha (89.94%) area was considered for study and 114 ha (10.06%) area was covered under habitation and waterbody. The average rainfall in the study area was 655 mm. The survey of India toposheet (57 A/6) was used to prepare base maps covering Hebbalagere micro-watershed. The cadastral map having parcel boundaries with survey numbers were produced from KSRSAC, Bangalore were used for the study. The survey of India toposheet (57A/6) with 1:50,000 scale was used along with the satellite imagery for updating the base map. Grid sampling (0 – 15 cm depth) was done in the study area by imposing grids of 320 × 320 m intervals in the micro-watershed with 1:7,920 scale. A total of 100 surface soil samples were collected from the fixed grid points using hand held GPS for studying nutrient status in the micro-watershed.

Soil samples were analysed using standard procedure. Particle size distribution was determined by international pipette method (Piper, 1966). Soil pH and EC was determined 1:2.5 soil to water suspension by potentiometric and conductometric methods respectively (Jackson, 1973) [4]. The organic carbon in soil (0.2mm sieved) was determined by wet oxidation method (Walkley and Black, 1934) [18].

Available nitrogen in the soil was determined by alkaline potassium permanganate method as described by Subbiah and Asija (1956) [16]. Available phosphorus were extracted using Olsen's extractant for neutal and alkaline soils and Bray's extractant for acid soils and was determined by spectrophotometer (Jackson, 1973) [4]. Available potassium extracted using neutral normal ammonium acetate was determined by using flame photometer (Jackson, 1973) [4]. The exchangeable calcium and magnesium were determined by Versenate titration method (Jackson, 1973) [4]. Available sulphur was extracted from soil using 0.15 per cent calcium chloride solution and determined turbidimetrically as described by Black (1965) [2]. The available micro nutrient like Fe, Zn, Mn and Cu in the soil were extracted with DTPA - extractant and was determined by atomic absorption spectrophotometer (AAS) as described by Lindsay and Norvell (1978) [7]. Hot water extractable boron in soil was determined as per the procedure outlined by John *et al*. (1975) [5] by using Azomethane – H reagent.

Soil nutrient status maps

A *dbf* file consisting of data for X and Y co-ordinates in respect of sampling site location was created. A shape file (Vector data) showing the outline of Hebbalagere micro-watershed was created. The *dbf* file was opened in project window and in the X- field, X-coordinates were selected and in Y- field, Y-coordinates were selected. The Z-field was used for different nutrients. The Hebbalagere micro-watershed shape file was also opened and from the surface menu of Arc GIS spatial analyst "*Interpolate grid option*" was selected. On the output '*grid specification dialogue*'', output grid extend chosen was same as Hebbalagere micro- watershed shape and the interpolation method employed was a spline. The generated map was reclassified based on ratings of respective nutrients.

Results and discussion

Texture of surface soils

Surface soil texture of Hebbalagere micro watershed was predominantly covered with sandy clay and clay texture (Fig.1). Sandy clay texture was observed in 395 ha (34.97%) and clay texture in 622 ha (54.97%). The variation might be due to differences in topography, slope gradient and parent material consistent with this suggestion (Thangasamy *et al*., 2005) [17] reported variation in soil texture might be due caused by variation in parent material, topography, in-situ weathering and translocation of clay.

Soil reaction

The mapping of soil pH status (Fig. 2) by GIS technique indicated that 15 ha (1.31%) of the study area was slightly acidic (6-6.5), 282 ha (24.94%) was neutral (6.5-7.3), 96 ha (8.46%) was slightly alkaline (7.3-7.8), 485 ha (42.87%) was moderately alkaline (7.8-8.4) and 139 ha (12.36%) was strongly alkaline (8.4-9.0). The variation in soil pH was related to the parent material, rainfall and topography (Thangasamy *et al*., 2005) [17]. The high pH of the soils might be due to the presence of high degree of base saturation as reported by Meena *et al.* (2006) [8]. Relatively higher pH value in soils was due to the accumulation of the high amounts of exchangeable bases in the solum. The soils were acidic due to the acidic parent material (granite gneiss). The relatively low pH in red soils was mainly due to iron hydroxide species which contributed to higher H^+ concentration (Dasog and Patil, 2011) [3].

Electrical conductivity

The electrical conductivity values were low indicating that the soils of the selected micro watershed were non-saline (Fig. 3). The normal electrical conductivity may be ascribed to leaching of salts to lower horizons (Singh and Mishra, 2012) [1].

Soil organic carbon

Majority of the study area 58.92 per cent (666 ha) showed higher level of soil organic carbon status, 275 ha (24.28%) was medium, and 76 ha (6.74%) was low in soil organic carbon status (Fig. 4). The medium to high organic carbon status in the soil attributed to good vegetative growth and consequent addition of organic matter to soil (Patil and Ananthanarayana, 1990) [9]. Low organic carbon in the soil was due to low input of FYM and crop residues (Binita *et al.*, 2009) [1].

Exchangeable calcium and magnesium

The exchangeable Ca and Mg were sufficient in the entire study area (Fig. 5 and 6) was due to the type and amount of clay, present in these soils. These results were in confirmation of the findings of Krishnamurthy (1993) [6] reported the highest values of exchangeable calcium and magnesium were reported in surface and subsurface soils.

Available sulphur

Available sulphur content was high in 861 ha (76.20%) and medium in 156 ha (13.74%) (Fig. 7). The high amount of organic carbon coupled with fine-textured soils in the study area contributed to higher sulphur content. The higher availability is due to the negative charge of the clay which shows anionic repulsion to sulphate anion (Seth *et al*., 2017) [12].

DTPA extractable micronutrients and available boron

Entire micro watershed area (1017 ha) was sufficient in DTPA extractable micronutrients like copper (Fig. 8), iron (Fig. 9), manganese (Fig. 10), while the available zinc (Fig. 11) was sufficient in 721 ha (63.74%) and deficient in 296 ha (26.21%) area. Entire micro watershed area (1017 ha) was sufficient in available boron (Fig. 12).

The DTPA extractable iron content in micro-watershed was sufficient. This might be due to the granite gneiss parent material which was known to posses higher iron content (Rajkumar, 1994) [11]. The DTPA extractable zinc content in micro-watershed showed both deficient and sufficient. The zinc deficiency was attributed to the alkaline soil condition which might occur due to high precipitation of zinc as hydroxide and carbonates (Thangasamy *et al.*, 2005) [17]. The DTPA extractable manganese content in the entire study area was sufficient. The higher DTPA extractable manganese content in the study area was attributed to its higher content in granite gneiss parent material (Srikanth *et al.,* 2008) [15]. The DTPA extractable copper status in the micro-watershed was sufficient. The sufficiency of copper in the study area was related to its parent material, *i.e.,* granite gneiss containing higher copper content (Rajkumar, 1994) [11]. Majority of micro-watershed area was medium in boron content. Like sulphur status, available boron status is also closely followed the organic carbon status in these soils.

Table 1: Chemical properties, secondary and micro nutrient status in Hebbalagere micro-watershed

Parameters	Range	Mean
Soil pH (1:2.5)	6.02 - 8.92	7.81
EC(dSm^{-1})	0.121-0.699	0.444
Soil organic carbon(g kg^{-1})	2.10 - 14.13	8.31
Exchangeable calcium (cmol (p+) kg^{-1}**)**	2.80-29.00	13.30
Exchangeable magnesium (cmol (p+) kg^{-1}**)**	1.70-14.75	6.65
Available S (mg kg^{-1})	12-45	29.11
Available zinc (mg kg^{-1})	0.25-1.34	0.71
Available iron (mg kg^{-1})	4.03-31.72	11.24
Available copper (mg kg^{-1})	1.64-4.18	2.79
Available manganese (mg kg^{-1})	3.69-25.52	9.60

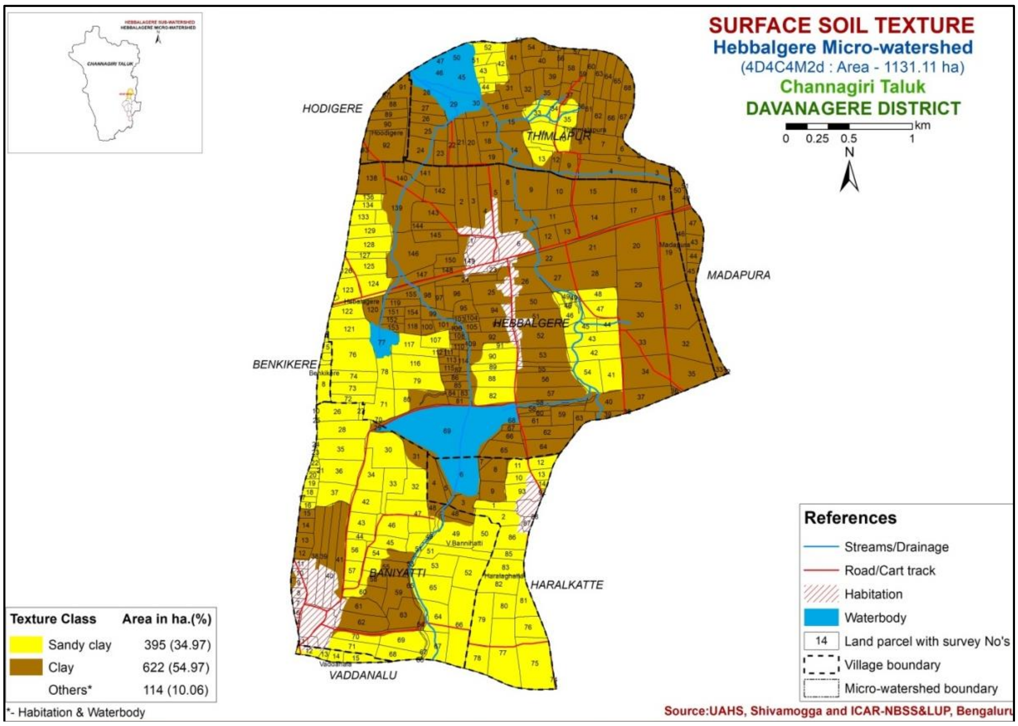

Fig 1: Surface soil texture of Hebbalagere micro watershed

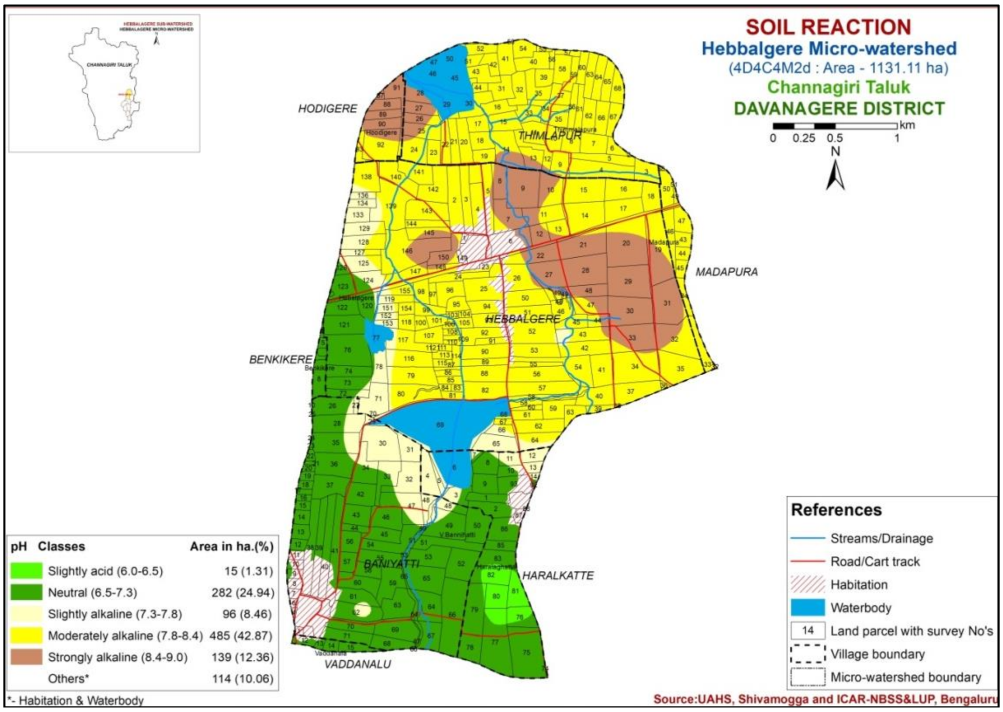

Fig 2: Soil pH status of Hebbalagere micro watershed

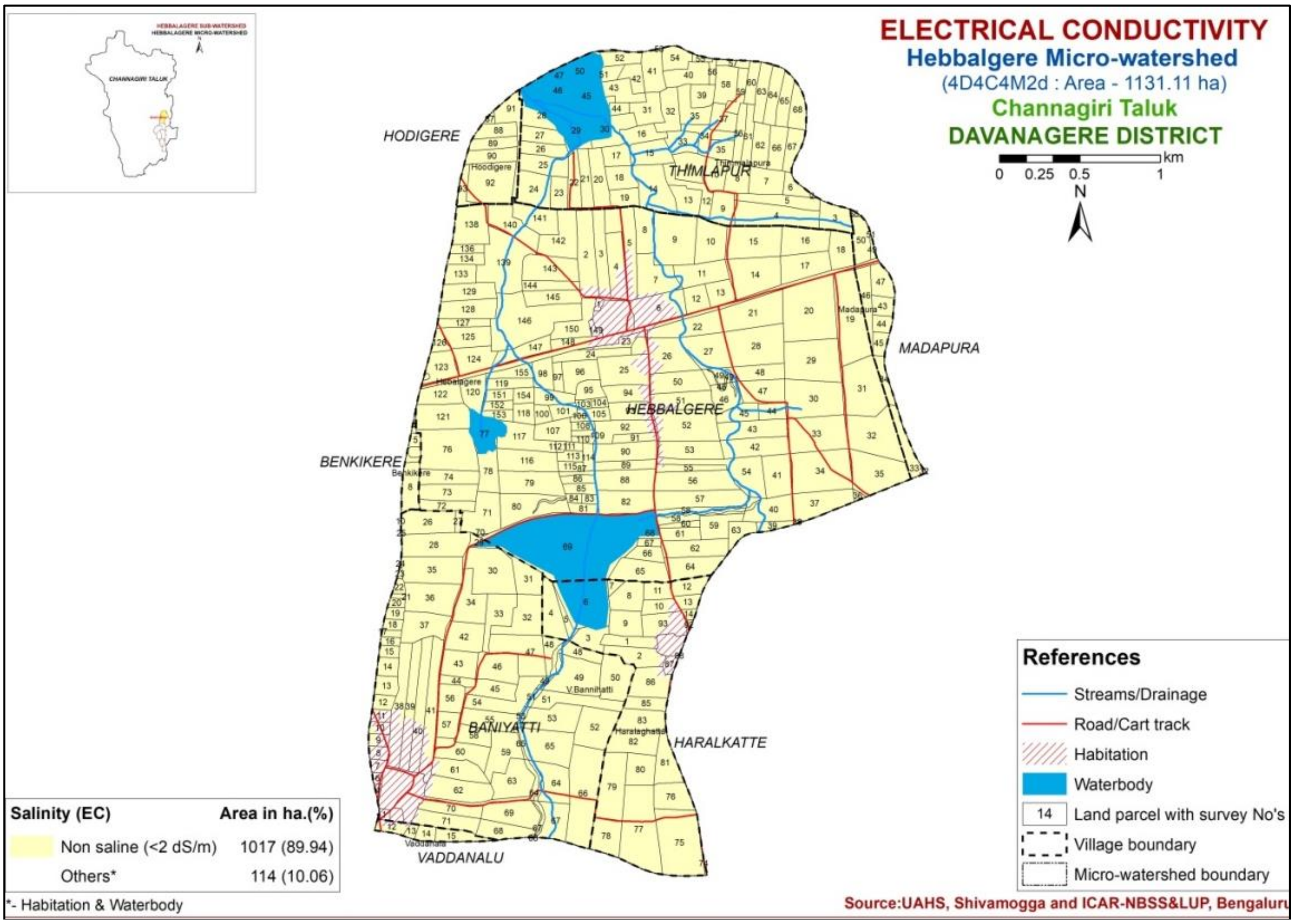

Fig 3: EC status of Hebbalagere micro watershed

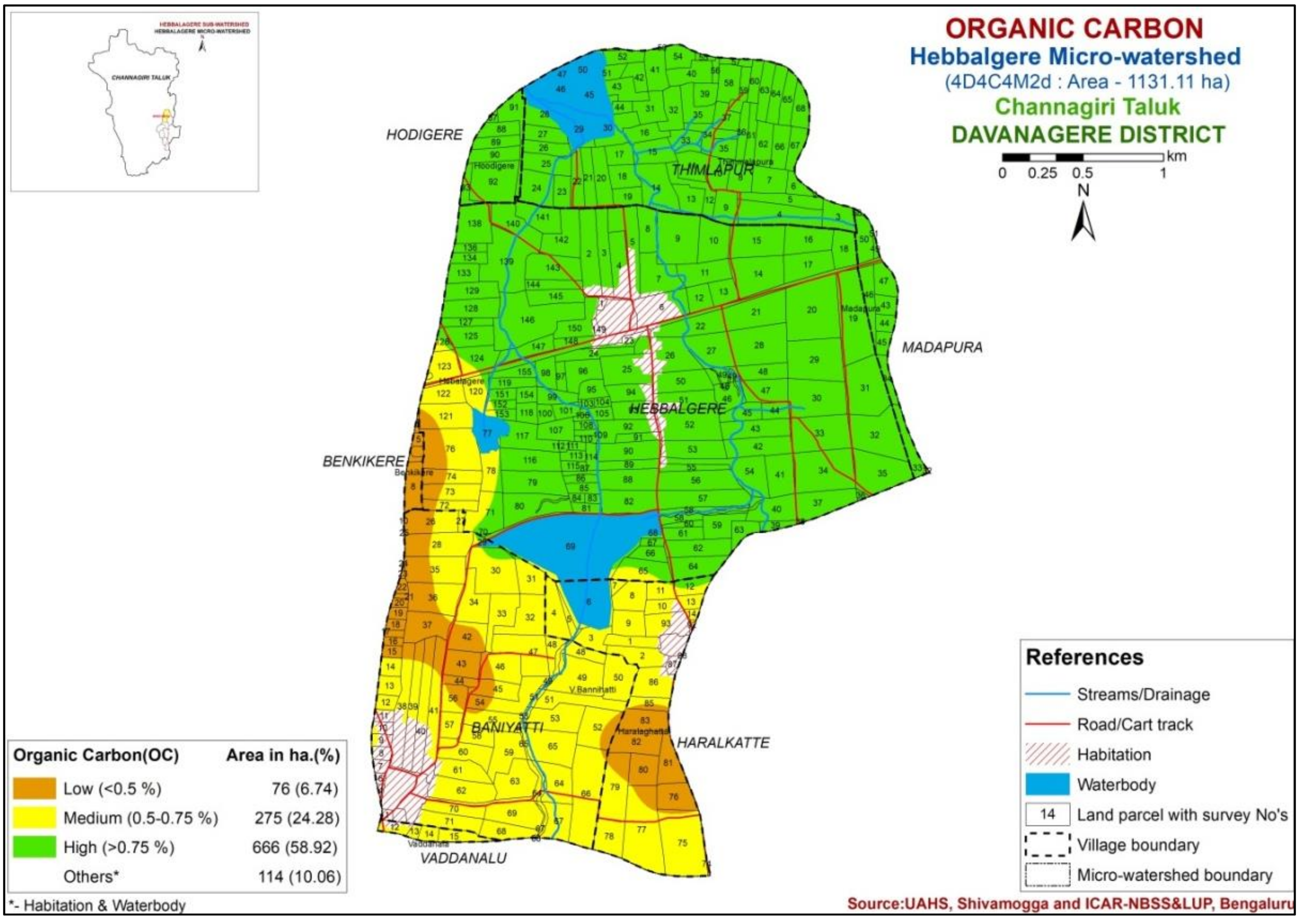

Fig 4: Soil organic carbon status of Hebbalagere micro watershed

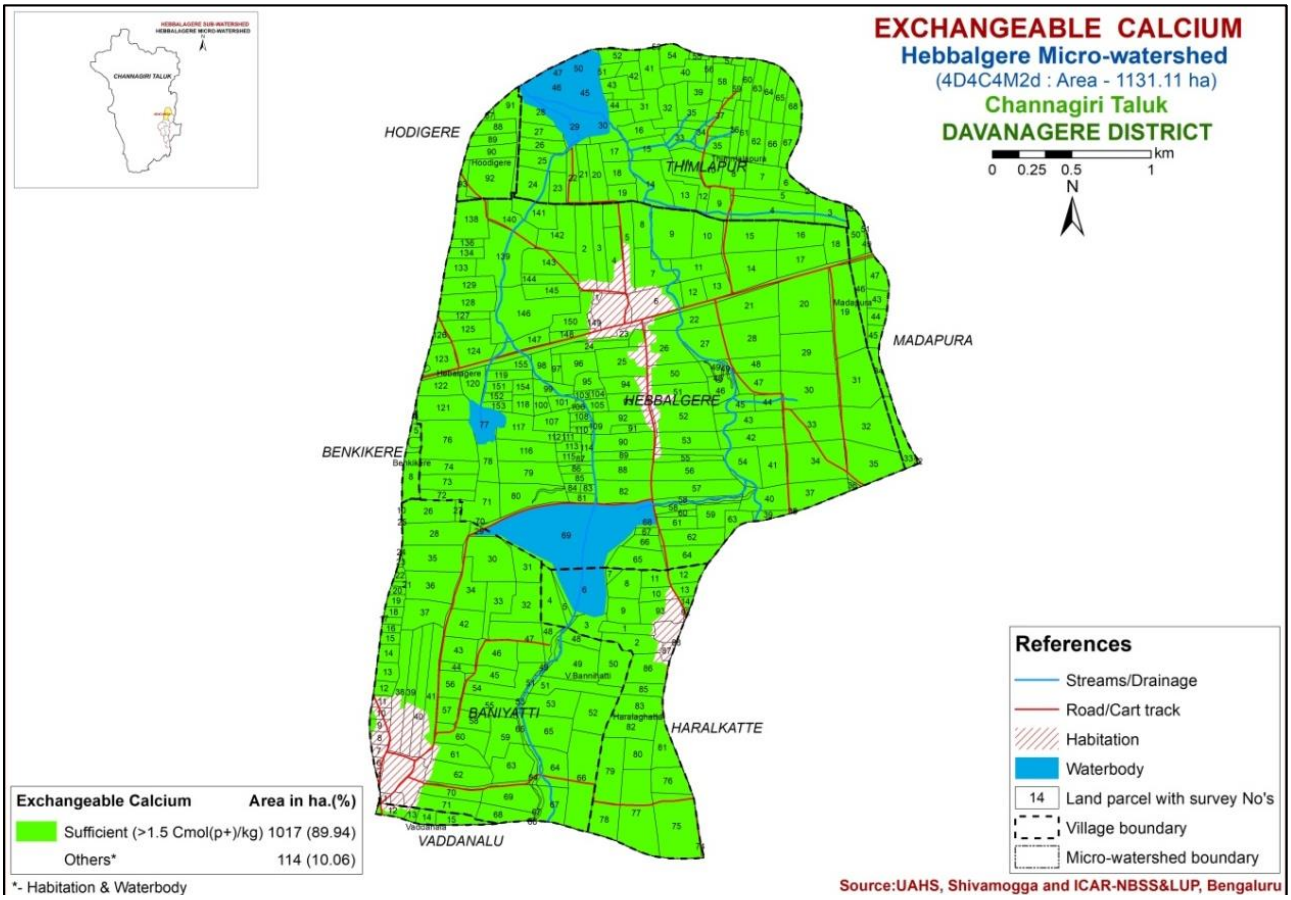

Fig 5: Exchangeable calcium status of Hebbalagere micro watershed

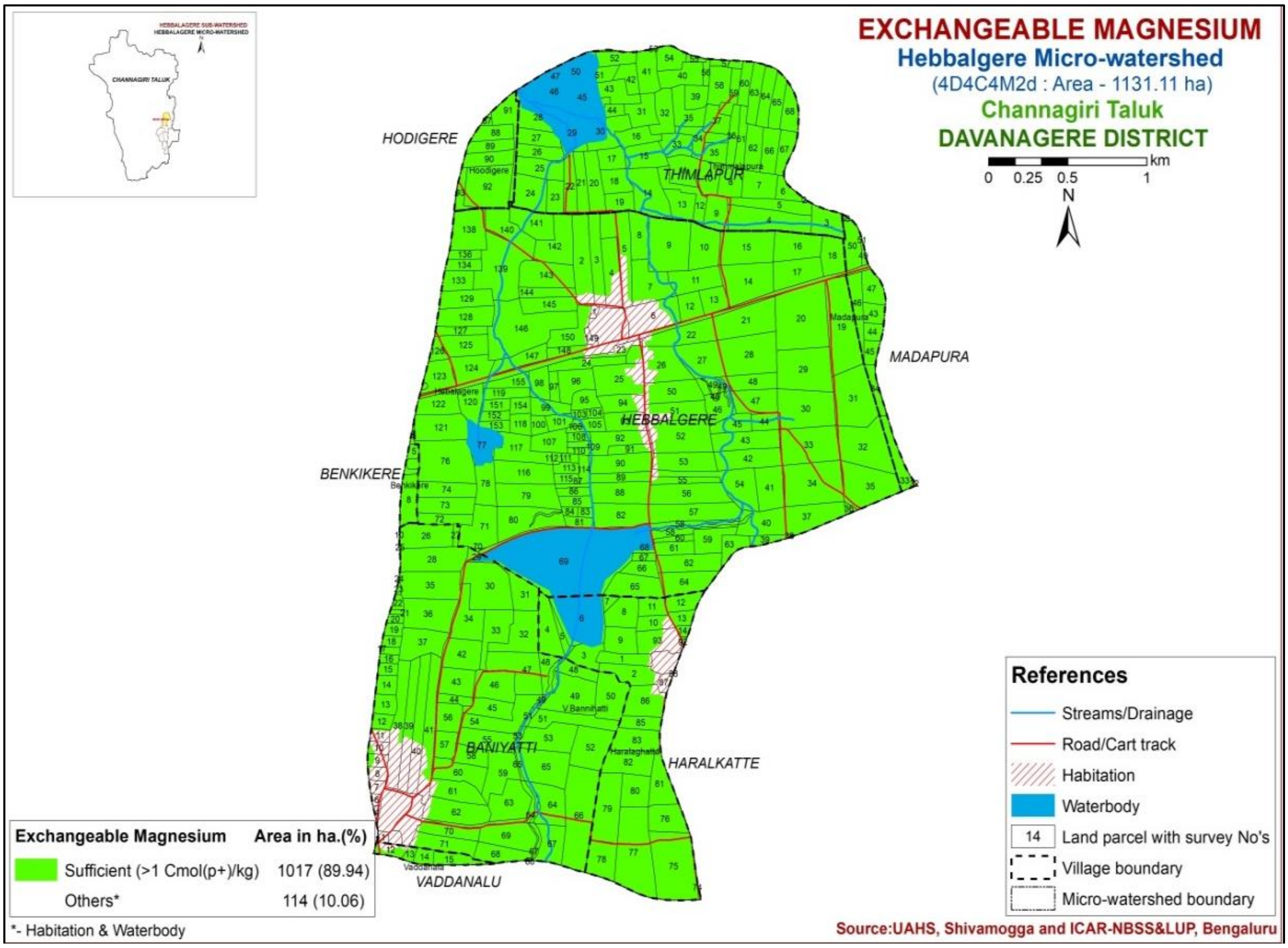

Fig 6: Exchangeable magnesium status of Hebbalagere micro watershed

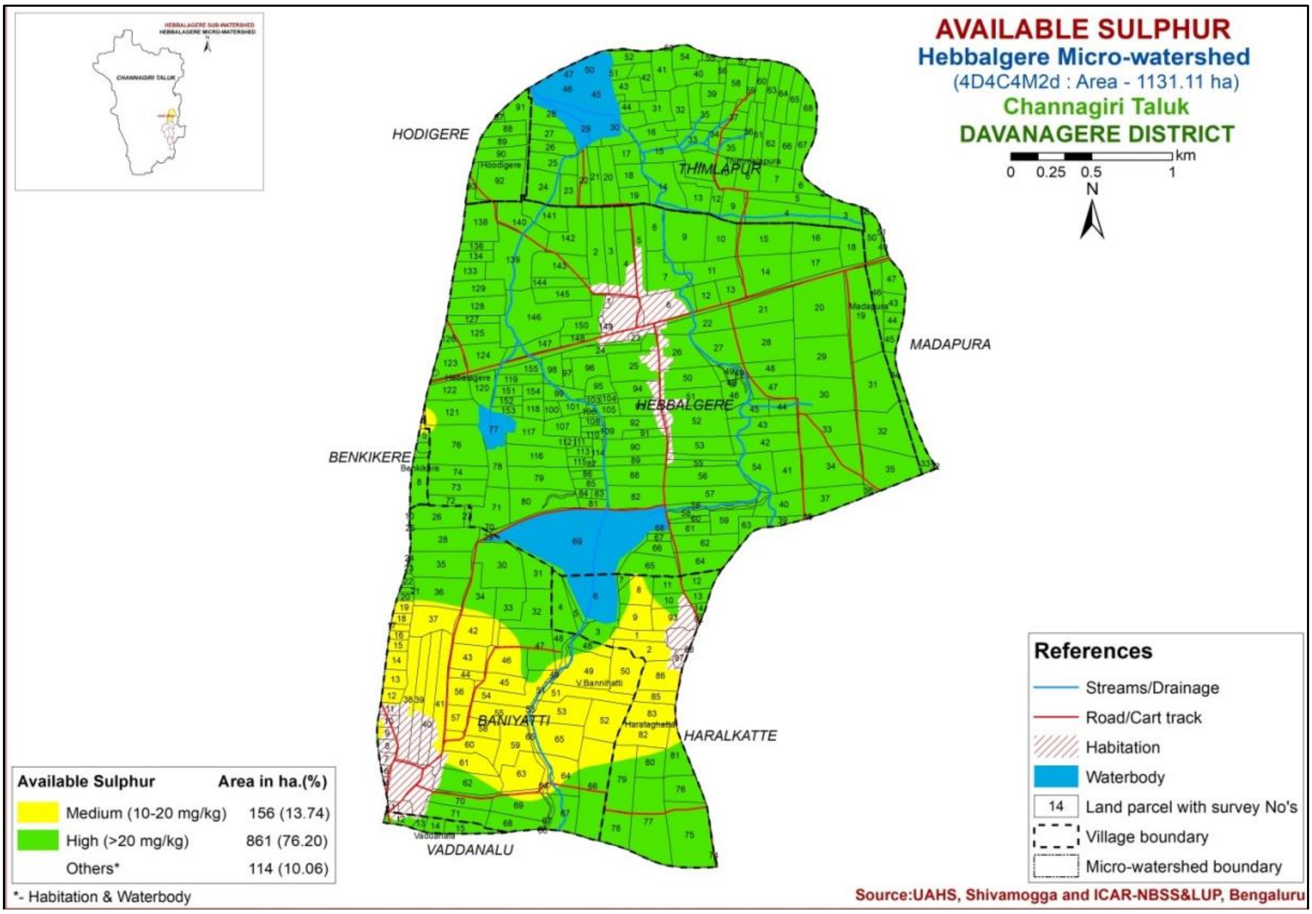

Fig 7: Available sulphur status of Hebbalagere micro watershed

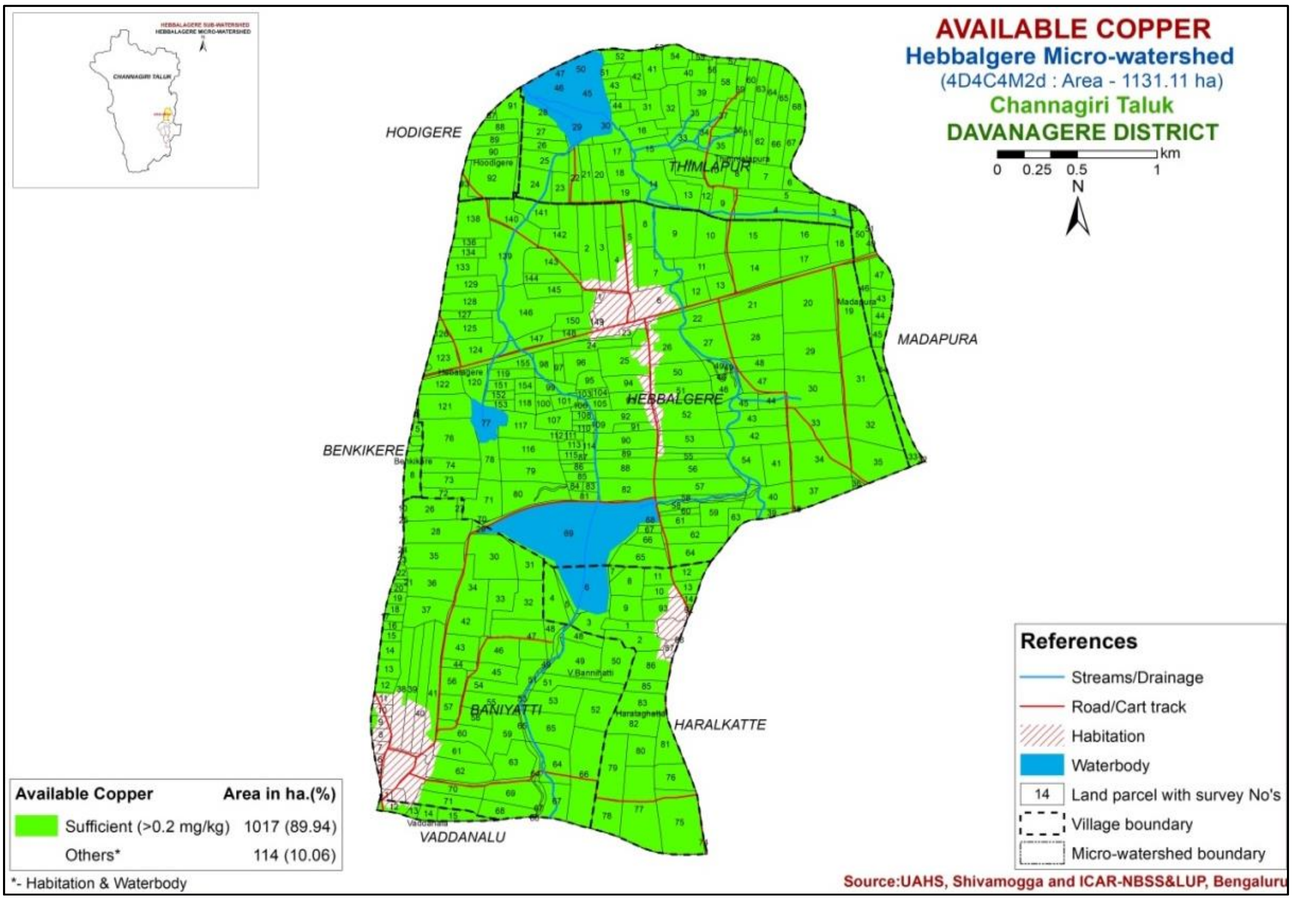

Fig 8: Available copper status of Hebbalagere micro watershed

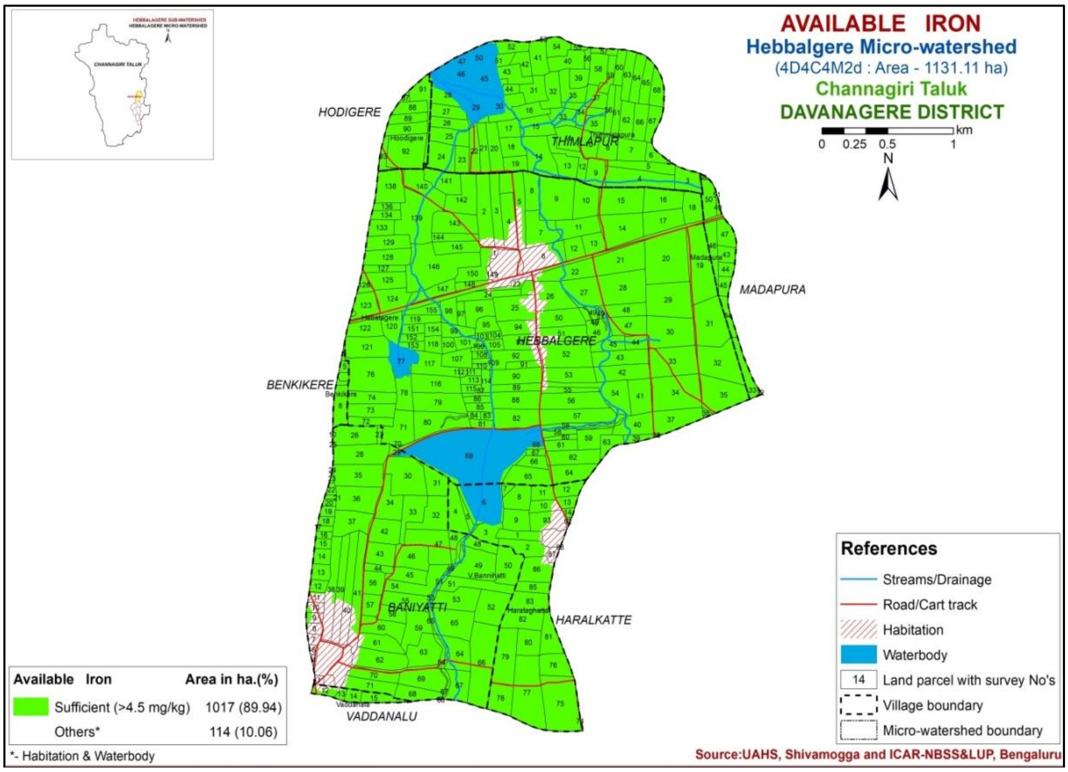

Fig 9: Available iron status of Hebbalagere micro watershed

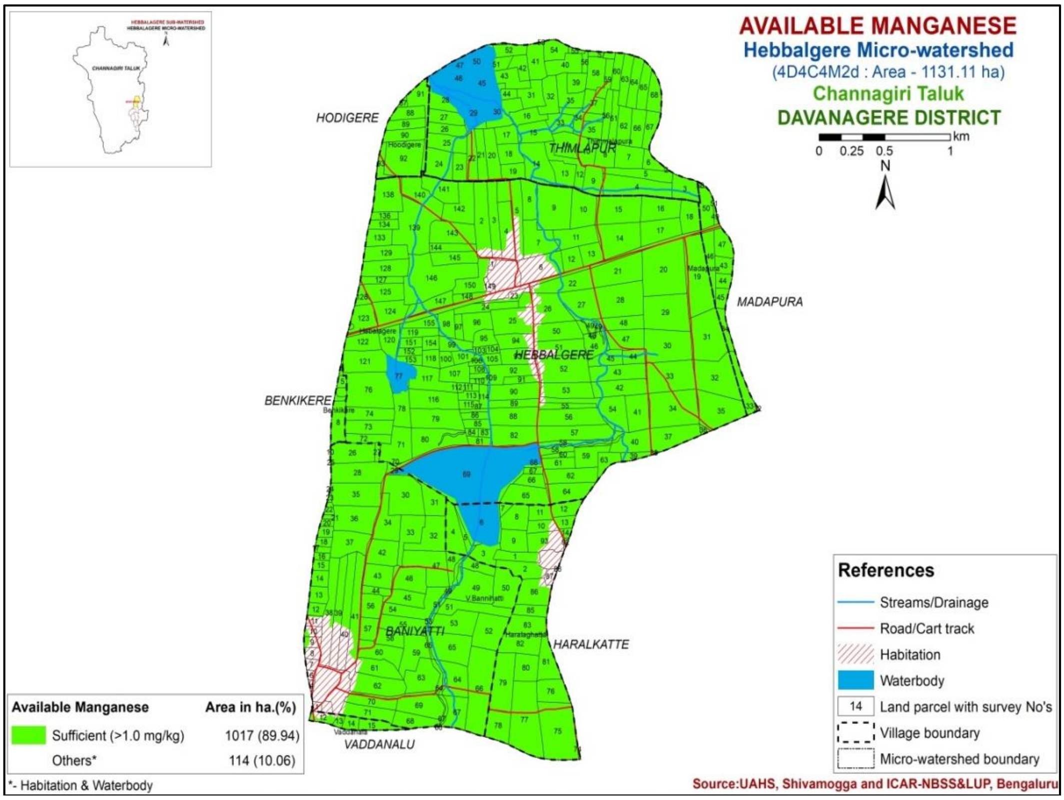

Fig 10: Available manganese status of Hebbalagere micro watershed

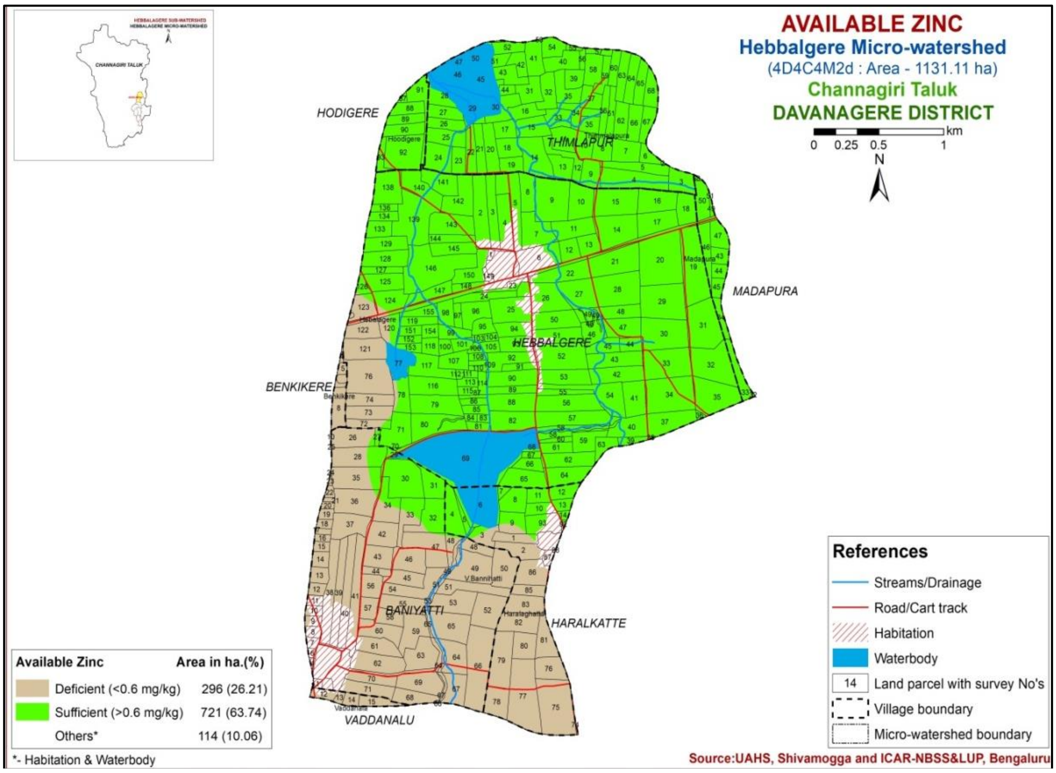

Fig 11: Available zinc status of Hebbalagere micro watershed

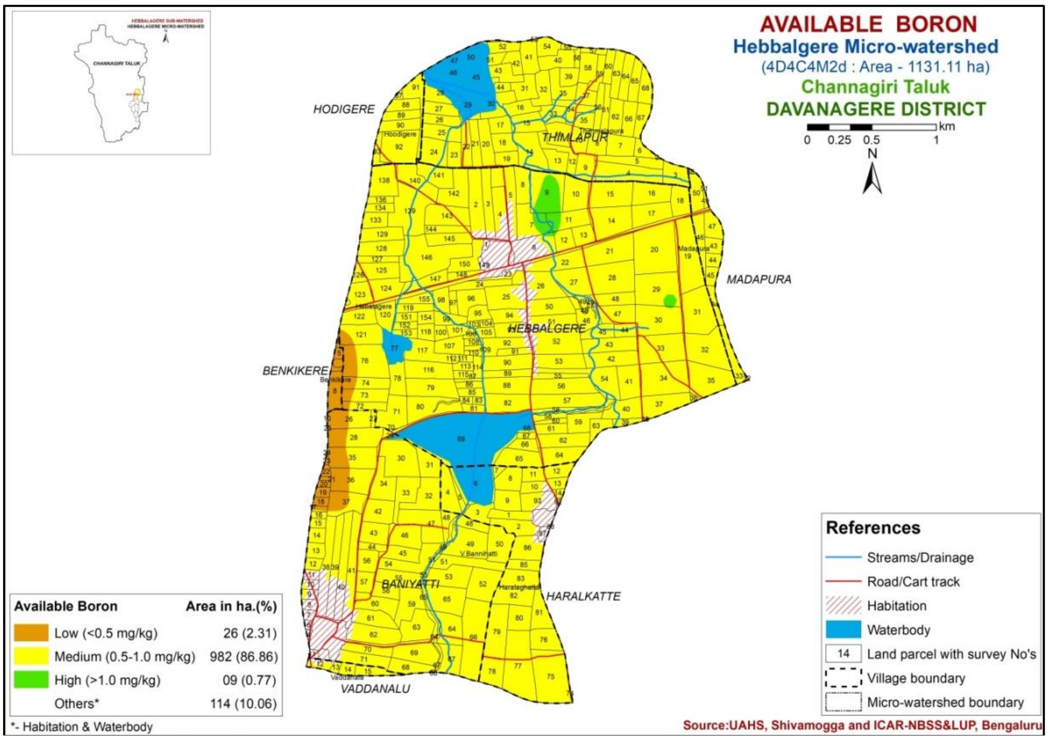

Fig 12: Available boron status of Hebbalagere micro watershed

Conclusion

Soils of Hebbalagere micro watershed were sufficient in exchangeable calcium and magnesium. Available sulphur and available zinc showed both deficient and sufficient status in the micro watershed whereas the other micro nutrients like available iron, manganese and copper was sufficient in the entire micro watershed. Available boron status was medium in the study area.

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