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Fertility assessment of soils of Nandipura micro-watershed under Chikkamagalur district, Karnataka

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Abstract
An assessment on fertility status was carried out on the soils of Nandipura micro-watershed during the year 2018-2019. Forty-eight grid samples were collected and analysed for its fertility status and were mapped using ArcGIS software. The mapping of fertility status of soils of Nandipura micro-watershed revealed that the soils were low (86.52% of the micro-watershed area) to medium (8.57%) in available nitrogen content, low (44.02%) to medium (51.07%) in available phosphorus, low (15.20%) to medium (79.89%) in available potassium, medium (21.56%) to high (73.52%) in available sulphur, exchangeable calcium and magnesium content were sufficient in entire micro-watershed area. DTPA extractable zinc was deficient in 105 ha and sufficient in 370 ha area whereas, DTPA extractable iron, copper and manganese were sufficient throughout the study area. Available boron was low (34.38%) to medium (60.25%).

Keywords: Fertility, Nandipura, Micro-watershed, Chikkamagalur

Introduction
Increase in population, changes in dietary habits are associated with an increase in income, the decline in per capita land area and availability of renewable freshwater. The scarcity of water is further aggravated by the excessive withdrawal of groundwater from intensive agriculture. Repeated cultivation and bringing marginal lands under cultivation leading to soil degradation caused for low crop productivity. The inherent fertility of the soil is controlled by the set of pedogenic factors that varies from soil to soil and declining soil fertility is the main cause of low land productivity. Present-day exploitive agriculture which involves efforts to increase crop yield has not only depleted our soils of their nutrient reserve but also resulted in the emergence of many nutrient deficiencies.

To maintain or enhance the present level of productivity, management of land resources on scientific principles is very important. In this endeavor, soil resource inventory provides an insight into the potentialities and limitations for their optimum utilization through characterization and evaluation of land resources. It also provides an adequate information in terms of landform, terrain, vegetation as well as characteristics of soils which can be utilized for land resource management and development. In the recent past, the concept of watershed based holistic development has emerged as one of the potential approaches in rainfed areas which can lead to higher productivity and sustainability in agricultural production. For the sustainable use of natural resources, a detailed survey of land resources indicating its potential and constraints becomes pre-requisite for planning. At present, most systems of land evaluation are interpretative classifications. Land evaluation analysis for capability, irrigability and crop suitability would resolve these issues while providing better land-use options to the farmers.

Material and Methods
The Nandipura micro-watershed lies 40 km away from Chikkamagalauru district, Karnataka. It comes under Muguli sub-watershed of Tarikere taluk with an elevation of 769 m MSL with a total geographical area of 499.97 ha lying in the Southern Transition Zone of Karnataka with an annual average rainfall of 600 mm. Most of the study area is covered by peninsular gneiss.

The detailed soil survey of the Nandipura micro-watershed of the Muguli sub-watershed was carried out at 1:7,920 scale using the LISS-IV image and cadastral map as base maps. Forty-eight surface soil samples were collected by adopting grid techniques (320 x 320 m grid interval) at 0-20 cm depth. The collected soil samples were analysed for fertility status (available nitrogen, phosphorus, potassium, sulphur and secondary micro-nutrients, DTPA-extractable micro-nutrients and available boron content). These data obtained from laboratory analysis were mapped using ArcGIS software.

Result and Discussion

The available nitrogen status in the Nandipura micro-watershed was low to medium in status and it ranged between 94.08 to 338.69 kg ha^{-1} with an average value of 209 kg ha^{-1} and standard deviation of 68.76 (Table 1). About 433 ha (86.52%) area of the micro-watershed soil was low in available nitrogen status and 42 ha (8.57%) area of the soils were medium in available nitrogen status (Fig. 1). The low soil organic matter content in this area because of faster degradation and consequent removal of organic matter coupled with lesser nitrogen fertilization might be the reason for nitrogen deficiency (Pramod and Patil, 2015) [5].

The available phosphorus status of the Nandipura micro-watershed soil was varied from 19.47 to 85.42 kg ha^{-1} with a mean value of 52.90 kg ha^{-1} and standard deviation of 17.21 (Table 1). The 51.07 per cent area (255 ha) of the soil was medium in available phosphorus and 220 ha (44.02%) area was low in available phosphorus (Fig. 2). The low CEC content in the red soils might be the reason behind the low values of available phosphorus content. The clay content along with CEC and phosphorus fixing capacity of the soils might be the reason behind the medium range of available phosphorus content (Rajashekar, 2018) [7].

The soils of Nandipura micro-watershed varied (102.55 to 526.58 kg ha^{-1}) with respect to available potassium content with an average of 274.03 kg ha^{-1} and standard deviation 106.74 (Table 1). About 399 ha, which accounted for 79.89 per cent of the area was found to be medium whereas, 76 ha (15.20%) area of the soil was low in available potassium (Fig. 3). The presence of kaolinite types of clay mineralogy led to medium and low ratings (Pramod, 2015) [4].

The available sulphur status of soils of Nandipura micro-watershed was medium in 108 ha (21.56%) and high in 367 ha (73.52%) (Fig. 4) and it was ranging from 11.43 to 41.40 mg kg^{-1} with the mean value of 26.20 mg kg^{-1} and standard deviation of 8.45 (Table 1). The high amount of organic carbon coupled with fine-textured soils in the study area contributed to higher sulphur content. A similar observation was made by Seth *et al*. (2017) [9].

The exchangeable calcium [3.00 to 14.00 cmol (p$^+$) kg^{-1}] and magnesium content [1.00 to 9.00 cmol (p$^+$) kg^{-1}] of soils of Nandipura micro-watershed recorded an average of 9.21 and 5.40 cmol (p$^+$) kg^{-1}, respectively and standard deviations of 2.76 and 1.84, respectively (Table 1). The Nandipura micro-watershed soils were sufficient in exchangeable calcium and magnesium (Fig. 5 and 6). The sufficiency of exchangeable calcium and magnesium in the study area might be due to type and amount of clay present. These results were in confirmation with the findings of Harshita (2018) [3] and Rajashekar (2018) [7].

The available zinc status of the Nandipura micro-watershed soils was varying between 0.20 to 1.22 mg kg^{-1} with average and standard deviation of 0.73 mg kg^{-1} and 0.25, respectively (Table 1). The available zinc content was sufficient in 370 ha (74.05%) area and deficient in 105 ha (21.04%) area of the Nandipura micro-watershed (Fig. 7). The alkaline condition of soil condition might be the reason behind the deficiency of zinc in the study area. (Thangasamy *et al.*, 2005) [10]. The available zinc was sufficient in the surface samples might be due to the soils were not subjected to intensive cultivation (Rajashekar, 2018) [7].

The available iron content in Nandipura micro-watershed soil was ranging from 2.94 to 34.58 mg kg^{-1}, with the mean value of 17.55 mg kg^{-1} and standard deviation of 9.08 (Table 1). The available iron status of the Nandipura micro-watershed area of the soil was sufficient (95.09%) (Fig. 8). The available iron content was sufficient due to the granite gneiss parent material, which was known to possess higher iron content. These results were in conformity with the finding of Ravikumar *et al.* (2009) [8] and Denis and Patil (2014) [1].

The available manganese content in the Nandipura micro-watershed was ranged from 2.53 to 33.06 mg kg^{-1}, with a mean value of 13.00 mg kg^{-1} and standard deviation of 8.08 (Table 1). Major area of the micro-watershed is sufficient in available manganese (Fig. 9). The higher DTPA extractable manganese content in the micro-watershed area was attributed to its higher content in granite gneiss parent material. Similar finding was reported by Rajashekar (2018) [7].

The available copper content in Nandipura micro-watershed was ranged from 0.31 to 7.98 mg kg^{-1}, with the mean of value 0.98 mg kg^{-1}and standard deviation of 1.44 (Table 1). The major area of the micro-watershed was sufficient (95.09%) in available copper (Fig. 10). The sufficiency of copper in the study area was related to its parent material, *i.e.*, granite gneiss containing higher copper content (Rajkumar, 1994) [6].

With a variation of 0.16 to 0.88 mg kg^{-1} in available boron status in Nandipura micro-watershed the average and standard deviation was 0.54 mg kg^{-1} and 0.20 (Table 1). The micro-watershed area was low in 174 ha (34.83%) and medium in 301 ha (60.25%) in available boron content (Fig. 11). Like sulphur status, available boron status is also closely followed by organic carbon status in these soils (Harshita, 2018) [3]. A similar result was reported by Gurumurthy *et al*. (2019) [2].

Table 1: Fertility status of surface soils of Nandipura micro watershed of Tarikere taluk, Chikkamagaluru District

Soil properties	Range	Mean	SD
pH	4.42 - 8.92	7.12	1.06
EC (dS m^{-1})	0.02 - 0.16	0.08	0.03
OC (g kg^{-1})	2.30 – 9.80	0.55	0.19
Available N (kg ha^{-1})	94 – 339	208.73	68.76
Available P_2O_5 (kg ha^{-1})	19.47 - 85.42	52.90	17.21
Available K_2O (kg ha^{-1})	103 – 527	274.03	106.74
Exchangeable Ca [cmol (p$^+$) kg^{-1}]	3.00 - 14.00	9.21	2.76
Exchangeable Mg [cmol (p$^+$) kg^{-1}]	1.00 - 9.00	5.40	1.87
Available S (mg kg^{-1})	11.43 - 41.40	26.60	8.45
Available Zn (mg kg^{-1})	0.20 - 1.22	0.73	0.25
Available Fe (mg kg^{-1})	2.94 - 34.58	17.55	9.08
Available Mn (mg kg^{-1})	2.53 - 33.06	13.00	8.08
Available Cu (mg kg^{-1})	0.31 - 7.98	0.98	1.14
Available B (mg kg^{-1})	0.16 - 0.88	0.54	0.20

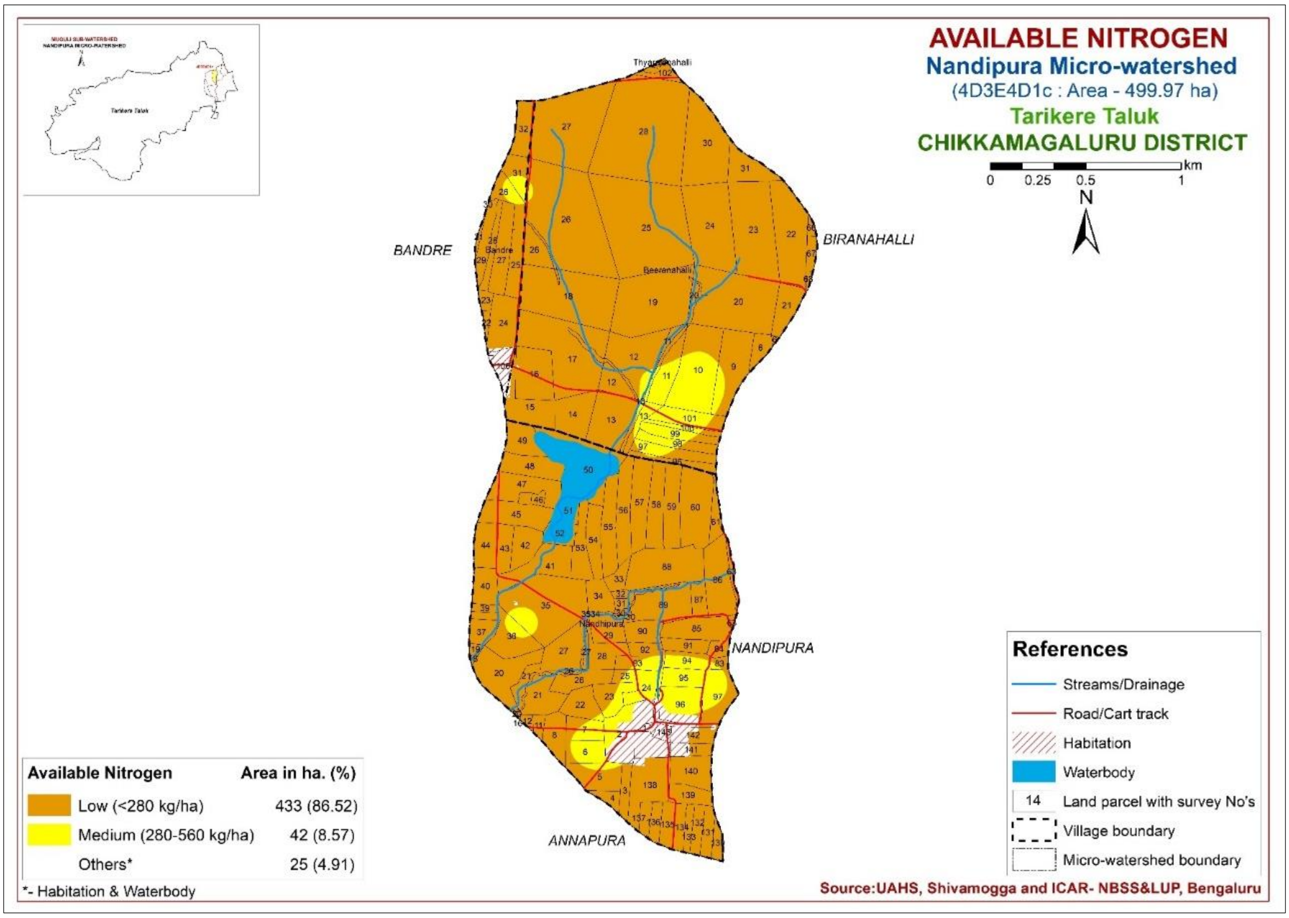

Fig 1: Available Nitrogen status of Nandipura micro-watershed

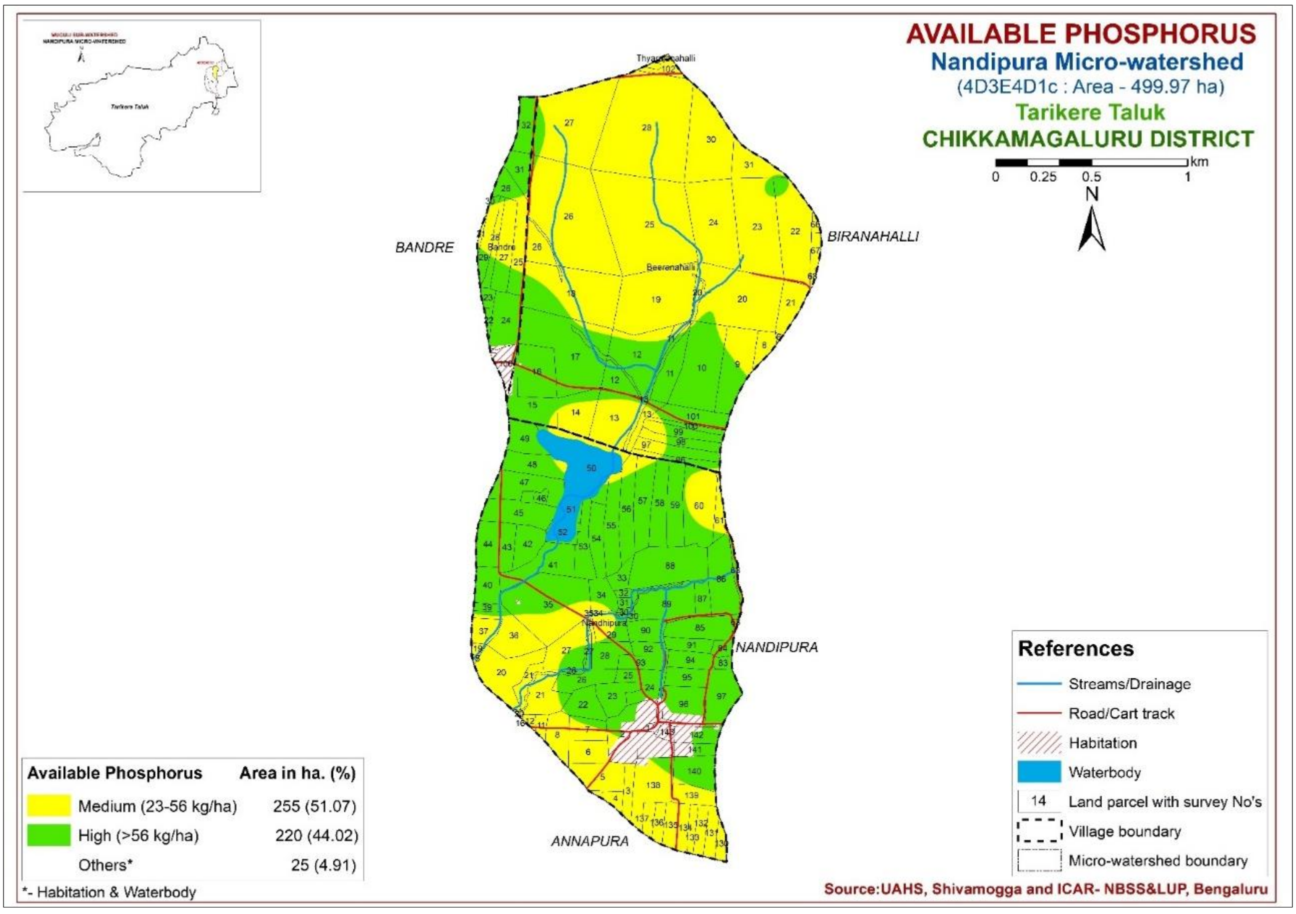

Fig 2: Available Phosphorus status of Nandipura micro-watershed

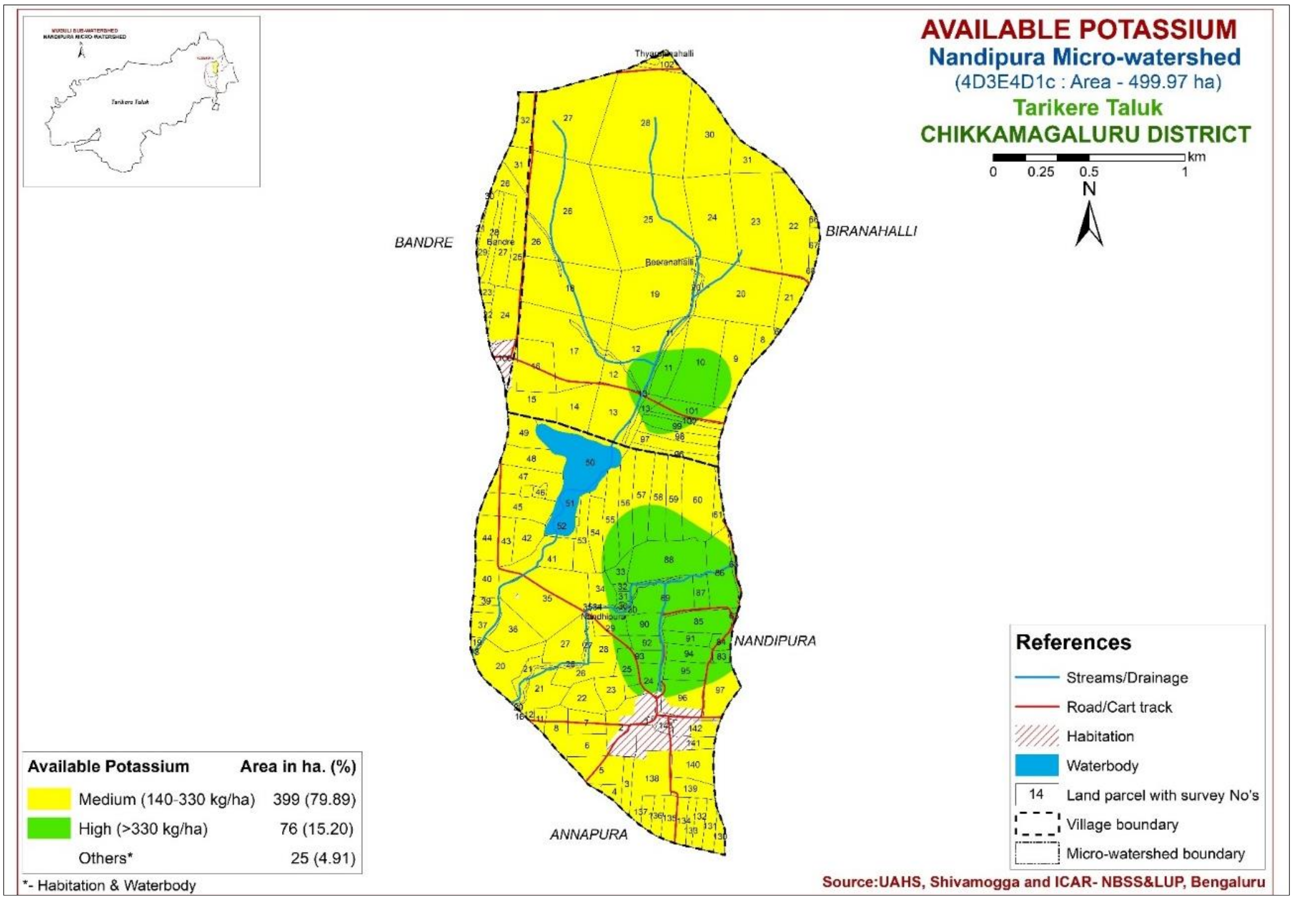

Fig 3: Available Potassium status of Nandipura micro-watershed

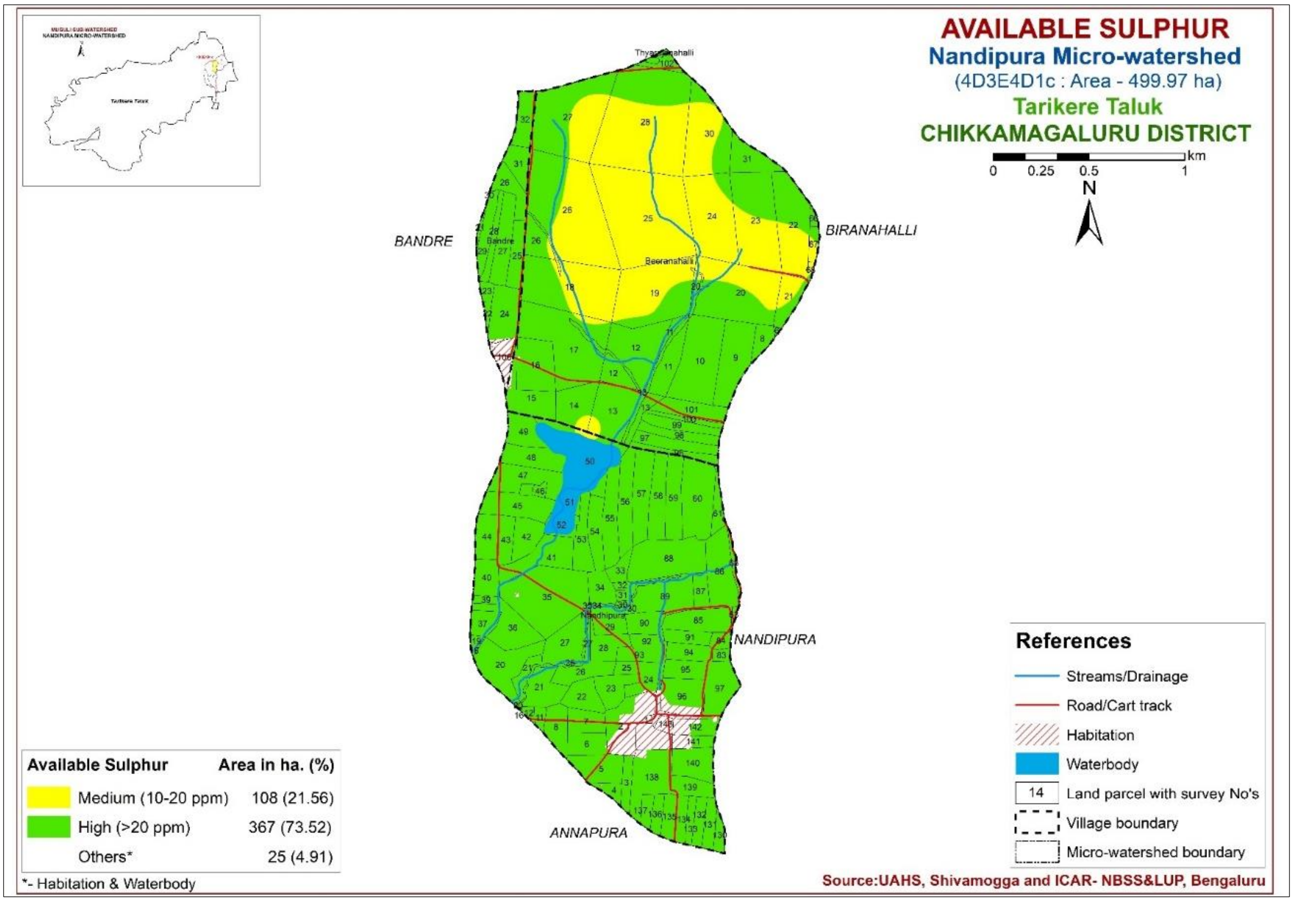

Fig 4: Available Sulphur status of Nandipura micro-watershed

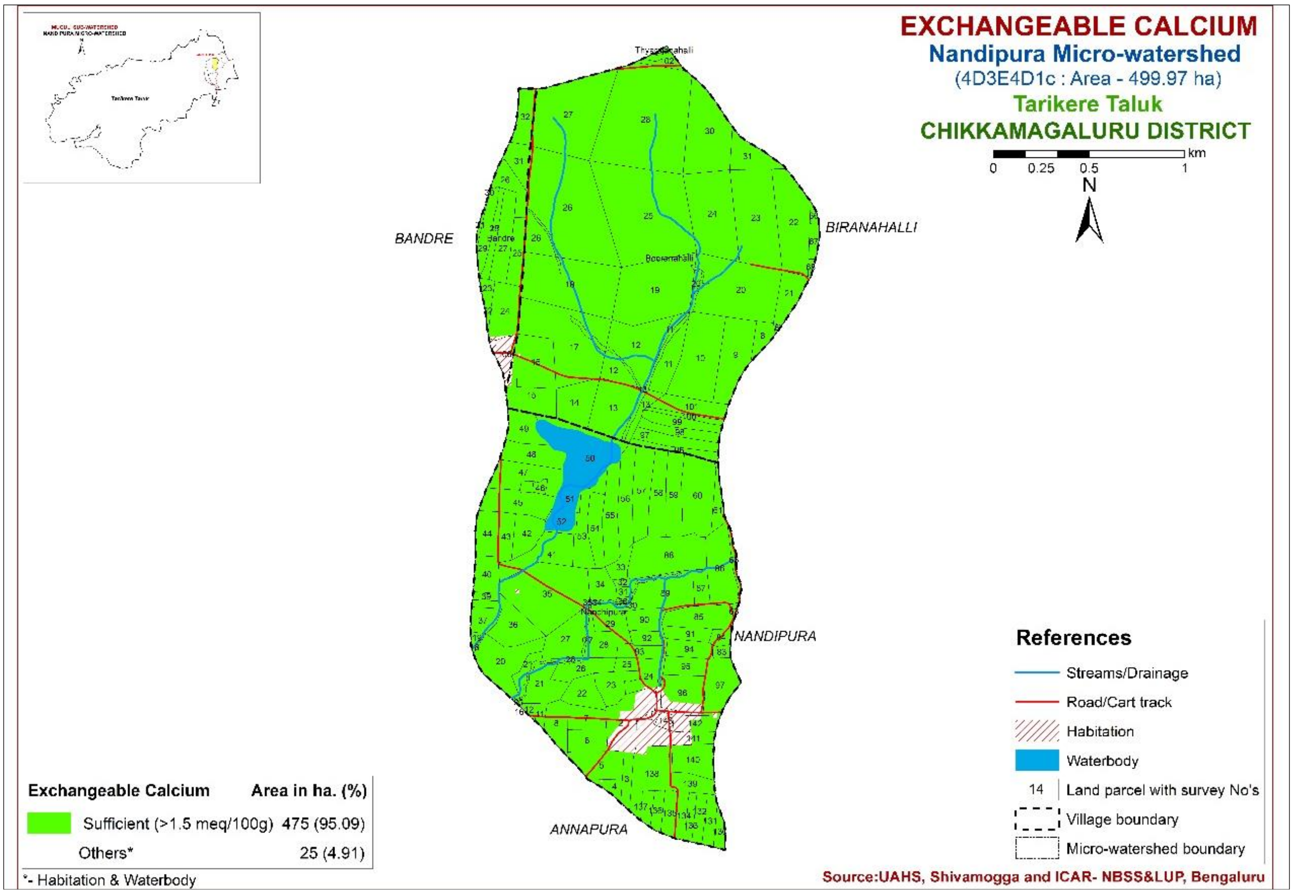

Fig 5: Exchangeable calcium status of Nandipura micro-watershed

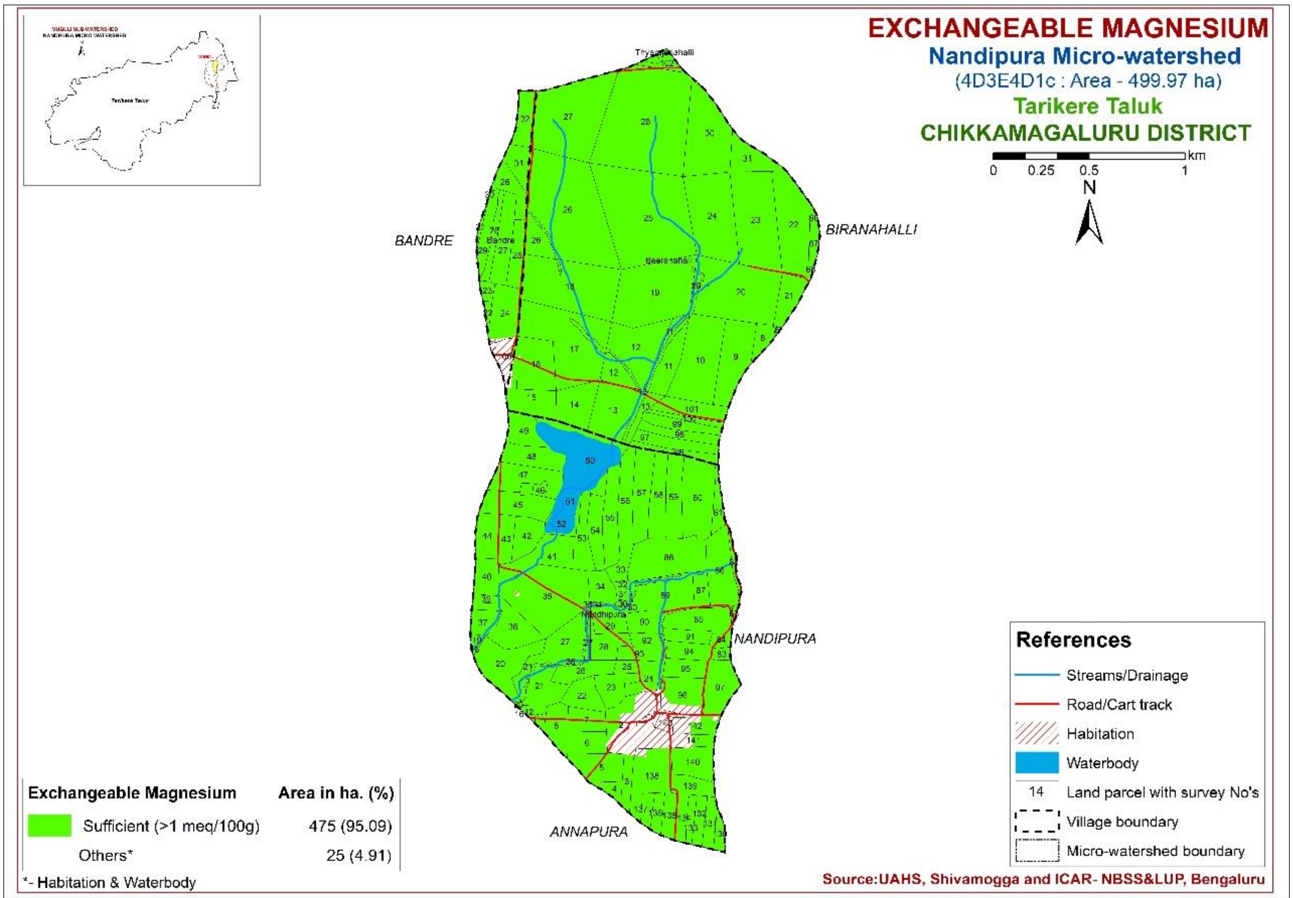

Fig 6: Exchangeable magnesium status of Nandipura micro-watershed

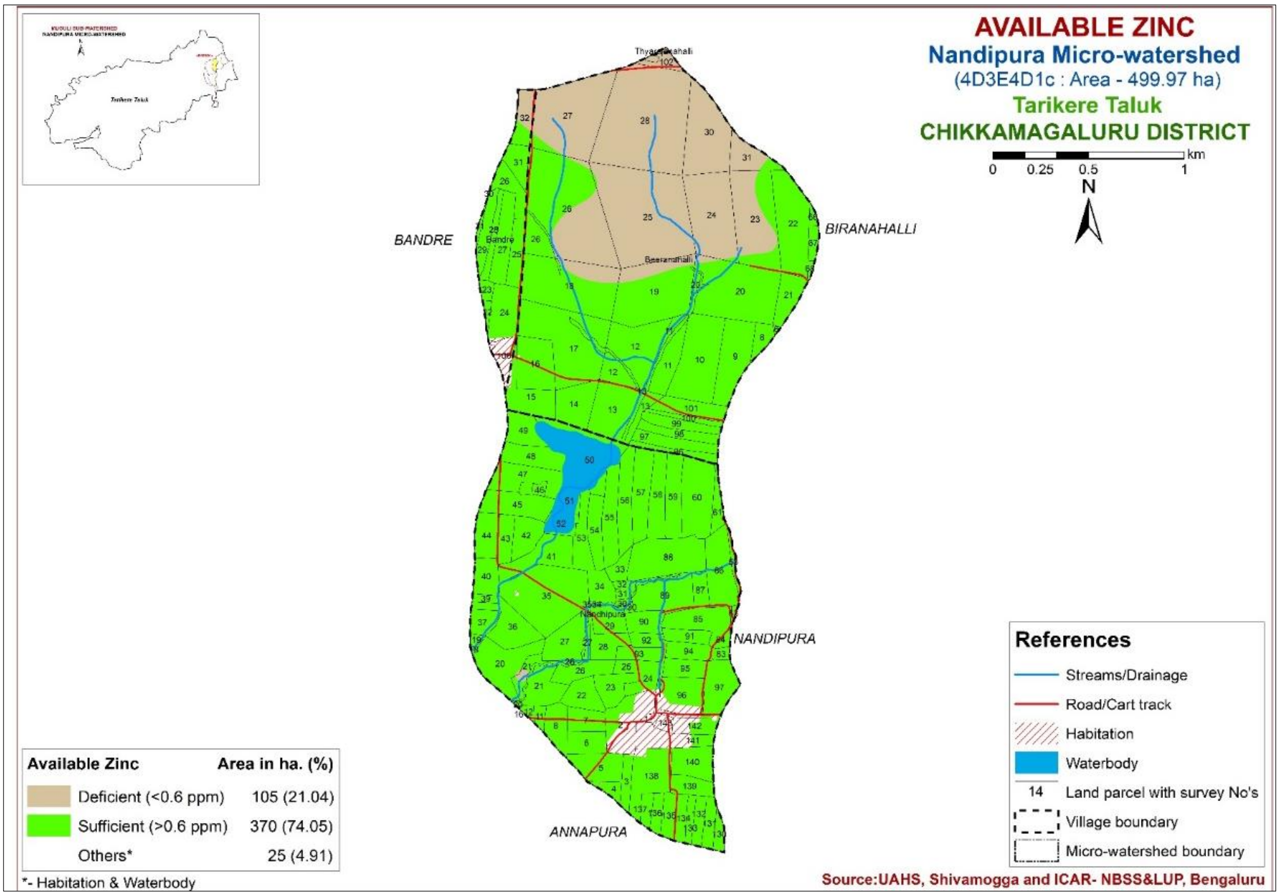

Fig 7: Available Zinc status of Nandipura micro-watershed

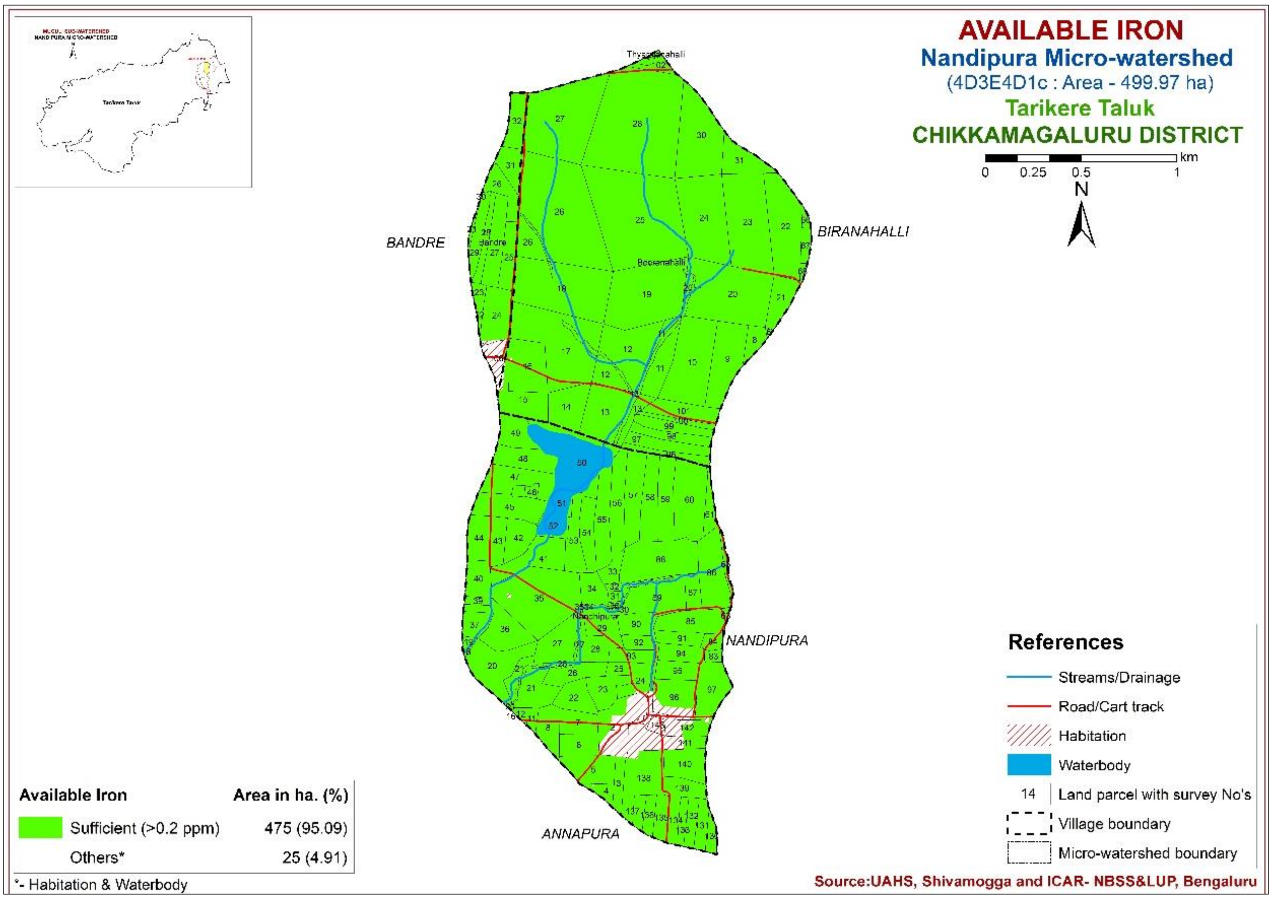

Fig 8: Available iron status of Nandipura micro-watershed

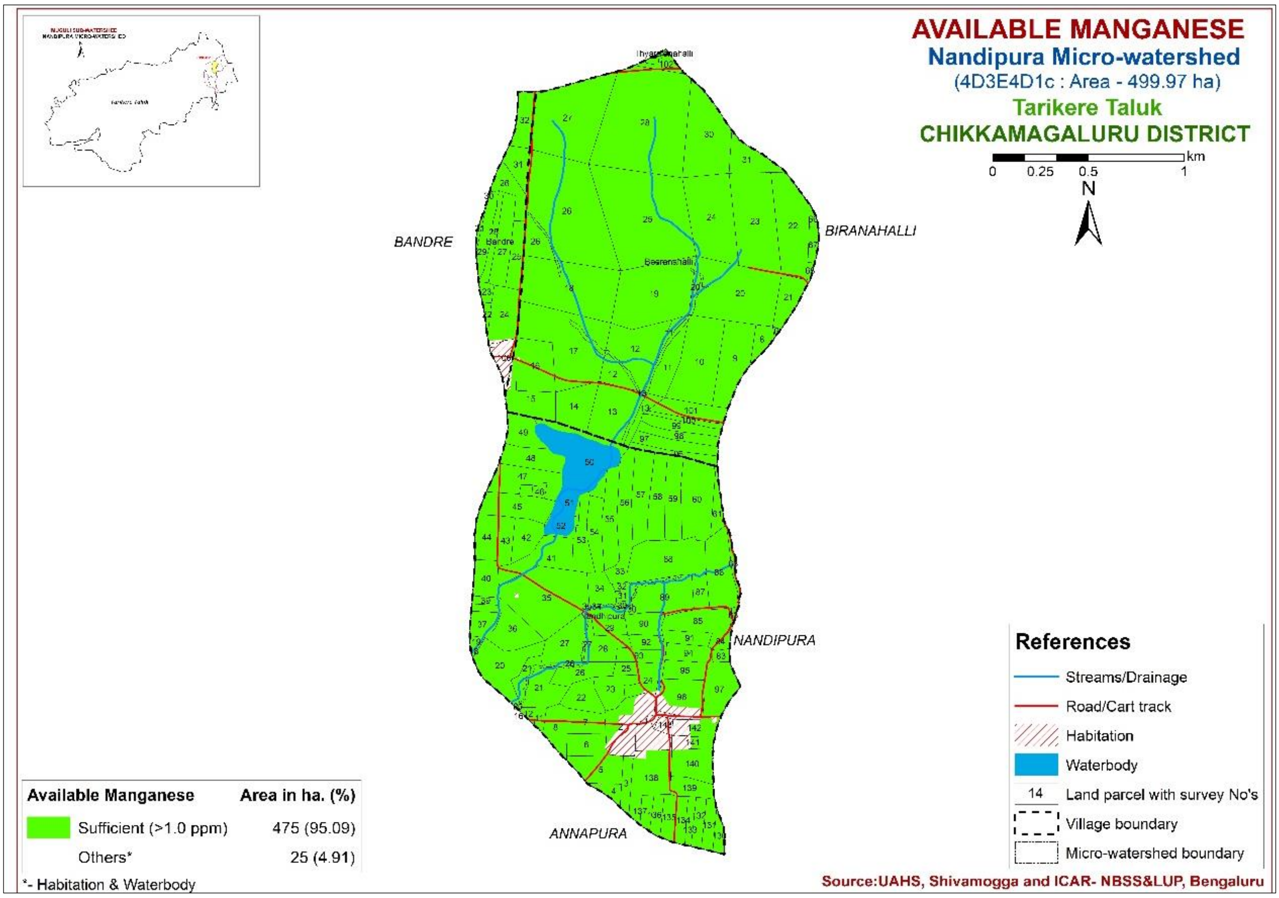

Fig 9: Available manganese status of Nandipura micro-watershed

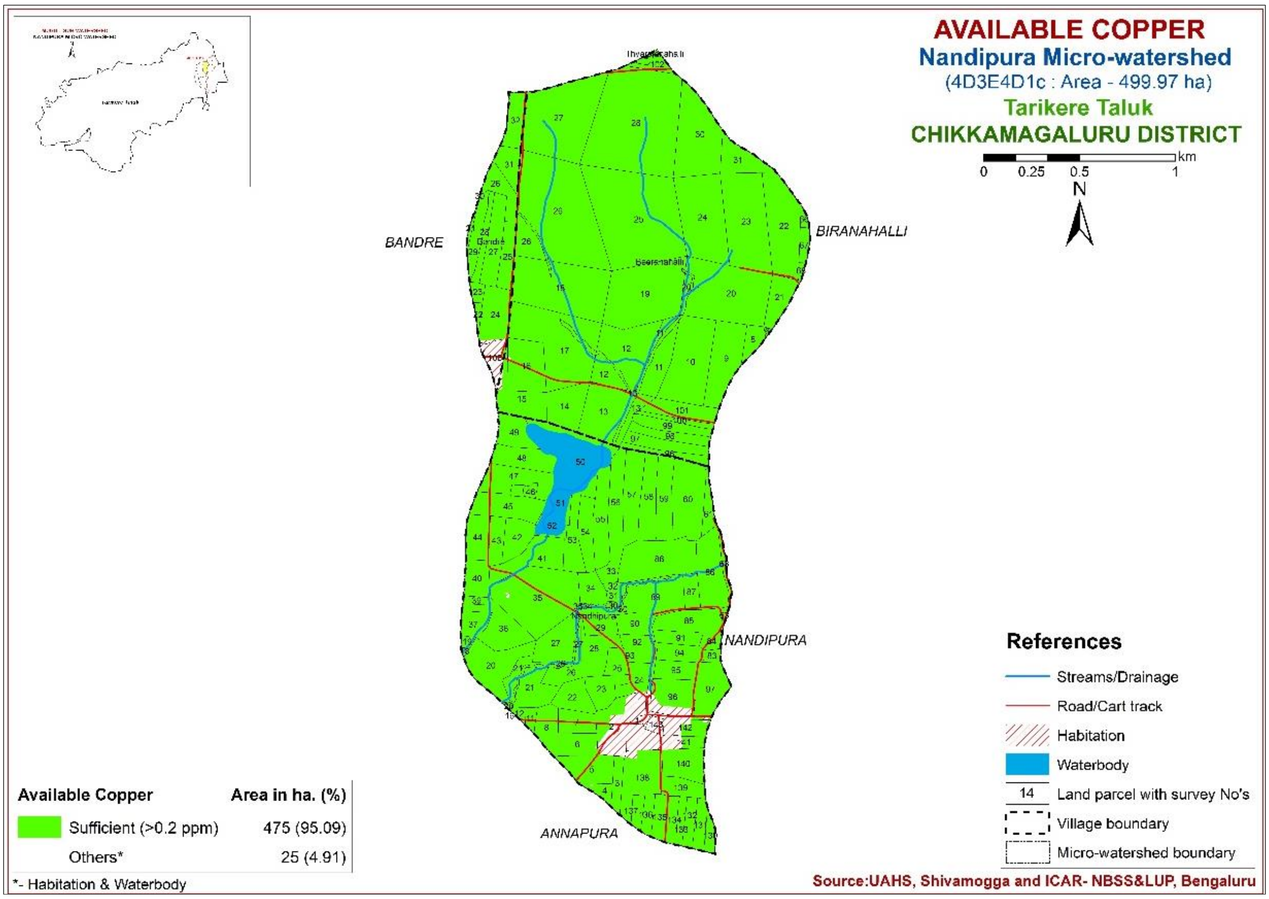

Fig 10: Available copper status of Nandipura micro-watershed

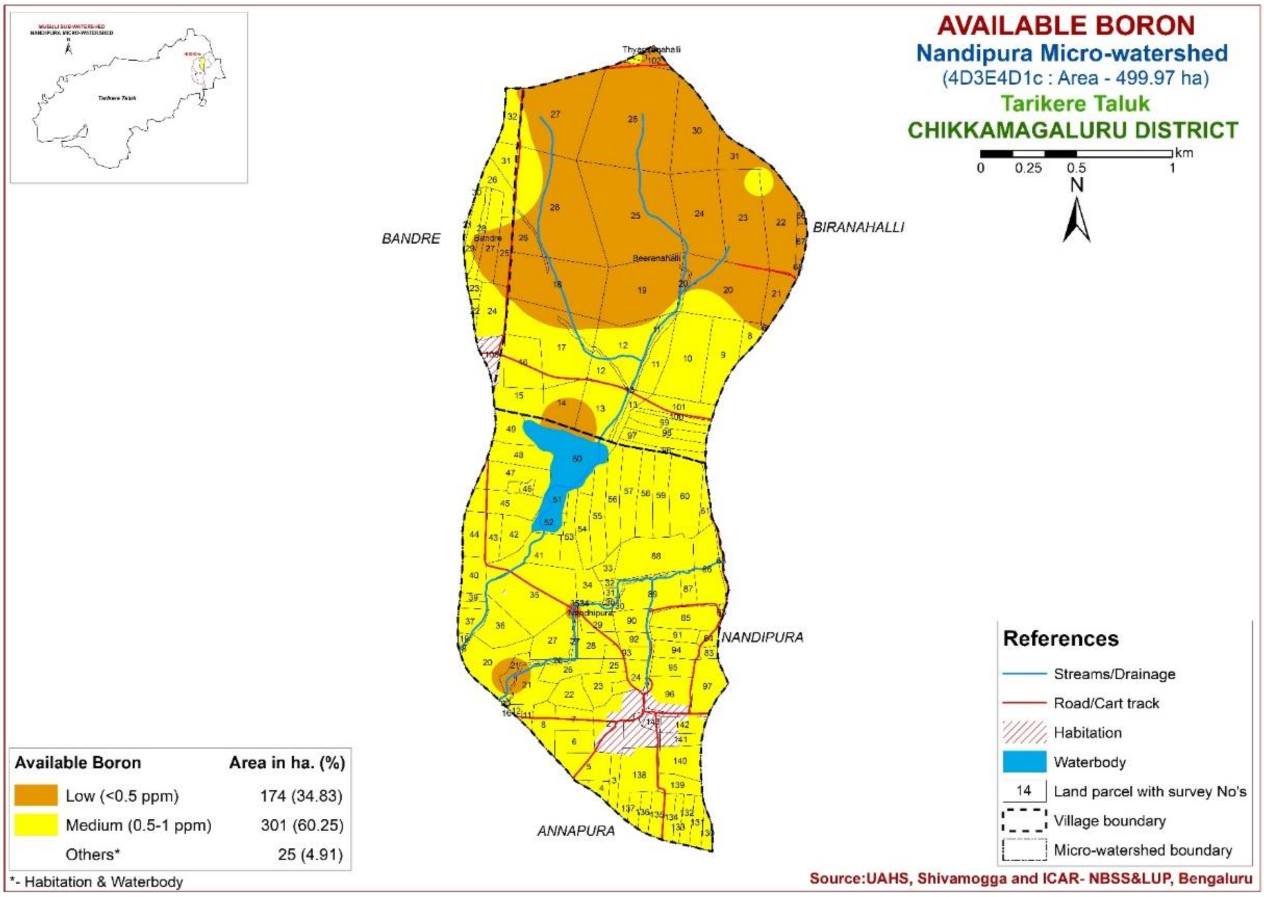

Fig 11: Available Boron status of Nandipura micro-watershed

Conclusion

The soils of Nandipura micro-watershed were low to medium available nitrogen, available phosphorus and available potassium content, whereas it was medium to high in available sulphur content. The soils of Nandipura mciro-watershed were sufficient in exchangeable calcium, magnesium, DTPA extractable iron, copper and manganese, whereas it was deficient and sufficient in DTPA extractable zinc. Available boron content was low to medium in the micro-watershed area. Overall, the soils of Nandipura micro-watershed are medium in fertility status. With proper fertilizer recommendation and soil management practices the soils can be made productive thereby, increasing the crop yield.

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