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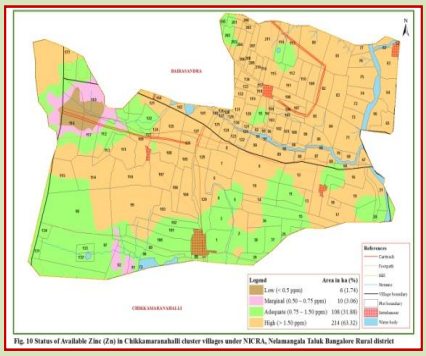

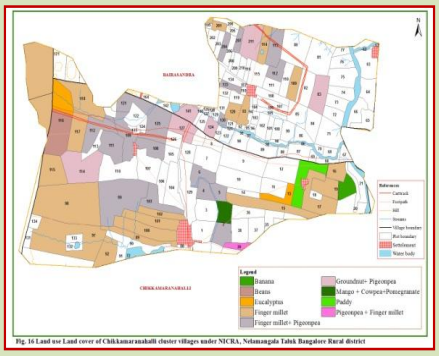

Directorate of Research

National Initiative on Climate Resilient Agriculture

All India Coordinated Research Project for Dryland Agriculture (AICRPDA)

University of Agricultural Sciences, GKVK, Bangalore 560 065, Karnataka

2014

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Soil Fertility Assessment, Mapping and Fertilizer Recommendation in Chikkamaranahalli Cluster Villages, Nelamangala Taluk, Bangalore Rural District, Karnataka using Geospatial Approach

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Front cover (clock wise) : Status of available Zn, Land Use System. Finger millet+ Pigeonpea (8:2) cropping system, Groundnut+ Pigeonpea (8:2) cropping system

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Foreword

Soil fertility is one of the important factors regulating crop yield. Agriculture sustainability and sustained food production is possible when the soil is managed scientifically.

Imbalanced and inadequate fertilizer use coupled with poor management has declined the response (production) efficiency of chemical fertilizer nutrients tremendously under intensive agriculture. Soil fertility evaluation must play a critical role in developing sustainable strategies of nutrient management in near future. In recent years, soil fertility evaluation has been made precise with modern geospatial technologies such as Remote Sensing (RS), Geographical Information System (GIS), Global Positioning System (GPS) and Information Technology (IT). The maps prepared using the tools do play an important role in determining the fertilizer requirements of crops considering crops and soil fertility, thus, ensuring economy of fertilizer use by the farmers.

This bulletin entitled "**Soil Fertility Assessment, Mapping and Fertilizer Recommendation in Chikkamaranahalli Cluster Villages, Nelamangala Taluk, Bangalore Rural District, Karnataka using Geospatial Approach**" containing soil fertility maps generated using GIS for all the plant nutrients for five cluster villages of Nelamangala taluk, Bangalore rural district under the project "National Initiative on Climate Resilient Agriculture" funded by CRIDA Hyderabad, will facilitate the farmers to economize the fertilizer application. It is believed that the data presented by using modern geospatial techniques would provide ample data on soil fertility status of Chikkamaranahalli cluster villages of Nelamangala taluk. I compliment the efforts of Dryland Agricultural Project team in bringing out this publication. I hope this bulletin will help the researchers, extension workers and farmers in bringing sustainability of dryfarming in cluster of villages and also serve as a module for further studies.

(D.P. KUMAR)
Vice Chancellor
UAS, Bangalore.

December, 2014

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Soil Fertility Assessment, Mapping and Fertilizer Recommendation in Chikkamaranahalli Cluster Villages, Nelamangala Taluk, Bangalore Rural District, Karnataka using Geospatial Approach

BACKGROUND

Food production in India witnessed an unprecedented increase over the last four decades. It bounced from nearly 71 million tonnes during 1960's to 247.6 million tonnes during 2010's. This achievement was mainly the resultant of intensification of agriculture rather than contribution from the marginally increased (135 to 145 m. ha) land over the same period. But in the process, it caused soil exhaustion especially through depleted plant nutrients. Because of imbalanced and inadequate fertilizer use coupled with lower input efficiency, the response (production) efficiency of chemical fertilizer has declined tremendously under intensive agriculture in recent years. Soil characterization in relation to soil fertility status is an important aspect in sustaining agriculture production. However exploitative nature of modern agriculture involving use of high analysis N P K fertilizers coupled with limited use of organic manures and less recycling of crop residues are important factors contributing towards accelerated exhaustion of micronutrients from soil. As seen, deficiency of micronutrients has become a major constraint for productivity, stability and sustainability in many Indian soils.

For plants to utilize these nutrients efficiently, light, heat, and water must be adequate. Good agronomic practices and timely control of diseases and insects also play an important role in crop production. Below certain level, of nutrients plants start to show deficiency symptoms. While excessive nutrient uptake can also cause poor growth because of toxicity. Therefore, proper source, time, amount of application and the placement of nutrients are important.

The modern geospatial technologies such as Geographical Information System (GIS), Global Positioning System (GPS) and Information Technology (IT) offer immense potential for soil and resources characterization, development and management. GIS facilitates visualization, manipulation of attribute data spatially.

GPS based soil sampling results are used with parcel boundary to create coordinates/grid nutrient maps to show any differences in soil nutrient status within a field or farm. Farmers can often predict whether fields will have no differences or big differences based on local knowledge. For example, fields that generally yield fairly evenly are less

likely to show higher differences, and likewise fields with uniform soil type are less likely to reveal big differences. For any data source to be useful, it has to be processed, simplified and interpreted to extract useful and useable information for farm management. Data on its own has limited uses, but manipulation of data highlights differences within the data set.

Details of NICRA project

Indian Council of Agriculture Research (ICAR) launched a network project, National Initiative on Climate Resilient Agriculture (NICRA) which aims to enhance resilience of agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The project is in operation at the All India Coordinated Research Project for Dryland Agriculture, Bangalore since January, 2011 to reduce the climate related risks in drylands of five villages of Nelamangala taluk, Bangalore rural district of Karnataka. Further, the different technologies under the themes like Real time Contingency Plan, Rainwater harvesting, Efficient Energy Use and Management and Alternate Land Use and Carbon sequestration for sustainable dryland Agriculture were demonstrated both on-station and on-farm in a Participatory action research mode.

General description of the area

Chikkamaranahalli cluster villages (Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya) Nelamangala taluk, Bangalore rural district, Karnataka state comes under Eastern Dry Zone (Zone No.5) of Karnataka (Fig. 1). The study area is located at 13^{o} 6' N Latitude, 77^{o}19' E Longitude and 896 to 970 m above Mean Sea Level Altitude and at a distance of about 50 km from GKVK Campus. The soils are lateritic and sandy loamy in texture.

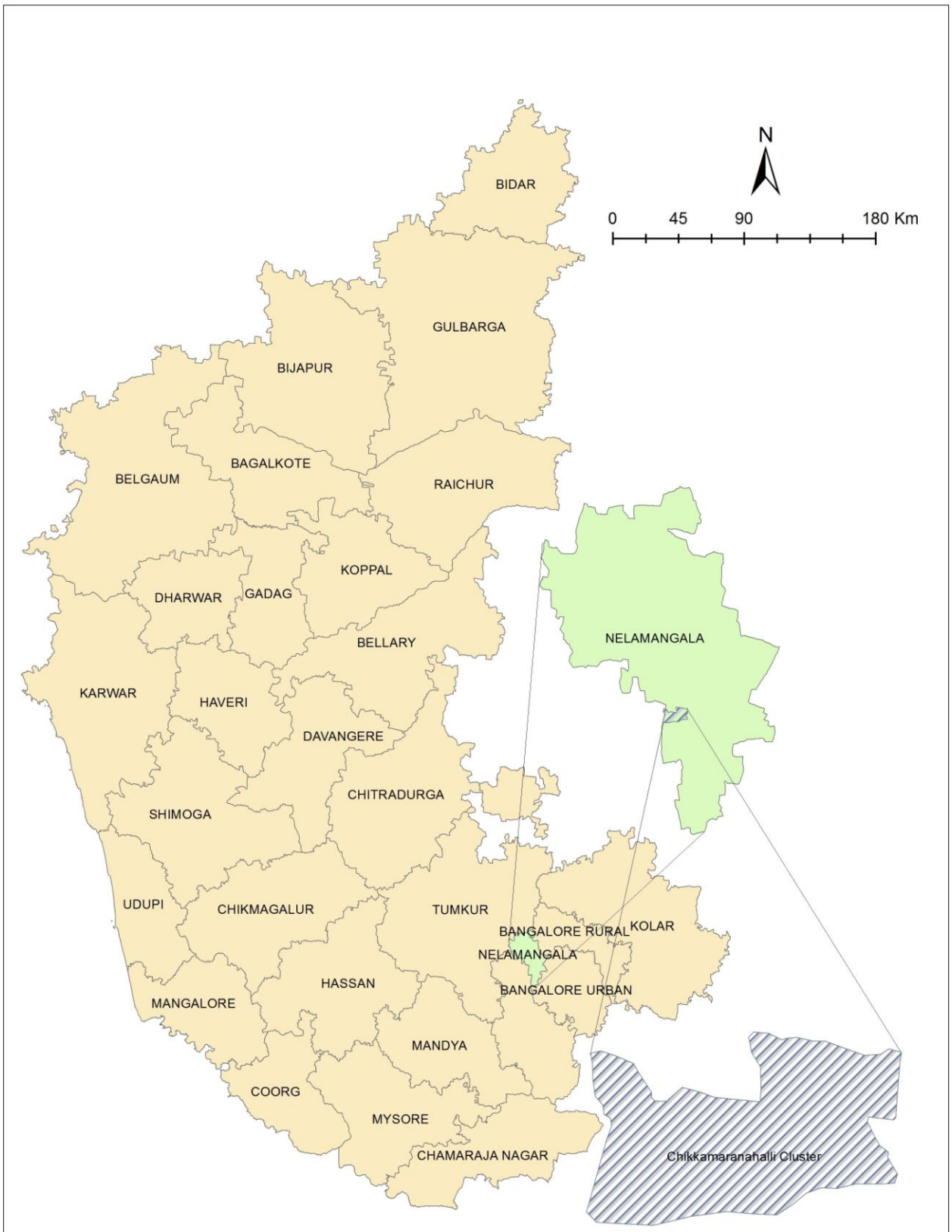

Fig. 1 Location of project site

Climate

The average rainfall of project villages for 8 years was 734.1 mm and distribution is highly erratic. The area is experiencing higher temperature, low to moderate humidity in most part of the year.

Table -1 Average rainfall of Chikkamaranahalli cluster

Sl. No	Period	Normal rainfall (mm)	Actual Rainfall (mm)							
		C.M. Halli	2005-06	2006-07	2007-08	2008-09	2009-10	2011-12	2012-13	2013-14
1.	**Summer**	79.4	153.0	42.4	196.0	0.0	213.8	137	92	110
	(April-May)		(5)	(3)	(9)	(0)	(11)	(6)	(4)	(9)
2.	***Kharif***	563.9	700	172.0	696.0	882.6	519.4	529	268	498
	(June-October)		(28)	(11)	(31)	(31)	(29)	(28)	(20)	(23)
3.	***Rabi***	90.8	158.0	0.0	203.4	24.0	49.0	26	82	35
	(Nov-March)		(7)	(0)	(5)	(3)	(2)	(2)	(2)	(3)
4.	**Total**	734.1	1011.0	214.4	1095.4	906.6	782.2	692	442	643
			(40)	(14)	(45)	(34)	(42)	(36)	(26)	(35)
5.	**% deviation from normal RF**		22.2%	-71.5%	45.7%	20.6%	4.0%	-7.73%	-41.22%	-12.41

Methodology

The study on nutrient status in soils of Chikkamaranahalli, Chikkamaranahalli colony, Chikkaputtayanaplaya, Mudalaplaya and Hosaplaya villages was assessed during 2014-15.

Village map collection and digitisation

Village map showing cadastral boundaries was collected from Department of Land Records, Government of Karnataka, which is geo-referenced and digitised using Arc GIS 10.2.1 software. The village map was used for collecting soil samples in the cluster villages.

Collection of soil samples

The surface soil samples upto a depth of 15 cm was collected by following the standard procedure. The collected soil samples were cleaned and placed in ploythene cover with proper labelling. While collecting the soil samples, the latitude-longitude points were

noted using GPS and details of cropping system of previous year and proposed cropping were also recorded in all the fields of farmer's. Based on the cropping pattern 129 soil samples were collected in the domain area (Fig. 2).

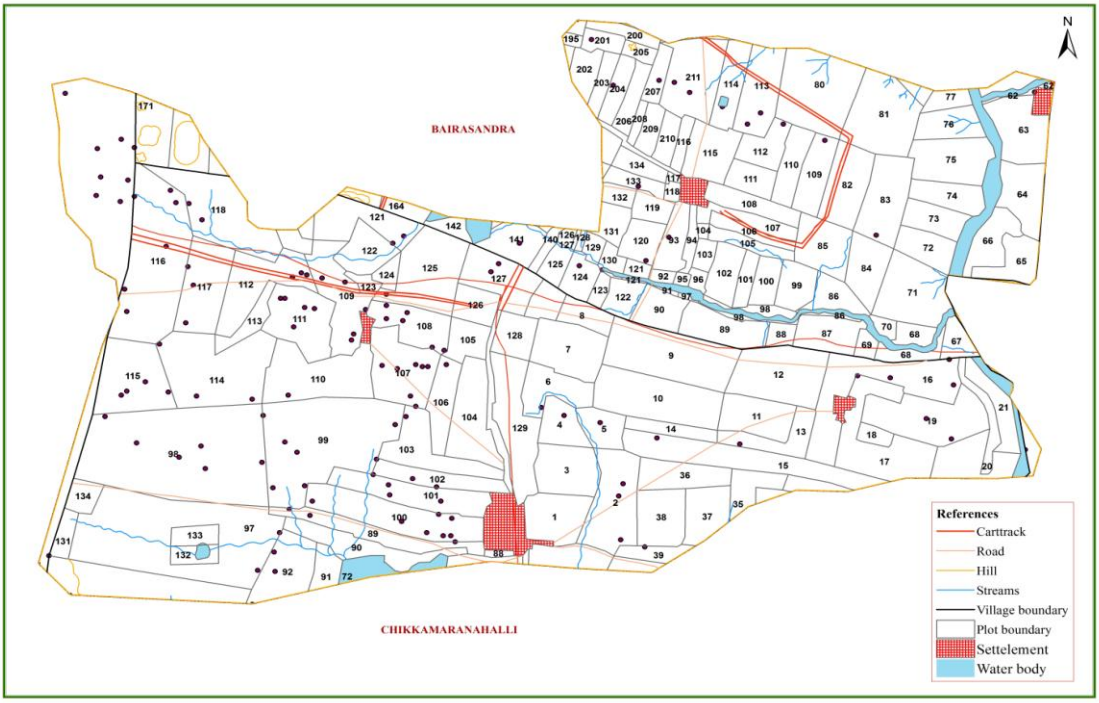

Fig.2 Location of Soil samples collected in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

Preparation of soil samples

The representative soil samples were brought to the laboratory, air dried under shade, powdered using wooden pestle and mortar, passed through 2 mm sieve and stored in polyethylene bag for further analytical work.

For organic carbon determination, 2 mm sieved sample were further subjected for grinding and passed through 0.2 mm sieve (Jackson, 1973).

Method of soil analysis

Soil reaction (pH)

Soil pH was determined by potentiomentric method in 1:2.5 soil: water suspension by dipping the combined electrode (glass electrode plus calomel electrode) of a digital pH meter as described by Jackson 1973.

Electrical Conductivity (EC)

EC of soil sample was measured in 1:2.5 soil: water extract using Conductivity Bridge and result were expressed in terms of dSm^{-1} at 25°C (Jackson 1973).

Organic Carbon (OC)

Organic carbon of soil samples were determined by Walkely and Black's wet oxidation method. In this method 0.5g of soil (0.2mm sieved) was treated with a known excess volume of potassium dichromate to oxidize organic carbon to CO_2 and untreated $K_2Cr_2O_7$ was back titrated against standard ferrous ammonium sulphate using diphenylamine indicator (Jackson 1973).

Available Nitrogen

The available nitrogen was determined by macro distillation following alkaline permanganate method as suggested by Subbaiah and Asija (1956).

Available Phosphorus

Available phosphorus was extracted with Bray's No.1 extractant (0.03N NH_4F + 0.025 N HCl). The phosphorus in the extract was determined by chlorostannous reduced molybdophosphric blue colour method in HCl acid medium. The intensity of blue colour was read at 660 nm using a spectrophotometer (Jackson, 1973).

Available Potassium

Available potassium was determined by flame photometer after extracting the soil with neutral normal ammonium acetate as described by Page (1982)

Exchangeable Calcium and Magnesium

Exchangeable Calcium was estimated by titrating ammonium acetate extract aliquot of soil against standard EDTA solution using sodium hydroxide and murreoxide as indicator. Exchangeable calcium plus magnesium were estimated by titrating a separate aliquot of ammonium acetate extract of soil against EDTA solution using ammonium chloride and ammonium hydroxide buffer using EBT indicator. Exchangeable magnesium content in soil was calculated by subtracting exchangeable calcium content from exchangeable calcium plus magnesium content of the soil (Jackson, 1973)

Available Sulphur

Available sulphur in the form of sulphate was determined by using 0.15 per cent $CaCl_2$ as extractant and measured turbidometrically using spectrophotometer at 420 nm (Jackson 1973).

DTPA Extractable Micronutrients

Available micronutrients in soil was determined with DTPA extractant (0.005 M diethyl triamine penta acetic acid + 0.01 M $CaCl_2$ $2H_2O$ + 0.1 N triethanolamine buffered at pH 7.3) at 1: 2 soil to extractant ratio as described by Lindsay and Norwell (1978). The concentration of micronutrients (Fe, Mn, Cu and Zn) in the extract was determined by using Atomic Absorption Spectrophotometer fitted with appropriate hallow cathode lamps under specific measuring concentration as specified in the instruction manual.

Available Boron

Available boron in soil was extracted using hot water (boiling the 1:2 soil water suspension taken in a flask fitted with reflux condenser for 5 minutes) and estimated using Azomethine-H method as described by John *et al*., (1975).

Thematic maps

The fertility maps showing nutrient status was generated using the analytical data of individual nutrient. The point data collected using GPS was then transformed into polygon data using krigging interpolation technique in Arc GIS software.

Chemical properties of surface soil samples

Surface soil samples collected in different locations were analyzed for various properties and the data is presented in Table 2,3,4,5 and 6.

Soil reaction

The soil reaction in surface soils of Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya and Mudalapalya and Hosapalya were ranged from 4.50 to 6.33, 5.21 to 6.30, 5.38 to 6.3, 5.26 to 6.40, and 5.06 to 6.20 respectively with the mean of 5.36, 5.58, 5.50, 5.86 and 5.83 respectively. The soil reaction of the surface soil was generally acidic in nature and results also indicated about 31.31 per cent area was moderately acidic (pH – 5.5-6.0), 68.59 per cent area was strongly acidic (pH – 5.0-5.5) and 1 per cent area was slightly acidic (pH – 6.0-6.5) (Fig. 3).

Electrical conductivity

The electric conductivity of surface soil samples varied from 0.02 to 0.24 dSm^{-1} in Chikkamaranahalli colony, 0.04 to 0.24 dSm^{-1} in Chikkamaranahalli, 0.02 to 0.34 dSm^{-1} in Chikkaputtayanapalya, 0.04 to 0.30 dSm^{-1} in Mudalapalya, and 0.03 to 0.34 dSm^{-1} in Hosapalya. All the soil samples were found to be normal in electric conductivity (Fig. 4).

Organic carbon

The Organic carbon content of the surface soils ranged from 0.1 to 0.75 per cent with mean of 0.38 per cent in Chikkamaranahalli colony, 0.1to 0.54 per cent with mean of 0.28 per cent in Chikkamaranahalli, 0.09 to 1.14 per cent with mean of 0.44 per cent in Chikkaputtayanapalya, 0.15 to 0.75 per cent with mean of 0.46 per cent of in Mudalapalya and 0.15 to 0.69 per cent with mean of 0.505 per cent in Hosapalya. In general available organic carbon content in surface soils were found to be low to medium in Chikkamaranahalli cluster and about 83.46 per cent area was low in organic carbon content and 16.54 per cent area was medium in organic carbon content (Fig. 5).

Available nitrogen

The available nitrogen content of surface soil samples in different villages varied from 50.4 to 315.8 kg ha^{-1} in Chikkamaranahalli colony, 42.0 to 226.8 kg ha^{-1} in Chikkamaranahalli, 37.8 to 378.0 kg ha^{-1} in Chikkaputtayanapalya, 63.0 to 315.0 kg ha^{-1} in Mudalapalya and 63.0 to 289.6 kg ha^{-1} in Hosapalya, whereas, mean value 160.9 kg ha^{-1}, 119.0 kg ha^{-1}, 188.9 kg ha^{-1}, 194.6 kg $ha^{-1}$and 212.2 kg ha^{-1} in Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya and Mudalapalya and Hosapalya respectively (Table- 7,8,9,10 &11). The result indicated entire area is low in available nitrogen status (Fig. 6).

Available phosphorus (P_2O_5)

The available phosphorus ranged from 18.2 to 167.7 kg ha^{-1}, 15.1 to 135.8 kg ha^{-1}, 15.3 to 283.4 kg ha^{-1}, 13.1 to 137.3 kg ha^{-1} and 28.1 to 456.5 with the mean of 68. 9 kg ha^{-1}, 58.9 kg ha^{-1}, 100.3 kg ha^{-1}, 53.0 kg ha^{-1} and 145.8 kg ha^{-1} in Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya respectively (Table-7,8,9,10 &11). In general available phosphorus content in surface soils were found to be medium to high in Chikkamaranahalli cluster and about 8.61 per cent area were medium in available phosphorus content and 91.39 per cent area was high in available phosphorus content(Fig.7).

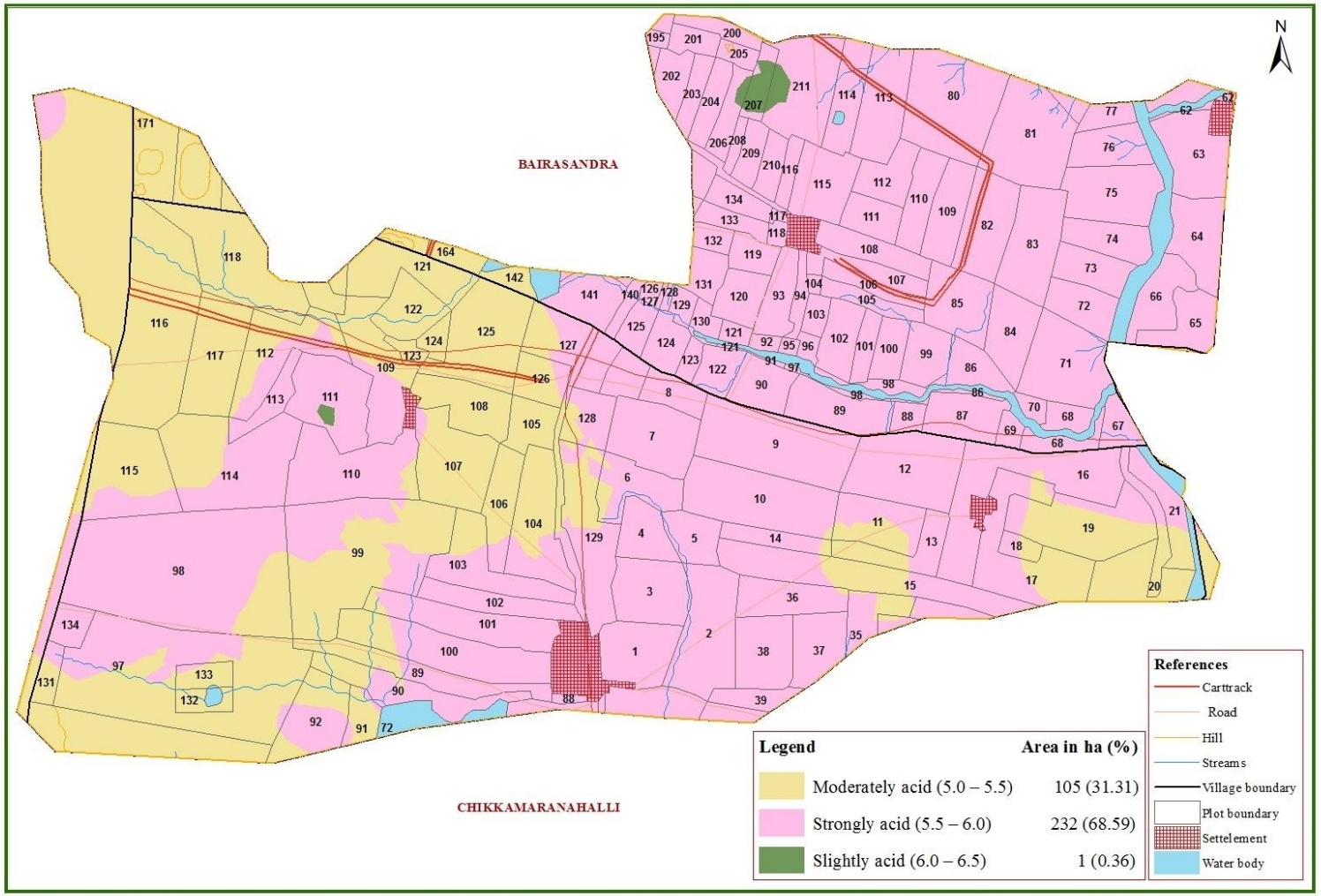

Fig.3 Status of Soil reaction (pH) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore rural district

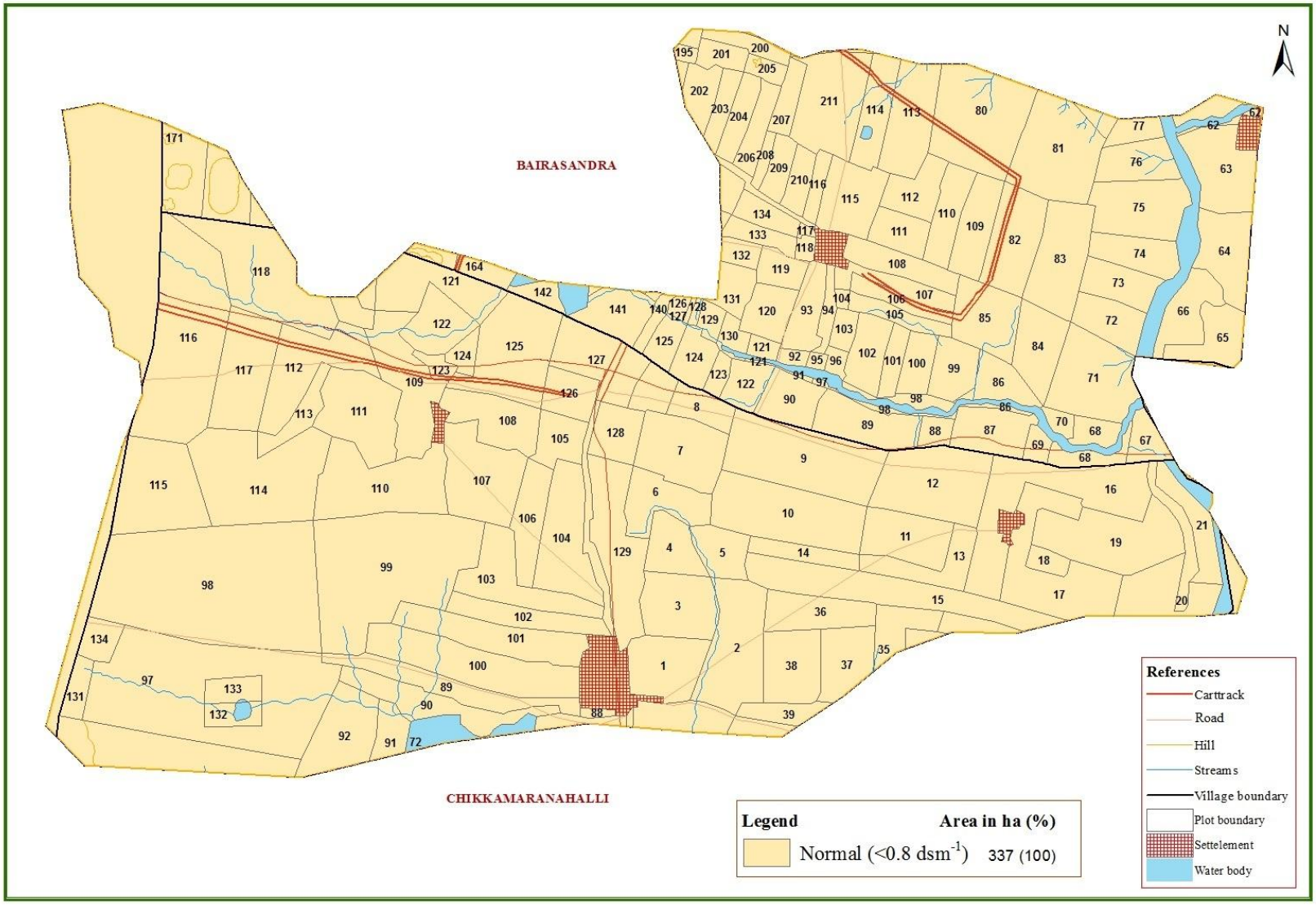

Fig. 4 Status of Salinity (EC) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore rural district

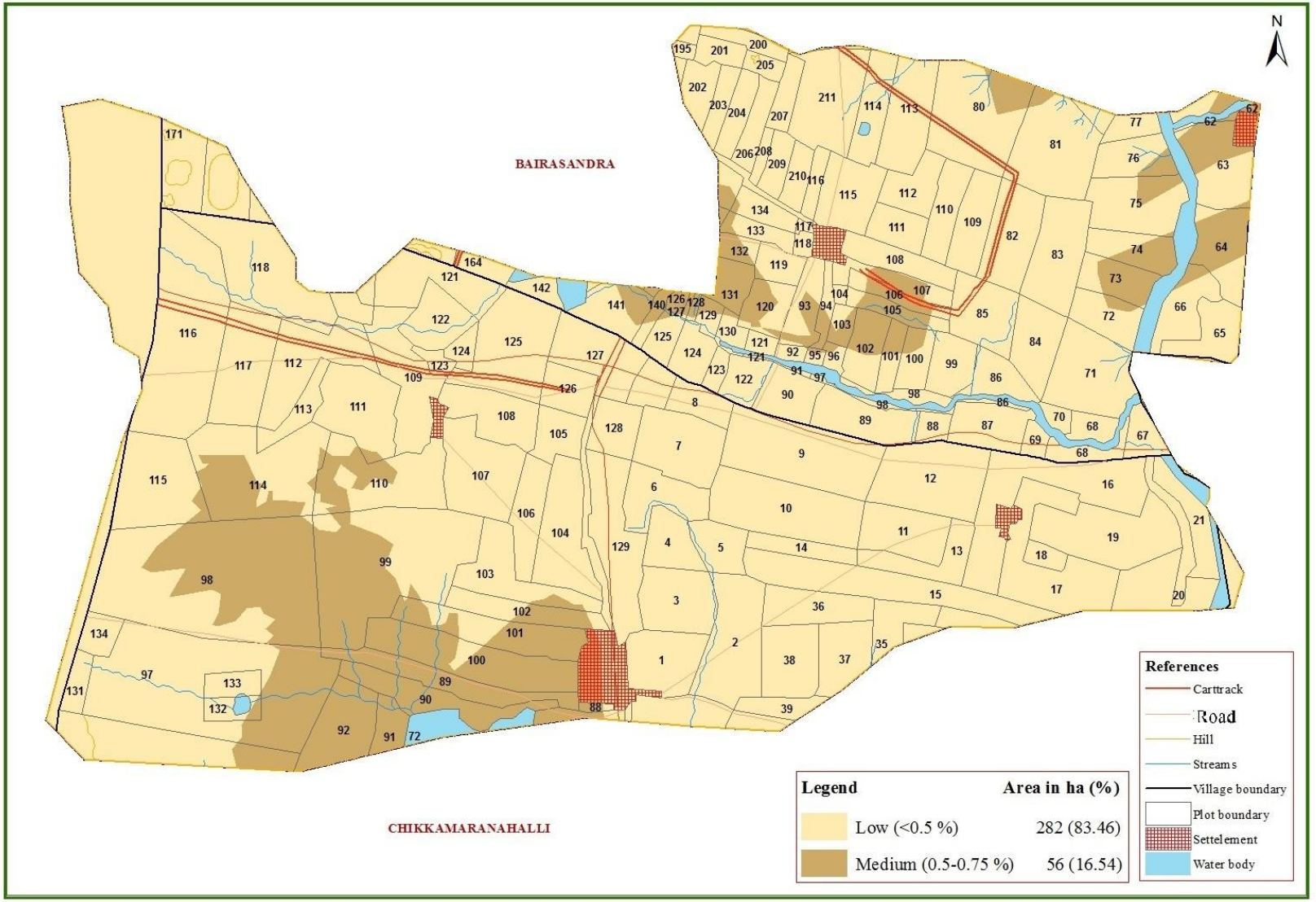

Fig. 5 Status of Organic Carbon (OC) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore rural district

This calls for meticulous management of costly imported phosphatic fertilizers through judicious soil test based recommendation and encouraging use of phosphate solubilizing biofertilizers

Available potassium (K_2O)

The available potassium content of surface soil samples varied from 68.5 to 653.8 K_2O kg ha^{-1} in Chikkamaranahalli colony, 98.7 to 238.0 K_2O kg ha^{-1} in Chikkamaranahalli, 48.2 to 651.6 K_2O kg ha^{-1} in Chikkaputtayanapalya, 131.2 to 847.2 K_2O kg ha^{-1} in Mudalapalya and 126.4 to 648.0 K_2O kg ha^{-1} in Hosapalya and mean values were 231.0 K_2O kg ha^{-1}, 160.5 kg ha^{-1} K_2O, 267.9 K_2O kg ha^{-1}, 338.2 K_2O kg ha^{-1} and 338.0 K_2O kg ha^{-1} in Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya respectively (Table- 7,8,9,10 &11). About 0.31 per cent area was low in available potassium content, 73.07 per cent area was medium in available potassium content and 26.62 per cent area was high in available potassium content (Fig. 8).

Exchangeable calcium and magnesium

In surface soil samples of Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya, exchangeable calcium varied from 1.3 to 6.8 meq/100g, 2.2 to 4.6 meq/100g, 0.9 to 13.5 meq/100g, 2.3 to 5.8 meq/100g and 2.0 to 5.9 meq/100g with mean value of 3. 1 meq/100g, 2.7 meq/100g, 2.8 meq/100g, 3.9 meq/100g and 3.7 meq/100g respectively. Soil samples were found to be sufficient in exchangeable calcium (Fig. 9).

Exchangeable magnesium contents in surface soil samples varied from 0.2 to 2.9 meq/100g with mean of 2.0 meq/100g in Chikkamaranahalli colony, 1.3 to 2.9 meq/100g with mean of 2.0 meq/100g in Chikkamaranahalli, 0.2 to 4.5 meq/100g with mean of 1.5 meq/100g in Chikkaputtayanapalya, 1.1 to 3.3 meq/100g with mean of 1.96 meq/100g in Mudalapalya and 0.8 to 3.8 meq/100g with mean of 2.1 meq/100g in Hosapalya. In general about 90 per cent area was found to be sufficient in exchangeable magnesium content in soil and 10 per cent area was found to be deficient in exchangeable magnesium content in soils (Fig. 10).

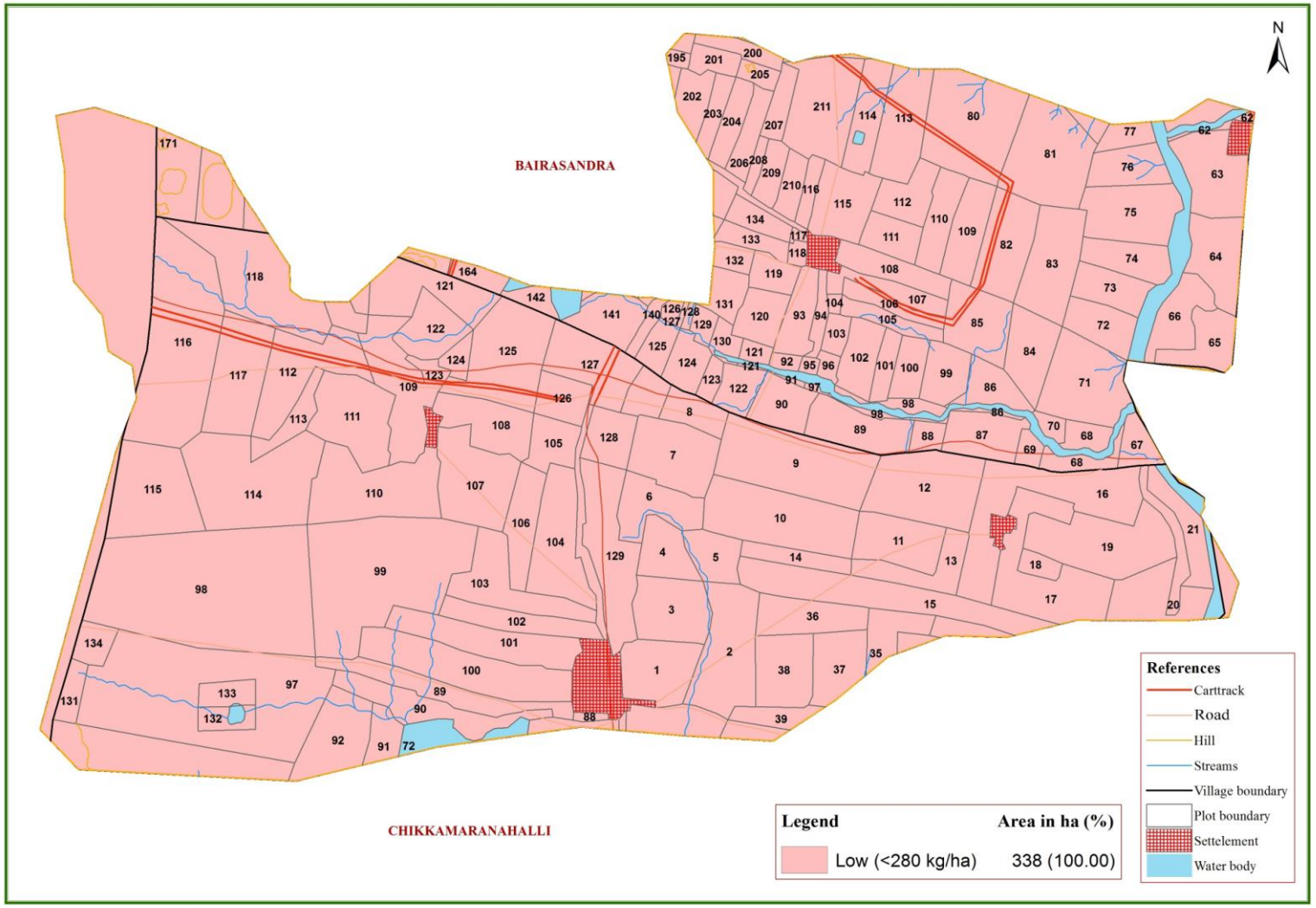

Fig.6 Status of available Nitrogen in Chikkamaranahalli cluster villages , Nelamangala Taluk Bangalore Rural district

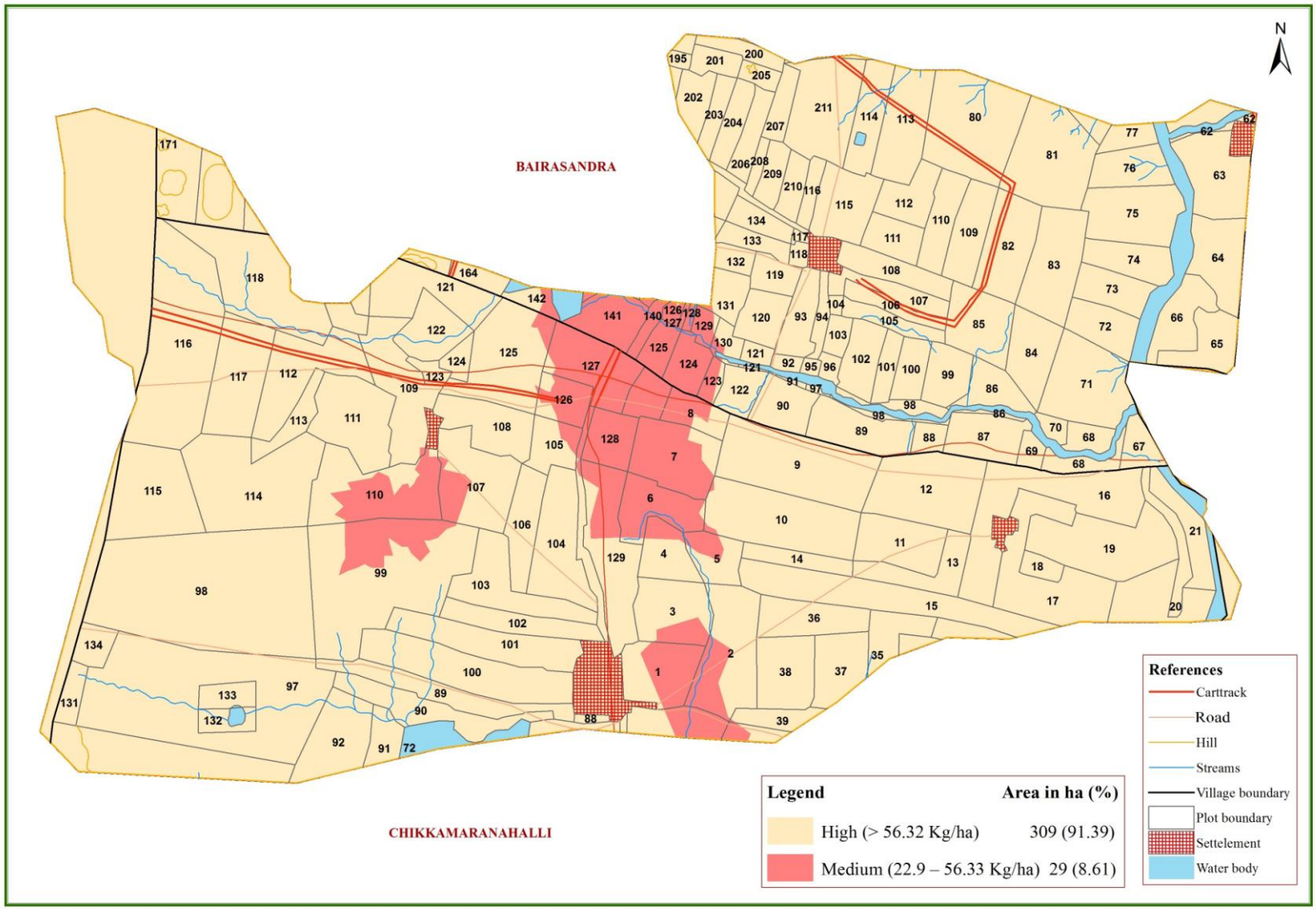

Fig.7 Status of available Phosphorus in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

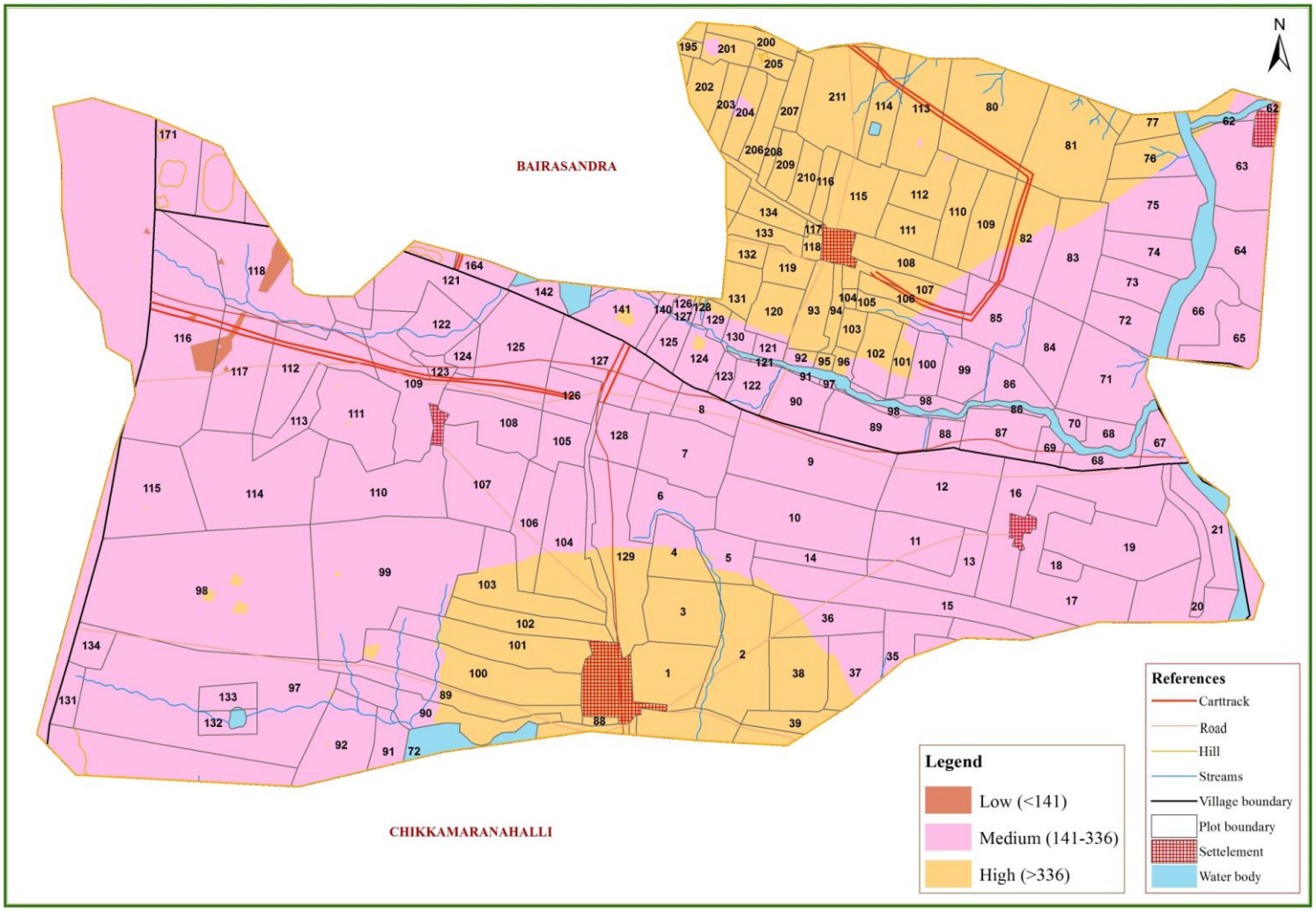

Fig.8 Status of Available Potassium in Chikkamaranahalli cluster villages ., Nelamangala Taluk Bangalore Rural district

Available sulphur

The available sulphur status in surface soil samples of Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya varied from 8.7 to 46.3 mg kg^{-1}, 5.9 to 49.1 mg kg^{-1}, 1.3 to 54.8 mg kg^{-1}, 9.7 to 58.1 mg kg^{-1} and 1.3 to 31.6 mg $kg^{-1}$with mean values of 27.0 mg kg^{-1}, 28.6 mg kg^{-1}, 22.4 mg kg^{-1}, 31.1 mg $kg^{-1}$and 27.4 mg kg^{-1} respectively. About 15.88 per cent area was low in available sulphur content, 17.23 per cent area was medium available sulphur content and 66.89 per cent area was high in available sulphur content (Fig. 11).

Available zinc (Zn)

The available zinc content in these soils varied from 0.2 to 10.7 mg kg^{-1} with mean of 2.8 mg kg^{-1} in Chikkamaranahalli colony, 0.6 to 3.0 mg kg^{-1} with mean of 1.5 mg kg^{-1}in Chikkamaranahalli, 0.1 to 7.3 mg kg^{-1} with mean of 1.6 mg kg^{-1} in Chikkaputtayana palya, 0.7 to 5.2 mg kg^{-1} with mean of 2.9 mg kg^{-1} in Mudalapalya and 0.6 to 10.3 mg kg^{-1} with mean of 1.9 mg kg^{-1} in Hosapalya. About 1.74 per cent area was found to be low in available zinc, 3.06 per area was found to be marginal in available zinc, 31.88 per cent area was found to be adequate in available zinc and 63.32 per cent area was found to be high in available zinc in surface soils (Fig. 12).

Available boron (B)

The available boron content of surface soil samples in different villages varied from 0.3 to 0.63 mg kg^{-1} with mean of 0.4 mg kg^{-1} in Chikkamaranahalli colony, 0.3 to 0.9 mg kg^{-1} with mean of 0.5 mg kg^{-1} in chikkamaranahalli, 0.1 to 1.0 mg kg^{-1} with mean of 0.5 mg kg^{-1} in Chikkaputtayana palya, 0.4 to 0.7 mg kg^{-1} with mean of 0.5 mg kg^{-1} in Mudalapalya and 0.2 to 0.7 mg kg^{-1} with mean of 0.4 mg kg^{-1} in Hosapalya. About 75.65 per cent area was found to be low in available boron and 24.65 per area was found to be medium in available boron in surface soils (Fig. 13).

Available copper (Cu)

Available copper content in surface soil samples of Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya varied from 0.2 to 2.1 mg kg^{-1}, 0.5 to 3.4 mg kg^{-1}, 0.2 to 1.8 mg kg^{-1}, 0.7 to 1.6 mg kg^{-1}, 0.3 to 2.1 mg kg^{-1} with mean value of 1.04 mg kg^{-1}, 1.3 mg kg^{-1}, 0.8 mg kg^{-1}, 0.9 mg kg^{-1} and 0.7 mg kg^{-1} respectively.

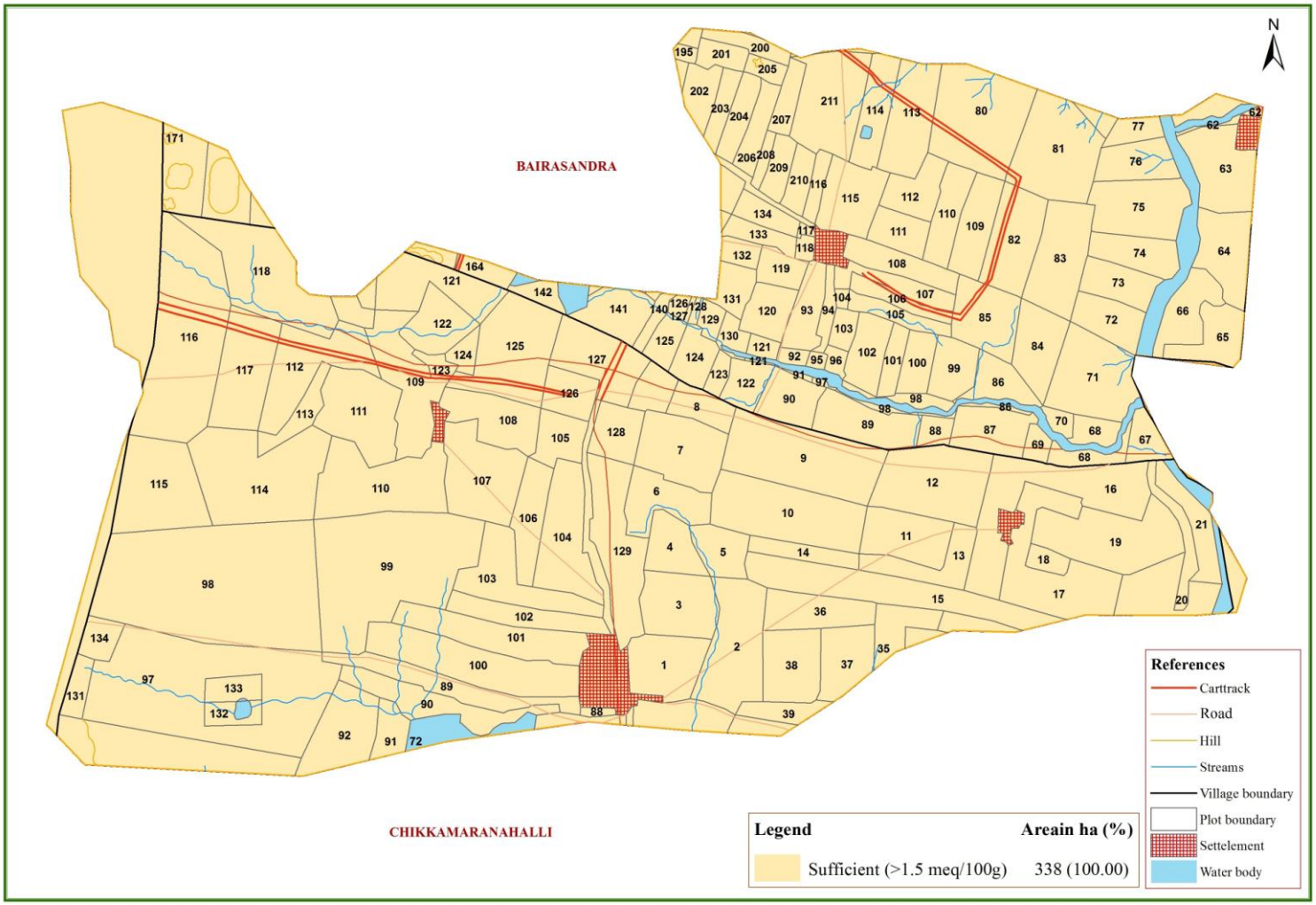

Fig. 9 Status of Exchangeable Calcium in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

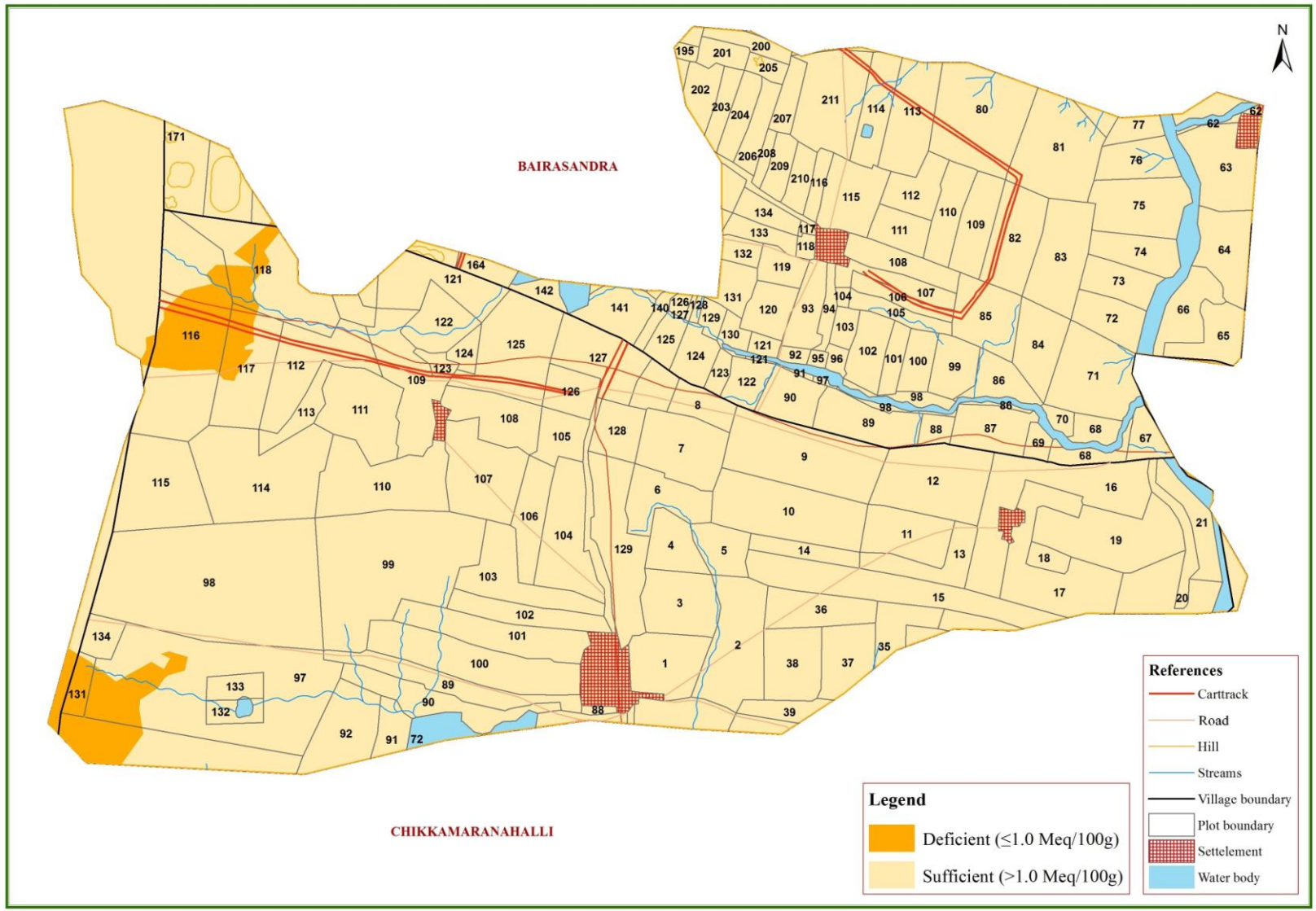

Fig.10 Status of Exchangeable Magnesium (Mg) in Chikkamaranahalli cluster villages ., Nelamangala Taluk Bangalore Rural district

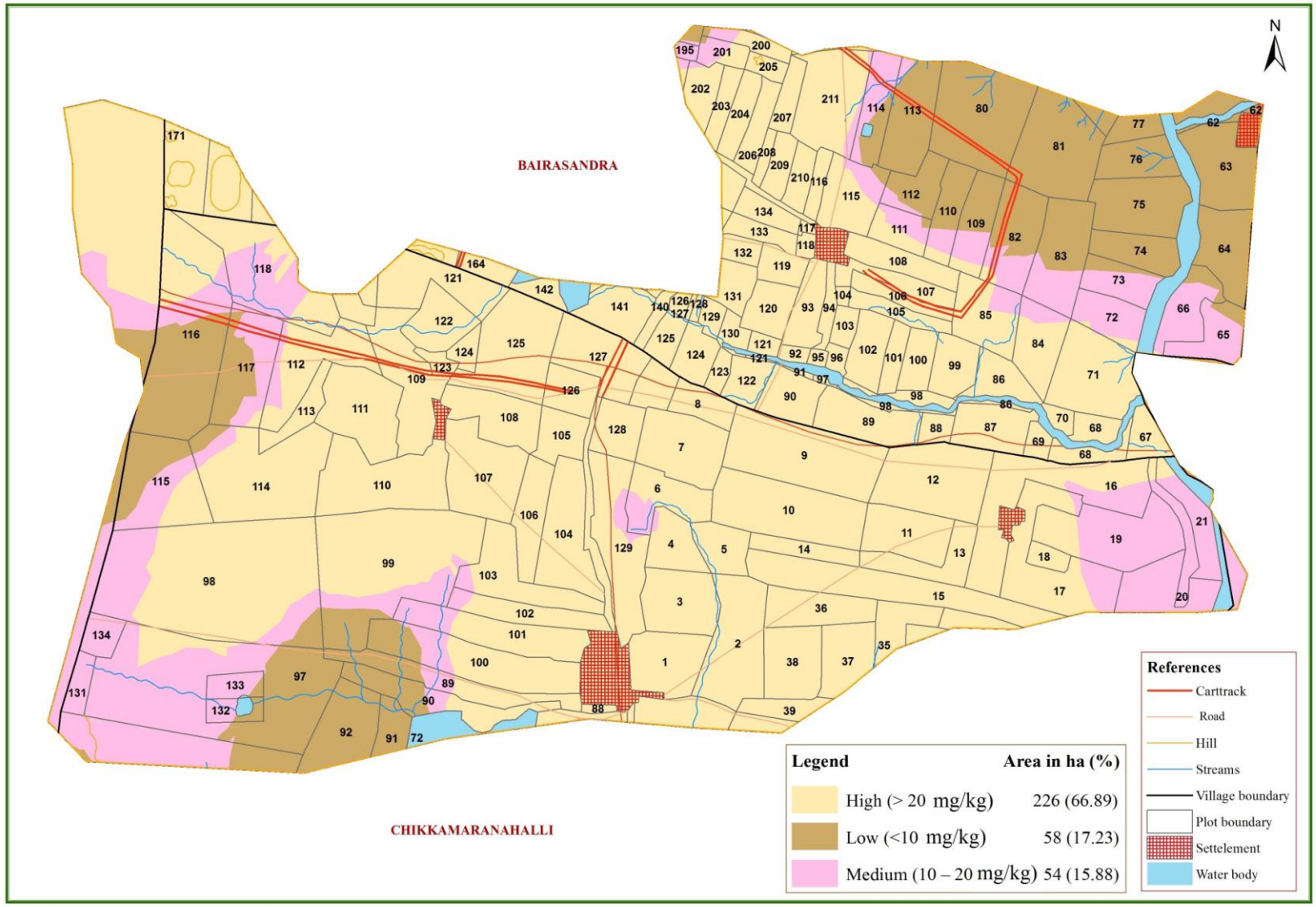

Fig. 11 Status of Available Sulphur in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

The result also indicated that all soils were found to be sufficient in available copper content in surface soils (Fig. 14).

Available manganese (Mn)

The available manganese content in surface soils of Chikkamaranahalli colony, Chikkamaranahalli, Chikkaputtayanapalya, Mudalapalya and Hosapalya varied from 3.3 to 30.7 mg kg^{-1}, 2.9 to 27.9 mg kg^{-1}, 2.1 to 31.3 mg kg^{-1}, 13.7 to 30.7 mg kg^{-1}, 10.8 to 31.1 mg kg^{-1} with mean value of 20.2 mg kg^{-1}, 23.1 mg kg^{-1}, 17.5 mg kg^{-1}, 25.2 mg kg^{-1} and 18.7 mg kg^{-1} respectively. In general all the soil samples were found to be sufficient of available manganese in surface soils (Fig. 15).

Available iron (Fe)

The available iron content in these soils varied from 8.8 to 55.5 mg kg^{-1} with mean of 35.5 mg kg^{-1} in Chikkamaranahalli colony, 6.4 to 54.9 mg kg^{-1} with mean of 32.2 mg kg^{-1} in Chikkamaranahalli, 6.6 to 25.1 mg kg^{-1} with mean of 24.2 ppm in Chikkaputtayana palya, 9.4 to 53.7 mg kg^{-1} with mean of 31.5 mg kg^{-1} in Mudalapalya and 3.9 to 47.9 mg kg^{-1} with mean of 20.0 mg kg^{-1} in Hosapalya. In general all the soil samples were found to be sufficient in available iron in surface soils (Fig. 16).

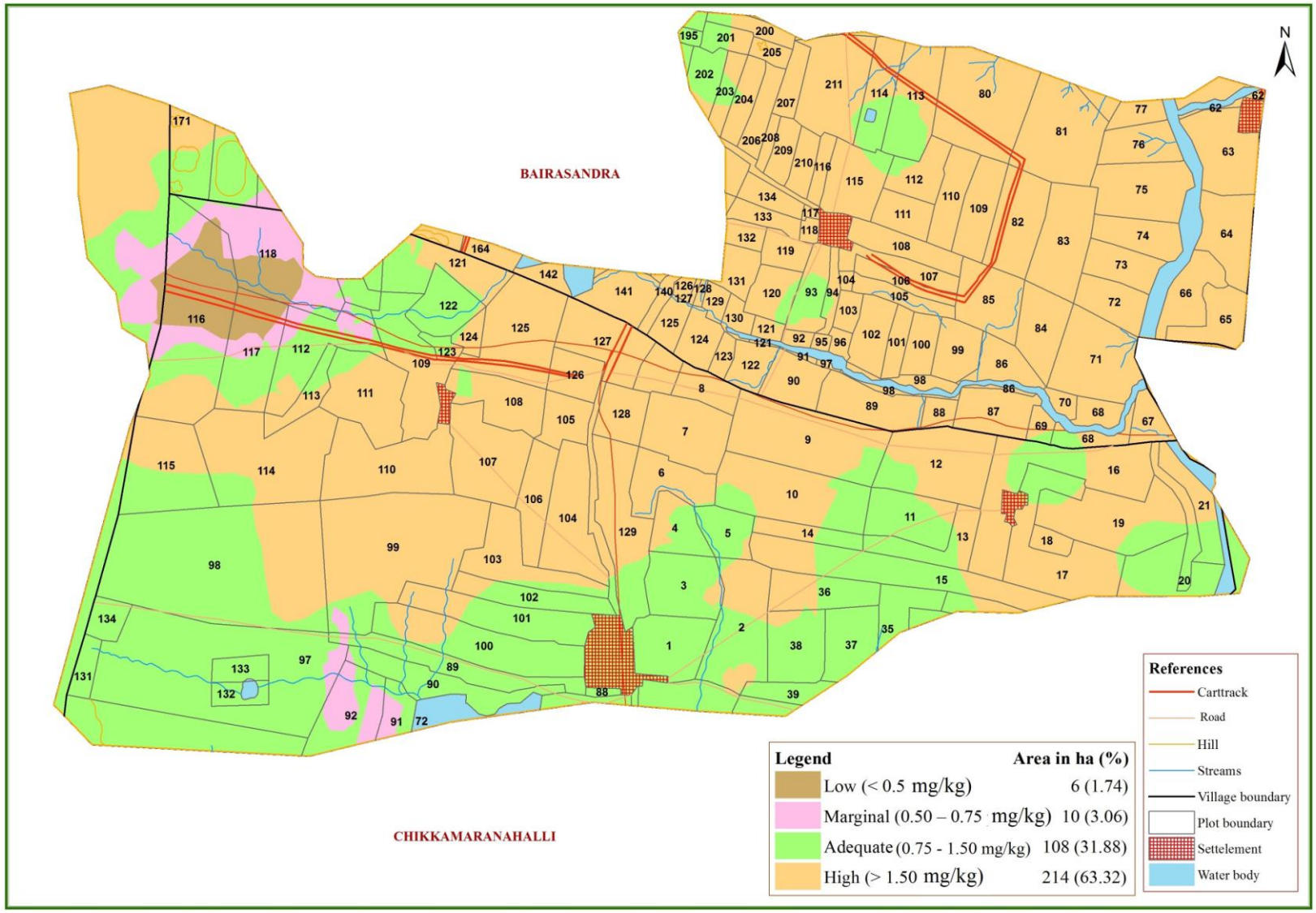

Fig. 12 Status of Available Zinc (Zn) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

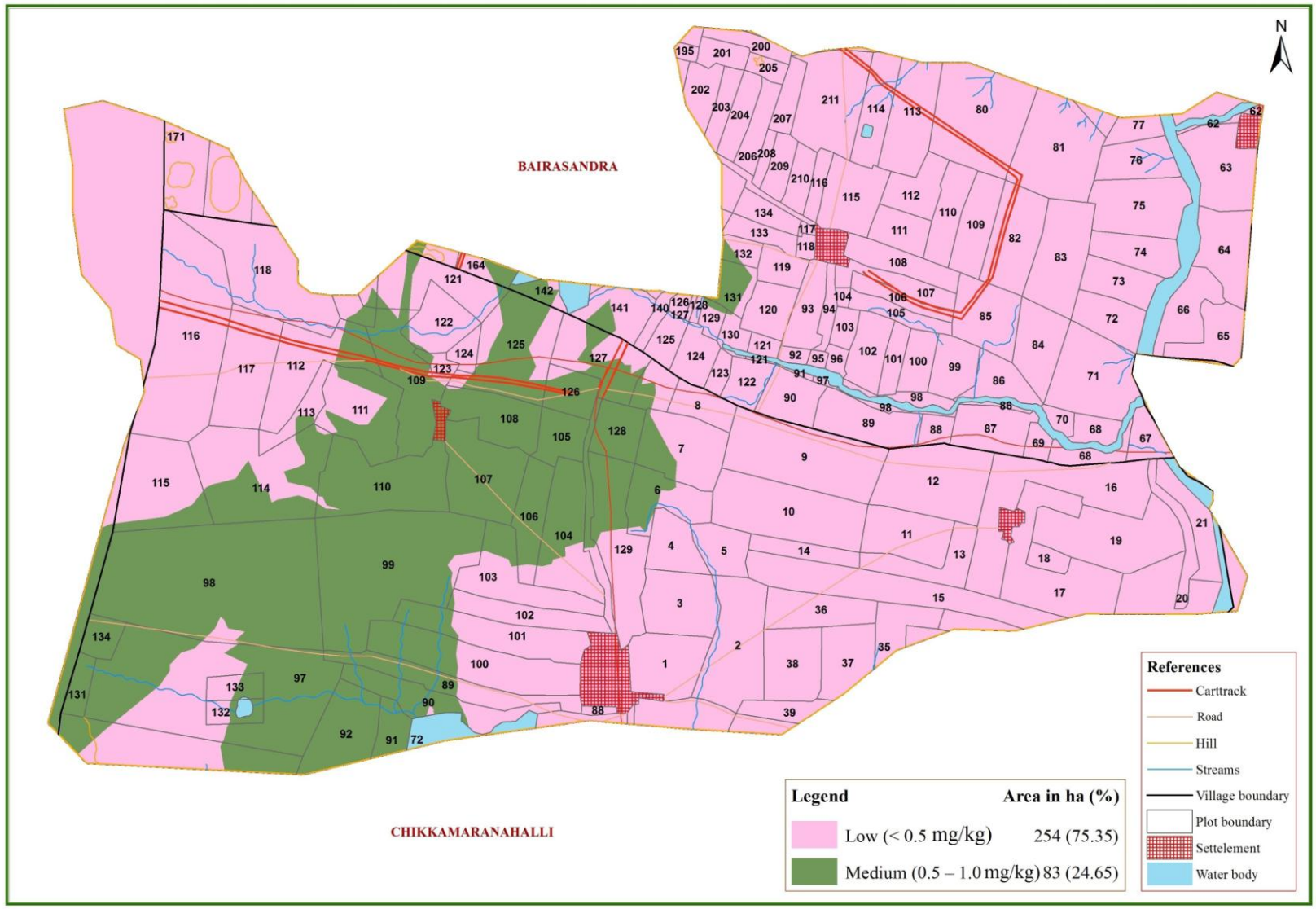

Fig. 13 Status of Available Boron in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

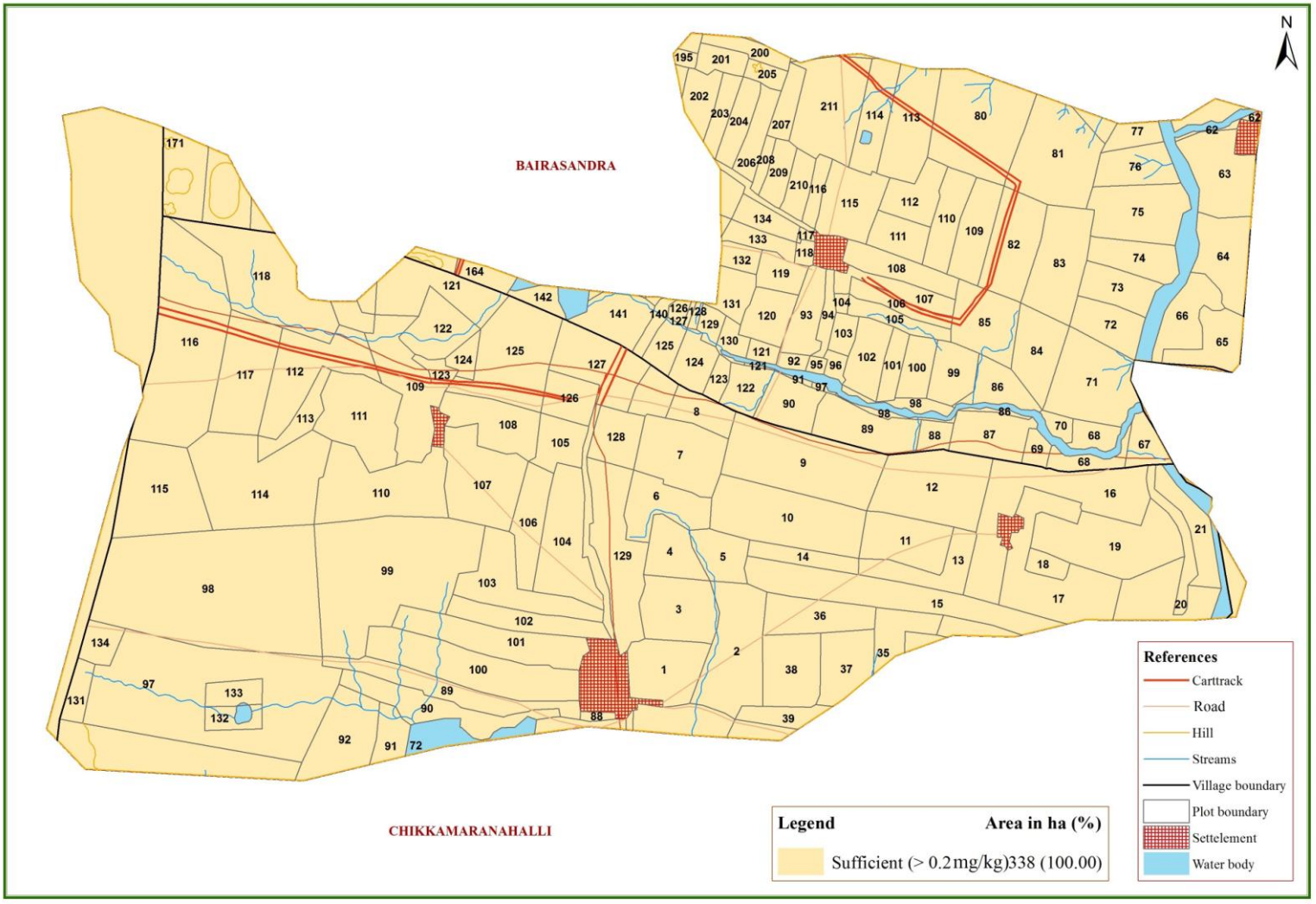

Fig. 14 Status of Available Copper in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

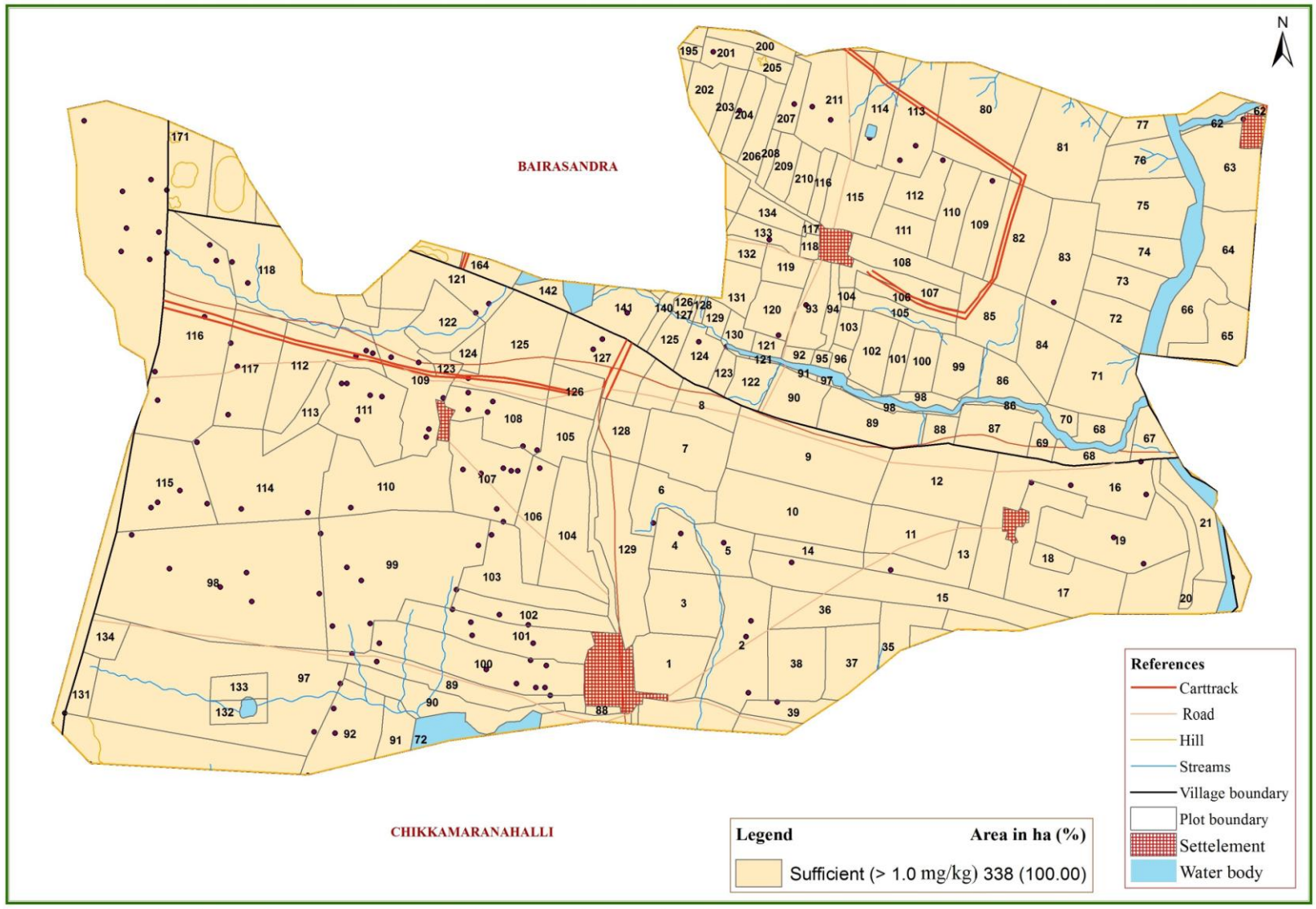

Fig. 15 Status of Available Manganese (Mn) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

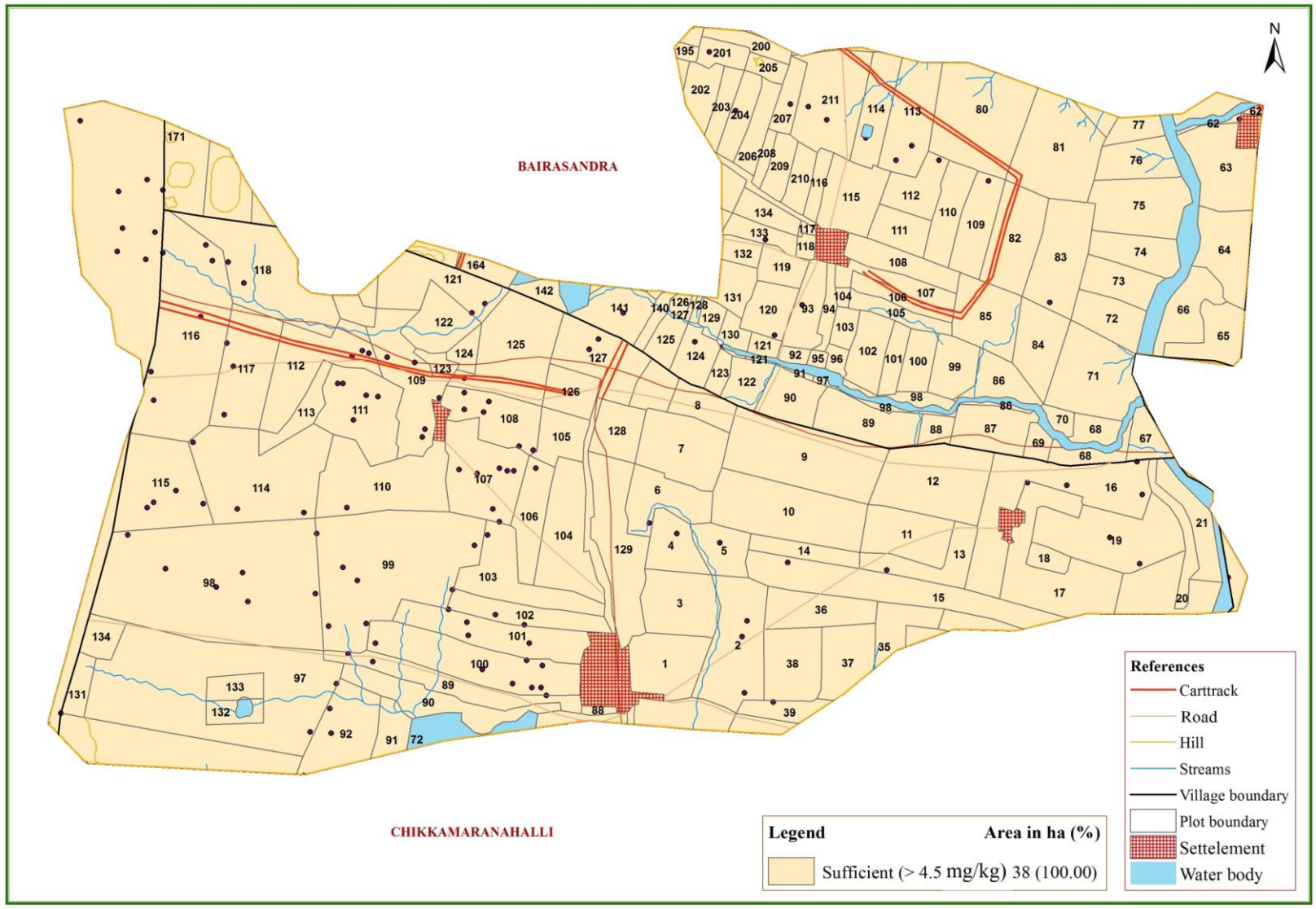

Fig. 16 Status of Available Iron (Fe) in Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

Table – 2 Chemical properties of Chikkamarnahalli colony village

Sl.No	Longitude	Latitude	pH	EC	OC	Exch. Ca	Exch. Mg	Av. S	Av. Zn	Av. Fe	Av. Mn	Av. Cu	Av. B
				(dS m^{-1})	(%)	(meq/100g)		(mg kg^{-1})					
1	13° 05’ 48.3’’	77° 19’ 14.2’’	4.50	0.08	0.54	1.9	1.4	18.7	0.9	38.8	11.9	1.2	0.4
2	13° 05’ 49.0’’	77° 19’ 15.2’’	5.20	0.13	0.60	2.5	1.8	26.8	2.8	50.9	24.1	1.0	0.4
3	13° 05’ 45.5’’	77° 19’ 23.2’’	5.60	0.18	0.51	3.6	2.9	46.3	10.7	44.7	29.6	1.1	0.5
4	13°05’ 46.3’’	77° 19’ 23.9’’	5.20	0.09	0.60	3.8	1.8	25.9	4.7	45.7	30.5	2.0	0.6
5	13° 05’ 48.3’’	77° 19’ 25.8’’	6.30	0.20	0.75	4.1	2.9	31.0	2.4	47.3	30.7	0.9	0.7
6	13° 05’ 41.5’’	77° 19’15.5’’	5.40	0.13	0.36	2.5	1.7	25.0	3.1	53.8	22.7	0.5	0.3
7	13° 05’ 36.4’’	77° 19’ 19.1’’	5.40	0.13	0.36	2.5	1.7	25.0	3.1	53.8	22.7	0.5	0.3
8	13° 05’37.8’’	77° 19’ 18.9’’	5.20	0.08	0.15	2.5	1.8	15.0	1.5	46.8	28.6	2.3	0.4
9	13° 05’ 38.1’’	77° 19’ 17.8’’	5.30	0.09	0.39	3.0	1.5	35.6	6.6	55.5	30.1	2.1	0.5
10	13° 05’ 44.9’’	77° 19’ 07.7’’	5.80	0.24	0.15	5.0	2.2	17.5	5.7	52.6	30.0	1.1	0.6
11	13° 05’ 45.2’’	77° 19’ 06.3’’	5.10	0.07	0.10	1.7	2.2	33.1	1.3	33.8	12.0	0.4	0.4
12	13° 05’45.4’’	77° 19’ 05.8’’	5.30	0.06	0.27	3.1	1.6	8.8	0.8	38.6	22.2	1.4	0.4
13	13° 05’45.0’’	77° 19’ 05.0’’	5.70	0.07	0.18	6.8	3.0	25.0	0.2	10.9	21.8	0.7	0.5
14	13° 05’ 54.8’’	77° 18’ 47.4’’	5.30	0.12	0.45	2.6	2.0	19.4	0.7	41.0	20.7	2.1	0.5
15	13° 05’ 57.6	77° 18’ 47.1’’	5.86	0.04	0.36	1.3	6.7	15.9	1.1	8.9	10.7	0.5	0.4
16	13° 05’ 58.5’’	77° 18’49.3’’	5.87	0.05	0.42	2.5	1.1	31.9	6.6	10.3	12.5	0.4	0.3
17	13° 05’ 57.7’’	77° 18’50.5’’	4.73	0.02	0.12	2.3	0.2	16.6	0.5	11.7	5.2	0.4	0.3
18	13° 05’ 54.5’’	77° 18’ 49.9’’	4.59	0.15	0.24	3.7	1.7	34.6	0.6	17.2	3.3	0.2	0.4
19	13° 05’ 38.5’’	77° 19’ 17.3’’	5.57	0.11	0.69	3.0	1.2	60.9	1.6	12.9	14.0	0.4	0.3
Mean			**5.36**	**0.10**	**0.38**	**3.1**	**2.1**	**27.0**	**2.9**	**35.5**	**20.2**	**1.0**	**0.4**
Range			**4.50-6.30**	**0.02-0.24**	**0.10-0.75**	**1.3-6.8**	**0.2-2.9**	**8.8-46.3**	**0.2-10.7**	**8.9-55.5**	**3.3-30.68**	**0.2-2.1**	**0.3-0.7**

Table – 3: Chemical properties of Chikkamaranahalli village

Sl.No	Longitude	Latitude	pH	EC	OC	Exch. Ca	Exch. Mg	Av. S	Av. Zn	Av. Fe	Av. Mn	Av. Cu	Av. B
				(dS m^{-1})	(%)	(meq/100g)		(mg kg^{-1})					
1.	13° 05' 19.2''	77° 19' 35.09''	5.40	0.15	0.21	2.2	1.3	18.3	1.7	37.4	25.4	1.1	0.4
2.	13° 05' 18.5''	77° 19' 37.3''	5.90	0.12	0.24	3.6	2.4	37.4	1.2	38.0	24.0	1.5	0.5
3.	13° 05' 23.5''	77° 19' 34.9''	6.20	0.18	0.15	3.5	2.4	30.2	0.8	33.7	26.1	1.0	0.4
4.	13° 05' 24.7''	77° 19' 35.3''	6.10	0.24	0.15	4.6	2.9	9.4	2.6	30.3	27.9	1.2	0.3
5.	13° 05' 32.2''	77° 19' 27.8''	5.20	0.13	0.30	2.7	2.3	6.0	1.7	33.9	28.8	1.6	0.5
6.	13° 05' 31.4''	77° 19' 29.9''	6.30	0.07	0.15	2.2	1.7	36.6	1.2	36.8	24.9	1.1	0.5
7.	13° 05' 30.7''	77° 19' 33.2''	5.30	0.04	0.45	2.5	1.4	13.6	1.0	43.8	2.9	1.7	0.4
8.	13° 05' 36.2''	77° 19' 16.9''	5.30	0.07	0.54	2.8	1.8	43.1	3.0	54.9	30.8	3.4	0.5
9.	13° 05' 36.2''	77° 19' 17.4''	5.10	0.12	0.10	3.4	2.0	25.0	2.0	40.6	29.0	1.5	0.9
10.	13° 05' 35.3''	77° 19' 56.8''	5.60	0.05	0.48	3.0	1.0	49.2	1.1	23.3	11.2	0.6	0.4
11.	13° 05' 28.6''	77° 19' 46.0''	5.01	0.05	0.24	2.0	4.0	30.5	0.6	6.4	20.6	0.5	0.7
12.	13° 05' 29.2''	77° 19' 38.4''	5.58	0.10	0.39	2.9	1.7	43.6	1.7	7.1	19.3	0.7	0.4
Mean			**5.58**	**0.11**	**0.28**	**2.8**	**2.1**	**28.6**	**1.5**	**32.2**	**22.6**	**1.3**	**0.5**
Range			**5.01-6.30**	**0.04-0.24**	**0.1-0.54**	**2.2-4.6**	**1.3-2.9**	**6.0-49.2**	**0.6-3.0**	**6.4-54.9**	**2.9-30.8**	**0.5-3.4**	**0.3-0.9**

Table – 4: Chemical properties of Chikkaputtayanaplaya village

Sl.No	Longitude	Latitude	pH	EC	OC	Exch. Ca	Exch. Mg	Av. S	Av. Zn	Av. Fe	Av. Mn	Av. Cu	Av. B
				(dS m^{-1})	(%)	(meq/100g)		(mg kg^{-1})					
1.	13° 05' 40.1''	77° 19' 05.1''	6.30	0.16	0.15	4.3	1.8	27.6	3.3	42.6	30.9	1.6	0.5
2.	13° 05'41.9''	77° 19' 07.0''	6.20	0.20	0.54	3.9	2.8	30.2	3.1	41.6	30.5	1.1	0.5
3.	13° 05'39.4''	77° 19' 10.6''	6.50	0.32	0.60	4.0	2.2	38.3	2.6	33.8	30.9	1.4	0.7
4.	13° 05'38.8''	77° 19' 10.4''	6.30	0.15	0.51	2.0	1.0	31.0	2.1	55.18'	15.1	1.8	0.4
5.	13° 05' 41.8''	77° 19' 11.7''	5.20	0.11	0.66	2.2	0.8	51.9	2.0	55.3	13.5	1.8	1.0
6.	13° 05' 40.7''	77° 19' 15.1''	5.30	0.10	0.21	1.8	1.0	36.1	2.6	0.0	14.1	1.5	0.4
7.	13° 05' 31.4''	77° 19' 02.3''	5.30	0.07	0.51	2.0	1.0	29.8	2.6	45.9	10.9	1.0	0.4
8.	13° 05' 33.0''	77° 19' 01.3''	5.90	0.34	0.96	4.3	2.2	54.8	6.4	57.6	30.0	1.1	0.6
9.	13° 05' 27.8''	77° 19' 05.4''	5.00	0.11	0.30	1.7	0.8	40.8	1.9	50.2	20.2	0.6	0.6
10.	13° 05' 28.8''	77° 19' 04.3''	6.10	0.19	0.57	4.4	3.4	37.8	3.1	46.3	31.3	1.8	0.8
11.	13° 05' 25.6''	77° 19' 12.4''	6.00	0.10	0.36	2.4	1.5	18.8	4.7	58.4	30.4	1.3	0.7
12.	13° 05' 27.1''	77° 19' 12.7''	5.90	0.13	0.33	3.0	1.7	11.3	3.9	56.6	30.0	0.9	0.6
13.	13° 05' 30.5''	77° 19' 14.4''	5.00	0.08	0.21	3.9	1.2	17.5	1.1	48.3	28.0	1.2	0.6
14.	13° 05' 31.3''	77° 19' 15.4''	4.90	0.07	0.36	1.7	0.9	24.4	1.9	37.0	13.7	0.6	0.3
15.	13° 05' 32.3''	77° 19' 16.3''	5.70	0.13	0.36	4.8	2.7	33.1	6.4	37.3	28.0	1.3	0.7
16.	13° 05' 33.3''	77° 19' 15.8''	5.80	0.19	0.54	3.7	2.0	31.3	2.6	56.4	29.0	0.9	0.4
17.	13° 05' 36.4''	77° 19' 16.3''	5.50	0.17	0.63	3.3	2.5	23.1	2.4	54.3	26.6	0.6	0.7
18.	13° 05' 43.3''	77° 19' 13.6''	5.50	0.07	0.15	3.5	1.6	10.0	1.6	39.0	27.5	1.3	0.5
19.	13° 05' 36.3''	77° 19' 13.2''	5.10	0.05	0.45	1.9	1.3	25.6	3.1	41.0	16.2	0.9	0.5
20.	13° 05' 36.0''	77° 19' 14.6''	5.20	0.10	0.51	2.4	1.5	16.9	2.7	58.9	30.8	2.7	0.4
21.	13° 05' 40.9''	77° 19' 13.6''	5.10	0.08	0.45	1.3	1.8	20.0	0.8	42.7	12.3	1.1	0.5
22.	13° 05' 42.2''	77° 19' 13.6''	5.30	0.09	0.42	1.7	0.7	13.1	1.3	33.8	12.9	0.4	0.4
23.	13° 05' 44.5''	77° 19' 09.8''	5.10	0.12	0.66	2.5	1.1	48.8	1.1	30.6	12.0	0.4	0.5
24.	13° 05' 44.8''	77 19' 04.2''	5.20	0.05	0.15	2.1	1.6	31.9	1.0	37.6	23.9	1.2	0.5
25.	13° 05' 42.9''	77° 19' 04.3''	6.30	0.05	0.72	6.4	3.2	18.8	1.0	41.5	26.0	1.4	0.8
26.	13° 05' 42.9''	77° 19' 03.9''	5.40	0.08	0.30	1.7	0.9	68.8	1.1	41.6	11.4	1.0	0.4
27.	13° 05' 42.0''	77° 19' 06.1''	5.50	0.17	0.30	3.4	2.0	18.8	3.2	30.6	24.7	0.5	0.5

28.	13° 05’ 35.1’’	77° 19’ 59.8’’	5.30	0.05	0.30	3.0	2.0	2.1	0.8	23.9	13.7	1.5	0.3
29.	13° 05’ 31.1’’	77° 20’ 03.1’’	5.36	0.15	0.39	1.9	1.1	15.9	2.2	13.5	18.3	0.9	0.4
30.	13° 05’ 28.4’’	77° 18’ 56.6’’	5.60	0.06	0.60	4.0	2.4	10.4	0.4	6.9	21.3	0.4	0.4
31.	13° 05’ 26.2’’	77° 18’ 57.0’’	6.07	0.11	0.33	3.5	1.5	51.3	0.8	12.4	14.4	0.4	1.4
32.	13° 05’ 27.3’’	77° 18’ 54.6’’	5.65	0.10	0.39	2.5	1.5	20.8	1.1	10.8	14.8	0.4	0.4
33.	13° 05’ 28.7’’	77° 18’ 50.7’’	5.83	0.07	0.39	2.5	1.5	19.39	0.7	10.8	20.8	1.0	0.7
34.	13° 05’ 31.3’’	77° 18’ 47.8’’	5.37	0.06	0.54	2.0	0.2	14.5	1.3	21.9	11.6	0.5	0.3
35.	13° 05’ 33.8’’	77° 18’ 49.8’’	5.23	0.07	0.78	2.0	1.8	18.7	1.05	6.4	26.0	0.7	0.7
36.	13° 05’ 33.4’’	77° 18’ 49.3’’	5.94	0.07	0.39	3.0	1.0	11.1	0.9	16.3	15.9	0.3	0.9
37.	13° 05’ 34.7’’	77° 18’ 51.5’’	5.44	0.08	0.42	0.0	4.5	16.6	1.3	17.9	12.3	0.5	0.5
38.	13° 05’ 33.7’’	77° 18’ 53.6’’	5.53	0.14	0.51	3.6	1.6	51.3	0.7	25.2	10.2	0.5	0.4
39.	13° 05’ 33.3’’	77° 18’ 56.2’’	5.48	0.08	0.69	4.6	2.2	45.7	0.3	9.7	18.9	0.8	0.6
40.	13° 05’ 33.4’’	77° 19’ 04.6’’	5.69	0.05	0.51	3.3	1.7	36.7	1.3	16.4	27.6	1.1	0.5
41.	13° 05’ 24.4’’	77° 19’ 18.2’’	5.58	0.11	0.54	2.5	1.3	27.0	0.7	11.8	13.8	0.4	0.4
42.	13° 05’ 23.0’’	77° 19’ 18.6’’	6.17	0.07	0.42	3.0	2.0	27.7	1.6	7.1	19.64	0.7	0.5
43.	13° 05’ 21.7’’	77° 19’ 18.4’’	5.78	0.08	0.72	3.0	1.4	29.8	1.1	22.4	23.2	0.6	0.4
44.	13° 05’ 21.3’’	77° 19’ 19.6’’	5.65	0.04	0.33	3.5	2.5	18.7	1.5	10.5	32.7	1.1	0.6
45.	13° 05’ 19.6’’	77° 19’ 19.5’’	5.76	0.06	0.99	3.5	2.7	19.4	1.1	6.1	23.3	0.9	0.6
46.	13° 05’ 19.0’’	77° 19’ 19.9’’	6.06	0.08	0.36	6.5	4.3	36.7	1.4	19.6	14.3	0.6	0.5
47.	13° 05’ 19.6’’	77° 19’ 18.8’’	5.81	0.08	0.39	3.0	1.2	20.8	0.9	24.5	22.2	0.5	0.6
48.	13° 05’ 19.9’’	77° 19’ 17.3’’	5.71	0.08	0.57	0.0	0.0	35.3	1.0	13.0	25.4	0.9	0.5
49.	13° 05’ 21.0’’	77° 19’ 15.0’’	5.89	0.08	0.48	3.0	1.8	15.9	0.8	6.6	17.2	0.5	0.3
50.	13° 05’ 25.2’’	77° 19’ 16.0’’	5.84	0.08	0.60	2.0	0.5	19.4	0.6	11.1	20’.20	0.5	0.4
51.	13° 05’ 24.6’’	77° 19’ 13.8’’	5.87	0.08	0.36	3.0	2.3	21.5	0.7	7.1	19.7	0.5	0.6
52.	13° 05’ 23.6’’	77° 19’ 13.9’’	5.49	0.07	0.42	5.2	2.2	29.8	0.7	25.1	10.4	0.6	0.3
53.	13° 05’ 52.4’’	77° 18’ 49.2’’	5.46	0.06	0.39	3.0	1.5	36.0	0.8	16.2	13.9	0.4	0.3
54.	13° 05’ 53.0’’	77° 18’ 47.0’’	4.87	0.05	0.24	2.3	1.2	8.3	0.4	13.4	27.5	0.9	0.3
55.	13° 05’ 52.9’’	77° 18’ 50.5’’	4.70	0.06	0.24	2.7	1.2	42.9	0.7	16.6	6.3	0.4	0.4

56.	13° 05’ 52.3’’	77° 18’ 54.3’’	5.50	0.05	0.24	1.7	0.6	20.8	0.4	11.4	4.9	0.4	0.3
57.	13° 05’ 53.5’’	77° 18’ 53.8’’	5.07	0.06	0.39	0.9	0.3	34.6	0.3	13.2	4.0	0.4	0.3
58.	13° 05’ 50.6’’	77° 18’ 56.7’’	5.28	0.05	0.24	1.0	0.4	20.1	0.3	11.9	3.9	0.4	0.3
59.	13° 05’ 46.0’’	77° 18’ 55.4’’	5.12	0.03	0.24	2.0	0.4	11.8	0.1	8.9	2.1	0.2	0.3
60.	13 05’ 44.2’’	77° 18’ 55.9’’	5.10	0.02	0.42	1.5	0.6	6.9	0.6	14.0	15.3	0.6	0.4
61.	13° 05’ 40.5’’	77° 18’ 55.2’’	5.32	0.03	0.15	2.0	0.5	4.2	0.6	13.1	5.1	0.5	0.4
62.	13° 05’ 38.4’’	77° 18’ 52.8’’	5.14	0.05	0.21	1.5	0.8	3.5	7.3	9.6	11.6	0.5	0.2
63.	13° 05’ 41.6’’	77° 18’ 49.8’’	5.13	0.07	0.54	2.0	1.8	2.8	1.3	12.4	7.8	0.4	0.2
64.	13° 05’ 43.8’’	77° 18’ 49.6’’	5.03	0.02	0.54	2.5	1.1	6.9	0.5	20.1	2.6	0.3	0.2
65.	13 05’ 48.0’’	77° 18’ 53.4’’	5.15	0.01	0.09	1.5	0.6	12.5	0.1	7.0	8.2	0.7	0.1
66.	13° 05’ 52.2’’	77° 18’ 55.5’’	5.18	0.04	0.30	3.5	1.6	6.9	0.9	24.2	6.5	0.5	0.1
67.	13° 05’ 26.8’’	77° 19’ 02.2’’	5.04	0.04	0.54	1.2	0.5	9.7	6.6	10.3	12.5	0.4	0.2
68.	13° 05’ 24.5’’	77° 19’ 06.1’’	5.09	0.02	0.45	1.8	0.8	2.1	0.7	16.6	6.3	0.4	2.0
69.	13° 05’ 23.0’’	77° 19’ 06.8’’	5.13	0.05	1.14	4.7	0.9	9.7	1.3	12.4	7.8	0.4	0.2
70.	13° 05’ 21.6’’	77° 19’ 06.6’’	5.01	0.04	0.54	1.7	0.8	9.0	1.4	19.6	14.3	0.6	1.7
71.	13° 05’ 22.2’’	77° 19’ 04.7’’	5.30	0.06	1.08	1.4	0.6	1.4	0.7	25.1	10.4	0.6	0.2
72.	13° 05’ 19.9’’	77° 19’ 03.8’’	5.01	0.06	0.20	4.1	2.2	5.5	0.4	13.4	27.5	0.9	0.2
73.	13° 05’ 24.3’’	77° 19’ 03.2’’	5.35	0.09	0.24	3.1	1.6	2.8	0.1	8.9	2.1	0.2	0.3
74.	13° 05’ 18.0’’	77° 19’ 03.3’’	5.03	0.05	0.39	1.0	1.1	2.1	0.7	11.8	13.8	0.4	0.4
75.	13° 05’ 16.2’’	77° 19’ 01.8’’	5.45	0.04	0.36	1.5	1.1	4.2	1.1	22.4	23.2	0.6	0.2
76.	13° 05’ 16.1’’	77° 19’ 01.9’’	7.06	0.09	0.69	13.5	3.7	5.5	0.2	10.9	21.8	0.7	0.4
Mean			**5.50**	**0.09**	**0.45**	**2.8**	**1.5**	**22.4**	**1.6**	**24.3**	**17.5**	**0.8**	**0.5**
Range			**5.38-6.30**	**0.02-0.24**	**0.09-1.14**	**0.9-13.5**	**0.2-4.5**	**1.4-54.8**	**0.1-7.3**	**6.6-25.1**	**2.1-31.3**	**0.5-3.4**	**0.1-1.0**

Table – 5: Chemical properties of Mudalapalya village

Sl.No	Longitude	Lattitude	pH	EC	OC	Exch. Ca	Exch. Mg	Av. S	Av. Zn	Av. Fe	Av. Mn	Av. Cu	Av. B
				(dS m^{-1})	(%)	(meq/100g)		(mg kg^{-1})					
1.	13° 05' 38.0''	77° 20' 02.6''	5.70	0.21	0.15	3.1	1.6	35.7	1.5	28.8	23.9	0.8	0.5
2.	13° 05' 36.9''	77° 20' 05.2''	6.10	0.24	0.57	4.4	1.3	34.0	5.2	27.0	27.0	1.0	0.4
3.	13° 05' 41.3''	77° 19' 51.4''	6.30	0.22	0.42	5.8	2.5	36.1	2.6	48.9	30.9	1.0	0.5
4.	13° 05' 46.1''	77° 19' 31.3''	6.10	0.30	0.36	3.8	2.2	31.5	4.2	53.1	30.0	1.0	0.5
5.	13° 05' 45.7''	77° 19' 33.4''	5.90	0.21	0.30	3.3	2.1	28.1	4.4	53.7	30.3	1.2	0.6
6.	13° 05' 29.1''	77° 20' 05.4''	6.40	0.20	0.75	5.7	3.3	34.0	3.7	31.7	30.7	1.6	0.5
7.	13° 05' 34.4''	77° 20' 05.6''	5.26	0.07	0.39	3.0	1.4	12.5	0.7	9.4	22.0	0.7	0.4
8.	13° 05' 28.9''	77° 13 52.2''	5.66	0.08	0.69	4.3	2.1	9.7	1.9	12.0	13.7	0.8	0.7
9.	13° 05' 28.6''	77° 19' 46.0''	5.38	0.04	0.54	2.3	1.1	58.2	2.3	18.7	17.8	0.9	0.7
Mean			**5.87**	**0.17**	**0.46**	**4.0**	**2.0**	**31.1**	**3.0**	**31.5**	**25.2**	**1.0**	**0.5**
Range			**5.26-6.40**	**0.04-0.30**	**0.15-0.76**	**2.3-5.8**	**1.1-3.3**	**9.7-58.2**	**0.7-5.2**	**9.4-48.9**	**13.7-30.7**	**0.7-1.6**	**0.4-0.7**

Table – 6: Chemical properties of Hosapalya village

Sl.No	Longitude	Latitude	pH	EC	OC	Exch. Ca	Exch. Mg	Av. S	Av. Zn	Av. Fe	Av. Mn	Av. Cu	Av. B
				(dS m^{-1})	(%)	meq/100g		(mg kg^{-1})					
1.	13° 06' 04.1''	77° 19' 40.0''	6.10	0.22	0.30	5.8	2.2	38.7	2.6	47.9	30.9	1.1	0.6
2.	13° 06' 03.1''	77° 19' 41.4''	5.90	0.17	0.15	5.9	3.8	35.3	1.7	46.0	30.8	1.0	0.5
3.	13° 06' 04.3''	77° 19'38.6''	6.30	0.09	0.54	5.6	2.4	51.9	10.2	29.9	31.1	1.7	0.7
4.	13° 05' 03.8''	77° 19'36.7''	5.61	0.03	0.48	3.0	0.8	1.4	1.1	16.0	19.6	0.9	0.5
5.	13° 06' 01.1''	77° 19' 43.25''	5.94	0.07	0.57	3.7	2.0	9.0	1.1	14.5	13.8	0.3	0.5
6.	13° 06' 00.0''	77° 19' 47.9''	5.99	0.08	0.66	3.0	1.5	3.5	1.9	11.6	16.7	0.8	0.4
7.	13° 06' 00.0''	77° 19' 50.0''	5.87	0.07	0.24	2.8	2.0	1.4	0.6	3.9	11.7	0.4	0.5
8.	13° 05' 58.4''	77° 19' 46.7''	5.95	0.14	0.69	3.0	2.3	2.8	1.4	5.0	15.3	0.5	0.2
9.	13° 06' 01.7''	77° 19' 53.8''	5.68	0.10	0.63	3.8	2.9	2.1	1.0	12.3	24.4	0.9	0.4
10.	13° 06'' 03.8''	77° 19' 44.4''	6.09	0.03	0.54	2.0	1.4	47.1	0.7	5.6	11.2	0.3	0.4
11.	13° 06' 08.3''	77° 19' 34.4''	5.63	0.11	0.54	2.5	1.9	6.9	0.7	4.5	13.0	0.4	0.4
12.	13° 05' 46.6''	77° 19' 32.4''	5.69	0.04	0.69	3.2	2.8	131.6	1.0	40.0	13.7	2.1	0.2
13.	13° 05' 48.9''	77° 19' 37.4''	5.06	0.08	0.54	3.8	1.2	24.9	0.6	22.8	10.8	1.1	0.3
Mean			**5.83**	**0.09**	**0.51**	**3.7**	**2.1**	**27.4**	**1.9**	**20.0**	**18.7**	**0.9**	**0.4**
Range			**5.06-6.30**	**0.03-0.22**	**0.15-0.69**	**2.0-5.9**	**0.8-3.8**	**1.4-31.7**	**0.6-10.3**	**3.9-47.9**	**10.8-31.1**	**0.3-2.1**	**0.4-0.7**

Nutrient Management and Fertilizer Recommendations

The soil test results were used for management of soil and fertilizer recommendation to various crops. Application of fertilizers based on soil test results would help in providing balanced nutrients to crop, reduce excess application, reduces over mining of nutrient from the soil and also reduces the cost of cultivation.

Amendment for management of soil acidity

About 31.31 per cent area was moderately acidic, 68.59 per cent area was strongly acidic and 1 per cent area was slightly acidic in cluster villages of chikkamaranahalli. The soils to be amended with agricultural lime depending on severity of acidity. In ground nut based cropping system application of 500 k/ha gypsum as source of calcium and sulphur is recommended to enhance the yield.

Maintenance of organic matter status in soils

About 83.46 per cent area was low in organic carbon content and 16.54 per cent area was medium in organic carbon content. In these cluster villages cattle population (low and small ruminants) is considerably more and the farmers are applying organic manures every year but single crop is taken during *kharif* season in most of the area. The fields are left fallow during summer months, which has exposes the soils to sun and there will not be any crop cover in the field which results in fast decomposition and loss of organic carbon content. In order to maintain organic carbon level in soil, application of organic matter is recommended through various sources like FYM, vermicompost, green manuring and incorporation of crop residues into the soil so as to soil physical, chemical and biological properties of soils.

Recommendation of NPK based on soil testing

The entire project area soils were low in available Nitrogen, hence 12.5 kg of additional dose of nitrogen fertilizer is recommended along with recommended fertilizer in case of finger millet (Table 7 to 11).

About 91.39 per cent area was high in available phosphorus content in soils because of application of excess application of DAP fertilizer. Hence, 12.5 kg less phosphorus (P_2O_5) was recommended for finger millet.

Table – 7: Nutrient status and fertilizer recommendations for various crop in Chikkamaranahalli colony village

Sl.No	Name of farmer	Av. N	Av. P_2O_5	Av. K_2O	Cropping system	Soil test based Fertilizer recommendation		
		(kg ha^{-1})				DAP kg ha^{-1}	UREA kg ha^{-1}	MOP kg ha^{-1}
1	Gangamunayappa & Huchhaiah	226.8	54.4	192.1	FM + PP	59.78	112.47	62.50
2	Siddraju S/o Poojamma	252.0	67.2	230.2	FM + PP	59.78	112.47	62.50
3	Gangaraju S/o Muniyappa	214.2	18.2	211.8	GN + PP	114.00	91.20	62.50
4	Narayana swamyS/o Arasaiah	252.0	40.3	200.3	GN + PP	135.86	28.35	41.66
5	Muniyappa S/o Gangaiah,	315.0	82.9	653.8	GN + PP	135.86	28.35	20.83
6	Narasamma S/o Lakshmaiah	151.2	167.7	224.0	FM + PP	81.52	59.08	41.66
7	Bylamma W/o Chowdaiah	151.2	167.7	224.0	FM + PP	59.78	112.47	62.50
8	Aanjanmurthy S/o Kariyappa	63.0	23.6	210.2	FM + PP	86.95	101.84	62.50
9	Aanjan murthy S/o Kariyappa	163.8	85.7	170.6	FM + PP	59.78	112.47	62.50
10	Siddamma S/o Gangahanumaiah	63.0	97.1	394.2	FM + PP	59.78	112.47	41.66
11	Siddalingaiah S/o Munisiddaiah	60.1	45.3	190.4	FM + PP	86.95	101.84	62.50
12	Rajanna S/o Siddalingaiah	113.4	35.3	132.8	FM + PP	86.95	101.84	83.33
13	Srinivas S/o Siddilingaiah	75.6	27.9	139.9	FM + PP	86.95	101.84	83.33
14	Thimappa S/o Rangaiah	189.0	35.9	167.9	FM + PP	86.95	101.84	62.50
15	Ravi S/o Chikkegowda	151.2	47.5	160.2	FM + PP	86.95	101.84	62.50
16	Bhagyamma W/o Thimmraygowda	176.4	149.6	139.5	FM + PP	59.78	112.47	62.50
17	Gangamma S/o Muniyappa	50.4	84.3	166.3	FM + PP	59.78	112.47	62.50
18	Bhyranna S/o Kumaraiah	100.8	24.5	172.0	FM + PP	86.95	101.84	62.50
19	Suma w/o Kariyappa	289.8	86.8	68.5	FM + PP	59.78	85.20	83.33
	Mean	**161.0**	**68.7**	**213.1**				
	Range	**42.0-226.8**	**18.22-167.7**	**68.5-653.8**				

Note: FM+PP: Finger millet + pigeonpea(8:2); GN+PP : Groundnut + pigeonpea (8:2)
Recommended dose of fertilizer for finger millet: 50:40:37.5, DAP: 86.95, Urea: 75.62, MOP: 62.50
Recommended dose of fertilizer for groundnut: 25:50:25,,DAP: 108.69, Urea:11.81, MOP:41.66

Table – 8: Nutrient status and fertilizer recommendations for various crop in Chikkamaranahalli village

Sl.No	Name of farmer	Av. N	Av. P_2O_5	Av. K_2O	Cropping system	SOIL TEST BASED FERTILIZER RECOMMENDATION		
		(kg ha^{-1})				DAP kg ha^{-1}	UREA kg ha^{-1}	MOP kg ha^{-1}
1.	Gubbanna S/o Shivanna	88.2	76.9	141.2	FM + PP	59.78	112.78	62.50
2.	Gubbanna S/o Shivanna	100.8	22.8	167.9	FM + PP	86.95	101.84	62.50
3.	Ashok kumar S/o Thimrayappa	63.0	21.4	100.8	Mango + Cowpea	-	-	-
4.	Shivanna (JDA)	63.0	68.6	176.6	Pomegranate	-	-	-
5.	Venkatappa S/o gangaiah	126.0	35.0	139.0	FM + PP	86.95	101.84	83.33
6.	Jayamma W/o nagaraju	63.0	72.9	126.4	FM + PP	59.78	112.78	83.33
7.	Ashok kuar S/o Thimrayappa	189.0	15.1	96.7	FM + PP	114.0	91.20	83.33
8.	Venkatesh S/o Bettaiah	226.8	76.0	188.4	FM + PP	59.78	112.78	62.50
9.	Ravikumar S/o Tirumalaiah	42.0	16.5	202.2	FM + PP	114.00	91.20	62.50
10.	Ashok kumar S/o Mariyappa	201.6	33.2	127.5	FM + PP	86.95	101.84	83.33
11.	Rangappa S/o Mudlagiriah	100.8	135.8	238.0	Eucalyptus	-	-	-
12.	Kemparaju S/o Thimmanna	163.8	133.3	222.0	FM + PP	59.79	112.78	62.50
	Mean	**119.0**	**59.0**	**160.6**				
	Range	**42-226.8**	**15.1-135.8**	**98.7-238.0**				

Note: FM+PP: Finger millet + pigeonpea(8:2); GN+PP : Groundnut + pigeonpea (8:2)
Recommended dose of fertilizer for finger millet: 50:40:37.5, DAP: 86.95, Urea: 75.62, MOP: 62.50
Recommended dose of fertilizer for groundnut: 25:50:25, DAP: 108.69, Urea:11.81, MOP:41.66

Table – 9: Nutrient status and fertilizer recommendations for various crop in Chikkaputtayana palya village

Sl.No	Name of farmer	Av. N	Av. P_2O_5	Av. K_2O	Cropping system	Soil test based Fertilizer recommendation		
		(kg ha^{-1})				DAP kg ha^{-1}	UREA kg ha^{-1}	MOP kg ha^{-1}
1.	Gopal S/o Vnkatappa	63.0	94.2	470.4	FM + PP	59.78	112.47	41.66
2.	Gangahanumaiah S/o Gangabylappa	226.8	47.0	287.9	FM + PP	86.95	101.84	62.50
3.	Hanumanthrayappa S/o Doddaylappa	252.0	60.9	261.1	FM + PP	59.78	112.47	62.50
4.	Channe gowda S/o Ramanna	214.2	39.9	308.2	GN + PP	86.95	101.84	62.50
5.	Gopal S/o Vnkatappa	277.2	51.2	153.7	FM + PP	59.79	85.20	62.50
6.	Umesh S/o Hanumantaiah	88.2	38.7	308.3	FM + PP	86.95	101.84	62.50
7.	Byregowda S/o Byregowda	214.2	45.3	223.9	FM + PP	108.69	39.00	41.66
8.	Puttaswmaiah S/o Hanumaiah	403.2	43.6	153.7	GN + PP	108.69	11.81	41.66
9.	Gaja S/o tirumalaiah	126.0	41.6	330.5	FM + PP	86.95	101.84	62.50
10.	Thimmegowda S/o Huchaiah	239.4	26.2	450.1	FM + PP	86.95	101.84	41.66
11.	Govindraju S/o Gangaiah	151.2	71.2	465.0	FM + PP	59.78	112.47	41.66
12.	Nanjundai S/o Rangaiah	138.6	55.2	443.9	FM + PP	59.78	112.47	41.66
13.	Hanumanthrayappa S/o Muniyappa	88.2	37.0	101.9	FM + PP	86.95	101.84	83.33
14.	Chanappa S/o Channarayappa	151.2	95.1	358.4	FM + PP	59.78	112.47	62.50
15.	Prasanna kumar S/o Kanthaiah	151.2	19.9	343.4	FM + PP	114.00	91.20	41.66
16.	Nagaraju CH S/o Channarayappa	226.8	121.3	247.2	FM + PP	59.78	112.47	62.50
17.	Hanumanthraya S/o Doddabylappa	264.6	95.7	279.8	FM + PP	59.78	112.47	62.50
18.	Krishanppa S/o Huchhappa	63.0	47.3	133.2	FM + PP	86.95	101.84	83.33
19.	Channarayappa S/o Muniyappa	189.0	20.50	142.7	FM + PP	114.00	91.20	62.50
20.	Thimmegowda S/o Huchaiah	214.2	30.8	215.2	FM + PP	86.95	101.84	62.50
21.	Govindraju S/o Byregowda	189.0	105.6	188.8	FM + PP	114.00	91.20	62.50
22.	Siddamma S/o gangahanumaiah	176.4	59.8	181.7	FM + PP	59.78	112.47	62.50
23.	Nagaraju S/o Huchaiah	277.2	118’.15	178.3	FM + PP	59.78	1112.47	62.50
24.	Nagaraju S/Thimmaiah	63.0	32.2	95.9	FM + PP	86.95	101.84	83.333

25.	Bylanjinappa S/o Venkatappa	302.4	68.3	482.6	FM + PP	59.78	85.30	41.66
26.	Rajanna S/o Dodda bylappa	126.0	108.8	207.2	FM + PP	59.78	112.47	62.50
27.	Girijamma S/o Gopal	126.0	138.6	221.8	FM + PP	59.78	112.47	62.50
28.	Ramanna S/o Gururaj	126.0	31.2	201.0	FM + PP	86.95	101.84	62.50
29.	Krishnappa S/o Huchaiah	163.8	268.1	265.9	Paddy	81.52	212.66	30.00
30.	Kemparaju S/o Thimmanna	252.0	220.6	410.8	FM + PP	59.78	112.47	41.66
31.	Gangahanumaiah S/o Gangabylappa	138.6	177.7	446.9	FM + PP	59.78	112.47	41.66
32.	Rajamma W/o Venkatappa	163.8	247.2	548.3	FM + PP	59.78	112.47	41.66
33.	Govindraju S/o Gangaiah	163.8	257.4	314.7	FM + PP	59.78	112.47	62.5
34.	Ramakrishnaiah S/o Ramaiah	226.8	123.6	194.7	FM + PP	59.78	112.47	62.50
35.	Channa S/o Muniyappa	327.6	257.9	400.1	FM + PP	59.78	85.30	41.66
36.	Huchappa S/o Doddabylappa	163.8	177.7	213.3	FM + PP	59.78	112.47	62.50
37.	Chikkegowda S/o Putta hanumaiah	176.4	44.9	279.6	FM + PP	86.95	101.84	62.50
38.	Uma W/o rajanna	214.2	93.5	252.6	FM + PP	59.78	112.47	62.50
39.	Venkataraju S/o Byregowda	289.8	194.6	286.1	FM + PP	59.78	112.47	62.50
40.	Tiaamma S/o Ramakrishanaiah	214.2	36.3	314.9	FM + PP	86.95	101.84	62.50
41.	Bhagyamma W/o Thimmraygowda	226.8	220.1	151.5	FM + PP	59.78	112.47	62.50
42.	Rajamma W/o Venkatappa	176.4	67.9	430.0	FM + PP	59.78	112.47	41.66
43.	Puttaraju S/o Channamma	302.4	102.7	184.0	FM + PP	59.78	85.36	62.5
44.	Hanumakka W/o Hanumanthrayappa	138.6	65.4	645.2	FM + PP	59.78	112.47	41.66
45.	Govindraju S/o Bylegowda	415.8	73.0	435.5	FM + PP	59.78	85.36	41.66
46.	Venkatappa S/o Gangaiah	151.2	47.5	279.0	FM + PP	86.95	101.84	41.66
47.	Ramanna S/o Kemparaju	163.8	16.9	403.5	FM + PP	86.95	101.84	41.66
48.	Manjunatha S/o Ramanna	239.4	107.2	460.6	FM + PP	59.78	112.47	41.66
49.	Ramanna S/o Udayabanu	201.6	102.1	504.3	FM + PP	59.78	112.47	41.66
50.	Channa S/o Muniyappa	252.0	34.7	244.5	FM + PP	86.95	101.84	62.5
51.	Girish S/o Hanumanthrayappa	151.2	138.9	37.1	FM + PP	59.78	112.47	83.33
52.	Muniraju S/o Hanumanthaiah	176.4	85.3	202.5	FM + PP	59.78	112.47	62.50
53.	Shivaramaiah S/o Narasappa	163.8	111.8	590.6	FM + PP	59.78	112.47	41.66
54.	Shivaramaiah S/o Narasappa	100.8	58.7	143.4	FM + PP	59.78	112.47	62.5

55.	Shivaramaiah S/o Narasappa	100.8	120.5	143.1	Mango	-	-	-
56.	Rangaraju S/o	100.8	30.6	134.0	Chilli	81.52	212.66	104.00
57.	K C Muniyappa S/o Doddahuchaiah	163.8	56.2	149.2	FM + PP	-	-	
58.	Kaalappa S/o Thimmapgowda	100.8	103.7	131.3	FM + PP	59.78	112.47	83.33
59.	Hanumakka W/o Gangadharaiah	100.8	130.2	153.7	FM + PP	59.78	112.47	62.5
60.	Krishnappa S/o Huchaiah	176.4	109.8	88.7	FM + PP	59.78	112.47	83.33
61.	Manjunatha S/o Huchaiah	63.0	30.1	145.2	FM + PP	86.95	101.84	62.5
62.	Putamma W/o Muniswmayah	88.2	24.0	128.2	FM + PP	86.95	101.84	83.33
63.	MunirajuS/o Huchaiah	226.8	107.8	206.2	FM + PP	59.78	112.47	62.5
64.	Murthappa S/o Ramaiah	226.8	283.4	167.1	Beans	-	-	-
65.	Murthy S/o Nanjundappa	37.8	79.7	48.2	FM + PP	59.78	112.47	83.33
66.	Narasaiah S/o Mudlappa	126.0	150.7	89.2	Banana + Vegetables	-	-	-
67.	Gangaiah S/o Kaalaiah	226.8	15.3	170.0	Eucalyptus	-	-	-
68.	Munithimmaiah S/o Gangaiah	189.00	207.3	76.3	FM + PP	59.78	112.47	83.33
69.	Hanumathrtraju S/o Munithimaiah	478.8	39.8	651.7	FM + PP	86.95	75.32	41.66
70.	Chandrushekar S/ Gangaiah	226.8	141.5	102.2	FM + PP	59.78	112.47	83.33
71.	Dhalirangaiah S/ Chikkarangaiah	453.6	108.8	121.4	FM + PP	59.78	85.30	83.33
72.	Rangaswamy S/o Uma	84.0	109.3	573.7	FM + PP	59.78	112.47	41.66
73.	Rangegowda S/o Dhalirangaiah	100.8	102.7	368.4	FM + PP	59.78	112.47	41.66
74.	Puttaraju S/o Channamma	163.8	258.9	122.5	FM + PP	59.78	112.47	83.33
75.	Thirumalaiah S/o Kempaiah	151.2	177.2	140.8	FM + PP	59.78	112.47	83.33
76.	Hanumegowda S/o	289.8	102.1	381.4	FM + PP	59.78	85.30	41.66
	Mean	**188.9**	**100.4**	**268.0**				
	Range	**37.8-378.0**	**28.2-456.5**	**48.23-651.7**				

Note: FM+PP: Finger millet + pigeonpea(8:2); GN+PP : Groundnut + pigeonpea (8:2)
Recommended dose of fertilizer for finger millet: 50:40:37.5, DAP: 86.95, Urea: 75.62, MOP: 62.50
Recommended dose of fertilizer for groundnut: 25:50:25,,DAP: 108.69, Urea:11.81, MOP:41.66

Table – 10: Nutrient status and fertilizer recommendations for various crop in Mudalapalya village

Sl.No	Name of farmer	Av. N	Av. P_2O_5	Av. K_2O	Cropping system	Soil test based Fertilizer recommendation		
		(kg ha^{-1})				DAP kg ha^{-1}	UREA kg ha^{-1}	MOP kg ha^{-1}
1.	Vajarappa S/o Gangaiah	63.0	99.9	131.3	FM + PP	59.78	112.47	83.33
2.	Rajanna S/o Puttaswmaiah	239.4	35.9	154.0	FM + PP	86.95	101.84	62.50
3.	Rangegowda S/o Dhali rangaiah	176.4	48.7	492.0	GN + PP	108.69	39.00	20.80
4.	Palnetraiah S/o Paramashivaiah	151.2	16.8	399.8	GN + PP	135.86	28.35	20.80
5.	Rajanna CPS/o Puttaswmaiah	126.0	13.1	847.2	GN + PP	135.86	28.35	20.80
6.	Kemparaju S/ Bylappa	315.0	28.8	289.2	FM + PP	86.95	75.35	62.50
7.	Channaiah S/o Nagaraju,	163.8	35.8	181.6	Banana	-	-	-
8.	Chikkanna S/o Puttaramaiah	289.8	61.3	203.1	FM + PP	59.78	85.30	62.50
9.	Rangappa S/o Mudlagiriah	226.8	137.4	346.1	Mango	-	-	-
	Mean	**194.6**	**53.1**	**338.2**				
	Range	**63.0-315.0**	**13.1-137.4**	**131.3-847.20**				

Note: FM+PP: Finger millet + pigeonpea(8:2); GN+PP : Groundnut + pigeonpea (8:2)

Recommended dose of fertilizer for finger millet: 50:40:37.5, DAP: 86.95, Urea: 75.62, MOP: 62.50

Recommended dose of fertilizer for groundnut: 25:50:25, DAP: 108.69, Urea:11.81, MOP:41.66

Table – 11 Nutrient status and fertilizer recommendations for various crop in Hosapalya village

Sl.No	Name of farmer	Av. N	Av. P_2O_5	Av. K_2O	Cropping system	Soil test based Fertilizer recommendation		
		(kg ha^{-1})				DAP kg ha^{-1}	UREA kg ha^{-1}	MOP kg ha^{-1}
1.	Siddaraju S/o Revenasiddaiah	126.0	33.9	600.0	GN + PP	108.69	39	20.86
2.	Hanumantaiah S/o Revaiah	63.0	28.2	625.6	GN + PP	135.86	20.35	20’.86
3.	Rudramma W/o Muddaiah	226.8	38.4	648.0	FM + PP	86.95	101.84	41.66
4.	Manju S/o Kanpaiah	201.6	113.9	378.2	FM + PP	59.78	112.78	41.66
5.	Ramaiah S/o Siddaiah	239.4	296.7	193.8	FM + PP	59.78	112.78	62.5
6.	Shivanna S/o Siddahanumaia	277.2	456.5	232.4	FM + PP	59.78	112.78	62.5
7.	Rajanna S/o sidda hanumaiah	100.8	78.6	391.0	FM + PP	59.78	112.78	41.66
8.	Gangahanumaiah S/o Gangaiah	289.8	159.3	375.6	FM + PP	59.78	85.30	41.66
9.	Siddagangaiah S/o Kempaiah	264.6	109.3	299.4	FM + PP	59.78	112.78	62.5
10.	Gangahanumaiah S/o Gangaiah	226.8	149.1	126.5	FM + PP	59.78	112.78	62.5
11.	Nagamma W/o Gangaraju	226.8	183.8	209.3	FM + PP	59.78	112.78	62.5
12.	Channe gowda S/o Ramanna	289.8	133.3	151.2	FM + PP	59.78	85.20’	62.5
13.	Hanumantaiah S/o Revaiah	226.8	115.4	163.4	FM + PP	59.78	112.78	62.5
	Mean	**212.3**	**145.9**	**338.0**				
	Range	**63.0-289.6**	**28.2-456.5**	**126.5-648.0**				

Note: FM+PP: Finger millet + pigeonpea(8:2); GN+PP : Groundnut + pigeonpea (8:2)
Recommended dose of fertilizer for finger millet: 50:40:37.5, DAP: 86.95, Urea: 75.62, MOP: 62.50
Recommended dose of fertilizer for groundnut: 25:50:25,,DAP: 108.69, Urea:11.81, MOP:41.66

The cluster villages showed 26.62 per cent area as high in available potassium content in soil, hence, 12.5 kg less potassium fertilizer was recommended to reduce the luxury consumption.

Recommendation of micronutrients based on soil testing

A total of 63.32 per cent area was found to be high in available zinc status as most of the farmers are already applying 12.5kg/ha $ZnSO_4$ to the crops. Only 1.74 per cent area was low in available zinc and 31.88 per cent of area was found to be marginal in available zinc. Wherever the soils are showing lower zinc, 12.5 kg /ha $ZnSO_4$ is recommended along with organic manure and NPK. In the cluster villages, 75.65 per cent area was found to be low in available boron in soil because farmers are not applying boron containing fertilizes, hence 10 kg/ ha of borax is recommend along with organic manure and NPK.

Land use / land cover

The present land use/ land cover map of the project area was prepared by using the parcel wise information collected during field traversing. The major land use of the cluster villages is sole crop of finger millet, finger millet+ pigeonpea intercropping(8:2), groundnut + pigeonpea intercropping (8:2), followed by maize, horticulture plantations, vegetables and eucalyptus (Fig-17). Similarly the proposed land use/land cover map was also prepared by getting the information from the respective farmers, with major land use of finger millet, finger millet+ pigeonpea intercropping(8:2), groundnut + pigeonpea intercropping (8:2) and other crops (Fig-18).

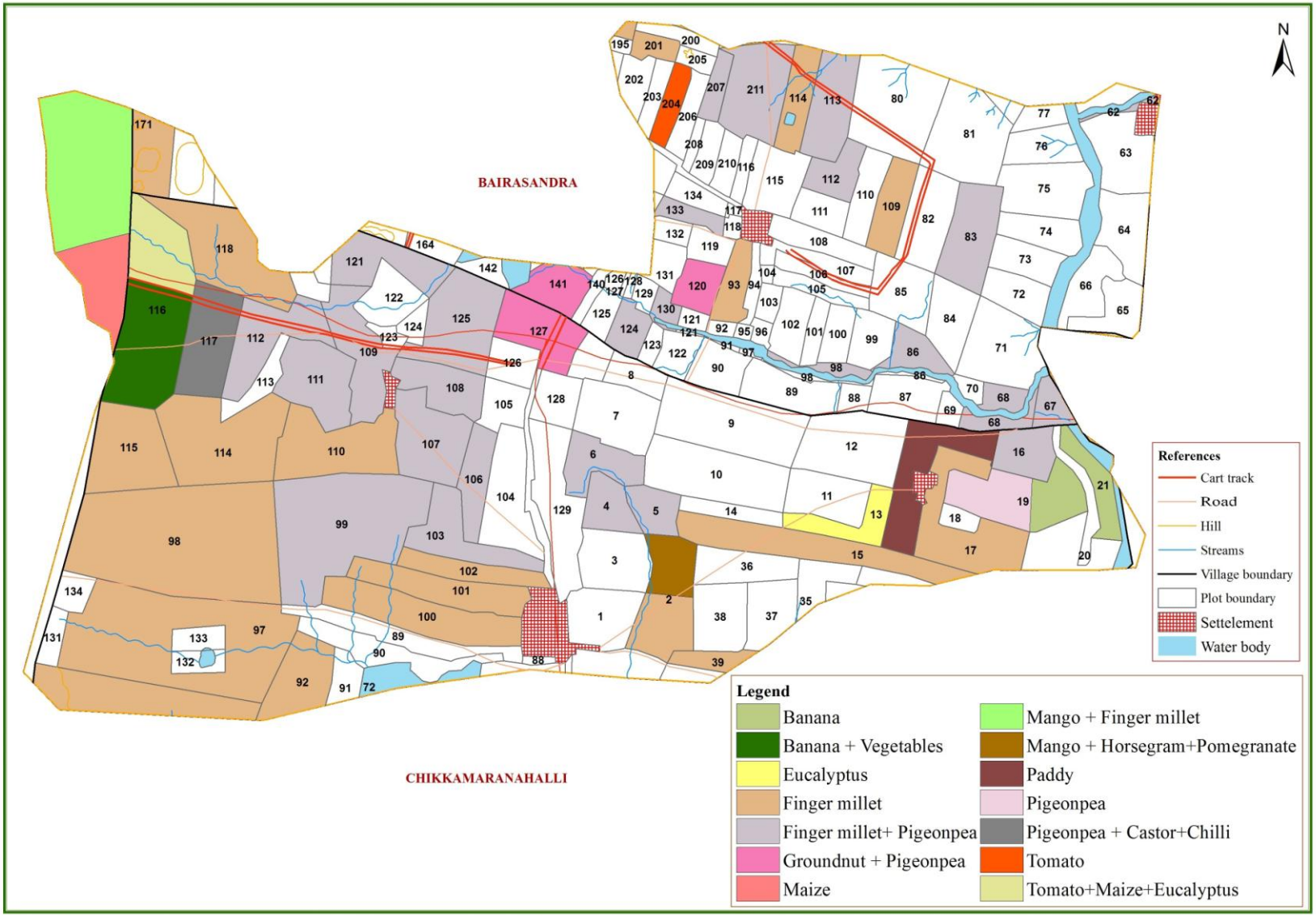

Fig. 17 Present land use map of Chikkamaranahalli cluster villages , Nelamangala Taluk Bangalore Rural district

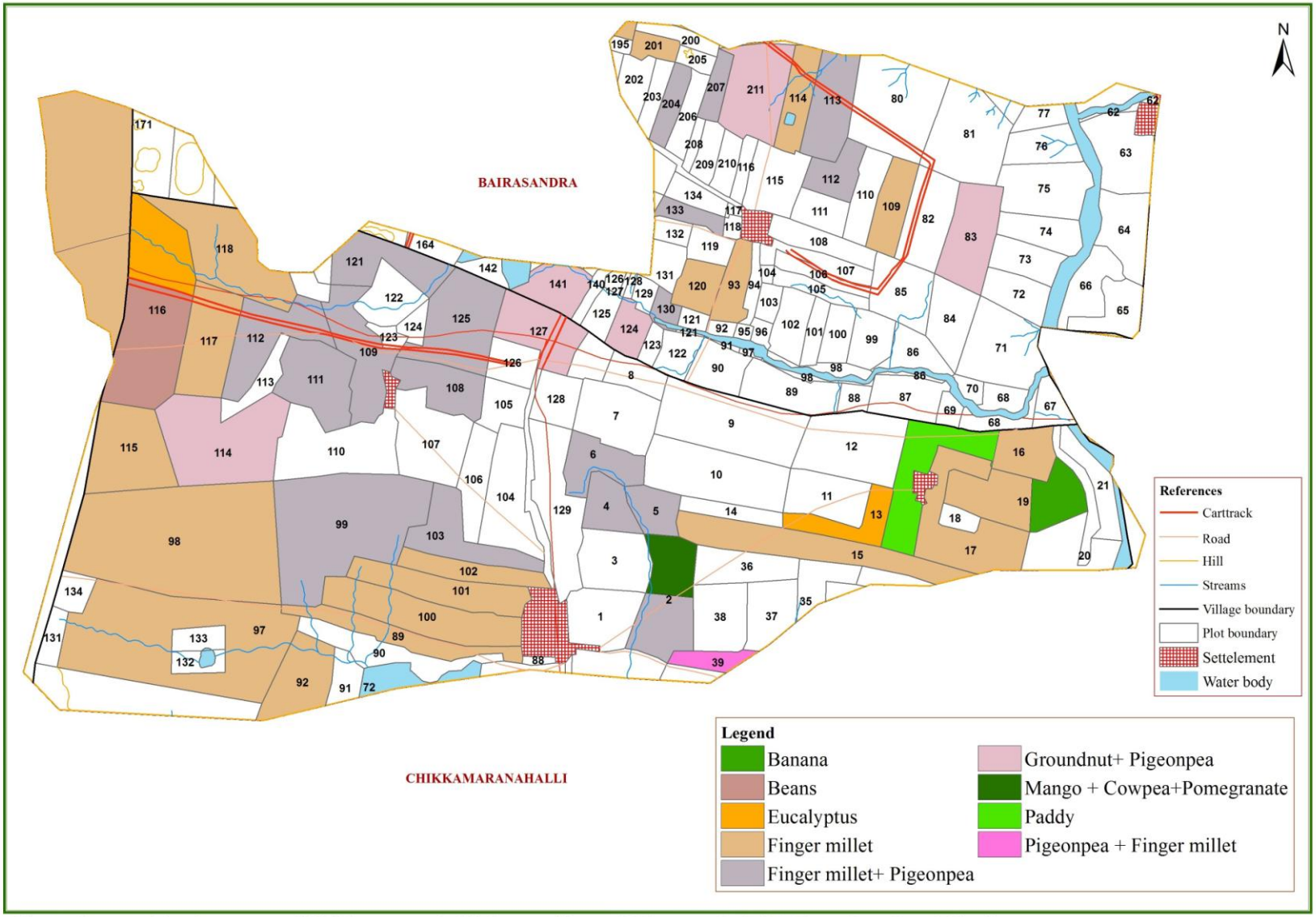

Fig. 18 Proposed land use map of Chikkamaranahalli cluster villages, Nelamangala Taluk Bangalore Rural district

Balanced fertilizer recommendation for improving soil fertility and enhancing crop productivity

Groundnut based cropping system

The soil fertility status of Thimmegowda field was -63.00 kg/ha available nitrogen, 28.18 kg/ha available phosphorus and 625.56 kg/ha available potassium which is low in nitrogen, medium in phosphorus and high in potassium status. Hence, based on soil test results, nutrients are recommended for groundnut @ 37.5:50:12.5 kg/ha (DAP: 108.69, Urea: 39.00 MOP: 20.83). The general recommendation for groundnut crop as per package of practice of University is 25:50:25 kg/ha (DAP: 108.69, Urea: 11.81, MOP: 41.66).There is saving of Rs 170.89/ha by adopting this method for fertilizer recommendation. The farmer is benefitted in terms of reduction in cost of cultivation apart from the nutrients are provided in balanced manner which helps in availability of nutrients to crop for better growth and yield. Groundnut + pigeonpea (BRG-2) (8:2), intercropping system recorded maximum groundnut pod yield (1333 kg ha^{-1}), net returns (Rs.48,700 ha^{-1}) and BC ratio (2.71) compared to farmers practice of groundnut (1000 kg ha^{-1}, Rs.32,500 ha^{-1} and 1.86, respectively and also additional yield from pigeonpea will further increase the benefit that farmer derives by adopting the system.

Groundnut at vegetative stage

Groundnut |at harvest stage

Fingermillet based cropping system

The soil fertility status of Vajrappa's field was 63 kg/ha available nitrogen, 99.9 kg/ha available phosphorus and 131 kg/ha available potassium which is low in nitrogen, high in phosphorus and low in potassium status. Hence, based on soil test results, nutrients are recommended for fingermillet @ 62.50:27.50:50 kg/ha (DAP: 59.78, Urea: 112.47 MOP: 83.33). The general recommendation for finger millet crop as per package of practice of University is 50:40:37.50 kg/ha (DAP: 86.95, Urea: 75.62, MOP: 62.50).There is saving of Rs 181.09/ha by adopting this method for fertilizer recommendation. The farmer is benefitted in terms of reduction in cost of cultivation. The nutrients are provided in balanced manner which helps in availability of nutrients to crop for better growth and yield. Finnger millet (MR-1) + pigeonpea (BRG -1) (8:2), intercropping system recorded maximum finger millet grain yield (1995 kg ha^{-1}), net returns (Rs.22, 579 ha^{-1}) and BC ratio (2.06) compared to farmers practice of finger millet (1065 kg ha^{-1}, Rs. 4095 ha^{-1} and 1.22, respectively). Additional yield from pigeon pea will further increase the benefit that farmer derives by adopting the system. Pigeonpea can add 2-3t/ha of leaf litter apart from 25-30kg/ha nitrogen fixation

Fingermillet at vegetative stage

Fingermillet at harvesting stage

Conclusions

Thus the fertility maps prepared using GIS-GPS helps in visualizing the spatial distribution of nutrient status over an area. The information derived out of these fertility maps is useful in recommending fertilizers for crops. Application of nutrients based on soil test results helps in supply of nutrients based on the actual status in soil. Nutrients are provided in balance proportion which helps in maintaining soil health and also crop productivity. In addition to this, the cost of cultivation also reduces which increases the benefit received from crop production. Application of DAP can be reduced to a great extent which not only reduces fertilizer cost but also reduces necessity of importing phosphorus fertilizers from other countries. The phosphorus status is high in most of the soils (91.39% area), which can be made available through application of bio fertilizers.

References

Jackson, M. L., 1973, *Soil Chemical Analysis*. Prentice Hall of India Private Limited, New Delhi.

John, M. K., Chuah, H. H. and Neufeld, J.H., 1975, Analysis of micro-macro nutrients in soil and plants., *Anal. lett.*, **8**:559.

Lindsay, W. L. AND Norvell, W. A., 1978, development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America.*,**42**:421-428.

Page, A.L., Miller, R.H. AND Kendy, D.R., 1982, Methods of soil analysis, part-2 , *Soil Science Society of America, Inc, Publishers*, Madison, Wisconsin, USA.

Subbaiah, B.V. and Asija, G., 1956, A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, **25**: 259-260.

Annexure I

Critical limit

pH	Acidic – <6.5 Neutral - 6.5-7.5 Alkaline - >7.5
EC	Normal - <0.8 dSm^{-1} Critical for sensitive crops- 0.8-1.6 dSm^{-1} Critical for salt tolerant crops- 1.6-2.5 dSm^{-1} Injurious for many crops- >2.5 dSm^{-1}
Organic carbon	Low – 0.5 % Medium – 0.5 – 0.75% High - > 0.75 %
Available N	Low – <280 kg/ha Medium –280-560 kg/ha High - >560
Available P_2O_5	Low – 22.5 kg/ha Medium – 55.5 -56 kg/ha High - >56 kg/ha
Available K_2O	Low – 141 kg/ha Medium – 141-336 kg/ha High - >336 kg/ha
Exchangeable Ca	Deficient - < 1.5 meq/100g Sufficient - >1.5 meq/100g
Exchangeable Ca	Deficient - < 1.0 meq/100g Sufficient - >1.0 meq/100g
Available S	Low – <10 ppm Medium – 10 -20 ppm High - > 20 ppm
Available Zn	Low – < 0.5 ppm Marginal – 0.5-0.75ppm Adequate - 0.75-1.50 ppm High - > 1.5 ppm
Available B	Low – <0.5 ppm Medium – 0.5 -1.0 ppm High - > 1.0 ppm
Available Cu	Deficient - < 0.2 ppm Sufficient - > 0.2 ppm
Available Mn	Deficient - < 1 ppm Sufficient - > 1 ppm
Available Fe	Deficient - < 4.5 ppm Sufficient - > 4.5 ppm