Assessment of nutrient status in Rajagondanahallli Micro-watershed of Channagiri taluk, Davanagere district, Karnataka by using geographic information system technique

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Citation: Balaji Naik. D, and Gurumurthy, K. T (2022) Assessment of nutrient status in Rajagondanahallli Micro-watershed of Channagiri taluk, Davanagere district, Karnataka by using geographic information system technique, *International Journal of Environment and Pollution Research*, Vol.10, No.3 pp.29-38

ABSTRACT: *The study was conducted to assess the soil fertility status and to prepare the fertility mapping at Rajagondanahallli micro-watershed (480.55 ha) of Davangere district by using GIS and GPS techniques during the year of 2019 to 2021. Total 44 surface soil samples at 320 × 320 m grid intervals (0 to 15 cm depths) were collected and soil fertility mapping were developed by using Arc GIS software. The fertility status of soils of Rajagondanahallli micro-watershed indicated that the soil were low (81.15 %) to medium (9.58 %) in available nitrogen, low (4.77 %) to medium (85.95 %) in available phosphorus, medium (52.10 %) to high (38.63 %) in available potassium, available sulphur were found to be sufficient, whereas exchangeable calcium and magnesium were found to be sufficient. DTPA extractable zinc was sufficient in 434 ha (90.24 %) and deficient in 2 ha (0.49 %) area. Whereas DTPA extractable iron, manganese, copper were sufficient. Available boron was low (20.19 %) to medium (70.53 %) in the study area.*

KEYWORDS: arc GIS software, mapping and micro-watershed and soil fertility

INTRODUCTION

The basis of life on earth is soil. Crop production depends heavily on soil nutrients. The amount of readily available nutrients, particularly micronutrients, is declining in intensively formed soils. There is a rising demand for site-specific balanced fertilizer recommendations based on the crop type, yield level, and soil conditions since the nutrients that are exported from the farm in agricultural products must be replaced in order to maintain soil fertility and the production system. As a result, it is necessary to examine the nutrient restrictions of soils that are subjected to intense agricultural cultivation and high yielding crops. The Geographical Information System (GIS) analyses and presents many data layers drawn from diverse sources and offers helpful assistance to handle large amounts of data produced by conventional and remote sensing technology in both spatial and non-spatial format. An area's soil fertility can be mapped using GIS techniques, which can be used to provide balanced fertilizer recommendations and comprehend the state of soil fertility across time and space. GIS can therefore be used in a variety of agricultural contexts. Assessing the soil fertility status is crucial since it may reveal essential details about crop research. In light of these facts, a study was started with the aim of mapping the Rajagondanahallli micro-watershed of Channagiri taluk, Davanagere district, Karnataka, and evaluating fertility status of soil.

MATERIAL AND METHOD

The study area is a Rajagondanahallli micro-watershed, covering an area of 480.55 ha. The Davangere district lies in the center of Karnataka between the latitudes 14° 27' 50.7708" N and 75° 55' 17.9796" E. The average rainfall in the study area is 808 mm. The detailed soil survey of the Rajagondanahallli micro-watershed was carried out at 1:7920 scale by using the Quick Bird satellite imagery and cadastral map as base maps. Forty four surface soil samples were collected by adopting grid techniques (320 x 320 m grid interval) at 0 to 15 cm depth. The collected soil samples were processed and analyzed for chemical properties and available nutrients using standard procedures. The pH (1:2.5) and electrical conductivity (EC) of soils were measured by using standard procedures as described by Jackson (1973). Organic carbon (OC) was determined using the Walkley-Black method (1934). Available nitrogen (Subbaiah and Asija 1956), Available phosphorus (Jackson 1973), Available potassium (Jackson 1973), Available sulphur (Black 1965), exchangeable calcium and magnesium (Jackson 1973), Micronutrients (Fe, Mn, Cu and Zn) were extracted by DTPA reagent by adopting procedure as outlined by Lindsay and Norvell (1978) and Available boron (John *et al*., 1975).

RESULTS AND DISCUSSION

The soil reaction in Rajagondanahalli micro-watershed was ranged from 5.02 to 8.85 (Table 1), with a mean value of 6.80 and a standard deviation (SD) of 1.06. Soil reaction was varied acidic to moderately alkaline in reaction. About 35.50 per cent of the micro-watershed area was neutral followed by slightly alkaline in 25.78 per cent and 16.59 per cent was slightly acidic and moderately acidic in 10 per cent area and moderately alkaline in 1.80 per cent and 1.06 per cent was strongly acidic (Fig. 1). The variation in soil pH was related to the parent material and topography.

The electrical conductivity of Rajagondanahalli micro-watershed was non- saline in nature. It was ranged from 0.11 to 0.46 dS m^{-1} (Table 1), with a mean of 0.23 dS m^{-1} and a standard deviation of 0.09. This may be due to undulating nature of the terrain coupled with fairly good drainage conditions, which favored the removal of released bases by the percolating drainage water. The soil organic carbon status of the Rajagondanahalli micro-watershed varied from 3.06 to 13.05 g kg^{-1} and with a mean value of 6.23 g kg^{-1} and a standard deviation of 2.24 (Table 1). About 15.94 per cent area (77 ha) of soils were low in organic carbon and 61.41 per cent area were medium (295 ha) and 64 ha area were high (13.38 %) in organic carbon status. In general, organic carbon was low to high in status (Fig. 1). Low organic carbon in the soil might be due to low input of FYM and crop residues as well as their rapid rate of decomposition under high temperature. Medium organic matter content is attributed due to rapid rate of decomposition of organic matter due to high temperature and lack of addition of FYM and crop residues. Higher organic matter content mainly due to accumulation of organic materials through crop residue and external applications in the surface soils

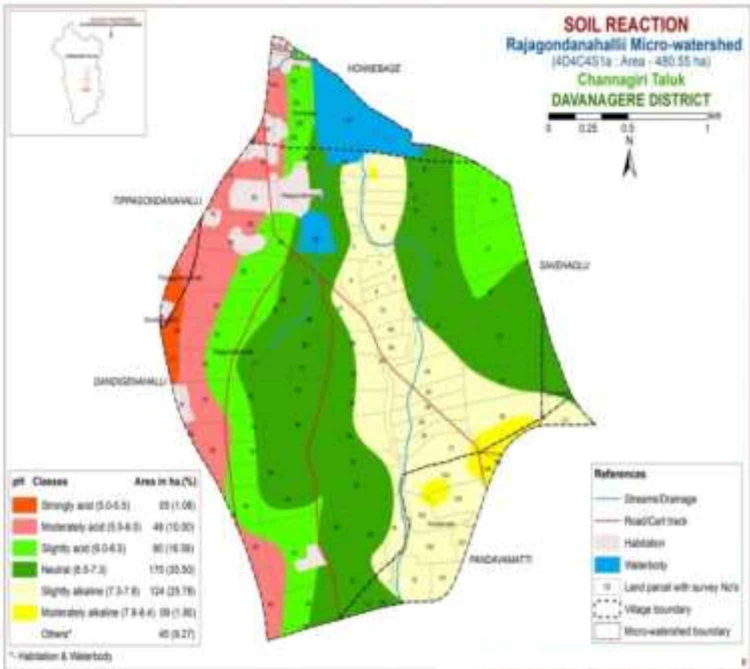
The Rajagondanahalli micro-watershed soils were low to medium in available nitrogen status and it was ranged from 114.15 to 382.59 kg ha^{-1} with a mean value of 224.18 kg ha^{-1} and a standard deviation of 66.41 (Table 1). The 81.15 per cent area soils were low (390 ha) and 9.58 per cent area (46 ha) soils were medium in nitrogen status (Fig. 1). The low available nitrogen may be due to low organic carbon, low vegetation cover, accelerated degradation coupled with low nitrogen fertilization (Mathews *et al*., 2009).

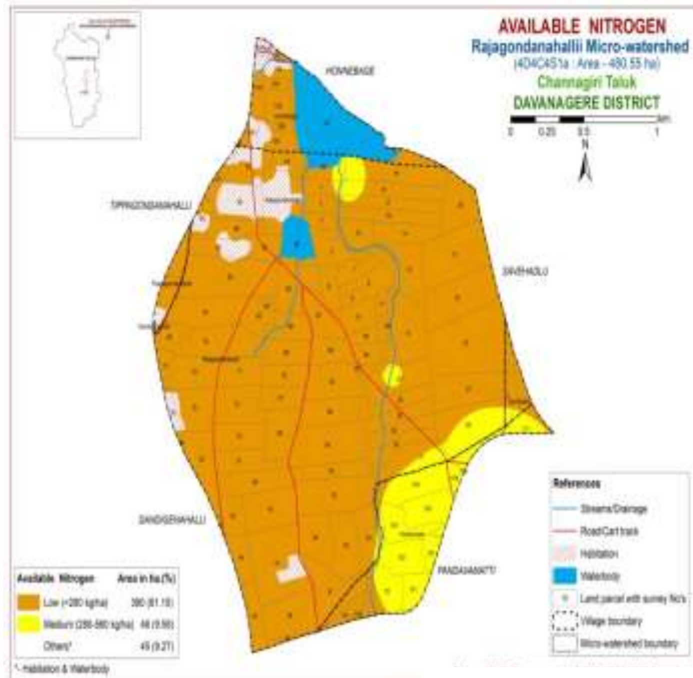
The available phosphorus content of Rajagondanahalli soils were ranged from 14.66 to 54.04 kg ha^{-1} with a mean value of 33.16 kg ha^{-1} and a standard deviation of 10.32 (Table 1). About 23 ha (4.77 %) area of the micro-watershed soils were low in available phosphorus status and 413 ha (85.95 %) area of the soils were medium in available phosphorus (Fig. 1) due to low CEC, clay content and acidic soil reaction (Mini *et al.*, 2004)

The available potassium content of Rajagondanahalli micro-watershed soils were medium to high in status and it was ranged between 141.74 to 583.30 kg ha^{-1} with a mean value of 311.69 kg ha^{-1} and a standard deviation of 107.96 (Table 1). About 250 ha (52.10 %) area of the micro-watershed soils were medium in available potassium status and 186 ha (38.63 %) area of the soils were high in available potassium status (Fig. 2). This could be attributed to more intense weathering, release of labile K from organic residues, application of K fertilizers and upward translocation of potassium from lower depth along with capillary rise of ground water.

Table 1: Fertility status of surface soil samples of Rajagondanahalli micro- watershed of Gullahalli sub-watershed of Channagiri taluk of Davanagere district

Soil properties	Range	Mean	SD
pH (1:2.5)	5.02-8.85	6.80	1.06
EC (dS m^{-1})	0.11-0.46	0.23	0.09
OC (g kg^{-1})	3.06-13.05	6.23	2.24
Available N (kg ha^{-1})	114.15-382.59	224.18	66.41
Available P_2O_5 (kg ha^{-1})	14.66-54.04	33.16	10.32
Available K_2O (kg ha^{-1})	141.74-583.30	311.69	107.96
Exchangeable Ca (cmol (p^+) kg^{-1})	1.75-20.75	9.05	3.81
Exchangeable Mg (cmol (p^+) kg^{-1})	1.70-15.25	4.95	3.16
Available S (mg kg^{-1})	20.05-47.30	29.75	7.88
Available Zn (mg kg^{-1})	0.47-1.51	0.93	0.25
Available Fe (mg kg^{-1})	2.19-37.28	14.53	8.59
Available Mn (mg kg^{-1})	3.18-37.08	12.69	8.11
Available Cu (mg kg^{-1})	0.84-5.05	1.69	0.83
Available B (mg kg^{-1})	0.27-0.99	0.58	0.17


SOIL REACTION
Rajagondanahallii Micro-watershed
Channagiri Taluk
DAVANAGERE DISTRICT
HONNEBAGE
TIPPAGONDANAHALLI
SAVEHADLU
DANDIGENAHALLI
PANDAVANATTI
pH Classes
Area in ha (%)
Others*
References
Stream/Drainage
Road/Cart track
Habitation
Waterbody
Land parcel with survey No's
Village boundary
Micro-watershed boundary
*- Habitation & Waterbody


AVAILABLE NITROGEN
Rajagondanahallii Micro-watershed
Channagiri Taluk
DAVANAGERE DISTRICT
HONNEBAGE
TIPPAGONDANAHALLI
SAVEHADLU
DANDIGENAHALLI
PANDAVANATTI
Available Nitrogen
Area in ha (%)
Others*
References
Stream/Drainage
Road/Cart track
Habitation
Waterbody
Land parcel with survey No's
Village boundary
Micro-watershed boundary
*- Habitation & Waterbody

Vol.10, No.3 pp.29-38, 2022
Print ISSN: 2056-7537(print)
Online ISSN: 2056-7545(online)

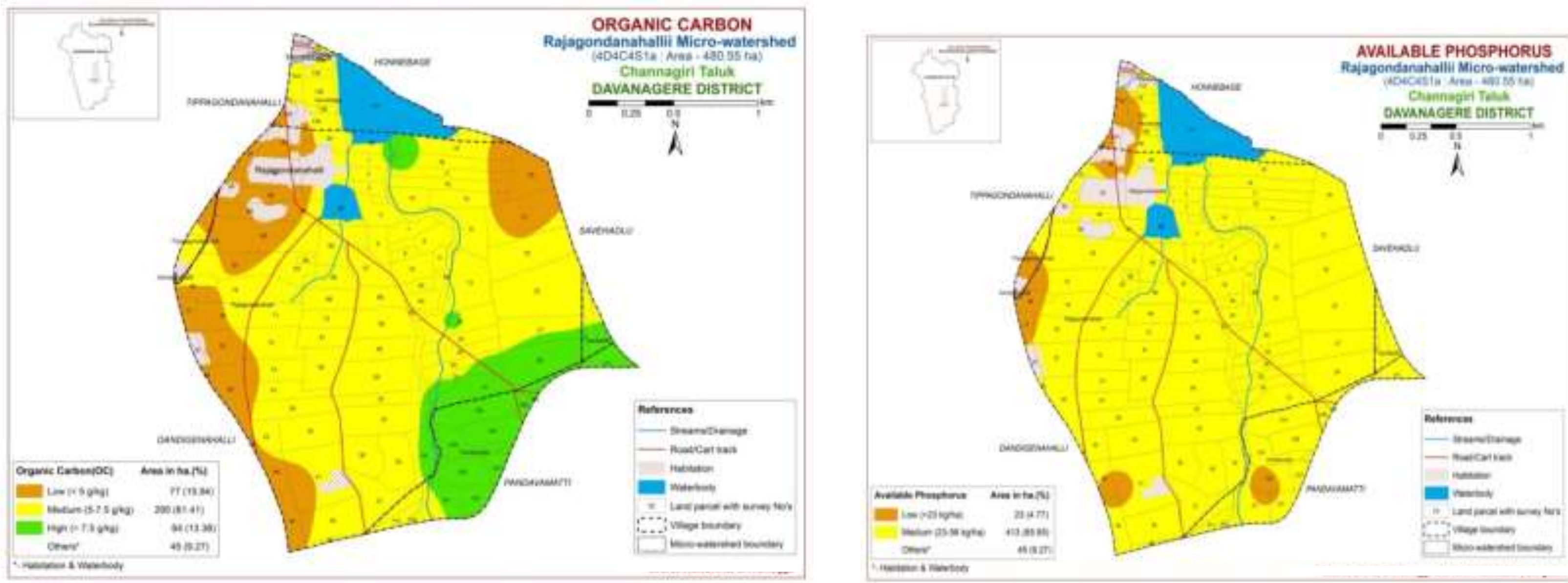


Fig. 1: PH, OC, N and P status of Rajagondanahalli micro-watershed of Channagiri taluk of Davanagere district, Karnataka

International Journal of Environment and Pollution Research
Vol.10, No.3 pp.29-38, 2022
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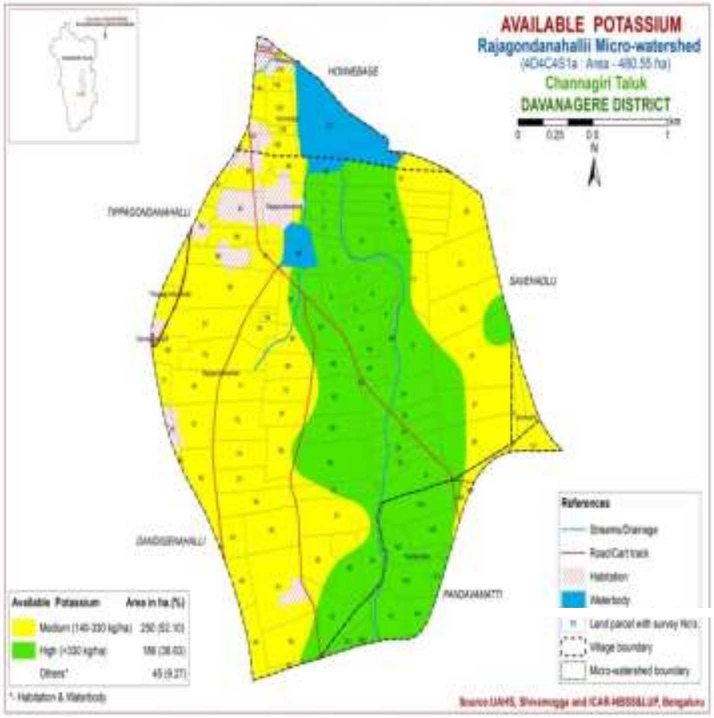

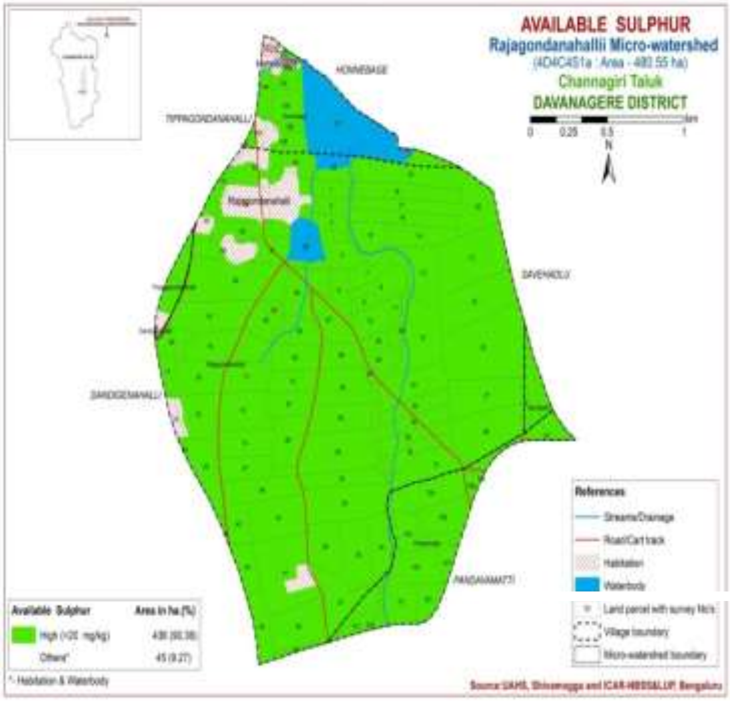

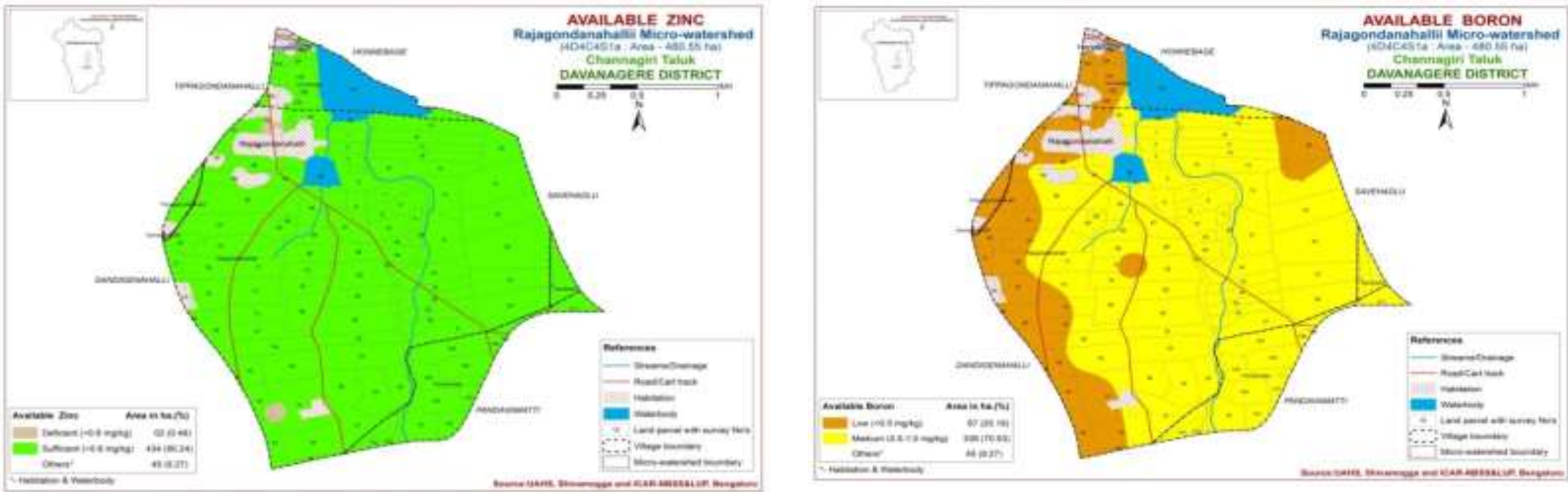

Fig. 2: Available K, S, Zn and B status of Rajagondanahalli micro-watershed of Channagiri taluk of Davanagere district, Karnataka

The higher content of potassium might be due to the predominance of potash rich micaceous and feldspar minerals in parent rocks (Dasog and Patil, 2004).

The exchangeable calcium and magnesium content of Rajagondanahalli micro-watershed soils were sufficient (Table 1). It was ranged from 1.75 to 20.75 and 1.70 to 15.25 cmol (p^+) kg^{-1} with a mean value of 9.05 and 4.95 cmol (p^+) kg^{-1}, respectively and standard deviations of 3.81 and 3.16, respectively. The Rajagondanahalli micro-watershed area soils were found to be sufficient of exchangeable calcium and magnesium status. The studied areas are sufficiency of exchangeable calcium and magnesium might be attributed to the type and amount of clay present.The available sulphur content of Rajagondanahalli micro-watershed soils were varied from 20.05 to 47.30 mg kg^{-1} with the mean value of 29.75 mg kg^{-1} and a standard deviation of 7.88 (Table 1). The status of available sulphur in the micro-watershed was medium.

The available iron content in the Rajagondanahall micro-watershed was sufficient (90.73 %) (Table 1). It was ranged from 2.19 to 37.28 mg kg^{-1}, with a mean value of 14.53 mg kg^{-1} and a standard deviation of 8.59 ppm. The amount of available iron in the study area was sufficient. This might be due to the granite gneiss parent material having larger iron content. Rajagondanahalli micro-watershed soils contained 3.18 to 37.08 mg kg^{-1} of available manganese with a mean value of 12.69 mg kg^{-1} and a standard deviation of 8.11(Table 1) and available manganese is sufficient (90.73 %) in the Rajagondanahalli micro-watershed soils. The Rajagondanahalli micro-watershed area soils were sufficient (90.73 %) in available copper content (Table 1) and a variation of 0.84 to 5.05 mg kg^{-1} of available copper content with a mean value of 1.69 mg kg^{-1} and a standard deviation of 0.83. Copper found to be higher in this micro-watershed area due to $CaCO_3$ and clay content resulting in copper fixation. The overall higher copper content in the micro watershed area was due to the parent material. The available zinc content Rajagondanahalli micro-watershed area was sufficient in 434 ha (90.24 %) and deficient in 2 ha (0.49 %) area (Table 1). It was varied from 0.47 to 1.51 mg kg^{-1} with a mean value of 0.93 mg kg^{-1} and a standard deviation of 0.25 (Fig 2).
The available boron status in Rajagondanahalli micro-watershed soils were low in 97 ha (20.19 %) and medium in 339 ha area (70.53 %) (Table 1) with a variation of from 0.27 to 0.99 mg kg^{-1} with a mean value of 0.58 mg kg^{-1} and a standard deviation of 0.17 (Fig 2).

CONCLUSION

In conclusion, soil pH ranged from acidic to alkaline in reaction (5.02-8.85), salt content was very low indicates soils are non-saline in nature. Organic carbon content was low to high and ranged from 3.06 to 13.05 g kg^{-1}. The available nitrogen was low to medium in status and it was ranged from 114.15 to 382.59 kg ha^{-1} and phosphorus was found to be low to medium (14.66 to 54.04 kg ha^{-1}). The available potassium was medium to high and it ranged from 141.74 to 583.30 kg ha^{-1}. The available sulphur was medium (20.05-47.30 mg kg^{-1}). The micronutrient Fe, Mn and Cu were sufficient, were as Zn was deficient to sufficient in status. The available boron was low to medium in status (0.27-0.99 mg kg^{-1}) soils of micro-watershed. The study highlights the importance of mapping the soil fertility status, which gives the spatial extent rather than the means which have limited applicability for better soil management and precise management of nutrients.

ACKNOWLEDGEMENT: The authors are grateful to Sujala III Project, Karanataka Watershed Development programme, for their warm reception and support during the data collection phase of this study.

COMPETING INTEREST

Authors have declared that no competing interest exists.

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