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LAND RESOURCE INVENTORY AND SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS FOR WATERSHED PLANNING AND DEVELOPMENT

KUNIKERI -2 (4D3A1Z1g) MICRO WATERSHED

Koppal Taluk and District, Karnataka

Karnataka Watershed Development Project – II

SUJALA – III

World Bank funded Project

The World Bank

ICAR – NATIONAL BUREAU OF SOIL SURVEY AND LAND USE PLANNING

WATERSHED DEVELOPMENT DEPARTMENT
GOVT. OF KARNATAKA, BANGALORE

About ICAR - NBSS&LUP

The ICAR-National Bureau of Soil Survey and Land Use Planning (ICAR-NBSS&LUP), Nagpur, a premier Institute of the Indian Council of Agricultural Research (ICAR), was set up during 1976 with the objective to prepare soil resource maps at national, state and district levels and to provide research inputs in soil resource mapping and its applications, land evaluation, land use planning, land resource management, and database management using GIS for optimising land use on different kinds of soils in the country.

The Bureau has been engaged in carrying out soil resource survey, agro-ecological and soil degradation mapping at the country, state and district levels for qualitative assessment and monitoring the soil health towards viable land use planning. The research activities have resulted in identifying the soil potentials and problems, and the various applications of the soil surveys with the ultimate objective of sustainable agricultural development. The Bureau has the mandate to correlate and classify soils of the country and maintain a National Register of all the established soil series. The Institute is also imparting in-service training to staff of the soil survey agencies in the area of soil survey, land evaluation and soil survey interpretations for land use planning. The Bureau in collaboration with Panjabrao Krishi Vidyapeeth, Akola is running post-graduate teaching and research programme in land resource management, leading to M.Sc. and Ph.D. degrees.

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PREFACE

In Karnataka, as in other Indian States, the livelihoods of rural people are intertwined with farming pursuits. The challenges in agriculture are seriously threatening the livelihood of a large number of farmers as they have been practicing farming in contextual factors beyond their control. Climatic factors are the most important ones and have become much more significant in recent times due to rapid climate changes induced by intensive anthropogenic activities affecting our ecosystem in multiple ways. Climate change has become the reality, it is happening and efforts to evolve and demonstrate climate resilient technologies have become essential. Due to the already over stressed scenario of agrarian sector, the climate change is resulting in manifold increase in the complexities, pushing the rural mass to face more and more unpredictable situations. The rising temperatures and unpredictable rainfall patterns are going to test seriously the informed decisions farmers have to make in order to survive in farming and sustain their livelihood.

It is generally recognized that impacts of climate change shall not be uniform across the globe. It is said that impact of climate change is more severe in South Asia. Based on the analysis of meteorological data, it is predicted that in India, there will be upward trend in mean temperature, downward trend in relative humidity, annual rainfall and number of wet days in a year. Also, in general, phenomena like erratic monsoon, spread of tropical diseases, rise in sea levels, changes in availability of fresh water, frequent floods, droughts, heat waves, storms and hurricanes are predicted. Each one of these adverse situations are already being experienced in various parts of India and also at the global level. Decline in agricultural productivity of small and marginal farmers becoming more vulnerable is already witnessed.

In Karnataka, more than 60 per cent of the population live in rural areas and depend on agriculture and allied activities for their livelihood. Though the state has achieved significant progress in increasing the yield of many crops, there is tremendous pressure on the land resources due to the growing and competing demands of various land uses. This is reflected in the alarming rate of land degradation observed. Already more than 50 per cent of the area is affected by various forms of degradation. If this trend continues, the sustainability of the fragile ecosystem will be badly affected. The adverse effects of change in the climatic factors are putting additional stress on the land resources and the farmers dependent on this.

The natural resources (land, water and vegetation) of the state need adequate and constant care and management, backed by site-specific technological interventions and investments particularly by the government. Detailed database pertaining to the nature of

the land resources, their constraints, inherent potentials and suitability for various land based rural enterprises, crops and other uses is a prerequisite for preparing location-specific action plans, which are in tune with the inherent capability of the resources. Any effort to evolve climate resilient technologies has to be based on the baseline scientific database. Then only one can expect effective implementation of climate resilient technologies, monitor the progress, make essential review of the strategy, and finally evaluate the effectiveness of the implemented programs. The information available at present on the land resources of the state are of general nature and useful only for general purpose planning. Since the need of the hour is to have site-specific information suitable for farm level planning and detailed characterization and delineation of the existing land resources of an area into similar management units is the only option.

ICAR-NBSS&LUP, Regional Centre, Bangalore has taken up a project sponsored by the Karnataka Watershed Development Project-II, (Sujala-III), Government of Karnataka funded by the World Bank under Component -1 Land Resource Inventry. This study was taken up to demonstrate the utility of such a database in reviewing, monitoring and evaluating all the land based watershed development programs on a scientific footing. To meet the requirements of various land use planners at grassroots level, the present study on "Land Resource Inventory and Socio-Economic Status of Farm Households for Watershed Planning and Development of for Kunikeri-2 microwatershed in Koppal Taluk, and District, Karnataka" for integrated development was taken up in collaboration with the State Agricutural Universities, IISC, KSRSAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots and socio-economic status of farm households covering thirty per cent farmers randomely selected representing landed and landless class of farmers in the micro-watershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner

It is hoped that this database will be useful to the planners, administrators and developmental agencies working in the area in not only for formulating location specific developmental schemes but also for their effective monitoring at the village/watershed level.

Nagpur **S.K. SINGH**

Date: 25-10-2019 Director, ICAR - NBSS&LUP Nagpur

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PART-A

LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

The land resource inventory of Kunikeri-2 microwatershed was conducted using village cadastral maps and IRS satellite imagery on 1:7920 scale. The false colour composites of IRS imagery were interpreted for physiography and these physiographic delineations were used as base for mapping soils. The soils were studied in several transects and a soil map was prepared with phases of soil series as mapping units. Random checks were made all over the area outside the transects to confirm and validate the soil map unit boundaries. The soil map shows the geographic distribution and extent, characteristics, classification, behavior and use potentials of the soils in the microwatershed.

The present study covers an area of 441 ha in Koppal taluk and district, Karnataka. The climate is semiarid and categorized as drought - prone with an average annual rainfall of 662 mm, of which about 424 mm is received during south–west monsoon, 161 mm during north-east and the remaining 77 mm during the rest of the year. An area of about 76 per cent is covered by soils, 4 per cent by mining/industrial, 16 per cent by rock outcrops and 3 per cent by habitation and water bodies, settlements and others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 9 soil series and 17 soil phases (management units) and 5 land management units.*
- *The length of crop growing period is <90 days and starts from 2nd week of August to 2nd week of November.*
- *From the master soil map, several interpretative and thematic maps like land capability, soil depth, surface soil texture, soil gravelliness, available water capacity, soil slope and soil erosion were generated.*
- *Soil fertility status maps for macro and micronutrients were generated based on the surface soil samples collected at every 320 m grid interval.*
- *Land suitability for growing 31 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- *Entire area is suitable for agriculture.*
- *About 1 per cent of the soils are shallow (25-50 cm), 18 per cent of the soils are moderately shallow (50-75 cm), 7 per cent of the soils are moderately deep (75-100 cm), 38 per cent area has deep (100-150 cm) and 13 per cent are very deep (>150 cm) soils.*
- *An area of about 47 per cent has loamy and 30 per cent has clayey soils at the surface.*
- *About 52 per cent of the area has non-gravelly (<15%) soils, 14 per cent gravelly (15-35% gravel) and 10 per cent has very gravelly (35-60%) soils.*

- *About 26 per cent are very low (<50 mm/m), 38 per cent low (51-100 mm/m), <1 per cent medium (101-150 mm/m), 12 per cent is high (151-200 mm/m) and <1 per cent very high (>200 mm/m) in available water capacity.*
- *An area of about 4 per cent has nearly level (0-1%) and 72 per cent area has very gently sloping (1-3%) lands.*
- *An area of about 4 per cent has soils that are slightly eroded (e1) and 72 per cent moderately eroded (e2) lands.*
- *An area of about 12 per cent are slightly acid (ph 6.0-6.5), 14 per cent are neutral (pH 6.5-7.3), 10 per cent are slightly alkaline (pH 7.3-7.8), 39 per cent are moderately alkaline (pH pH 7.8-8.4) and <1 per cent are strongly alkaline (pH 8.4-9.0) in soil reaction.*
- *The Electrical Conductivity (EC) of the soils is <2 dS m^{-1} and as such the soils are non-saline.*
- *Organic carbon is low (<0.5%) in 1 per cent, medium (0.5-0.75%) in 16 per cent and high (>0.75%) in 59 per cent area of the soils.*
- *Available phosphorus is medium (23-57 kg/ha) in area of about 13 per cent and high (>57 kg/ha) in 64 per cent in the microwatershed.*
- *About 13 per cent of the soils are low (<145 kg/ha), 58 per cent of the soils are medium (145-337 kg/ha) and 5 per cent soils are high (>337 kg/ha) in available potassium content.*
- *Available sulphur is low (<10 ppm) in about 47 per cent and medium (10-20 ppm) in about 29 per cent soils.*
- *Available boron is low (0.5 ppm) in about 76 per cent area and <1 per cent are medium (0.5-1.0 ppm).*
- *Available iron is sufficient (>4.5 ppm) in 24 per cent and deficient (<4.5 ppm) in about 53 per cent area.*
- *Available zinc is deficient (<0.6 ppm) in 36 per cent and sufficient (>0.6 ppm) in about 40 per cent area.*
- *Available manganese and copper are sufficient in all the soils.*
- *The land suitability for 31 major agricultural and horticultural crops grown in the microwatershed were assessed and the areas that are highly suitable (S1) and moderately suitable (S2) are given below. It is however to be noted that a given soil may be suitable for various crops but what specific crop to be grown may be decided by the farmer looking to his capacity to invest on various inputs, marketing infrastructure, market price and finally the demand and supply position.*

Land suitability for various crops in the microwatershed

Crop	Suitability Area in ha (%)			Crop	Suitability Area in ha (%)	
	Highly suitable (S1)	Moderately suitable (S2)			Highly suitable (S1)	Moderately suitable (S2)
Sorghum	*144 (33)*	*45 (10)*		*Sapota*	*144 (33)*	*29 (7)*
Maize	*91 (21)*	*99 (22)*		*Pomegranate*	*144 (33)*	*31 (7)*
Bajra	*144 (33)*	*112 (25)*		*Musambi*	*144 (33)*	*31 (7)*
Groundnut	*53 (12)*	*237 (54)*		*Lime*	*144 (33)*	*31 (7)*
Sunflower	*144 (33)*	*2 (<1)*		*Amla*	*144 (33)*	*186 (42)*
Red gram	*144 (33)*	*2 (<1)*		*Cashew*	*53 (12)*	*120 (27)*
Bengalgram	*2 (<1)*	*225 (51)*		*Jackfruit*	*144 (33)*	*29 (7)*
Cotton	*144 (33)*	*45 (10)*		*Jamun*	*144 (33)*	*31 (7)*
Chilli	*144 (33)*	*43 (10)*		*Custard apple*	*144 (33)*	*186 (42)*
Tomato	*144 (33)*	*43 (10)*		*Tamarind*	*144 (33)*	*28 (6)*
Brinjal	*<1 (<1)*	*221 (50)*		*Mulberry*	*144 (33)*	*106 (24)*
Onion	*<1 (<1)*	*221 (50)*		*Marigold*	*144 (33)*	*45 (10)*
Bhendi	*<1 (<1)*	*221 (50)*		*Chrysanthemum*	*144 (33)*	*45 (10)*
Drumstick	*144 (33)*	*77 (17)*		*Jasmine*	*144 (33)*	*43 (10)*
Mango	*144 (33)*	*<1 (<1)*		*Crossandra*	*144 (33)*	*43 (10)*
Guava	*53 (12)*	*120 (27)*				

- *Apart from the individual crop suitability, a proposed crop plan has been prepared for the 5 identified LMUs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and other horticulture crops that helps in maintaining productivity and ecological balance in the microwatershed.*
- *Maintaining soil-health is vital for crop production and conserve soil and land resource base for maintaining ecological balance and to mitigate climate change. For this, several ameliorative measures have been suggested for these problematic soils like saline/alkali, highly eroded, sandy soils etc.*
- *Soil and water conservation treatment plan has been prepared that would help in identifying the sites to be treated and also the type of structures required.*
- *As part of the greening programme, several tree species have been suggested to be planted in marginal and submarginal lands, field bunds and also in the hillocks, mounds and ridges. That would help in supplementing the farm income, provide fodder and fuel, and generate lot of biomass which in turn would help in maintaining the ecological balance and contribute to mitigating the climate change.*

Chapter 1

INTRODUCTION

Land is a scarce resource and basic unit for any material production. It can support the needs of the growing population, provided they use the land in a rational and judicious manner. But what is happening in many areas of the state is a cause for concern to everyone involved in the management of land resources at the grassroots level. The area available for agriculture is about 51 per cent of the total area and more than 60 per cent of the people are still dependant on agriculture for their livelihood. The limited land area is under severe stress and strain due to increasing population pressure and competing demands of various land uses. Due to this, every year there is significant diversion of farm lands and water resources for non-agricultural purposes. Apart from this, due to lack of interest in farmers for farming, large tracts of cultivable lands are turning into fallows in many areas and this trend is continuing at an alarming rate.

Further, land degradation has emerged as a serious problem which has already affected about 38 lakh ha of cultivated area in the state. Soil erosion alone has degraded about 35 lakh ha. Almost all the uncultivated areas are facing various degrees of degradation, particularly soil erosion. Salinity and alkalinity has emerged as a major problem in more than 3.5 lakh ha in the irrigated areas of the state. Nutrient depletion and declining factor productivity is common in both rainfed and irrigated areas. The degradation is continuing at an alarming rate and there appears to be no systematic effort among the stakeholders to contain this process. In recent times, an aberration of weather due to climate change phenomenon has added another dimension leading to unpredictable situations to be tackled by the farmers.

In this critical juncture, the challenge before us is not only to increase the productivity per unit area which is steadily declining and showing a fatigue syndrome, but also to prevent or at least reduce the severity of degradation. If the situation is not reversed at the earliest, then the sustainability of the already fragile crop production system and the overall ecosystem will be badly affected in the state.

The continued neglect and unscientific use of the resources for a long time has led to the situation observed at present in the state. It is a known fact and established beyond doubt by many studies in the past that the cause for all kinds of degradation is the neglect and irrational use of the land resources. Hence, there is urgent need to generate a detailed site-specific farm level database on various land resources for all the villages/watersheds in a time bound manner that would help to protect the valuable soil and land resources and also to stabilize the farm production.

Therefore, the land resource inventory required for farm level planning is the one which investigates not only the surface but also consider the other parameters which are critical for productivity *viz.*, soils, climate, water, minerals and rocks, topography, geology, hydrology, vegetation, crops, land use pattern, animal population, socio-economic conditions, infrastructure, marketing facilities and various schemes and

developmental works of the government etc. From the data collected at farm level, the specific problems and potentials of the area can be identified and highlighted, conservation measures required for the area can be planned on a scientific footing, suitability of the area for various uses can be worked out and finally viable and sustainable land use options suitable for each and every land holding can be prescribed.

The Land Resource Inventory is basically done for identifying potential and problem areas, developing sustainable land use plans, estimation of surface run off and water harvesting potential, preparation of soil and water conservation plans, land degradation/desertification etc. The Bureau is presently engaged in developing an LRI methodology using high resolution satellite remote sensing data and Digital Elevation Model (DEM) data to prepare Landscape Ecological Units (LEU) map representing agro-ecosystem as a whole. The LEU is preferred over landform as the base map for LRI. LEU is the assemblage of landform, slope and land use. An attempt was made to upscale the soil resource information from 1:250000 and 1:50000 scale to the LEU map in Goa and other states.

The land resource inventory aims to provide site-specific database for Kunikeri-2 Microwatershed in Koppal Taluk and District, Karnataka State for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological Units (LEUs) map.

The study was organized and executed by the ICAR- National Bureau of Soil Survey and Land Use Planning, Regional Centre, Bangalore under Generation of Land Resource Inventory Data Base Component-1 of the Sujala-III Project funded by the World Bank.

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Kunikeri-2 Microwatershed is located in the central part of northern Karnataka in Koppal Taluk and District, Karnataka State (Fig. 2.1). It comprises parts of Kunakeri and Hirebaganala Villages. It lies between $15^0$16' – $15^0$18' North latitudes and $76^0$13' –$76^0$14' East longitudes and covers an area of 441 ha. It is about 14 km from Koppal town. It is surrounded by Kunakeri village on the west and south and Hirebaganala on the north, east and southern side.

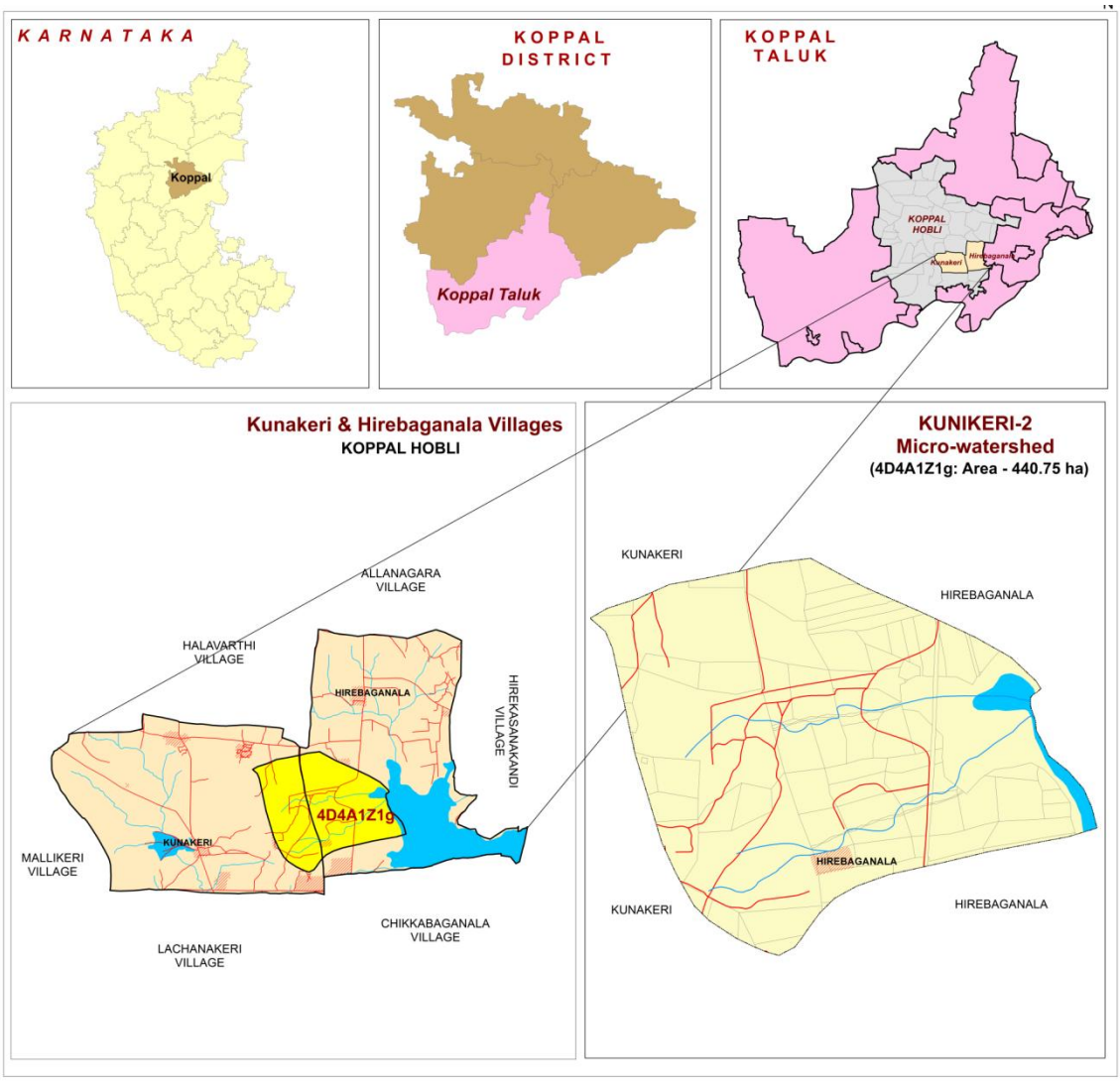


Fig. 2.1 Location map of Kunikeri-2 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss (Figs. 2.2). Granite gneisses are essentially pink to gray and are coarse to medium grained. They consist primarily of quartz, feldspar, biotite and hornblende. The gray granite gneisses are

highly weathered, fractured and fissured upto a depth of about 10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in the village.

Fig. 2.2 Granite and granite gneiss rocks

2.3 Physiography

Physiographically, the area has been identified as granite gneiss landscape based on geology. The microwatershed area has been further divided into summits, very gently sloping uplands and nearly level plains based on slope and its relief features. The elevation ranges from 502 to 529 m in the gently sloping uplands.

2.4 Drainage

The area is drained by several small seasonal streams that join Hire *halla* and Chenna *halla* along its course. Though, the streams are not perennial, during rainy season they carry large quantities of rain water. The microwatershed has only few small tanks which are not able to store the water flowing during the rainy season. Due to this, the ground water recharge is very much affected in the villages. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing tanks and recharge structures at appropriate places in the villages, then the drinking and irrigation needs of the area can be easily met. The drainage network is dendritic to sub parallel.

2.5 Climate

The district falls under semiarid tract of the state and is categorized as drought-prone with an average annual rainfall of 662 mm (Table 2.1). Maximum of 424 mm precipitation takes place during the south-west monsoon period from June to September, north-east monsoon contributes about 161 mm and prevails from October to early December and the remaining 77 mm takes place during the rest of the year. The winter season is from December to February. During April and May, the temperatures reach up

to 45 °C and in December and January, the temperatures will go down to 16 °C. Rainfall distribution is shown in Figure 2.3. The average Potential Evapo Transpiration (PET) is 145 mm and varies from a low of 101 mm in December and 193 mm in the month of May. The PET is always higher than precipitation in all the months except in the month of September. Generally, the Length of crop Growing Period (LGP) is <90 days and starts from 2nd week of August to 2nd week of November.

Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET at Koppal Taluk and District

Sl. No.	Months	Rainfall	PET	1/2 PET
1	January	1.60	116.70	58.35
2	February	1.50	129.20	64.60
3	March	14.10	169.80	84.90
4	April	18.10	180.60	90.30
5	May	41.60	193.50	96.75
6	June	85.80	167.90	83.95
7	July	72.10	156.20	78.10
8	August	110.50	152.50	76.25
9	September	155.60	138.50	69.25
10	October	116.30	122.30	61.15
11	November	36.00	106.40	53.20
12	December	9.10	101.00	50.50
	TOTAL	**662.30**	**144.55**	

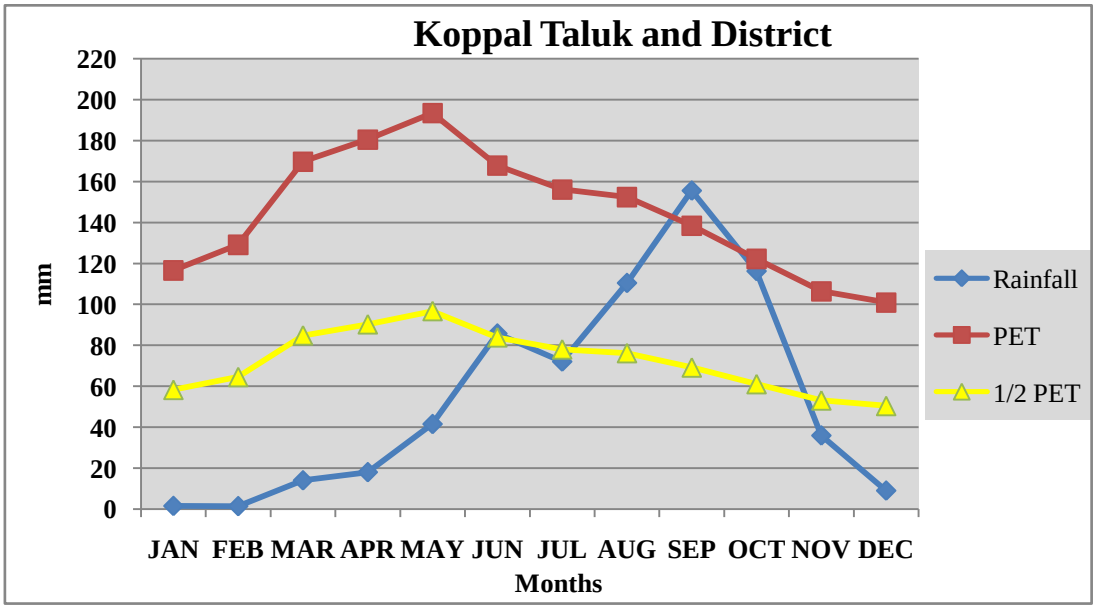


Fig. 2.3 Rainfall distribution in Koppal Taluk and District

2.6 Natural Vegetation

The natural vegetation is sparse comprising few tree species, shrubs and herbs. The mounds, ridges and boulders occupy sizeable areas which are under thin to moderately thick forest vegetation. Still, there are some remnants of the past forest cover which can be seen in patches in some ridges and hillocks in the microwatershed (Fig 2.4).

Apart from the continuing deforestation, the presence of large population of goats, sheep and other cattle in the microwatershed is causing vegetative degradation of whatever little vegetation left in the area. The uncontrolled grazing has left no time for the regeneration of the vegetative cover. This leads to the accelerated rate of erosion on the hill slopes, resulting in the formation of deep gullies in the foot slopes and eventually resulting in the heavy siltation of few tanks and reservoirs in the microwatershed.

Fig 2.4 Natural vegetation of Kunikeri-2 Microwatershed

2.7 Land Utilization

About 91 per cent area (Table 2.2) in Koppal district is cultivated at present and about 16 per cent of the area is sown more than once. The cropping intensity is 118 per cent. An area of about 3 per cent is currently barren. Forests occupy a small area of about 5 per cent and the tree cover is in a very poor state. Most of the mounds, ridges and bouldery areas have very poor vegetative cover. Major crops grown in the area are sorghum, maize, bajra, cotton, safflower, sunflower, red gram, horse gram, onion, mulberry, pomegranate, sugarcane, bengalgram and groundnut (Fig 2.5). While carrying out land resource inventory, the land use/land cover particulars are collected from all the survey numbers and a current land use map of the microwatershed is prepared. The current land use map prepared shows the arable and non-arable lands, other land uses and different types of crops grown in the area. The current land use map of Kunikeri-2 Microwatershed is presented in Fig. 2.6. Simultaneously, enumeration of existing wells (bore wells and open wells) and other soil and water conservation structures in the microwatershed is made and their location in different survey numbers is marked on the cadastral map. Map showing the location of wells and other water bodies in Kunikeri-2 Microwatershed is given Fig. 2.7.

Table 2.2 Land Utilization in Koppal District

Sl. no.	Agricultural land use	Area (ha)	Per cent
1	Total geographical area	552495	
2	Total cultivated area	500542	90.6
3	Area sown more than once	92696	16.8
4	Trees and groves	210	0.04
5	Cropping intensity	-	118
6	Forest	29451	5.33
7	Cultivable wasteland	2568	0.46
8	Permanent Pasture land	14675	2.66
9	Barren land	16627	3.01
10	Non agricultural land	40591	7.35
11	Current fallow	19660	3.56

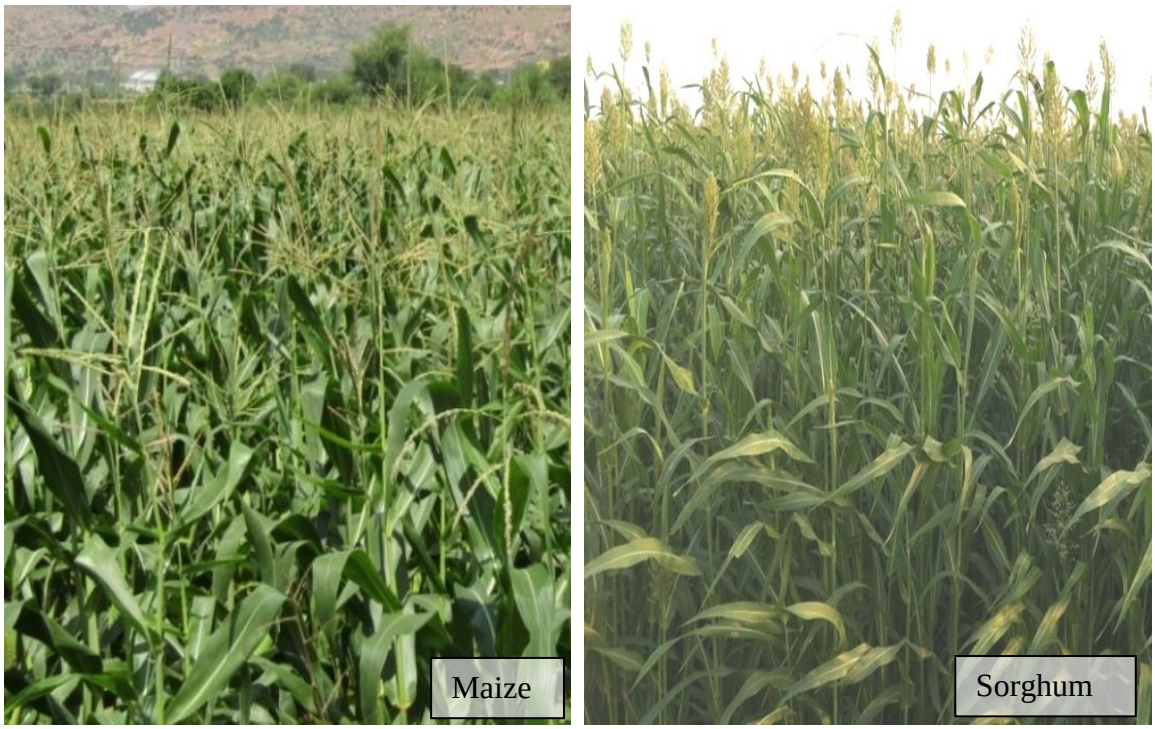


Fig. 2.5 (a) Different crops and cropping systems in Kunikeri-2 Microwatershed

Fig. 2.5 (b) Different crops and cropping systems in Kunikeri-2 Microwatershed

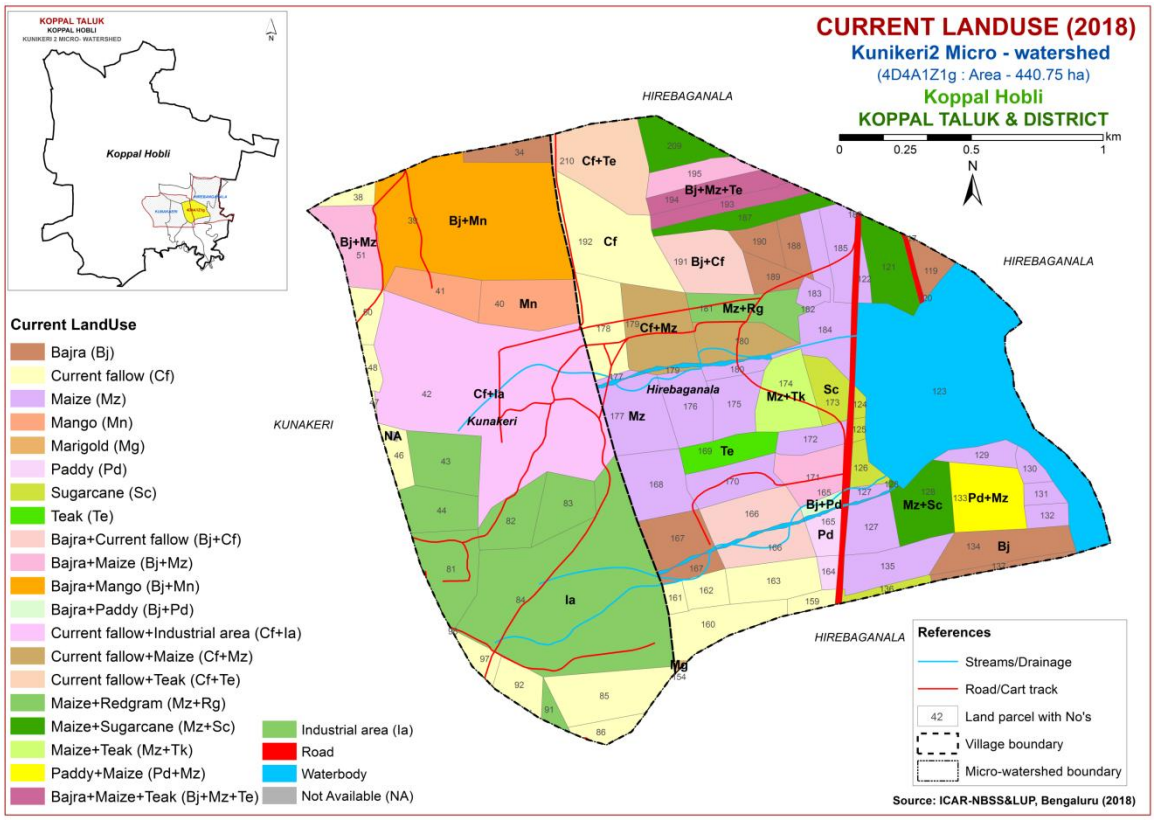


Fig. 2.6 Current Land Use – Kunikeri-2 Microwatershed

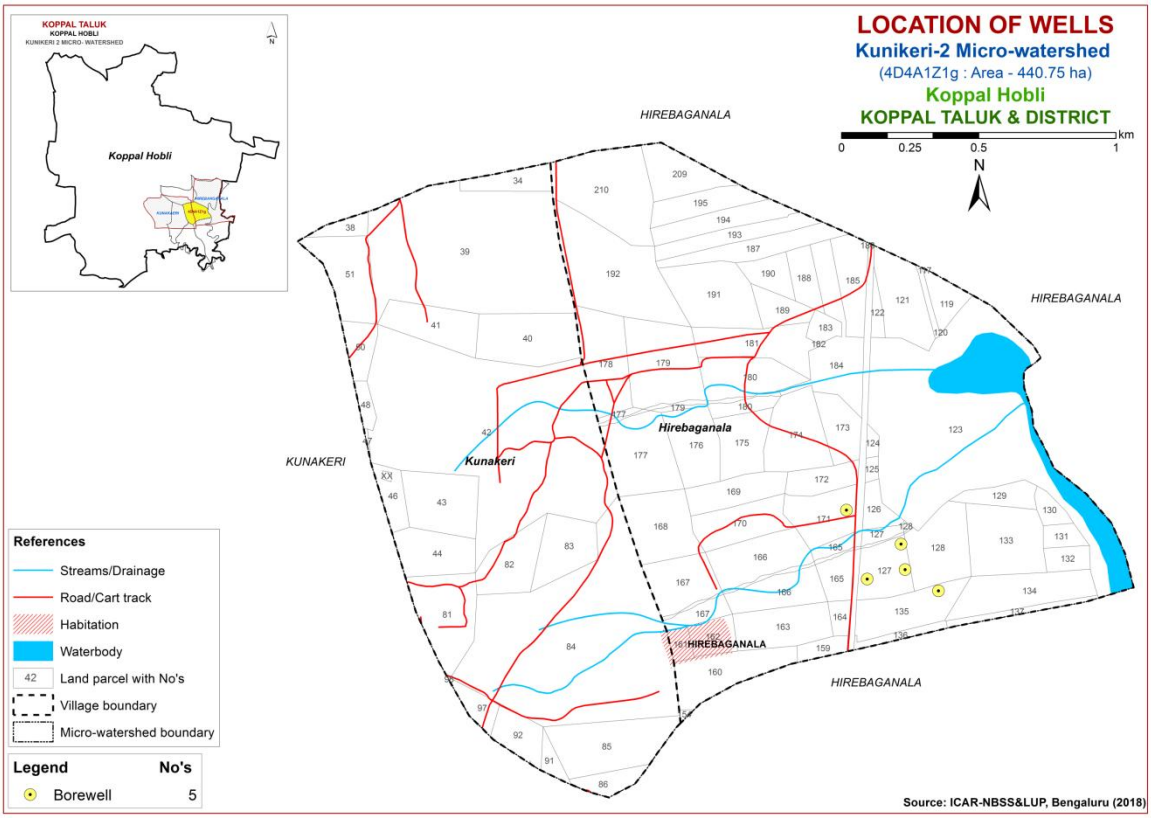


Fig. 2.7 Location of wells-Kunikeri-2 Microwatershed

Chapter 3

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly for a given level of management. This was achieved in Kunikeri-2 Microwatershed by the detailed study of all the soil characteristics (depth, texture, colour, structure, consistence, coarse fragments, porosity, soil reaction, soil horizons etc.) and site characteristics (slope, erosion, drainage, occurrence of rock fragments etc.) followed by grouping of similar areas based on soil-site characteristics into homogeneous (management units) units and showing their extent and geographic distribution on the microwatershed cadastral map. The detailed soil survey at 1:7920 scale was carried out in 441 ha area. The methodology followed for carrying out land resource inventory was as per the guidelines given in Soil Survey Manual (IARI, 1971; Soil Survey Staff, 2006; Natarajan *et al.*, 2015) which is briefly described below.

3.1 Base Maps

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map and satellite imagery as base supplied by the KSRSAC. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area (Fig. 3.1). Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the geology, landscapes, landforms and other surface features. The imagery helped in the identification and delineation of boundaries between hills, uplands and lowlands, water bodies, forest and vegetated areas, roads, habitations and other cultural features of the area (Fig. 3.2). The cadastral map was overlaid on the satellite imagery (Fig. 3.3) that helps to identify the parcel boundaries and other permanent features. Apart from cadastral maps and images, toposheets of the area (1:50,000 scale) were used for initial traversing, identification of geology, landscapes and landforms, drainage features, present land use and also for selection of transects in the microwatershed.

3.2 Image Interpretation for Physiography

False Colour Composites (FCC) of Cartosat-I and LISS-IV merged satellite data covering the microwatershed area was visually interpreted using image interpretation elements and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite gneiss landscapes and is divided into landforms such as ridges, mounds and uplands based on slope. They were further subdivided into physiographic/ image interpretation units based on image characteristics. The image interpretation legend for physiography is given below.

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

G1			Hills/ Ridges/ Mounds
	G11		Summits
	G12		Side slopes
		G121	Side slopes with dark grey tones
G2			Uplands
	G21		Summits
	G22		Gently sloping uplands
		G221	Gently sloping uplands, yellowish green (eroded)
		G222	Gently sloping uplands, yellowish white (severely eroded)
	G23		Very gently sloping uplands
		G231	Very gently sloping uplands, yellowish green
		G232	Very gently sloping uplands, medium green and pink
		G233	Very gently sloping uplands, pink and green (scrub land)
		G234	Very gently sloping uplands, medium greenish grey
		G235	Very gently sloping uplands, yellowish white (eroded)
		G236	Very gently sloping uplands, dark green
		G237	Very gently sloping uplands, medium pink (coconut garden)
		G238	Very gently sloping uplands, pink and bluish white (eroded)

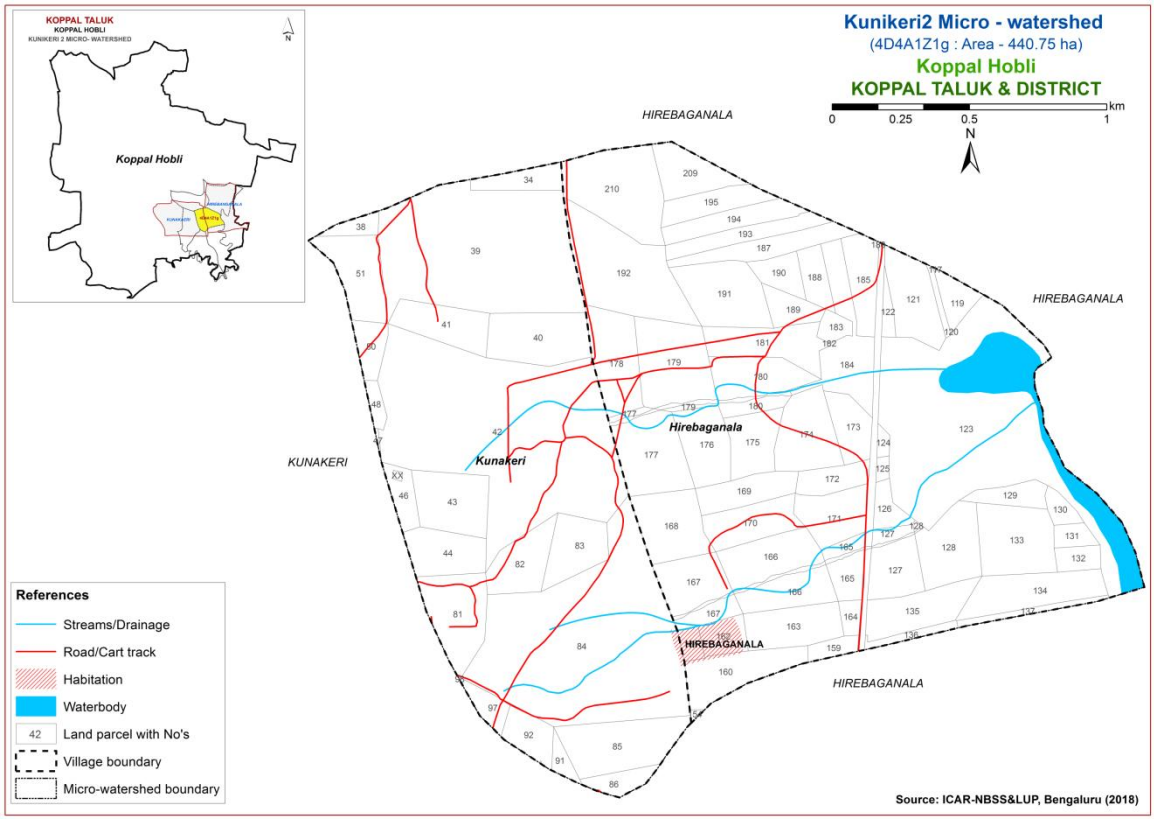


Fig. 3.1 Scanned and Digitized Cadastral map of Kunikeri-2 Microwatershed

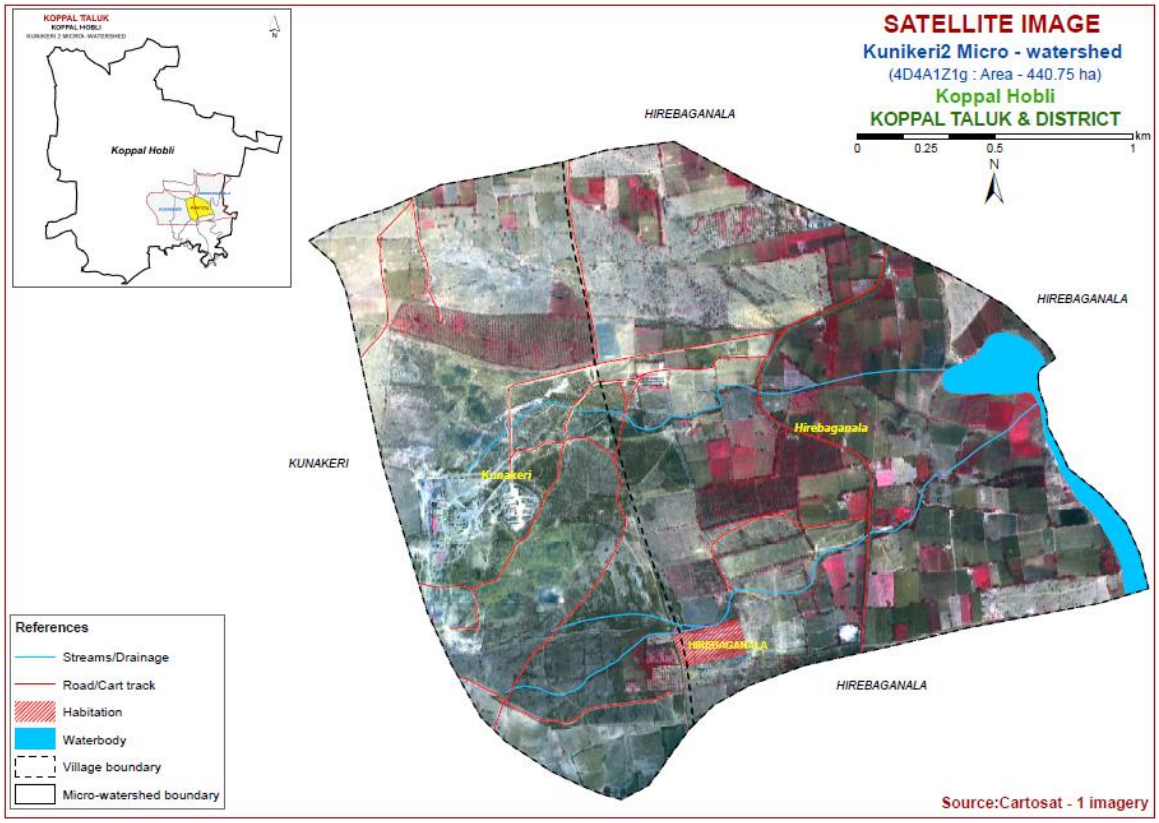


Fig. 3.2 Satellite Image of Kunikeri-2 Microwatershed

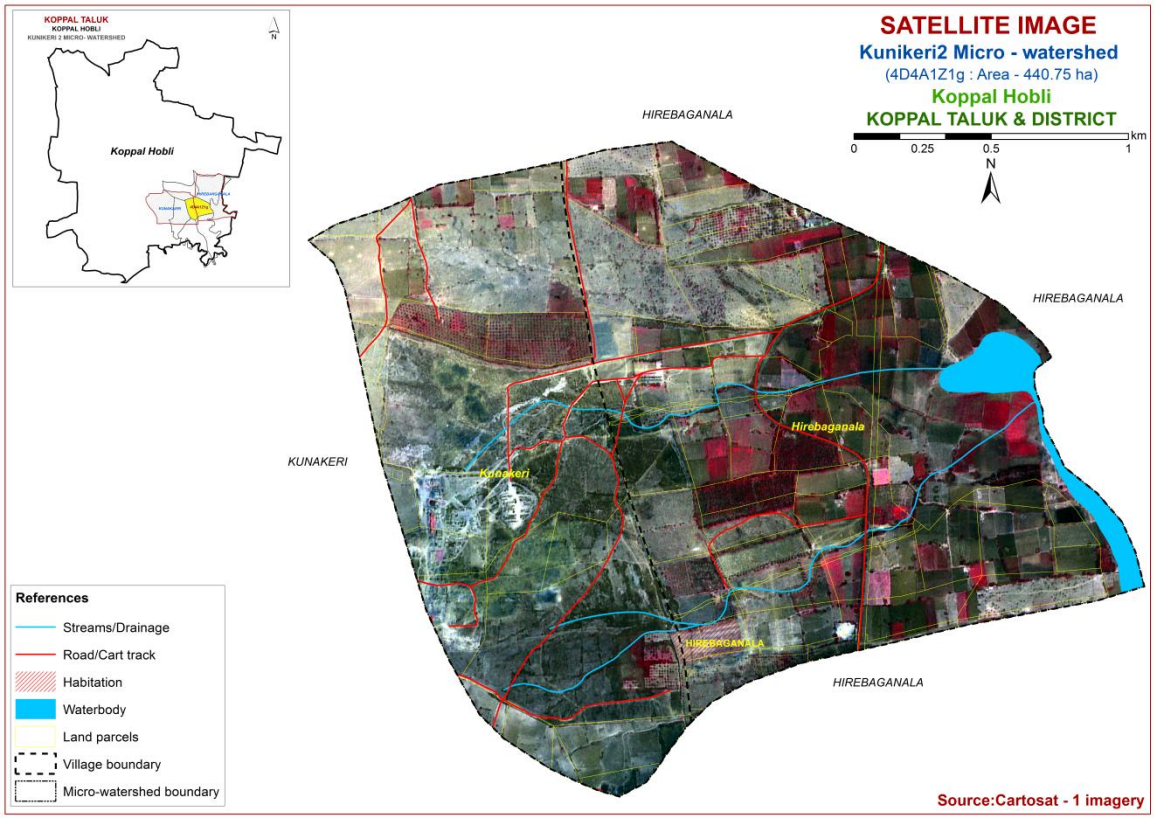


Fig. 3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Kunikeri-2 Microwatershed

3.3 Field Investigation

The field boundaries and survey numbers given on the cadastral sheet were located on the ground by following permanent features like roads, cart tracks, *nallas*, streams, tanks etc., and wherever changes were noticed, they were incorporated on the microwatershed cadastral map. Preliminary traverse of the microwatershed was carried out with the help of cadastral map, imagery and toposheets. While traversing, landforms and physiographic units identified were checked and preliminary soil legend was prepared by studying soils at few selected places. Then, intensive traversing of each physiographic unit like hills, ridges, uplands and plains was carried out. Based on the variability observed on the surface, transects (Fig. 3.4) were selected across the slope covering all the landform units in the microwatershed (Natarajan and Dipak Sarkar, 2010).

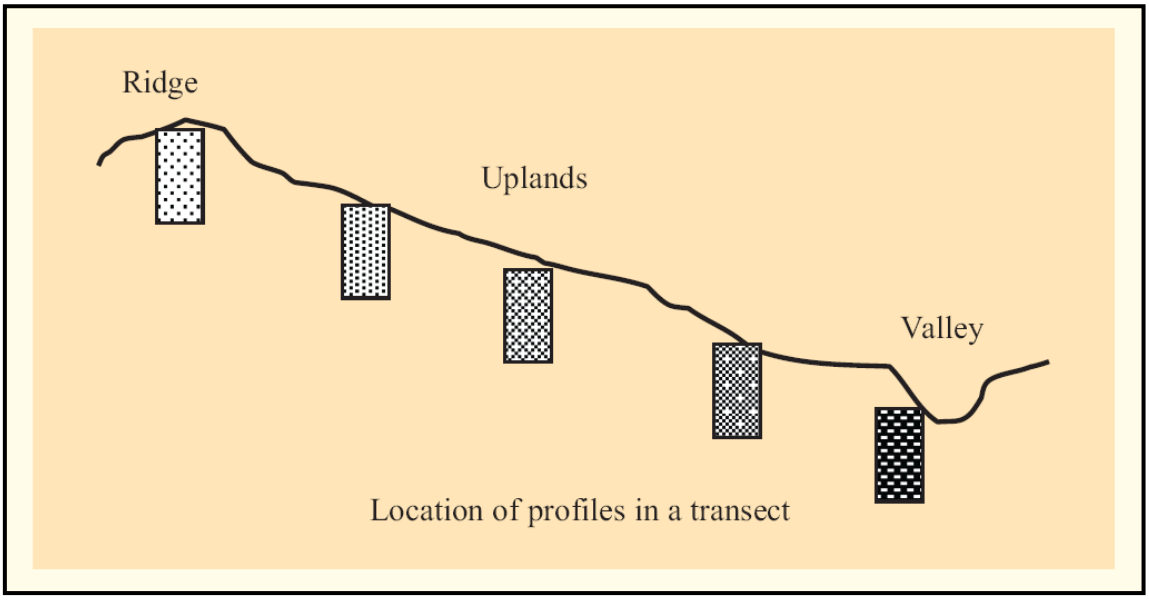


Fig. 3.4 Location of profiles in a transect

In the selected transect, soil profiles (Fig. 3.4) were located at closely spaced intervals to take care of any change in the land features like break in slope, erosion, gravel, stones etc. In the selected sites, soil profiles (vertical cut showing the soil layers from surface to the rock) were opened upto 200 cm or to the depth limited by rock or hard substratum and studied in detail for all their morphological and physical characteristics. The soil and site characteristics were recorded for all profile sites on a standard proforma as per the guidelines given in USDA Soil Survey Manual (Soil Survey Staff, 2012). Apart from the transect study, profiles were also studied at random, almost like in a grid pattern, outside the transect areas to validate the soil map unit boundaries.

Based on the soil characteristics, the soils were grouped into different soil series. Soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management. Soil depth, texture, colour, kind of

horizon and horizon sequence, amount and nature of gravel present, calcareousness, nature of substratum etc, were used as the major differentiating characteristics for identifying soil series occurring in the area. The differentiating characteristics used for identifying the soil series are given in Table 3.1. Based on the above characteristics, 9 soil series were identified in Kunikeri-2 Microwatershed.

Table 3.1 Differentiating Characteristics used for identifying Soil Series (Characteristics are of Series Control Section)

Soils of Granite gneiss Landscape							
Sl. No.	**Soil Series**	**Depth (cm)**	**Colour (moist)**	**Texture**	**Gravel (%)**	**Horizon sequence**	**Calcareo-usness**
1	Kaggalipura (KGP)	25-50	2.5YR2.5/4,3/4, 3/6	gsc	15-35	Ap-Bt-Cr	
2	Lakkur (LKR)	50-75	2.5YR 2.5/3, 2.5/4, 3/4, 3/6	gsc	40-60	Ap-Bt-Bc-Cr	
3	Mukhadahalli (MKH)	50-75	5YR3/3,3/4,4/3, 5/4,6/6 2.5YR3/4	gsc	>35	Ap-Bt-Cr	
4	Hooradhahalli (HDH)	75-100	2.5YR2.5/4,3/4, 3/6	gsc-gc	>35	Ap-Bt-Cr	
5	Kumchahalli (KMH)	100-150	2.5YR3/4, 3/6	sc	<15	Bt-Cr	
6	Balapur (BPR)	100-150	2.5YR2.5/4,3/4	gsc-gc	>35	Ap-Bt-Cr	-
7	Giddadapalya (GDP)	100-150	2.5YR3/4, 3/6	gsc-gc	35-60	Ap-Bt-Cr	-
8	Ranatur (RTR)	>150	2.5YR2.5/3,2.5/4, 3/3,4/6	c	-	Ap-Bt	
9	Thimmasandra (TSD)	>150	10YR2/12/2,3/1, 3/2,4/1, 4/2,4/3	c	-	Ap-Bw	

3.4 Soil Mapping

The area under each soil series was further separated into 17 soil phases and their boundaries delineated on the cadastral map based on the variations observed in the texture of the surface soil, slope, erosion, presence of gravel, stoniness etc. A soil phase is a subdivision of soil series based mostly on surface features that affect its use and management. The soil mapping units are shown on the soil map (Fig. 3.5) in the form of symbols. During the survey many soil profile pits, few minipits and a few auger bores representing different landforms occurring in the microwatershed were studied. In addition to the profile study, spot observations in the form of minipits, road cuts, terrace cuts etc., were studied to validate the soil boundaries on the soil map. The soil map shows the geographic distribution of 17 mapping units representing 9 soil series occurring in the microwatershed. The soil map unit (soil legend) description is presented in Table 3.2. The soil phase map (management units) shows the distribution of 17 soil phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil

and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and have to be treated accordingly.

3.5 Laboratory Characterization

Soil samples for each soil series were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected in the year 2018 from farmer's fields (43 samples) for fertility status (major and micronutrients) at 320 m grid interval were analyzed in the laboratory (Katyal and Rattan, 2003). By linking the soil fertility data to the survey numbers through GIS, soil fertility maps were generated using Kriging method for the microwatershed.

Table 3.2 Soil map unit description of Kunikeri-2 Microwatershed

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite and Granite gneiss landscape				
	KGP	Kaggalipura soils are shallow (25-50 cm), well drained, have brown to dark reddish brown gravelly sandy clay soils occuring on very gently sloping uplands under cultivation		**6 (1.45)**
17		KGPhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	6 (1.45)
	LKR	Lakkur soils are moderately shallow (50-75 cm), well drained, have dark reddish brown to dark red, red gravelly sandy clay soils occurring on very gently to moderately sloping uplands under cultivation		**38 (8.52)**
53		LKRiB2	Sandy clay surface, slope 1-3%, moderate erosion	38 (8.52)
	MKH	Mukhadahalli soils are moderately shallow (50-75 cm), well drained, have dark brown to reddish brown, gravelly sandy clay soils occuring on very gently to gently sloping uplands under cultivation		**43 (9.82)**
86		MKHhB2g2	Sandy clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	43 (9.82)
	HDH	Hooradhahalli soils are moderately deep (75-100 cm), well drained, have red to dark red and reddish brown gravelly sandy clay to clay soils occuring on very gently to gently sloping uplands under cultivation		28 (6.5)
106		HDHcA1g1	Sandy loam surface, slope 0-1%, slight erosion, gravelly (15-35%)	10 (2.36)
111		HDHcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	3 (0.69)
123		HDHhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	15 (3.45)
	KMH	Kumchahalli soils are deep (100-150 cm), well drained, have dark reddish brown to dark red sandy clay soils occuring on nearly level to very gently sloping uplands		**0 (0.0)**

		under cultivation		
201		KMHiB2	Sandy clay surface, slope 1-3%, moderate erosion	0 (0.0)
	BPR	Balapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red, gravelly sandy clay to clay soils occuring on very gently to gently sloping uplands under cultivation		**75 (17)**
220		BPRcA1	Sandy loam surface, slope 0-1%, slight erosion	6 (1.27)
230		BPRhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	36 (8.18)
231		BPRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	26 (5.85)
232		BPRhB2g2	Sandy clay loam surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	2 (0.51)
239		BPRiB2	Sandy clay surface, slope 1-3%, moderate erosion	5 (1.19)
	GDP	Giddadapalya soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils occuring on very gently sloping uplands under cultivation		**91 20.57)**
267		GDPcB2	Sandy loam surface, slope 1-3%, moderate erosion	1 (0.23)
268		GDPhB2	Sandy clay loam surface, slope 1-3%, moderate erosion	3 (0.64)
269		GDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	87 (19.7)
	RTR	Ranatur soils are very deep (> 150 cm), well drained, have dark reddish brown to dark red clayey soils occuring on very gently sloping uplands under cultivation		**53 (12.11)**
285		RTRcB2	Sandy loam surface, slope 1-3%, moderate erosion	53 (12.11)
	TSD	Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown clay soils occur on nearly level to very gently sloping lowlands under cultivation		**2 (0.49)**
444		TSDiA1	Sandy clay surface, slope 0-1%, slight erosion	2 (0.49)
994	Mining/ Industrial	mining and Industrial area		19 (4.25)
999	Rock outcrops	Rock lands, both massive and bouldery with little or no soil		72 (16.28)
1000	Others	Habitation and waterbody		13 (3.02)

*Soil map unit numbers are continuous for the taluk, not the microwatersheds

3.6 Land Management Units (LMU's)

The 17 soil phases identified and mapped in the microwatershed were regrouped into 5 Land Management Units (LMU's) for the purpose of preparing a Proposed Crop Plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Management Units (LMU's) based on the management needs. One or more than one soil site characteristic having influence on the management have been choosen for identification and delineation of LMUs. For Kunikeri-2 Microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LMUs. The Land Management Units are expected to behave similarly for a given level of management.

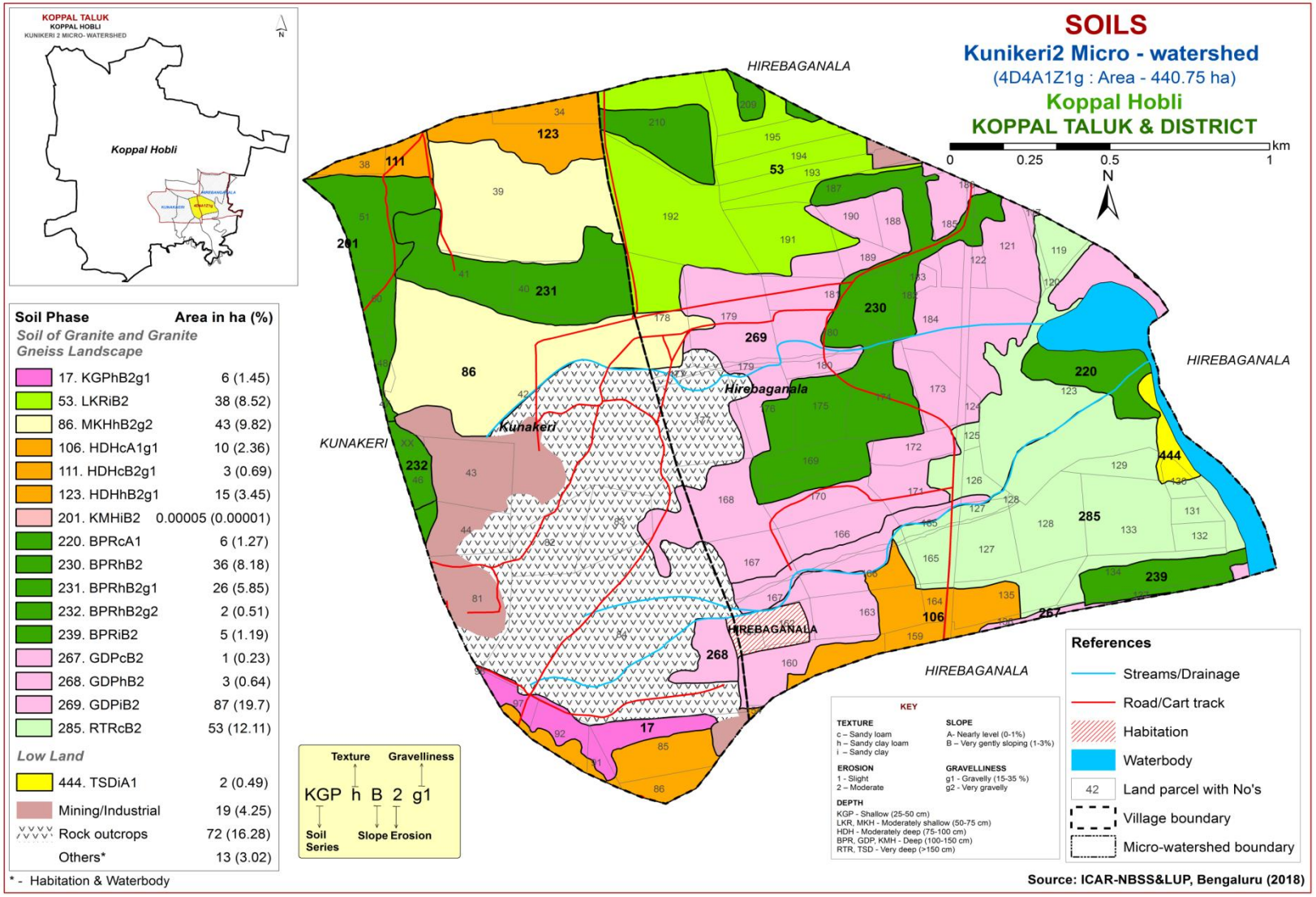


Fig 3.5 Soil Phase or Management Units-Kunikeri-2 Microwatershed

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Kunikeri-2 Microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss and alluvial landscapes based on geology. In all, 9 soil series are identified. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. The soil formation is dominantly influenced by the parent material, climate, time and relief.

A brief description of each of the 9 soil series identified followed by 17 soil phases (management units) mapped (Fig. 3.4) are furnished below. The physical and chemical characteristics of soil series identified in Kunikeri-2 Microwatershed are given in Table 4.1. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristic that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of granite and granite gneiss landscape

In this landscape, 9 soil series are identified and mapped. Of these, Giddadapalya (GDP) series occupies maximum area of 91 (21%), Balapur (BPR) 75 (17%), Ranatur (RTR) 53 ha (12%, Mukhadahalli (MKH) 43 ha (10%), Lakkur (LKR) 38 ha (9%), Hooradhahalli (HDH) 28 ha (7%), Kaggalipura (KGP) 6 ha (1%), Thimmasandra (TSD) 2 ha (<1%) and Kumchahalli (KMH) occupy negligible area of about 0 ha (0%) in the microwatershed. The brief description of each soil series along with the soil phases identified and mapped is given below.

4.1.1 Kaggalipura (KGP) Series: Kaggalipurasoils are shallow (25-50 cm), well drained, have brown to dark reddish brown gravelly sandy clay soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands. The Kaggalipura series has been classified as a member of the clayey, mixed, isohyperthermic family of (Paralithic) Rhodustalfs.

The thickness of the solum ranges from 30 to 50 cm. The thickness of A-horizon ranges from 10 to 17 cm. Its colour is in 7.5 YR, 5YR and 2.5 YR hue with value 2.5 to 4 and chroma 2 to 6. The texture varies from sandy clay loam to sandy clay with 10 to 25 per cent gravel. The thickness of B horizon ranges from 24 to 50 cm. Its colour is in 2.5 YR hue with value 2.5 and chroma 4. Its texture is sandy clay loam to sandy clay soils

with gravel content of 15 to 35 per cent. The available water capacity is low (50-100 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Kaggalipura (KGP) Series

4.1.2 Lakkur (LKR) Series: Lakkur soils are moderately shallow (50-75cm), well drained, have reddish brown to dark red gravelly sandy clay red soils. They have developed from weathered granite gneiss and occur on nearly level to very gently and gently sloping uplands. The Lakkur series has been classified as a member of the clayey-skeletal, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 51 to 74 cm. The thickness of A horizon ranges from 12 to 18 cm. Its colour is in 5YR and 2.5 YR hue with value 3 to 4 and chroma 4 to 6. The texture varies from loamy sand to sandy clay loam with 15 to 50 per cent gravel. The thickness of B horizon ranges from 39 to 58 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 4 to 6. Texture is sandy clay with 40 to 60 per cent gravel. The available water capacity is low (50-100 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Lakkur (LKR) Series

4.1.3 Mukhadahalli (MKH) Series: Mukhadahalli soils are moderately shallow (50-75 cm), well drained, have dark brown to reddish brown gravelly sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Mukhadahalli series has been classified as a member of the clayey-skeletal, mixed, isohyperthermic family of Typic Haplustalfs.

The thickness of the solum ranges from 51 to 72 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 5 YR and 7.5 YR hue with value 3 to 4 and chroma 2 to 4. The texture varies from loamy sand to sandy loam with 20 to 45 per cent gravel. The thickness of B horizon ranges from 40 to 68 cm. Its colour is in 2.5 YR and 5 YR hue with value and chroma 3 to 6. Texture is sandy clay loam to sandy clay with 35 to 50 per cent gravel. The available water capacity is low (50-100 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Mukhadahalli (MKH) Series

4.1.4 Hooradhahalli (HDH) Series: Hooradhahalli soils are moderately deep (75-100 cm), well drained, have red to dark red and reddish brown gravelly sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Hooradhahalli series has been classified as a member of the clayey-skeletal, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum ranges from 76 to 100 cm. The thickness of A horizon ranges from 11 to 19 cm. Its colour is in 5 YR and 2.5 YR hue with value 3 to 4 and chroma 3 to 6. The texture varies from loamy sand to sandy clay with 15 to 50 per cent gravel. The thickness of B horizon varies from 65 to 83 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4 to 6. Texture is sandy clay to clay with 35 to 50 per cent gravel. The available water capacity is low (50-100 mm/m). Three phases were identified and mapped.

Landscape and soil profile characteristics of Hooradhahalli (HDH) Series

4.1.5 Kumchahalli (KMH) Series: Kumchahalli soils are deep (100-150 cm), well drained, have dark reddish brown to dark red sandy clay soils. They have developed from weathered granite gneiss and occur on nearly level to very gently sloping uplands. The Kumchahalli series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 102 to 150 cm. The thickness of A horizon ranges from 11 to 23 cm. Its colour is in 5 YR and 2.5 YR hue with value 2.5 to 3 and chroma 3 to 6. The texture is dominantly sandy clay. The thickness of B horizon ranges from 95 to 132 cm. Its colour is in 2.5 YR hue with value 3 and chroma 4 to 6. Its texture is dominantly sandy clay loam to sandy clay. The available water capacity is high (150-200 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Kumchahalli (KMH) Series

4.1.6 Balapur (BPR) Series: Balapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils. These soils are developed from weathered granite gneiss and occur on very gently to gently sloping uplands. The Balapur series has been classified as a member of the clayey-skeletal, mixed, isohyperthermic family of Typic Rhodustalfs.

The thickness of the solum ranges from 102 to 147 cm. The thickness of A horizon ranges from 12 to 17 cm. Its colour is in 5 YR and 2.5 YR hue with value and chroma 3 to 4. The texture ranges from loamy sand to sandy clay with 15 to 50 per cent gravel. The thickness of B horizon ranges from 90 to 132 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 4 to 6. Texture is sandy clay to clay with 35 to 50 per cent gravel. The available water capacity is medium (100-150 mm/m). Five phases were identified and mapped.

Landscape and soil profile characteristics of Balapur (BPR) Series

4.1.7 Giddadapalya (GDP) Series: Giddadapalya soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation. The Giddadapalya series has been classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum ranges from 106 to 145 cm. The thickness of A-horizon ranges from 12 to 13 cm. Its colour is in 5 YR hue with value and chroma 3 to 4. The texture ranges from sandy loam with 10 to 15 per cent gravel. The thickness of B-horizon ranges from 106 to 123 cm. Its colour is in 2.5 YR hue with value 3 to 4 and chroma 3 to 6. Texture is sandy clay to clay with 35 to 75 per cent gravel after 60 cm depth. The available water capacity is low (51-100 mm/m). Three phases were identified andmapped.

Landscape and soil profile characteristics of Giddadapalya (GDP) Series

4.1.8 Ranatur (RTR) Series: Ranatur soils are very deep (> 150 cm), well drained, have dark reddish brown to dark red clayey soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands. The Ranatur series has been classified as a member of the fine, mixed, isohyperthermic family of Rhodic Paleustalfs.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 8 to 14 cm. Its colour is in 5 YR and 2.5 YR hue with value 2.5 to 4 and chroma 3 to 6. The texture varies from sandy loam to sand clay. The thickness of B horizon is more than 150 cm. Its colour is in 2.5 YR hue with value 2.5 to 3 and chroma 3 to 6. Its texture is clay. The available water capacity is high (150-200 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Ranatur (RTR) Series

4.1.9 Thimmasandra (TSD) Series: Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish brown clay soils. They have developed from weathered granite gneiss and occur on nearly level to very gently sloping lowlands under cultivation. The Thimmasandra series has been classified as a member of the fine, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 11 to 17 cm. Its colour is in 10 YR hue with value 3 and chroma 3. The texture is sandy clay. The thickness of B horizon is more than 150 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 3. Its texture is sandy clay to clay. The available water capacity is very high (>200 mm/m). Only one phase was identified andmapped.

Landscape and soil profile characteristics of Thimmasandra (TSD) Series

Table: 4.1 Physical and Chemical Characteristics of Soil Series identified in Kunikeri-2 Microwatershed

Soil Series: Lakkur (LKR), **Pedon:** RM-8.
Location: $15^0$04'26.3"N, $75^0$37'84.1"E, (4D4A3I1f), Belhatti village, Shirahatti taluk, Gadag distrtict
Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-21	Ap	74.00	8.34	17.66	9.62	11.57	15.76	23.13	13.92	20	sl	-	-
21-35	Bt	54.37	10.48	35.14	16.33	8.64	9.69	11.59	8.11	40	sc	-	-
35-56	Bc	48.37	13.46	38.17	10.96	7.69	9.17	11.28	9.27	60	sc	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-21	8.18	-	-	0.30	0.56	0.94	-	-	0.31	0.55	0.86	12.19	0.69	100.00	4.51
21-35	8.17	-	-	0.30	0.52	1.29	-	-	0.19	0.84	1.03	22.18	0.63	100.00	3.79
35-56	7.95	-	-	0.46	0.48	1.99	-	-	0.24	0.58	0.82	22.94	0.60	100.00	2.53

Contd...

Series Name: Mukahadahalli (MKH), **Pedon:** R-11
Location: $15^0$22'05.4"N, $76^0$04'10.3"E, Halageri village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Clayey-skeletal, mixed, isohyperthermic Typic Haplustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-19	Ap	65.71	8.83	25.46	9.27	9.06	14.42	21.52	11.43	70	scl	16.54	8.60
19-32	Bt	55.89	11.13	32.98	6.47	9.18	11.89	19.19	9.18	50	scl	19.24	12.78
32-58	Bt	47.95	10.41	41.63	17.52	3.78	9.13	9.55	7.97	50	sc	24.03	16.02

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-19	7.38	-	-	0.09	0.2	0.00	8.97	4.32	0.26	0.22	13.77	14.84	0.58	93	1.49
19-32	7.5	-	-	0.106	0.41	0.00	15.98	3.27	0.16	0.50	19.91	20.88	0.63	95	2.38
32-58	7.46	-	-	0.173	0.49	0.00	19.71	4.53	0.23	1.32	25.79	25.76	0.62	100	5.11

Contd...

Soil Series: Hooradhahalli (HDH), **Pedon:** RM-69
Location: $13^0$24'31"N, $76^0$33'41"E, (4D3D8G2d), Hesarahalli village, Chikkanayakanahalli taluk, Tumukura district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-18	Ap	72.56	15.17	12.27	4.57	8.33	17.38	23.88	18.39	35	sl	-	-
18-33	Bt1	56.29	10.75	32.96	7.88	10.24	13.41	14.43	10.34	55	scl	-	-
33-58	Bt2	46.66	10.79	42.55	10.79	9.87	8.43	9.04	8.53	55	sc	-	-
58-90	Bt3	43.09	13.63	43.27	9.90	8.25	7.32	8.76	8.87	45	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-18	6.54	-	-	0.07	0.60	0.00	2.68	1.38	0.44	0.42	4.91	5.84	0.48	84.07	7.11
18-33	5.90	-	-	0.07	0.52	0.00	3.99	1.27	0.09	0.37	5.71	8.61	0.26	66.32	4.29
33-58	6.16	-	-	0.07	0.44	0.00	4.92	1.67	0.08	0.55	7.22	10.00	0.24	72.23	5.50
58-90	6.39	-	-	0.06	0.40	0.00	4.30	2.02	0.08	0.46	6.87	9.21	0.21	74.61	5.05

Contd...

Series Name: Kumchahalli (KMH), **Pedon:** RM-9
Location: $15^0$20’05”N, $76^0$13’21”E, Basapura village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-13	Ap	51.76	9.05	39.19	7.99	8.84	13.42	14.38	7.14	-	sc	20.08	13.69
13-27	A21	53.50	8.12	38.38	7.00	11.05	15.21	14.33	5.91	-	sc	17.05	12.32
27-43	A22	63.60	5.01	31.40	3.85	11.56	24.52	18.52	5.14	-	scl	11.76	9.09
43-64	Bt1	48.74	5.91	45.35	8.87	9.31	12.49	12.27	5.81	10	sc	16.68	13.35
64-84	Bt2	45.13	8.90	45.97	9.86	7.12	10.95	10.62	6.57	20	sc	17.45	13.42
84-114	BC	65.04	6.94	28.02	10.49	16.21	17.80	13.88	6.67	40	scl	13.20	9.75

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-13	7.2	-	-	0.193	0.81	3.00	9.69	3.93	1.41	0.08	15.10	15.07	0.38	100	0.54
13-27	7.13	-	-	0.161	0.7	3.00	8.69	3.57	1.29	0.16	13.70	13.75	0.36	100	1.14
27-43	7.31	-	-	0.096	0.89	2.64	5.19	2.36	1.07	0.24	8.86	9.46	0.30	94	2.51
43-64	7.65	-	-	0.089	1.16	2.52	8.25	2.88	0.72	0.35	12.20	12.65	0.28	96	2.79
64-84	7.98	-	-	0.1	0.38	3.12	10.49	2.88	0.26	0.41	14.04	14.63	0.32	96	2.78
84-114	8.23	-	-	0.121	0.58	2.88	8.02	1.87	0.09	0.43	10.41	10.67	0.38	98	4.02

Contd...

Soil Series: Balapur (BPR), **Pedon**: RM-78
Location: 13^{0}26'39"N, 76^{0}35'03"E, (4D3D8G2c), Kasaba, Chikkanayakanahalli taluk, Tumakuru district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Clayey-skeletal, mixed, isohyperthermic Typic Rhodustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-12	Ap	65.66	18.66	15.68	4.14	6.16	13.33	21.82	20.20	-	sl	-	-
12-34	Bt1	61.91	11.52	26.57	2.36	6.78	12.53	21.36	18.89	-	scl	-	-
34-60	Bt2	51.81	11.24	36.94	4.66	5.70	12.23	15.96	13.26	30	sc	-	-
60-84	Bt3	46.61	9.02	44.37	14.70	6.88	7.51	8.97	8.55	55	sc	-	-
84-112	Bt4	48.75	12.92	38.33	15.73	8.13	6.87	8.23	9.79	60	sc	-	-
112-127	Bc	50.98	24.74	24.28	5.25	4.63	5.15	10.92	25.03	50	scl	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-12	6.64	-	-	0.03	0.56	0.00	1.90	1.32	0.21	0.03	3.46	5.45	0.35	63.48	0.51
12-34	6.99	-	-	0.02	0.48	0.00	3.66	1.90	0.07	0.08	5.70	7.82	0.29	72.93	0.96
34-60	7.29	-	-	0.02	0.40	0.00	5.13	2.08	0.11	0.20	7.52	11.19	0.30	67.18	1.75
60-84	7.50	-	-	0.02	0.32	0.00	5.83	6.36	0.13	0.23	12.55	12.38	0.28	101.43	1.83
84-112	7.54	-	-	0.02	0.24	0.00	6.02	6.59	0.11	0.25	12.96	12.77	0.33	101.49	1.97
112-127	7.90	-	-	0.02	0.20	0.00	8.04	3.62	0.07	0.32	12.04	12.47	0.51	96.56	2.55

Contd...

Series Name: Giddadapalya (GDP), **Pedon:** R-8
Location: $15^0$25'26"N, $76^0$10'59"E, Kalakeri village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. Classification: Fine, mixed, isohyperthermic Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-16	Ap	74.95	9.24	15.81	18.43	18.94	13.85	14.97	8.76	-	sl	11.88	5.09
16-43	Bt1	41.69	13.89	44.42	9.84	10.90	7.41	7.62	5.93	-	c	23.13	14.53
43-61	Bt2	47.67	6.13	46.19	21.14	10.15	5.29	6.45	4.65	-	sc	21.60	11.87
61-83	Bt3	52.52	7.10	40.38	24.42	10.59	5.66	7.55	4.30	40	sc	19.51	11.35
83-119	Bt4	43.76	11.59	44.65	20.15	7.56	5.77	5.46	4.83	60	c	20.80	12.06
119-139	Bt5	54.93	9.84	35.23	29.70	10.49	5.50	5.92	3.32	50	sc	15.24	11.97

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-16	7.88	-	-	0.103	0.79	-	5.98	1.35	0.05	0.22	7.60	7.8	0.49	97	2.87
16-43	7.81	-	-	0.117	0.66	-	13.99	1.97	0.08	0.46	16.50	16.9	0.38	98	2.74
43-61	7.74	-	-	0.132	0.51	-	12.70	2.18	0.08	0.69	15.64	15.9	0.34	98	4.36
61-83	7.72	-	-	0.142	0.39	-	11.46	2.22	0.08	0.66	14.41	14.6	0.36	99	4.53
83-119	7.58	-	-	0.115	0.22	-	11.30	2.70	0.09	0.73	14.82	15.3	0.34	97	4.79
119-139	7.50	-	-	0.113	0.22	-	10.03	2.19	0.07	0.65	12.95	13.2	0.37	98	4.89

Contd...

Soil Series: Ranatur (RTR), **Pedon:** TR7-3
Location: $15^0$07'58.3"N, $75^0$38'30.6"E, (4D4A3G2d), Devihal-4 microwatershed, Shirahatti taluk, Gadag district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification:** Fine, mixed, isohyperthermic Rhodic Paleustalfs

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-10	Ap	80.08	8.23	11.69	7.22	16.46	17.68	21.95	16.77	<5	sl	-	-
10-34	Bt1	44.96	12.64	42.39	3.84	11.42	10.07	11.32	8.31	<5	c	-	-
34-71	Bt2	43.35	13.02	43.63	5.20	10.40	9.77	9.77	8.21	<5	c	-	-
71-100	Bt3	47.00	10.23	42.77	10.43	12.71	9.09	7.54	7.23	<5	sc	-	-
100-138	Bt4	45.04	12.78	42.17	8.37	10.33	9.30	9.19	7.85	<5	sc	-	-
138-170	Bt5	44.63	13.79	41.58	9.19	8.99	8.26	9.40	8.78	<5	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-10	6.47	-	-	0.03	0.49	0.00	5.61	1.33	0.13	0.01	7.07	7.07	0.60	100.00	0.41
10-34	6.46	-	-	0.03	0.57	0.00	11.69	3.19	0.14	0.01	15.03	16.87	0.40	89.00	0.06
34-71	7.23	-	-	0.03	0.53	1.20	-	-	0.16	0.01	-	17.33	0.40	100.00	0.06
71-100	7.60	-	-	0.03	0.3	0.30	-	-	0.17	0.04	-	17.21	0.40	100.00	0.23
100-138	7.88	-	-	0.03	0.6	0.42	-	-	0.17	0.15	-	16.30	0.39	100.00	0.92
138-170	8.12	-	-	0.08	0.64	0.60	-	-	0.14	0.06	-	16.87	0.41	100.00	0.36

Contd...

Soil Series: Thimmasandra (TSD), **Pedon:** R-14
Location: 11°55'64.2"N, 76°51'82.9" E, (4B3A5K3b), Somanapura village, Chamarajanagara taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bengaluru **Classification**: Fine, mixed, isohyperthermic Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-19	Ap	12.27	25.92	61.81	0.98	0.98	1.52	3.91	4.89	-	c	-	-
19-33	Bw1	32.98	26.29	40.72	2.75	4.44	4.97	8.35	12.47	-	c	-	-
33-58	Bw2	10.21	27.99	61.81	0.98	1.30	1.19	2.17	4.56	-	c	-	-
58-83	Bw3	9.83	27.40	62.77	1.09	0.98	0.98	1.86	4.91	-	c	-	-
83-95	Bw4	6.17	26.07	67.76	0.99	0.77	0.55	0.99	2.86	-	c	-	-
95-116	Bw5	7.52	28.87	63.61	0.77	1.00	1.11	1.88	2.77	-	c	-	-

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-19	8.46	-	-	0.175	1.01	4.45	-	-	1.91	0.18	-	36.61	0.59	100	0.19
19-33	8.65	-	-	0.16	0.81	6.41	-	-	0.77	0.39	-	23.98	0.59	100	0.64
33-58	8.94	-	-	0.26	0.56	6.90	-	-	0.82	2.24	-	33.59	0.54	100	2.67
58-83	9.13	-	-	0.335	0.4	8.01	-	-	0.30	1.01	-	36.72	0.58	100	1.10
83-95	9.05	-	-	0.412	0.36	4.58	-	-	0.76	4.17	-	38.88	0.57	100	4.30
95-116	8.96	-	-	0.4	0.28	4.21	-	-	0.96	4.02	-	43.63	0.69	100	3.68

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

The most important soil and site characteristics that affect the land use and conservation needs of an area are land capability, land irrigability, soil depth, soil texture, coarse fragments, available water capacity, soil slope, soil erosion, soil reaction etc. These are interpreted from the data base generated through land resource inventory and several thematic maps are generated. These would help in identifying the areas suitable for growing crops and, soil and water conservation measures and structures needed thus helping to maintain good soil health for sustained crop production. The various thematic maps generated are described below.

5.1 Land Capability Classification

Land capability classification is an interpretative grouping of soil map units (soil phases) mainly based on inherent soil characteristics, external land features and environmental factors that limit the use of land for agriculture, pasture, forestry or other uses on a sustained basis (IARI, 1971). The land and soil characteristics used to group the land resources in an area into various land capability classes, subclasses and units are

Soil characteristics: Soil depth, soil texture, coarse fragments, soil reaction, available water capacity, calcareousness, salinity/alkali *etc*.

Land characteristics: Slope, erosion, drainage, rock outcrops.

Climate: Total rainfall and its distribution, and length of crop growing period.

The land capability classification system is divided into land capability classes, subclasses and units based on the level of information available. Eight land capability classes are recognized. They are

Class I: They are very good lands that have no limitations or very few limitations that restrict their use.

Class II: They are good lands that have minor limitations and require moderate conservation practices.

Class III: They are moderately good lands that have severe limitations that reduce the choice of crops or that require special conservation practices.

Class IV: They are fairly good lands that have very severe limitations that reduce the choice of crops or that require very careful management.

Class V: Soils in these lands are not likely to erode, but have other limitations like wetness that are impractical to remove and as such not suitable for agriculture, but suitable for pasture or forestry with minor limitations.

Class VI: The lands have severe limitations that make them generally unsuitable for cultivation, but suitable for pasture or forestry with moderate limitations.

Class VII: The lands have very severe limitations that make them unsuitable for cultivation, but suitable for pasture or forestry with major limitations.

Class VIII: Soil and other miscellaneous areas (rock lands) that have very severe limitations that nearly preclude their use for any crop production, but suitable for wildlife, recreation and installation of wind mills.

The land capability subclasses are recognised based on the dominant limitations observed within a given land capability class. The subclasses are designated by adding a lower case letter like ‘e’, ‘w’, ‘s’, or ‘c’ to the class numeral. The subclass “e” indicates that the main hazard is risk of erosion, “w” indicates drainage or wetness as a limitation for plant growth, “s” indicates shallow soil depth, coarse or heavy textures, calcareousness, salinity/alkalinity or gravelliness and “c” indicates limitation due to climate.

The land capability subclasses have been further subdivided into land capability units based on the kinds of limitations present in each subclass. Ten land capability units are used in grouping the soil map units. They are stony or rocky (0), erosion hazard (slope, erosion) (1), coarse texture (sand, loamy sand, sandy loam) (2), fine texture (cracking clay, silty clay) (3), slowly permeable subsoil (4), coarse underlying material (5), salinity/alkali (6), stagnation, overflow, high ground water table (7), soil depth (8) and fertility problems (9). The capability units thus identified have similar soil and land characteristics that respond similarly to a given level of management. The soils of the microwatershed have been classified upto land capability subclass level.

The 17 soil map units identified in the Kunikeri-2 Microwatershed are grouped under two land capability classes and six land capability subclasses (Fig. 5.1).

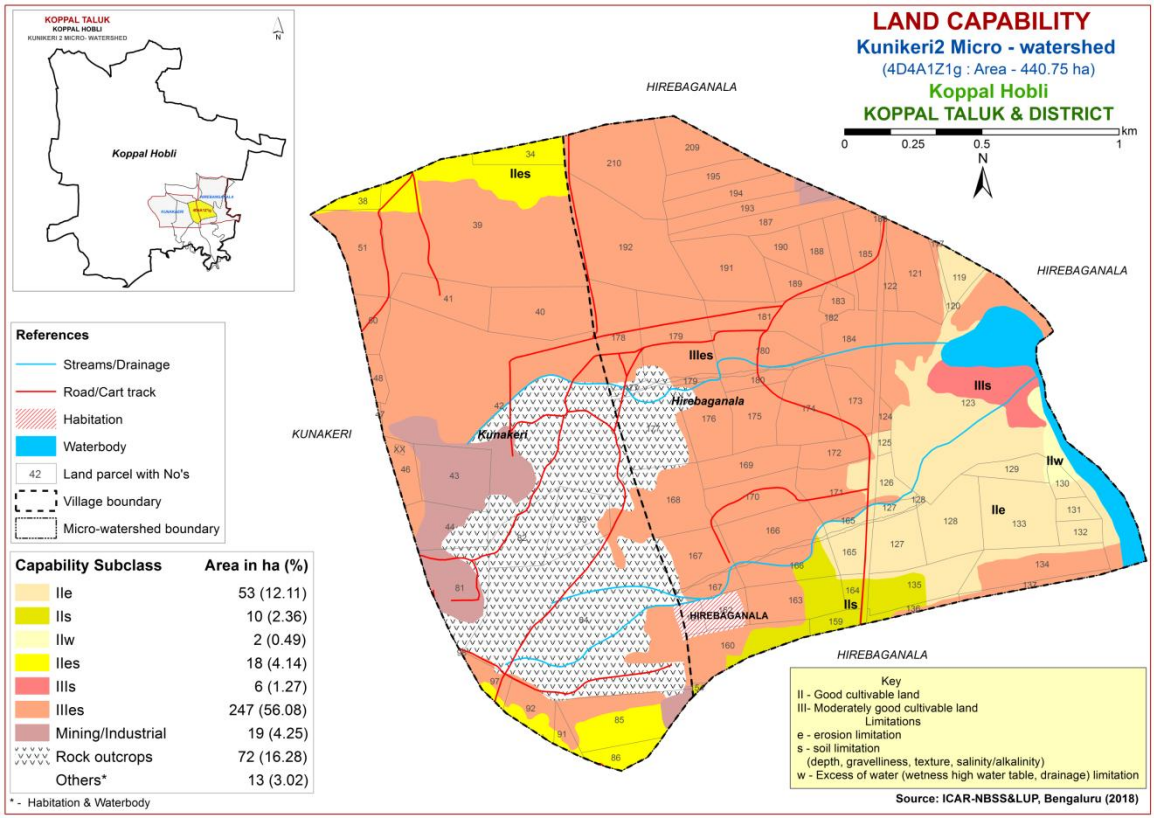


Fig. 5.1 Land Capability map of Kunikeri-2 Microwatershed

Entire area of the microwatershed is suitable for agriculture. An area of 83 ha (19%) are good lands (Class II) that have minor limitations and require moderate conservation practices and are distributed in the northern, southern and eastern part of the microwatershed. Moderately good lands (Class III) cover a maximum area of 253 ha (57%) and are distributed in all parts of the microwatershed with moderate problems of soil that require special conservation practices. An area of 4 per cent is mining/industrial and are distributed in the southern and western part of the microwatershed. An area of 16 per cent is rock outcrops such as Rock lands, both massive and bouldery with little or no soil. The other miscellaneous areas cover about 3 per cent habitations and water bodies.

5.2 Soil Depth

Soil depth refers to the depth of the soil occurring above the parent material or hard rock. The depth of the soil determines the effective rooting depth for plants and in accordance with soil texture, mineralogy and gravel content, the capacity of the soil column to hold water and nutrient availability. Soil depth is one of the most important soil characteristic that is used in differentiating soils into different soil series. The soil depth classes used in identifying soils in the field are very shallow (<25 cm), shallow (25-50 cm), moderately shallow (50-75 cm), moderately deep (75-100 cm), deep (100-150 cm) and very deep (>150 cm). They were used to classify the soils into different depth classes and a soil depth map was generated (Fig. 5.2).

An area of 6 ha (1%) is shallow (25-50 cm) and are distributed in the southern part of the microwatershed. Moderately shallow (50-75 cm) occur in an area of 81 ha (18%) and are distributed in the northern and western part of the microwatershed. Moderately deep soils (75-100 cm) occupy an area of 29 ha (7%) and occur in the northern and southern part of the microwatershed. Deep (100-150 cm) soils occupy a maximum area of 166 ha (38%) and are distributed in the major part of the microwatershed. An area of 56 ha (13%) is very deep (>150 cm) and are distributed in the eastern part of the microwatershed.

The most problem lands with an area of about 6 ha (1%) having shallow (25-50 cm) rooting depth. They are suitable for growing short duration agricultural crops but well suited for pasture, forestry or other recreational purposes. The most productive lands cover a maximum area about 222 ha (50%) where all climatically adapted long duration crops be grown.

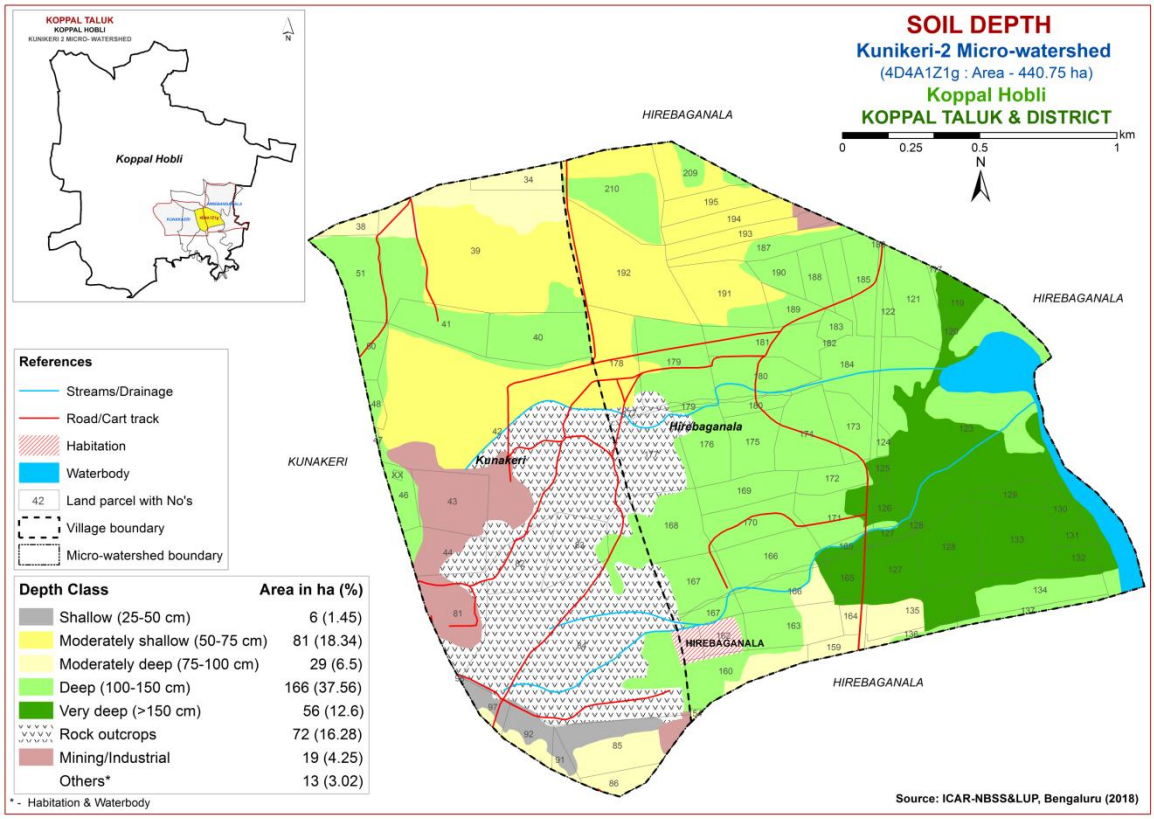


Fig. 5.2 Soil Depth map of Kunikeri-2 Microwatershed

5.3 Surface Soil Texture

Texture is an expression to indicate the coarseness or fineness of the soil as determined by the relative proportion of primary particles of sand, silt and clay. It has a direct bearing on the structure, porosity, adhesion and consistence. The surface layer of a soil to a depth of about 25 cm is the layer that is most used by crops and plants. The surface soil textural class provides a guide to understanding soil-water retention and availability, nutrient holding capacity, infiltration, workability, drainage, physical and chemical behaviour, microbial activity and crop suitability. The textural classes used for LRI were used to classify and a surface soil texture map was generated (fig. 5.3). The area extent and their spatial distribution in the microwatershed is shown in figure 5.3.

Maximum area of 205 ha (47%) has loamy soils at the surface and are distributed in the major part of the microwatershed. An area of 132 ha (30%) has clayey soils at the surface and are distributed in the northern, central, eastern and southern part of the microwatershed (Fig. 5.3).

The most productive lands 132 ha (30%) with respect to surface soil texture are the clayey soils that have high potential for soil-water retention and availability, and nutrient retention and availability, but have more problems of drainage, infiltration, workability and other physical problems. The other most productive lands 205 ha (47%) are loamy soils which also have high potential for AWC, nutrient availability but have no drainage or other physical problems compared to loamy soils.

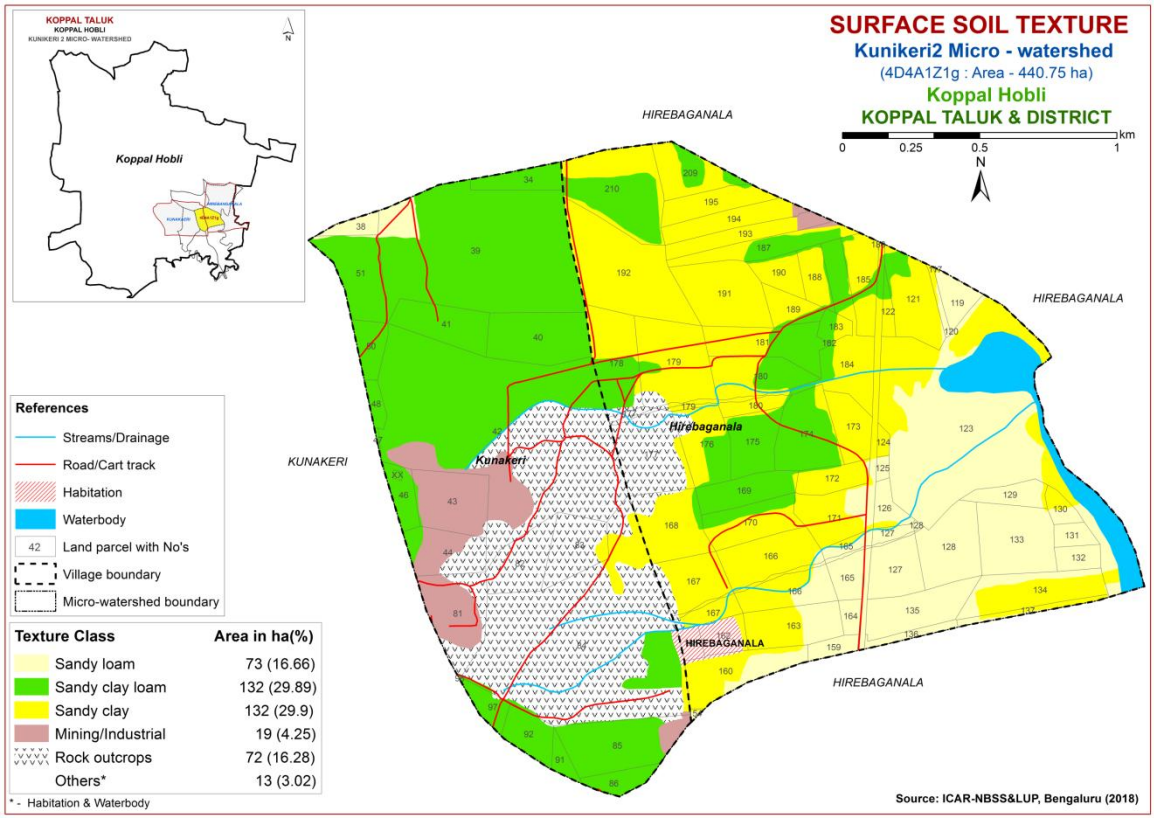


Fig. 5.3 Surface Soil Texture map of Kunikeri-2 Microwatershed

5.4 Soil Gravelliness

Gravel is the term used for describing coarse fragments between 2 mm and 7.5 cm diameter and stones for those between 7.5 cm and 25 cm. The presence of gravel and stones in soil reduces the volume of soil responsible for moisture and nutrient storage, drainage, infiltration and runoff, and hinders plant growth by impeding root growth and seedling emergence, intercultural operations and farm mechanization. The gravelliness classes used in LRI were used to classify the soils and using these classes a gravelliness map was generated. The area extent and their spatial distribution in the microwatershed is given in figure 5.4.

The soils that are non-gravelly (<15% gravel) cover a maximum area of 231 ha (52%) and are distributed in the major part of the microwatershed. An area of 61 ha (14%) is covered by gravelly (15-35% gravel) soils and are distributed in the southern, northern and western part of the microwatershed. An area of 46 ha (10%) is very gravelly (35-60%) and are distributed in the western and northern part of the microwatershed (Fig. 5.4).

The most productive lands with respect to gravelliness are found to be 52%. They are non-gravelly with less than 15 per cent gravel and have potential for growing both annual and perennial crops. The problem soils that are gravelly (15-35%) to very gravelly (35-60%) cover 107 ha (24%) where only short or medium duration crops can be grown.

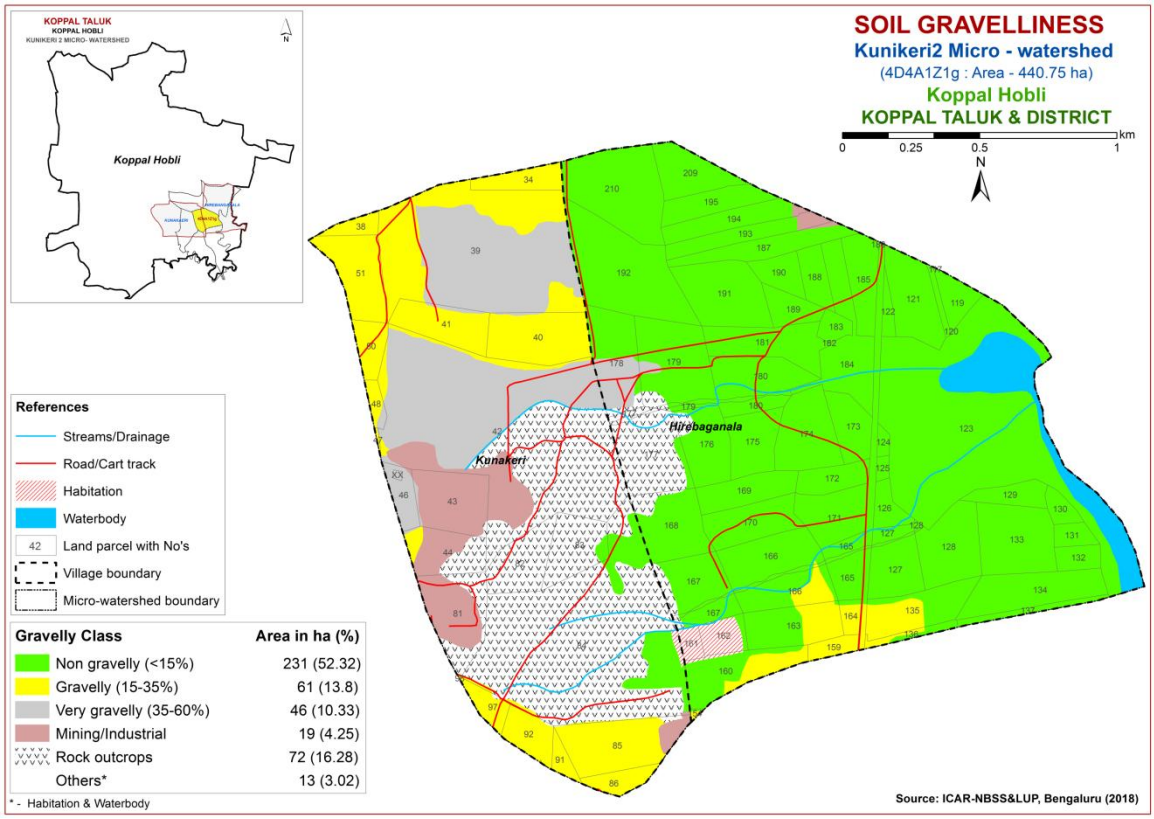


Fig. 5.4 Soil Gravelliness map of Kunikeri-2 Microwatershed

5.5 Available Water Capacity

The soil available water capacity (AWC) is estimated based on the ability of the soil column to retain water between the tensions of 0.33 and 15 bar in a depth of 100 cm or the entire solum if the soil is shallower. The AWC of the soils (soil series) as estimated by considering the soil texture, mineralogy, soil depth and gravel content (Sehgal *et al.*, 1990) and accordingly the soil map units were grouped into five AWC classes *viz*, very low (<50 mm/m), low (50-100 mm/m), medium (100-150 mm/m), high (150-200 mm/m) and very high (>200 mm/m) and using these values, an AWC map was generated (Fig. 5.5), showing the area extent and their spatial distribution in the microwatershed.

An area of about 116 ha (26%) are very low (<50 mm/m) in available water capacity and are distributed in the northern and southern part of the microwatershed. An area of about 166 ha (38%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the northern, western, central and eastern part of the microwatershed. Soils with medium available water capacity (101-150 mm/m) occupy an area of 0.05 ha and are distributed in negligible part of the microwatershed. Maximum area of about 55 ha (13%) is high (151-200 mm/m) to very high (>200 mm/m) in available water capacity and are distributed in the eastern part of the microwatershed.

An area of about 116 ha (26%) in the microwatershed has soils that are problematic with regard to available water capacity. Here, only short duration crops can be grown and the probability of crop failure is very high. These areas are best put to other

alternative uses. The potential soils with respect to AWC cover about 55 ha (13%) that have very high AWC, where all climatically adapted long duration crops can be grown.

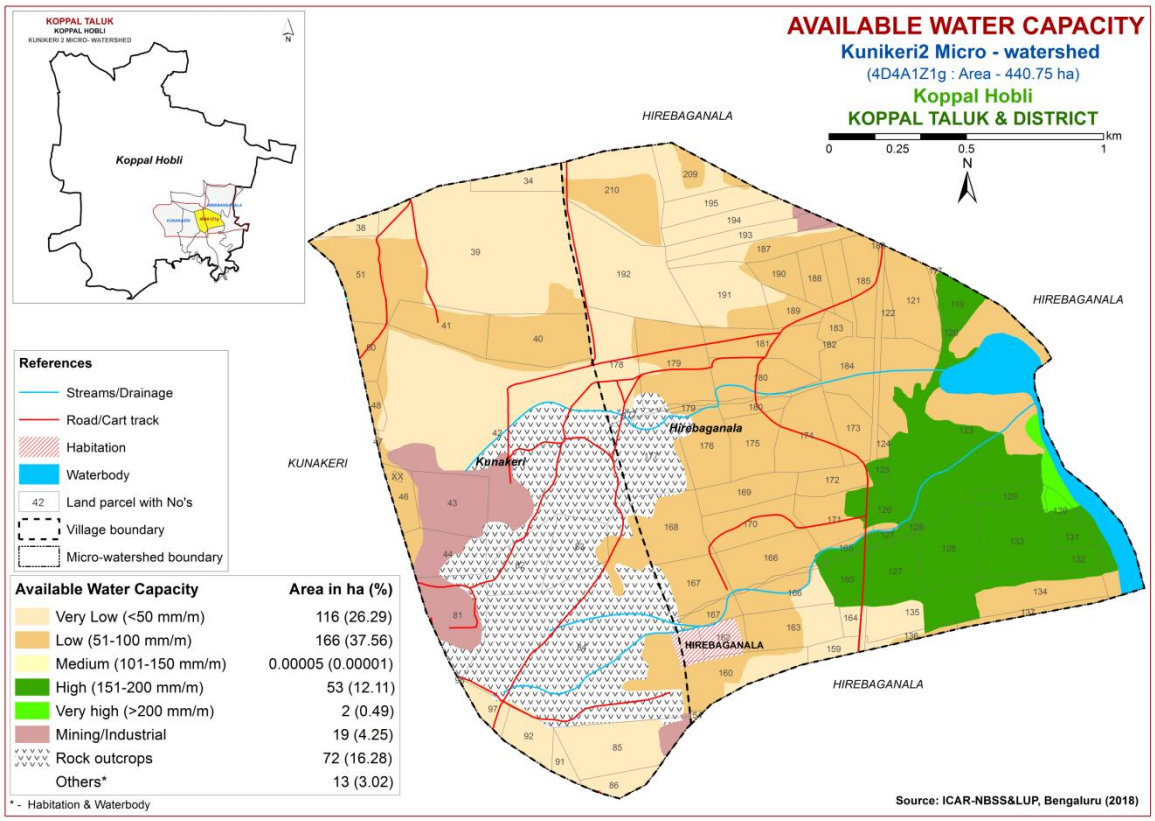


Fig. 5.5 Soil Available Water Capacity map of Kunikeri-2 Microwatershed

5.6 Soil Slope

Soil slope refers to the inclination of the surface of the land. It is defined by gradient, shape and length, and is an integral feature of any soil as a natural body. Slope is considered important in soil genesis, land use and land development. The length and gradient of slope influences the rate of runoff, infiltration, erosion and deposition. The soil map units were grouped into four slope classes and a slope map was generated showing the area extent and their geographic distribution of different slope classes in the microwatershed (Fig. 5.6).

An area of 18 ha (4%) is nearly level (0-1%) and are distributed in the eastern and southern part of the microwatershed. Major area of about 319 ha (72%) falls under very gently sloping (1-3% slope) lands and are distributed in all parts of the microwatershed. In all these lands, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.

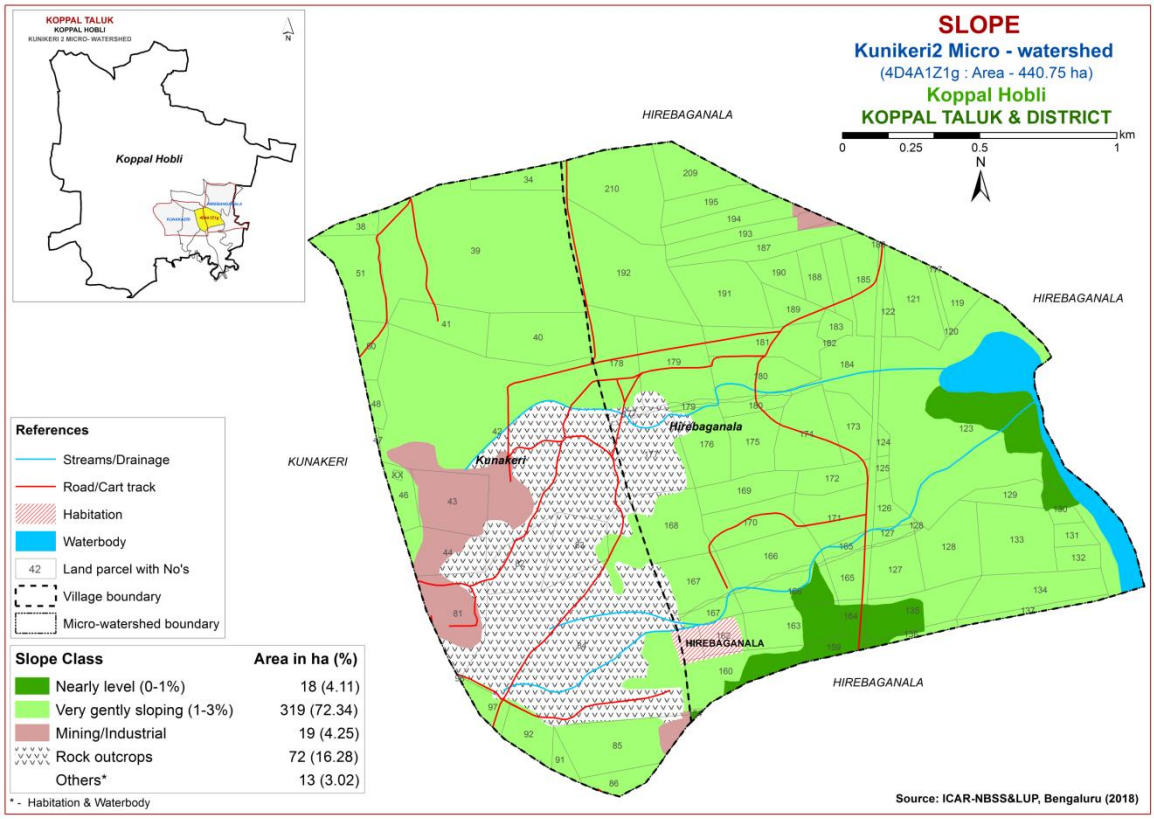


Fig. 5.6 Soil Slope map of Kunikeri-2 Microwatershed

5.7 Soil Erosion

Soil erosion refers to the wearing away of the earth's surface by the forces of water, wind and ice involving detachment and transport of soil by raindrop impact. It is used for accelerated soil erosion resulting from disturbance of the natural landscape by burning, excessive grazing and indiscriminate felling of forest trees and tillage, all usually by man. The erosion classes showing an estimate of the current erosion status as judged from field observations in the form of rills, gullies or a carpet of gravel on the surface are recorded. Four erosion classes, viz, slight erosion (e1), moderate erosion (e2), severe erosion (e3) and very severe erosion (e4) are recognized. The soil map units were grouped into different erosion classes and a soil erosion map generated. The area extent and their spatial distribution in the microwatershed is given in Figure 5.7.

Soils that are slightly eroded (e1 Class) occupy an area of about 18 ha (4%) and are distributed in the southern and eastern part of the microwatershed. Moderately eroded (e2 Class) soils cover a maximum area of 319 ha (72%) and are distributed in the major part of the microwatershed.

An area of about 319 ha (72%) in the microwatershed is problematic because of moderate erosion. These areas need soil and water conservation and other land development measures for restoring the soil health.

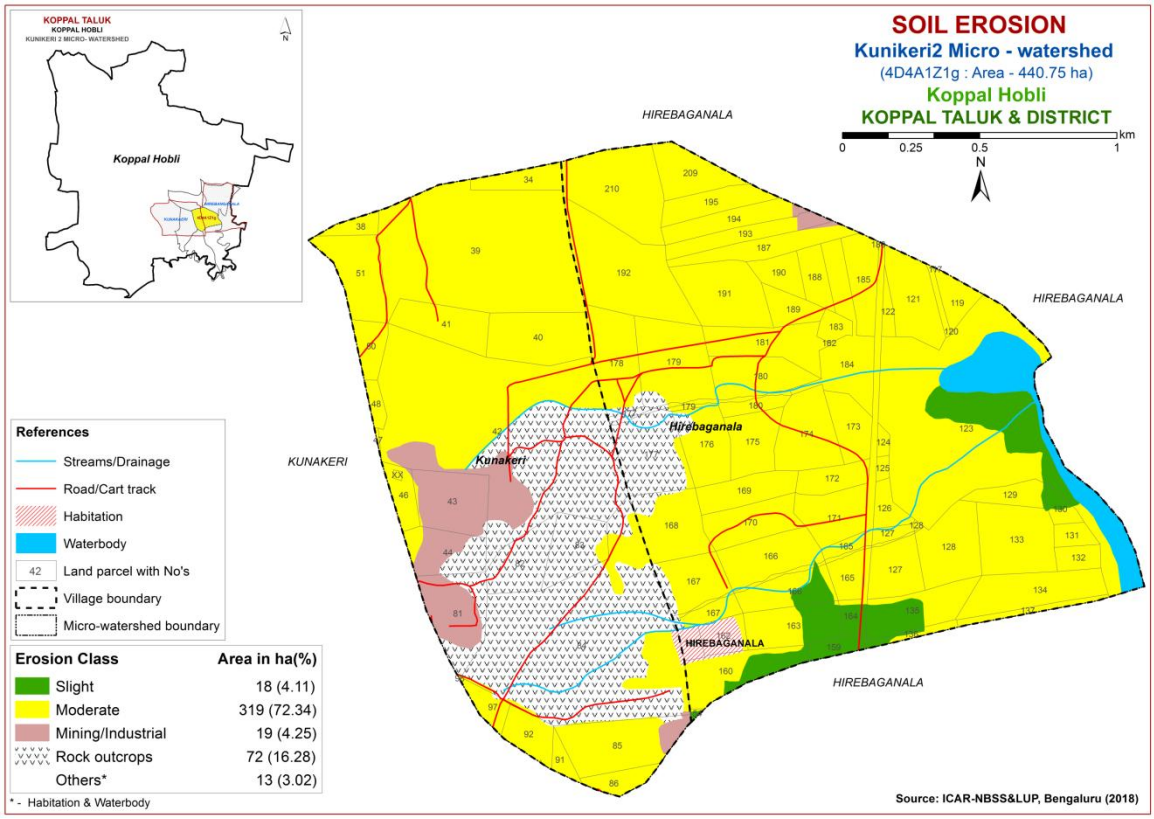


Fig. 5.7 Soil Erosion map of Kunikeri-2 Microwatershed

Chapter 6

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status, as these areas are characterised by low rainfall and high temperatures. Hence, it is necessary to know the fertility (macro and micro nutrients) status of the soils of the watersheds for assessing the kind and amount of fertilizers required for each of the crop intended to be grown. For this purpose, the surface soil samples collected from the grid points (one soil sample at every 320 m grid interval) all over the microwatershed through land resource inventory in the year 2018 were analysed for pH, EC, organic carbon, available phosphorus and potassium and for micronutrients like zinc, boron, copper, iron and manganese, and secondary nutrient sulphur.

Soil fertility data generated has been assessed and individual maps for all the nutrients for the microwatershed have been generated by using the Kriging method under GIS. The village/survey number wise fertility data for the microwatershed is given in Appendix-II.

6.1 Soil Reaction (pH)

The soil analysis of the Kunikeri-2 Microwatershed for soil reaction (pH) showed that an area of 54 ha (12%) is slightly acid (pH 6.0-6.5) and is distributed in the western and northwestern part of the microwatershed. An area of 63 ha (14%) is neutral (pH 6.5-7.3) and is distributed in the northern, central and southern part of the microwatershed. An area of 46 ha (10%) is slightly alkaline (pH 7.3-7.8) and is distributed in the central part of the microwatershed. Moderately alkaline (pH 7.8-8.4) soils occur in a maximum area of 174 ha (39%) and is distributed in the major part of the microwatershed. A minor area of 1 ha (<1%) is strongly alkaline (pH 8.4-9.0) and are distributed in the northern part of the microwaterhsed. Thus, major soils in the microwatershed are alkaline covering 221 ha.

6.2 Electrical Conductivity (EC)

The Electrical Conductivity of the soils is <2 dS m^{-1} in the entire microwatershed (Fig. 6.2) area and as such the soils are nonsaline.

6.3 Organic Carbon

The soil organic carbon content (an index of available Nitrogen) in the soils of the microwatershed is low (<0.5%) covering an area of 4 ha (1%) and is distributed in the western part of the microwatershed. An area of 72 ha (16%) is medium (0.5-0.75%) and is distributed in the southern and northwestern part of the microwatershed. Maximum area of 261 ha (59%) is high (>0.75%) and is distributed in the major part of the microwatershed (Fig. 6.3).

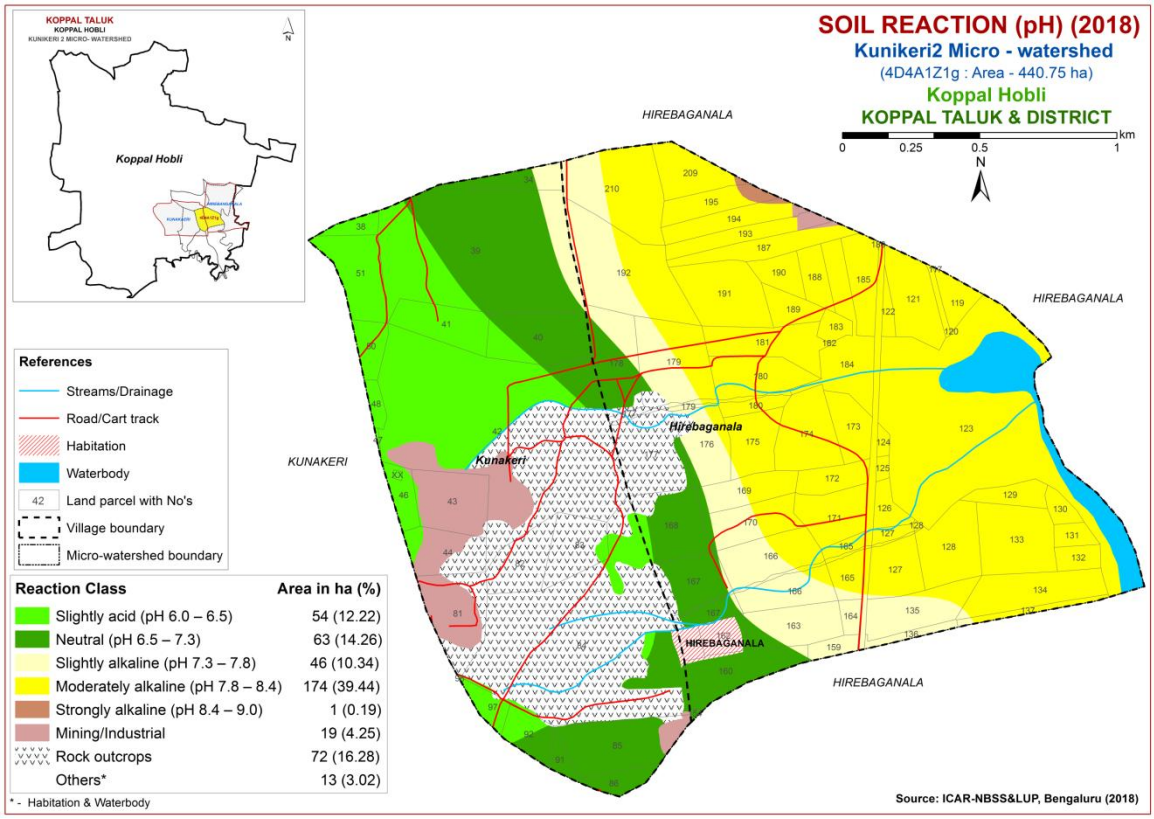


Fig. 6.1 Soil Reaction (pH) map of Kunikeri-2 Microwatershed

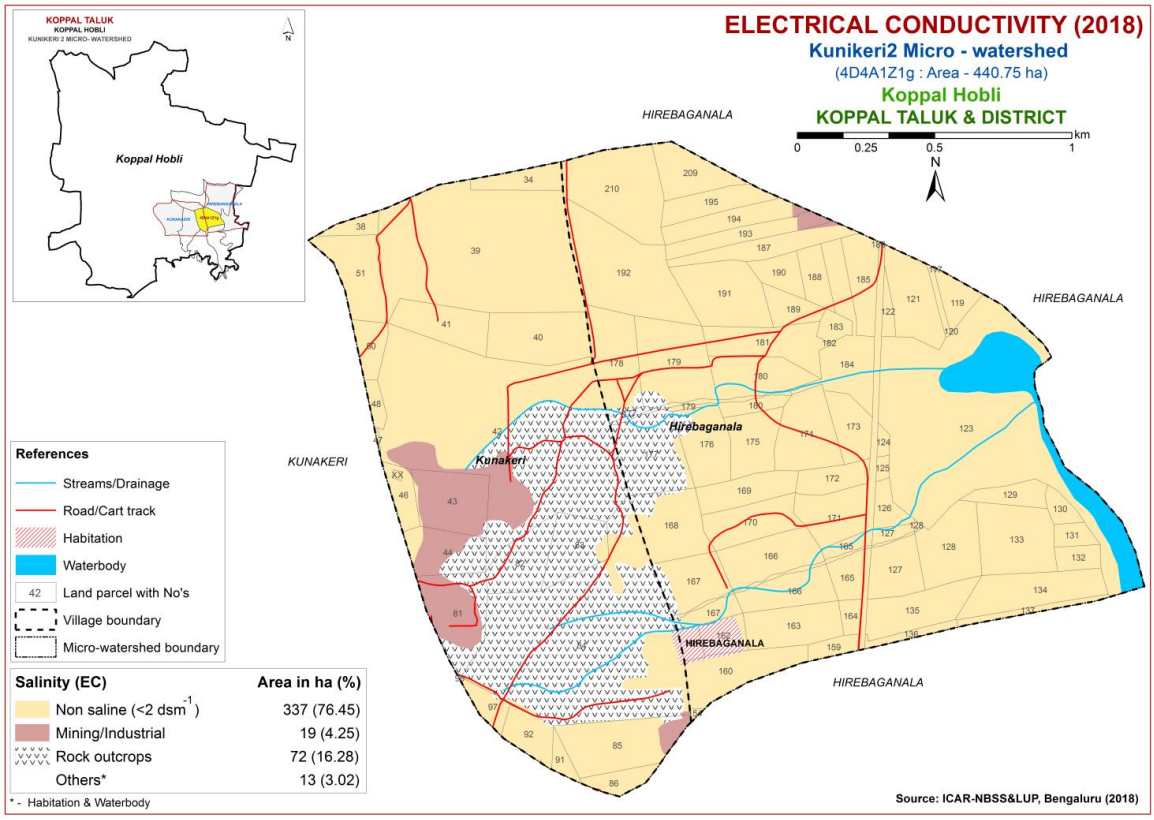


Fig. 6.2 Electrical Conductivity (EC) map of Kunikeri-2 Microwatershed

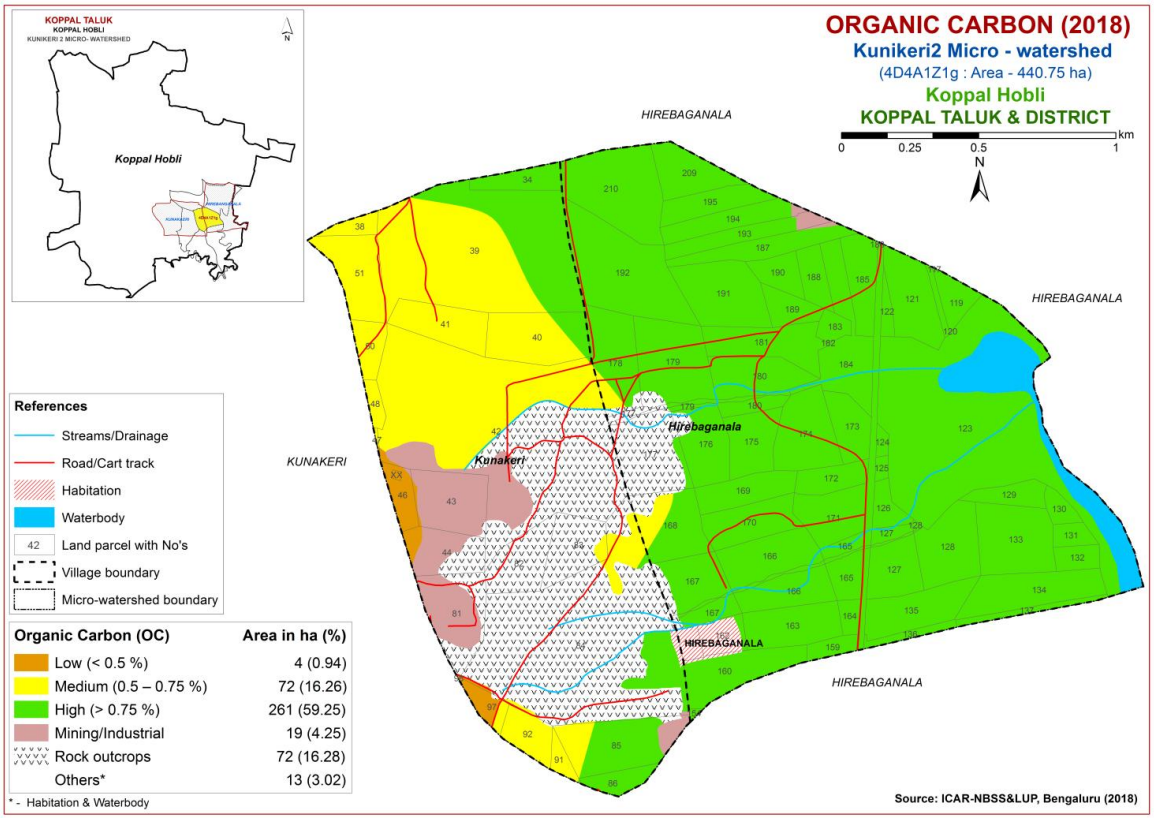


Fig. 6.3 Soil Organic Carbon map of Kunikeri-2 Microwatershed

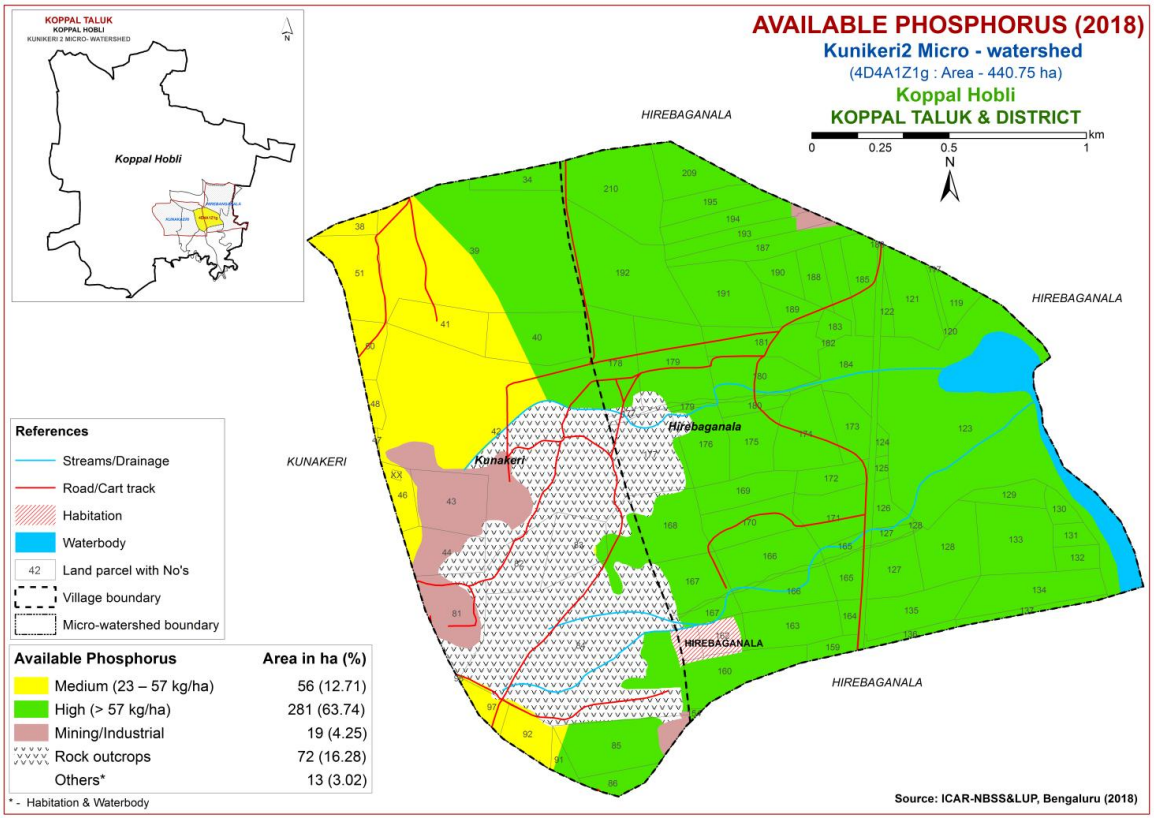


Fig. 6.4 Soil Available Phosphorus map of Kunikeri-2 Microwatershed

6.4 Available Phosphorus

An area of about 56 ha (13%) is medium (23-57 kg/ha) in available phosphorus and is distributed in the western part of the microwatershed. Maximum area of 281 ha (64%) is high (>57 kg/ha) and is distributed in the major part of the microwatershed (Fig. 6.4).

6.5 Available Potassium

An area of 58 ha (13%) is low (<145 kg/ha) and is distributed in the eastern and western part of the microwatershed. Medium (145-337 kg/ha) in available potassium content occupy a maximum area of 254 ha (58%) and are distributed in the major part of the microwatershed. An area of about 24 ha (5%) is high (>337 kg/ha) and are distributed in the northern and southern part of the microwatershed (Fig. 6.5).

6.6 Available Sulphur

Soils that are low (>10 ppm) in available sulphur content occupy a maximum area of 209 ha (47%) and are distributed in the major part of the microwatershed. An area of 128 ha (29%) is medium (10-20 ppm) and are distributed in the northern, central and southern part of the microwatershed (Fig. 6.6).

6.7 Available Boron

Available boron content is low (<0.5 ppm) in an area of 337 ha (76%) and are distributed in the major part of the microwatershed. A minor area of about 0.15 ha (<1%) is medium (0.5-1.0 ppm) in available boron and are distributed in the northern part of the microwatershed (Fig. 6.7).

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in an area of 105 ha (24%) and are distributed in the southern and eastern part of the microwatershed. An area of 232 ha (53%) is deficient (<4.5 ppm) and distributed in all parts of the microwatershed (Fig. 6.8).

6.9 Available Manganese

Available manganese content is sufficient (>1.0 ppm) in the entire microwatershed area (Fig. 6.9).

6.10 Available Copper

Available copper content is sufficient (>0.2 ppm) in the entire microwatershed area (Fig. 6.10).

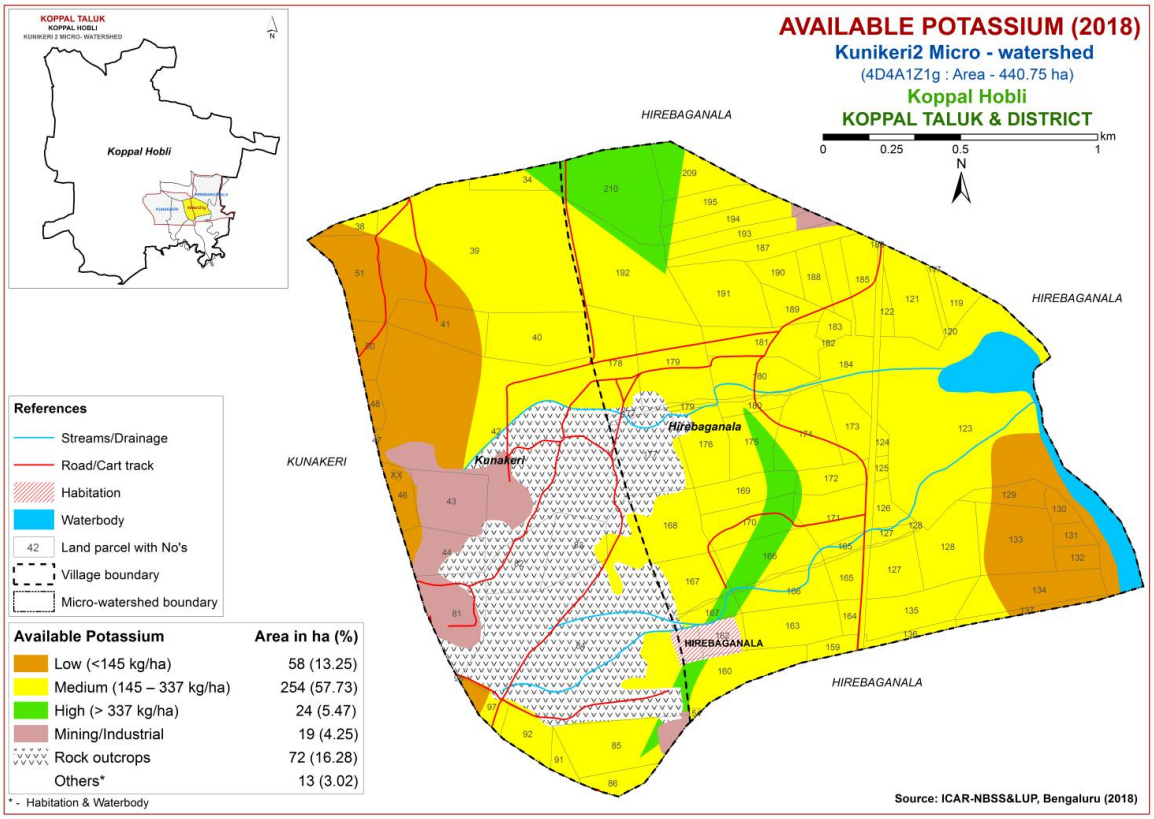


Fig. 6.5 Soil Available Potassium map of Kunikeri-2 Microwatershed

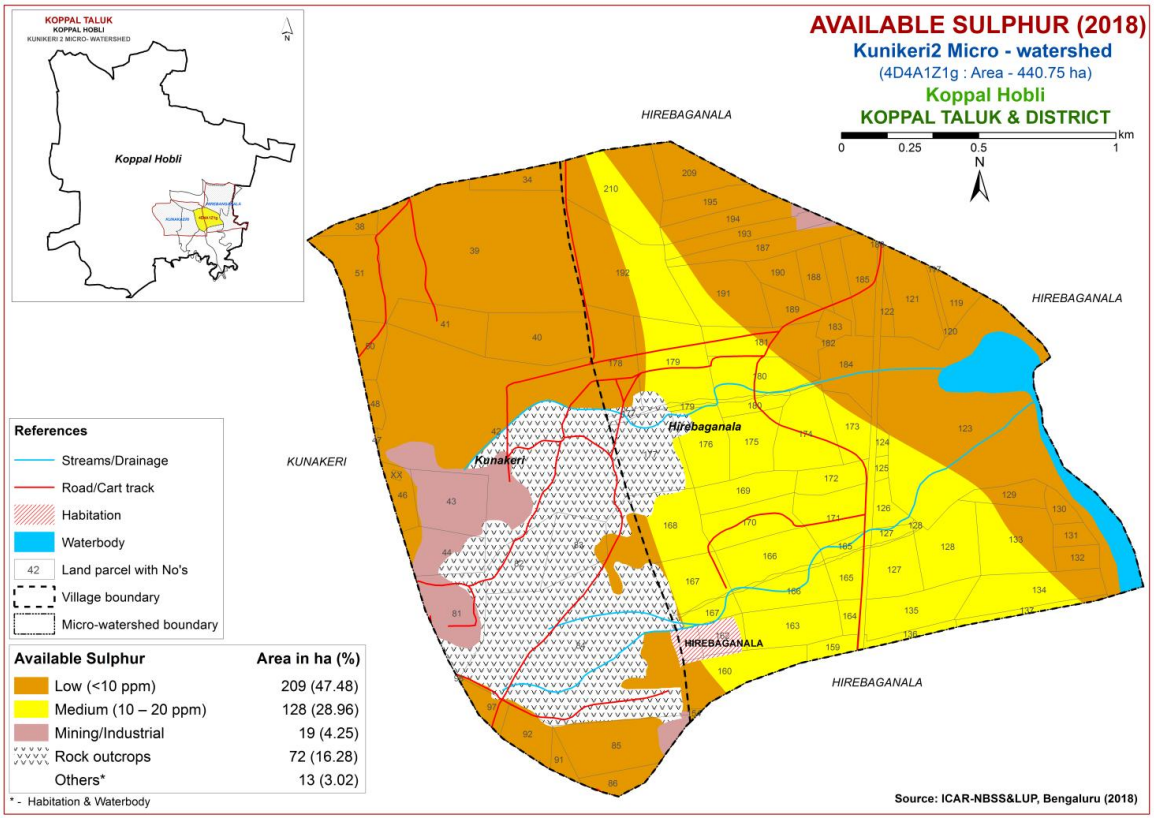


Fig. 6.6 Soil Available Sulphur map of Kunikeri-2 Microwatershed

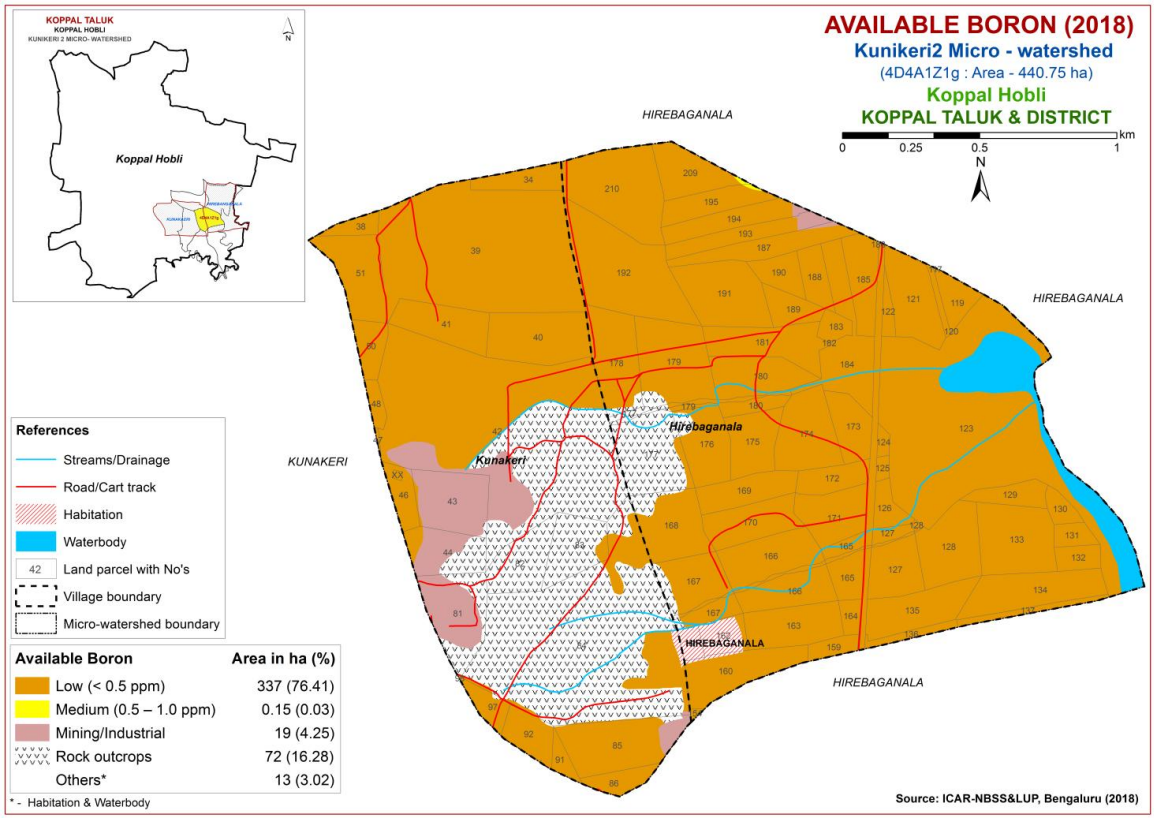


Fig. 6.7 Soil Available Boron map of Kunikeri-2 Microwatershed

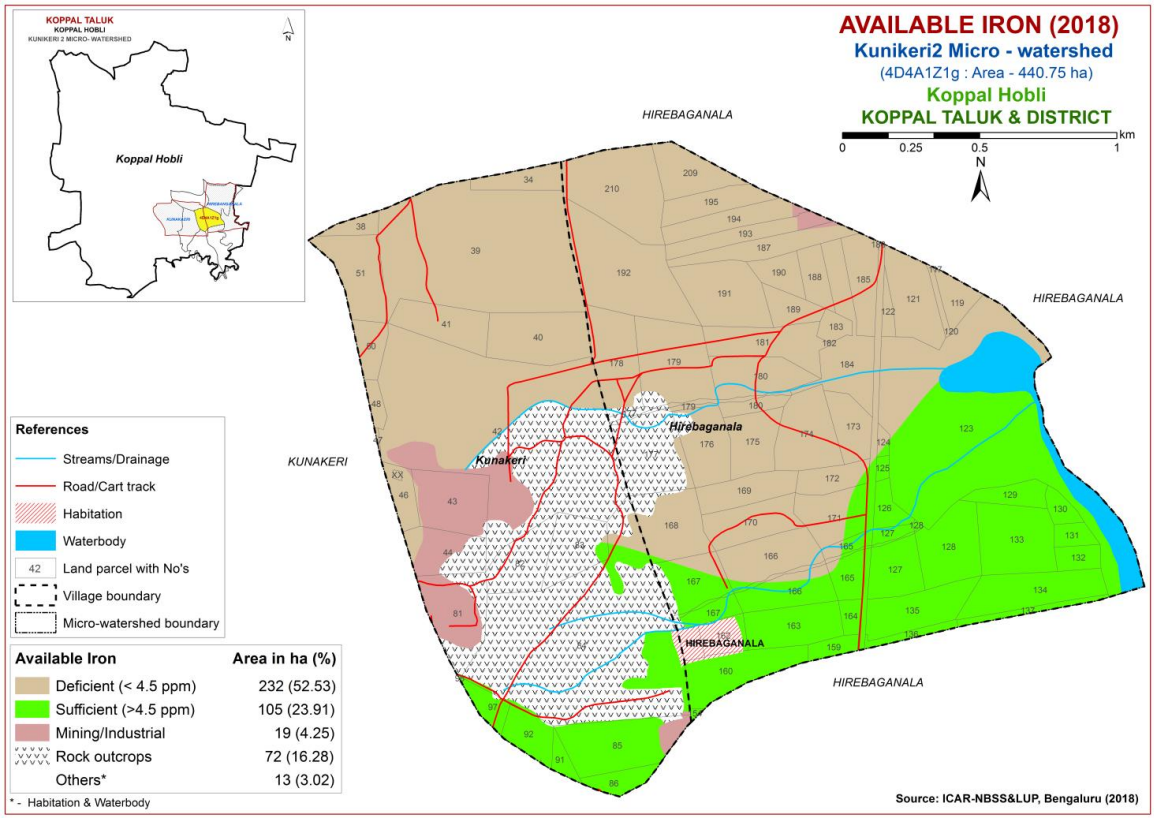


Fig. 6.8 Soil Available Iron map of Kunikeri-2 Microwatershed

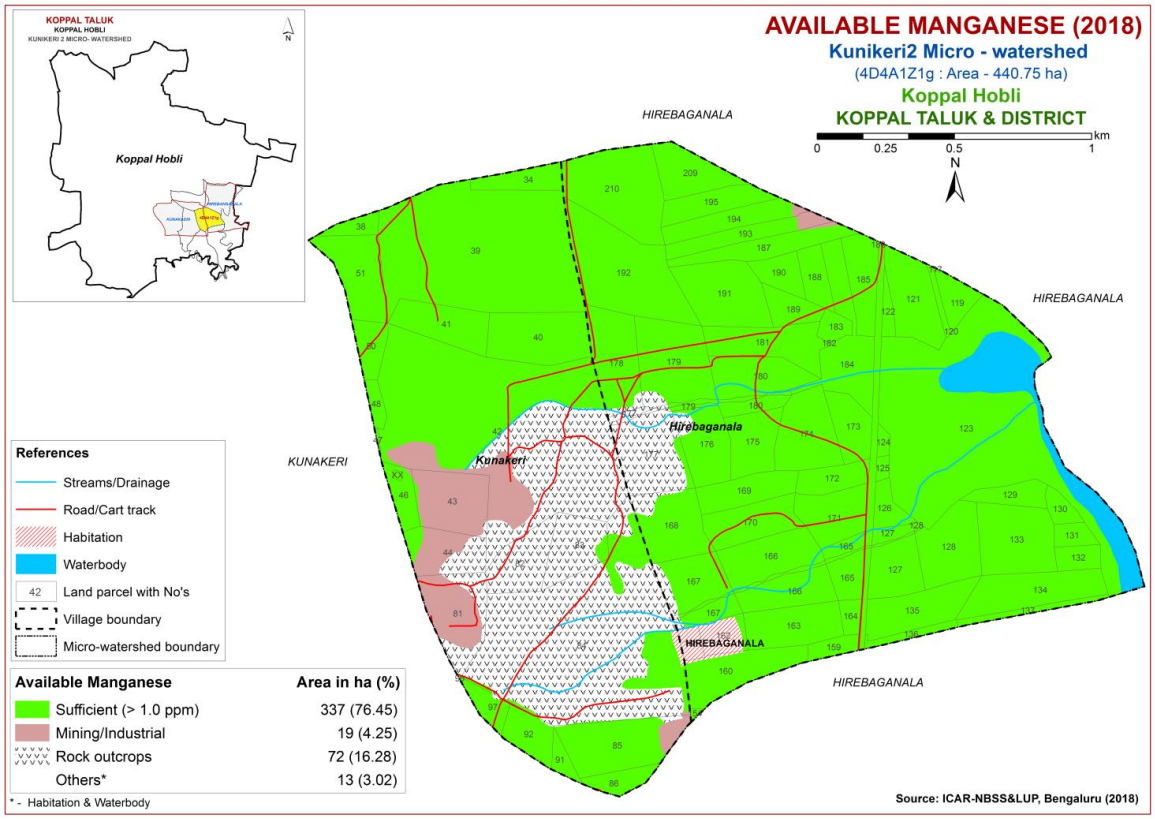


Fig. 6.9 Soil Available Manganese map of Kunikeri-2 Microwatershed

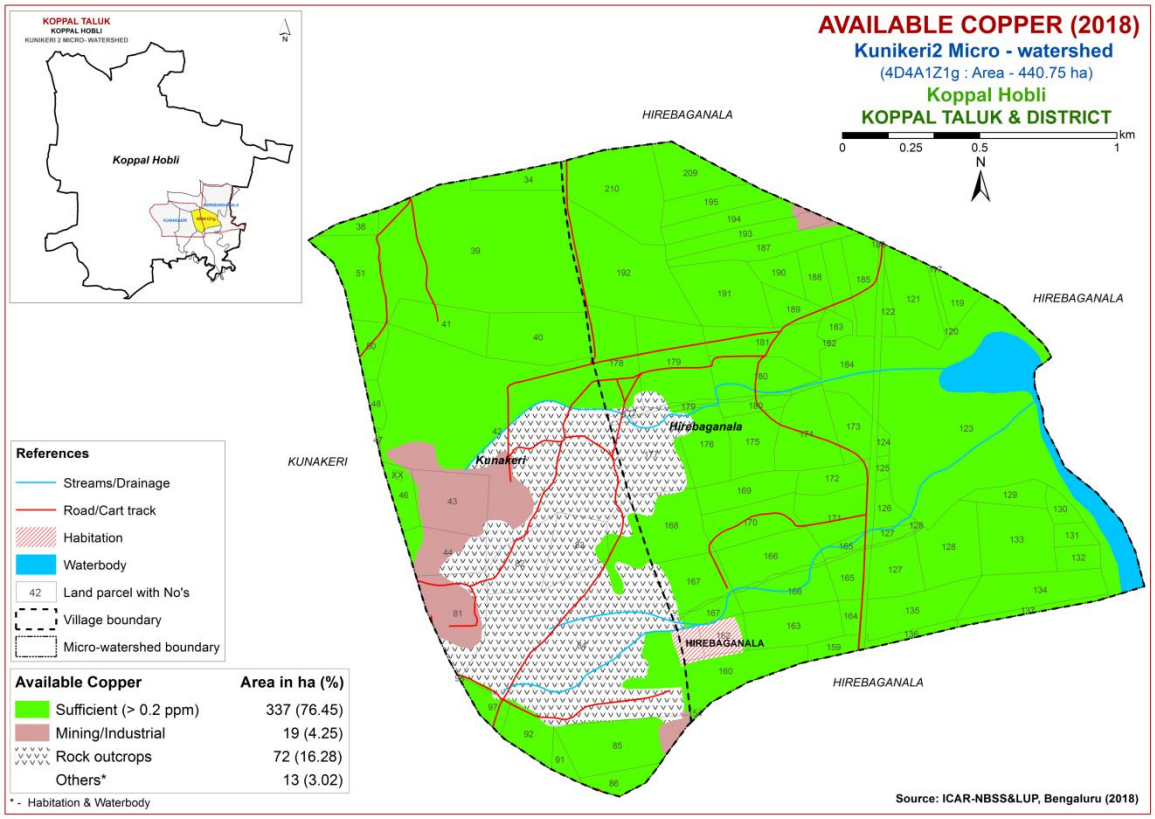


Fig. 6.10 Soil Available Copper map of Kunikeri-2 Microwatershed

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in an area of 160 ha (36%) and are distributed in the northern and western part of the microwatershed. A maximum area of 176 ha (40%) is sufficient (>0.6 ppm) and are distributed in the major part of the microwatershed (Fig. 6.11).

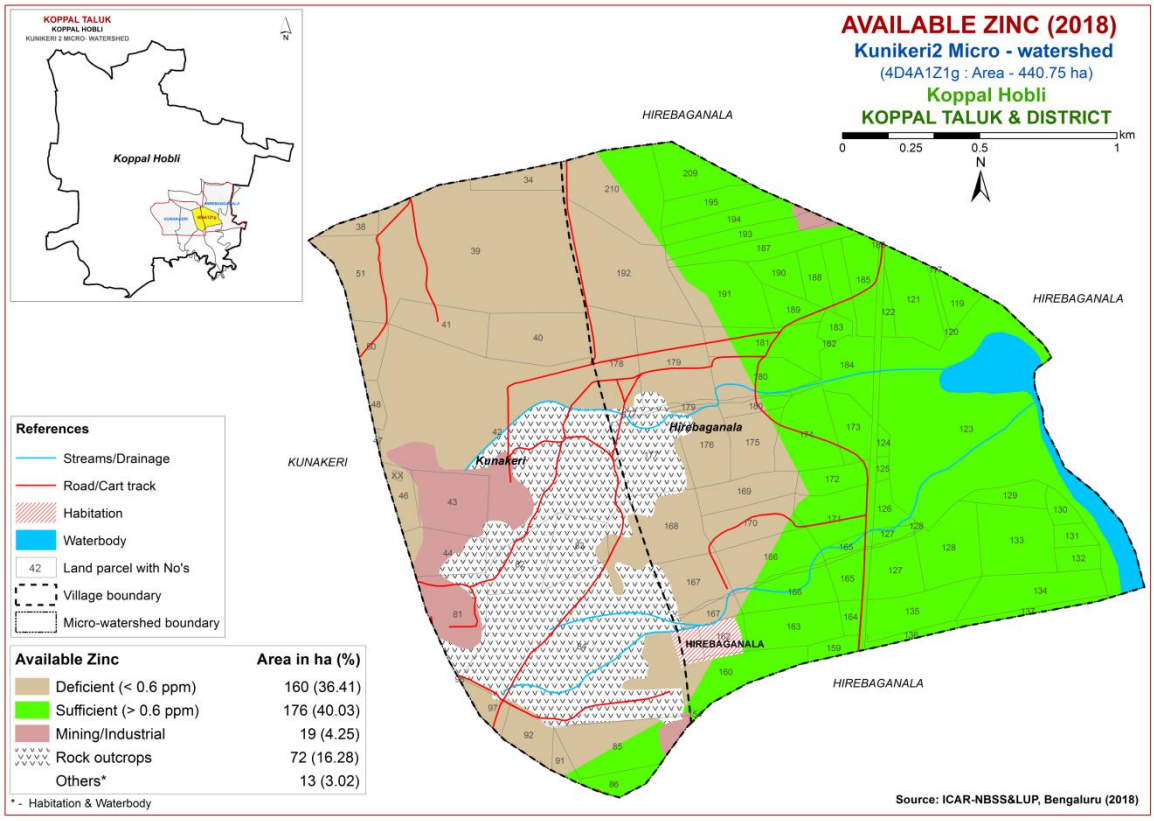


Fig. 6.11 Soil Available Zinc map of Kunikeri-2 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Kunikeri-2 Microwatershed were assessed for their suitability for growing food, fodder, fibre and other horticulture crops by following the procedure as outlined in FAO, 1976 and 1983. Crop requirements were developed for each of the crop from the available research data and also by referring to Naidu *et. al.* (2006) and Natarajan *et. al* (2015). The crop requirements (Table 7.2 to 7.33) were matched with the soil and land characteristics (Table 7.1) to arrive at the crop suitability. The criteria tables are given at the end of the Chapter. In FAO land suitability classification, two orders are recognized. Order S-Suitable and Order N- Not suitable. The orders have classes, subclasses and units. Order-S has three classes, Class S1-Highly Suitable, Class S2-Moderately Suitable and Class S3-Marginally Suitable. Order N has two Classes, N1-Currently not Suitable and N2-Permanently not Suitable. There are no subclasses within the Class S1 as they will have very minor or no limitations for crop growth. Classes S2, S3, N1 and N2 are divided into subclasses based on the kinds of limitations encountered. The limitations that affect crop production are 'c' for erratic rainfall and its distribution and length of growing period (LGP), 'e' for erosion hazard, 'r' for rooting condition, 't' for lighter or heavy texture, 'g' for gravelliness or stoniness, 'n' for nutrient availability, 'l' for topography, 'm' for moisture availability, 'z' for calcareousness 's' for sodium and 'w' for drainage. These limitations are indicated as lower case letters to the class symbol. For example, moderately suitable lands with the limitations of soil depth and erosion are designated as S2re. For the microwatershed, the soil mapping units were evaluated and classified up to subclass level.

Using the above criteria, the soil map units of the microwatershed were evaluated and land suitability maps for 31 major agricultural and horticultural crops were generated. The detailed information on the kind of suitability of each of the soil phase for the crops assessed are given village/ survey number wise for the microwatershed in Appendix-III.

7.1 Land Suitability for Sorghum (*Sorghum bicolor*)

Sorghum is one of the major food crop grown in Karnataka in an area of 10.47 lakh ha in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad, Bellary, Chitradurga, Mysore and Chamarajnagar districts. The crop requirements for growing sorghum (Table 7.2) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure. 7.1.

An area of 144 ha (33%) is highly suitable (Class S1) for growing sorghum and are distributed in the eastern, southern and central part of the microwatershed. An area of 45 ha (10%) is moderately suitable (Class S2) and are distributed in the northern and northwestern part of the microwatershed. They have minor limitations of gravelliness,

drainage and rooting condition. Maximum area of about 148 ha (33%) is marginally suitable (Class S3) for growing sorghum and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting condition.

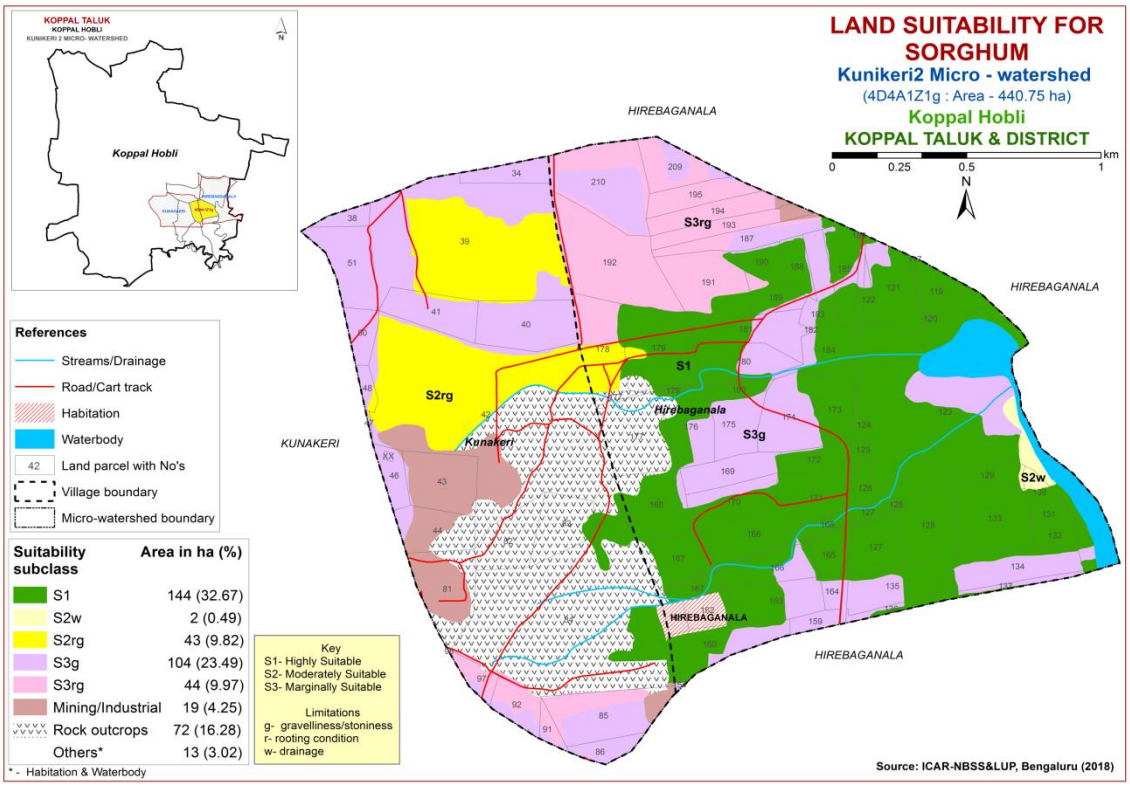


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

Maize is one of the most important food crop grown in an area of 13.37 lakh ha in almost all the districts of the State. The crop requirements for growing maize (Table 7.3) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing maize was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.2.

An area of 91 ha (21%) is highly suitable (Class S1) for growing maize and are distributed in the central, southern and eastern part in the microwatershed. An area of 99 ha (22%) is moderately suitable (Class S2) for growing maize and are distributed in the northern and northwestern part of the microwatershed with minor limitations of rooting condition, gravelliness and texture. Marginally suitable (Class S3) lands cover a maximum area of 148 ha (33%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

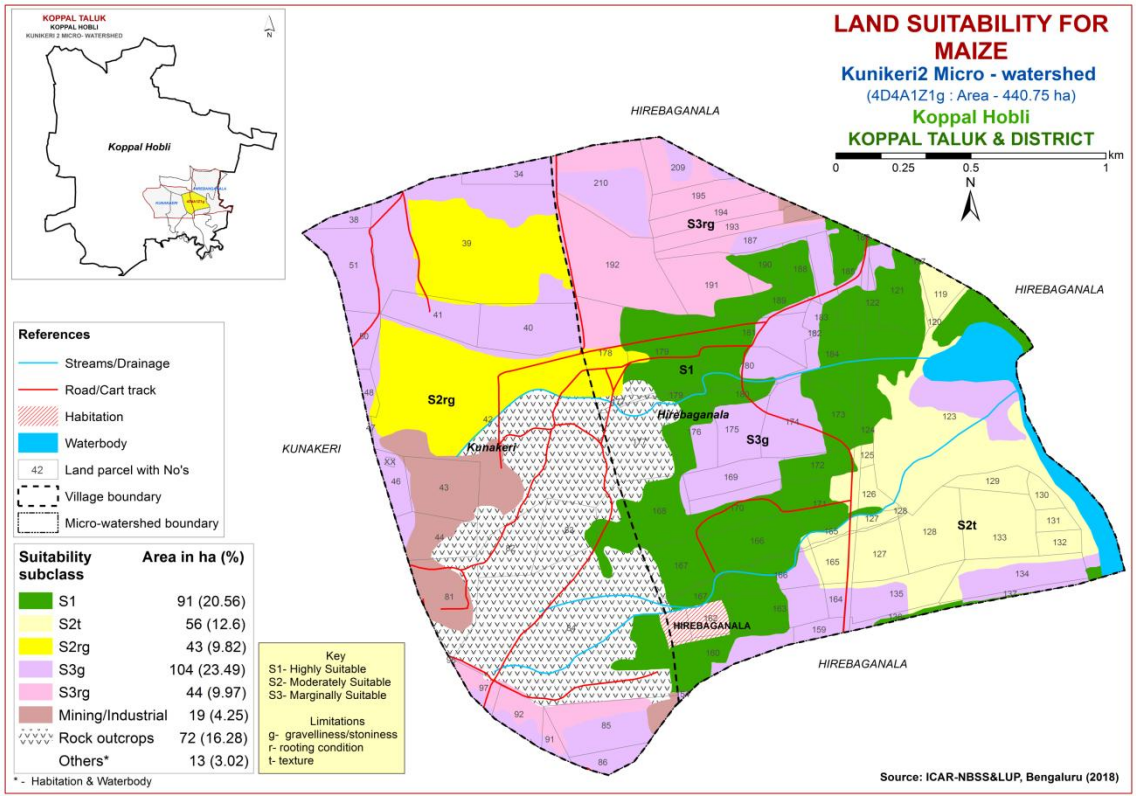


Fig. 7.2 Land Suitability map of Maize

7.3 Land Suitability for Bajra (*Pennisetum glaucum)*

Bajra is one of the major food crop grown in an area of 2.34 lakh ha in the northern districts of the Karnataka State. The crop requirements for growing bajra (Table 7.4) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing bajra was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.3.

Maximum area of 144 ha (33%) is highly suitable (Class S1) for growing bajra and are distributed in the major part of the microwatershed. Maximum area of 112 ha (25%) is moderately suitable (Class S2) and are distributed in the northern, southern and western part of the microwatershed with minor limitations of texture, gravelliness and rooting condition. Marginally suitable (Class S3) lands cover an area of 81 ha (18%) and are distributed in the southern, western, eastern and northern part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

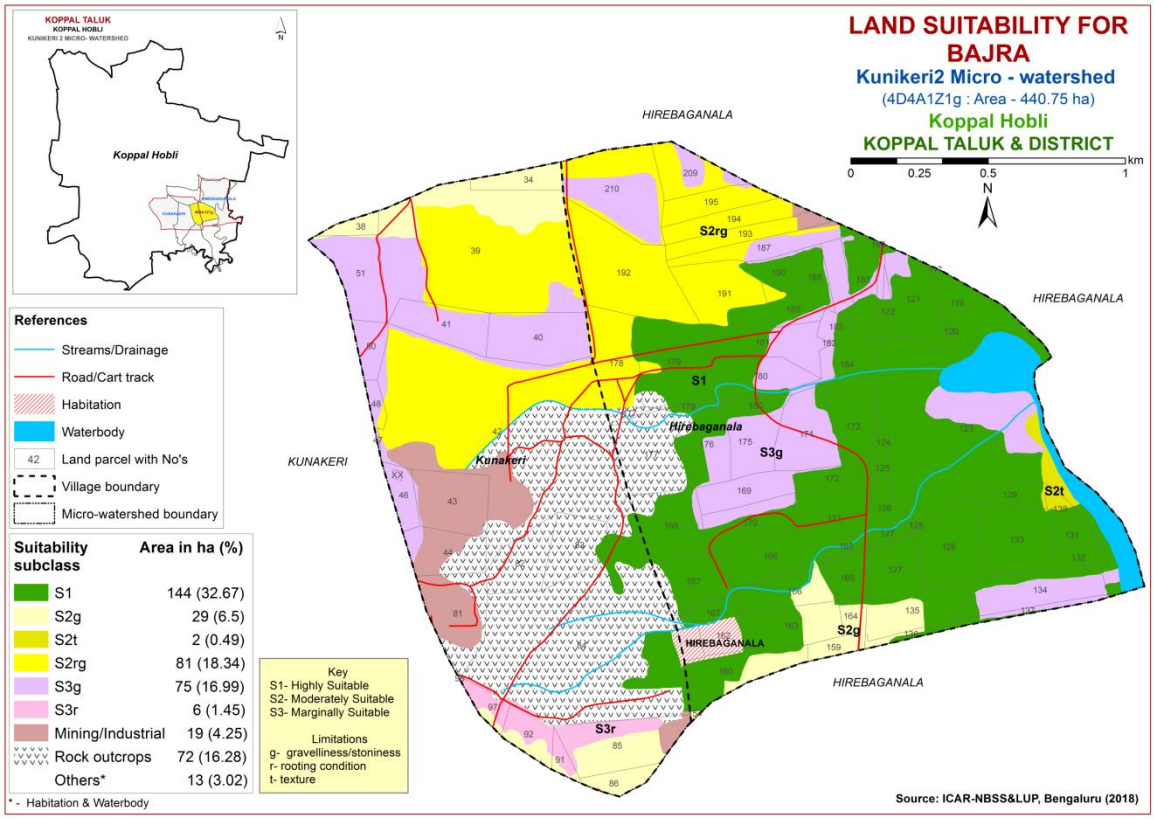


Fig. 7.3 Land Suitability map of Bajra

7.4 Land Suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the major oilseed crop grown in an area of 6.54 lakh ha in Karnataka in most of the districts either as rainfed or irrigated crop. The crop requirements for growing groundnut (Table 7.5) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing groundnut was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.4.

An area of 53 ha (12%) is highly suitable (Class S1) for growing groundnut and are distributed in the eastern part of the microwatershed. Maximum area of 237 ha (54%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of texture, rooting condition and gravelliness. An area of 46 ha (10%) is marginally suitable (Class S3) for groundnut and are distributed in the northern and southern part of the microwatershed. They have moderate limitations of rooting condition, gravelliness, drainage and texture.

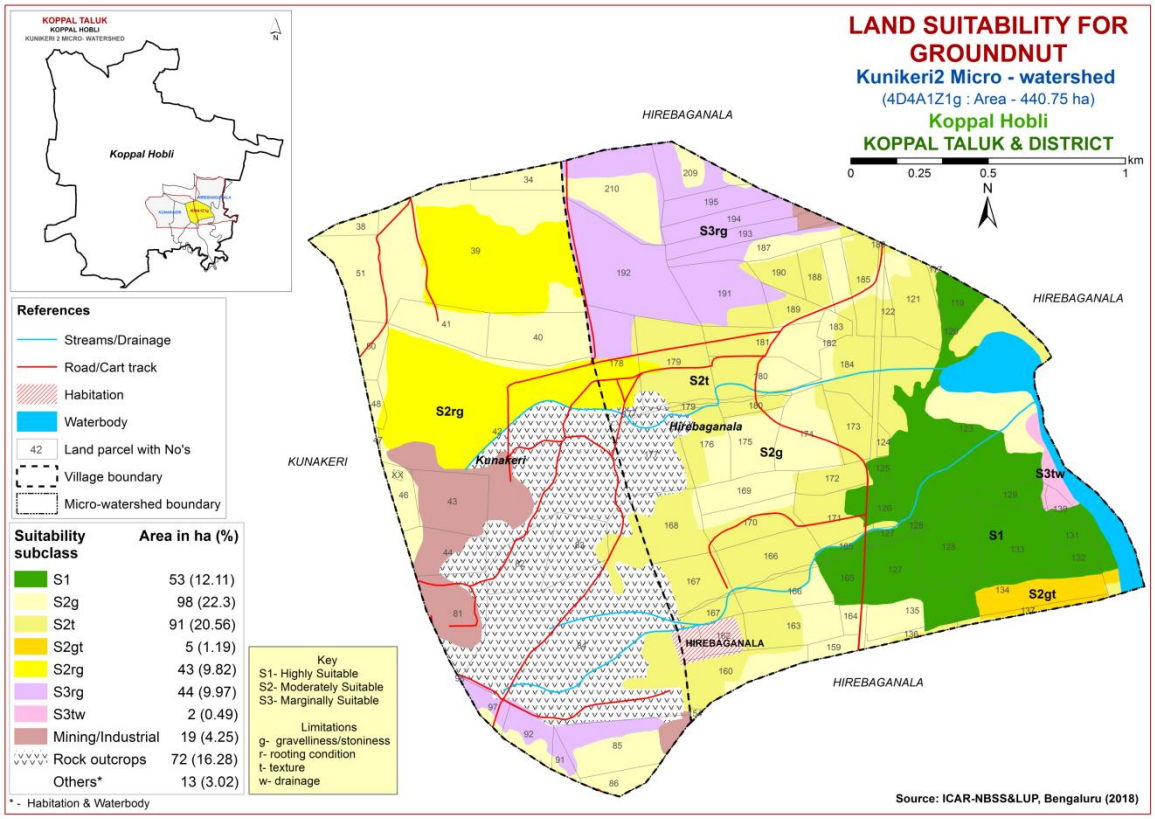


Fig. 7.4 Land Suitability map of Groundnut

7.5 Land Suitability for Sunflower (*Helianthus annus*)

Sunflower is one of the most important oilseed crop grown in an area of 3.56 lakh ha in the State in all the districts. The crop requirements for growing sunflower (Table 7.6) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sunflower was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

An area of 144 ha (33%) is highly suitable (Class S1) for growing sunflower and are distributed in the central and eastern part of the microwatershed. An area of 2 ha (<1%) is moderately suitable (Class S2) and are distributed in the eastern part of the microwatershed. They have minor limitations of drainage. Maximum area of 191 ha (6%) is marginally suitable (Class S3) for growing sunflower and are distributed in the major part of the microwatershed with moderate limitations of rooting condition and gravelliness.

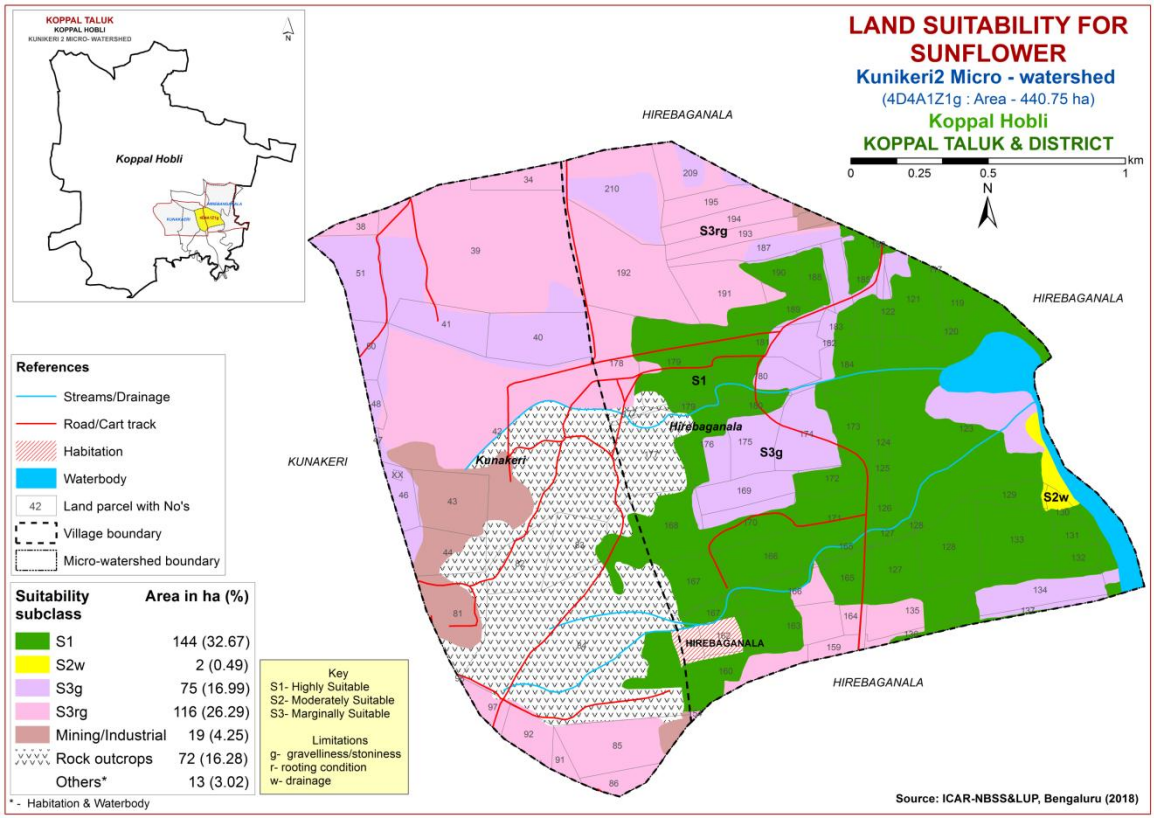


Fig. 7.5 Land Suitability map of Sunflower

7.6 Land Suitability for Red gram (*Cajanus cajan)*

Redgram is one of the most important pulse crop grown in an area of 7.28 lakh ha in almost all the districts of the State. The crop requirements for growing redgram (Table 7.7) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing redgram was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.6.

An area of 144 ha (33%) is highly suitable (Class S1) for growing red gram and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy a maximum area of 2 ha (<1%) and are distributed in the eastern part of the microwatershed with minor limitations of texture and drainage. Marginally suitable (Class S3) lands cover a maximum area of 185 ha (42%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting condition. Currently not suitable (Class N1) lands cover an area of 6 ha (1%) for growing red gram and are distributed in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

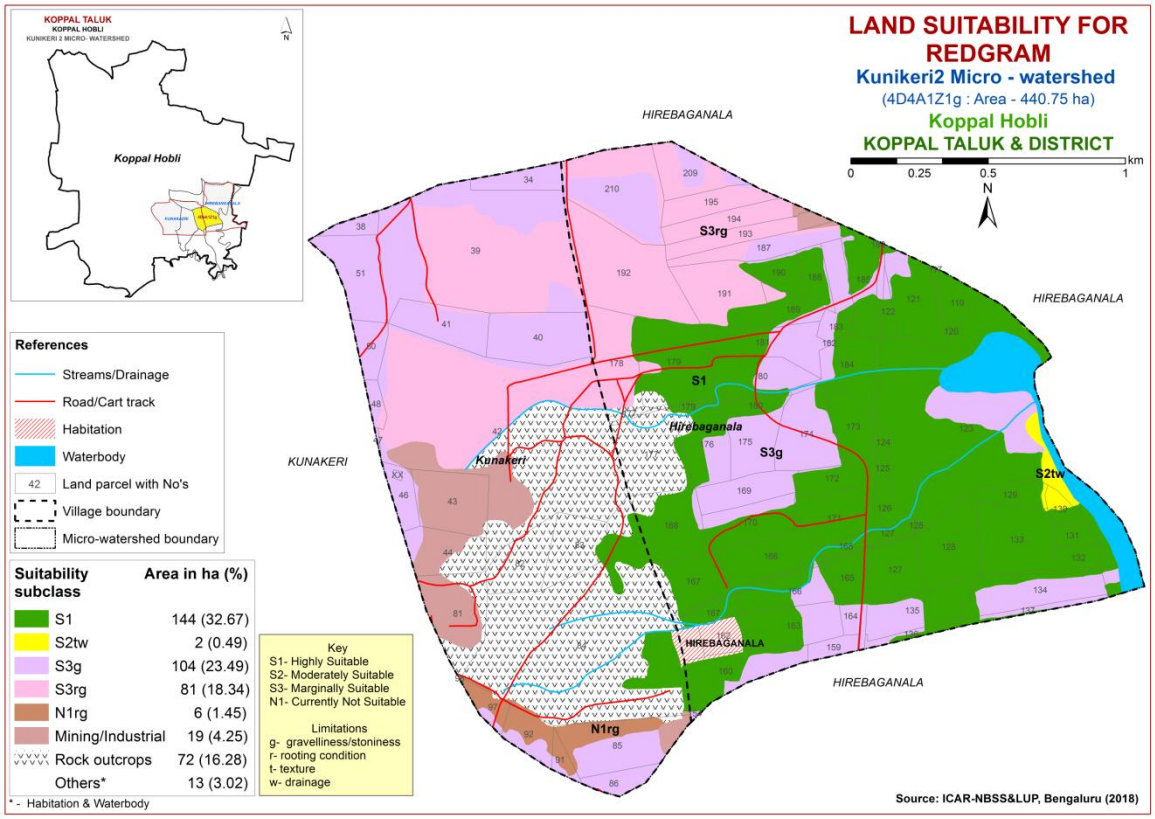


Fig. 7.6 Land Suitability map of Redgram

7.7 Land Suitability for Bengalgram (*Cicer arietinum*)

Bengalgram is one of the major pulse crop grown in an area of 9.39 lakh ha in northern Karnataka in Bijapur, Gulbarga, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing Bengalgram (Table 7.8) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing Bengalgram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.7.

An area of 2 ha (<1%) is highly suitable (Class S1) for growing bengalgram and are distributed in the eastern part of the microwatershed. Moderately suitable lands (Class S2) occupy a maximum area of 225 ha (51%) and are distributed in the major part of the microwatershed with minor limitations of texture and rooting condition. Marginally suitable (Class S3) lands cover an area of 110 ha (25%) and are distributed in the northern, southern, eastern, central and western part of the microwatershed. They have moderate limitations of rooting condition, texture and gravelliness.

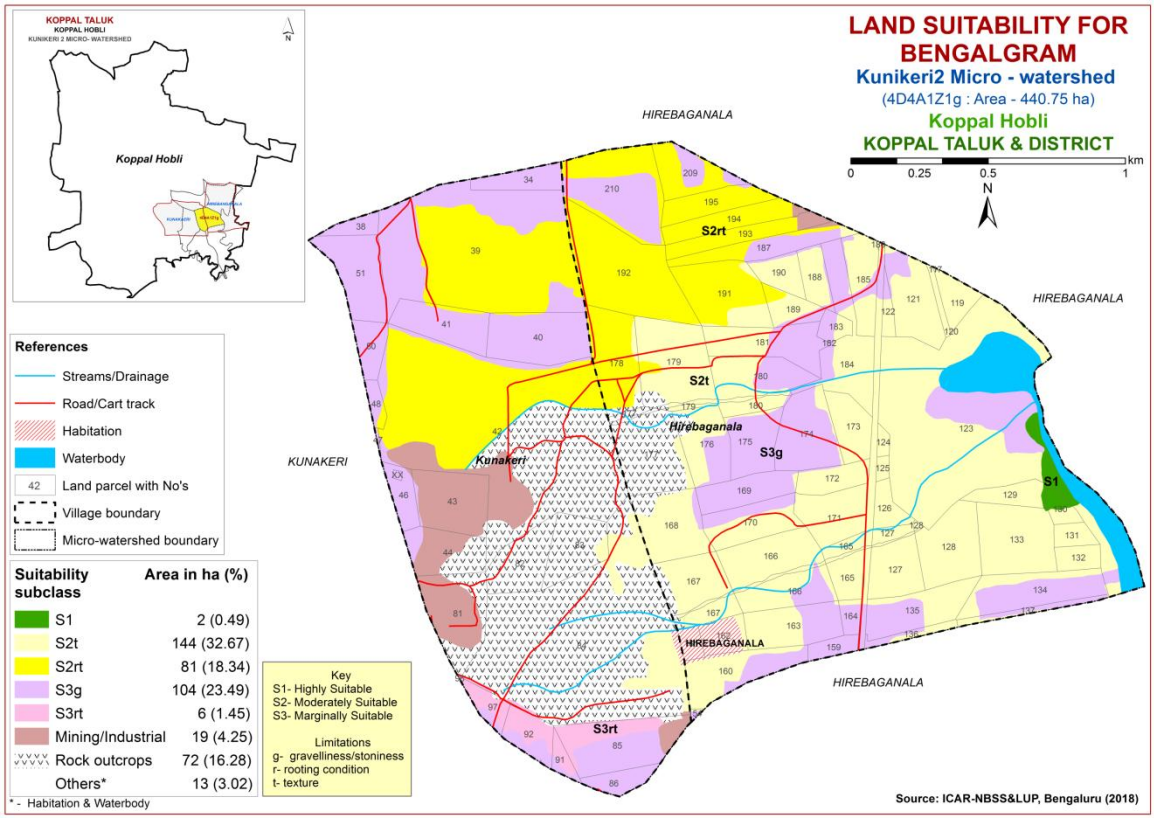


Fig. 7.7 Land Suitability map of Bengalgram

7.8 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is one of the most important fibre crop grown in the State in about 8.75 lakh ha area in Raichur, Dharwad, Belgaum, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.9) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cotton was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.8.

An area of 144 ha (33%) is highly suitable (Class S1) for growing cotton and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of 45 ha (10%) and are distributed in the western, northern and eastern part of the microwatershed. They have minor limitations of rooting condition, gravelliness, texture and drainage. Marginally suitable (Class S3) lands cover a maximum area of 147 ha (33%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture and rooting condition.

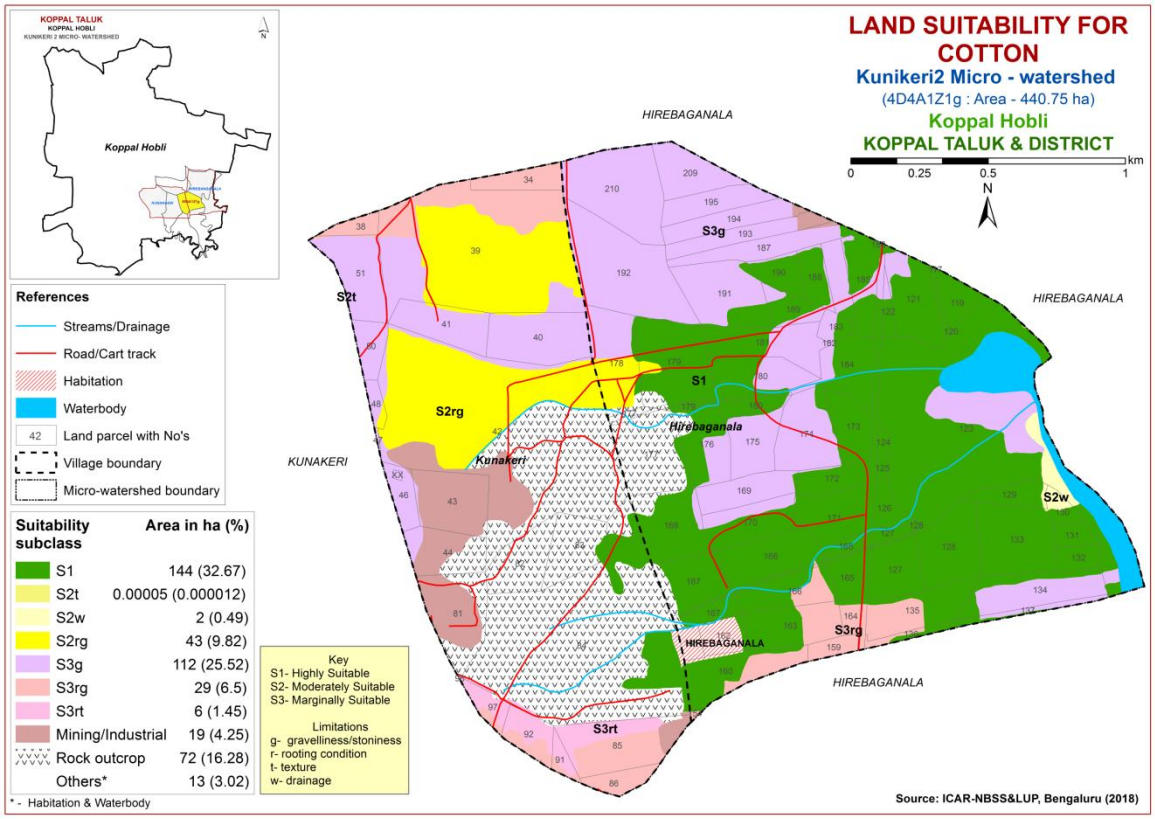


Fig. 7.8 Land Suitability map of Cotton

7.9 Land Suitability for Chilli (*Capsicum annuum L*)

Chilli is one of the most important commercial spice crop grown in an area of 0.89 lakh ha in all the districts of Karnataka State. The crop requirements for growing chilli (Table 7.10) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing chilli was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.9.

An area of 144 ha (33%) is highly (Class S1) suitable for growing chilli and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 43 ha (10%) and are distributed in the northern and western part of the microwatershed. They have minor limitations of rooting condition and gravelliness. Maximum area of 149 ha (34%) is marginally suitable (Class S3) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture, rooting condition and drainage.

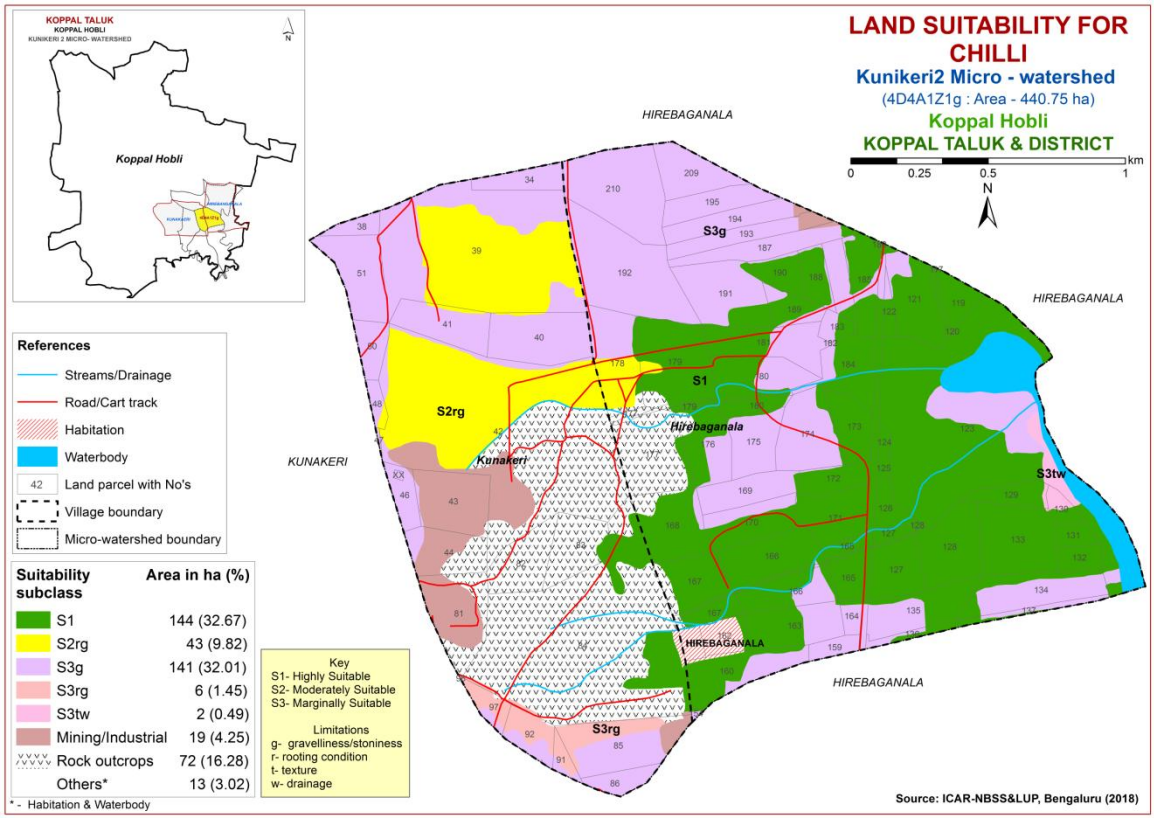


Fig. 7.9 Land Suitability map of Chilli

7.10 Land Suitability for Tomato (*Solanum lycopersicum*)

Tomato is one of the most important vegetable crop grown in an area of 0.65 lakh ha in almost all the districts of the State. The crop requirements (Table 7.11) for growing tomato were matched with the soil-site characteristics (Table 7.11) and a land suitability map for growing tomato was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.10.

An area of 144 ha (33%) is highly (Class S1) suitable for growing tomato and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 43 ha (10%) and are distributed in the northern and western part of the microwaterhsed. They have minor limitations of rooting condition and gravelliness. Marginally suitable (Class S3) lands occupy a maximum area of 149 ha (34%) and are distributed in the major part of the microwatershed with moderate limitations of gravelliness, rooting condition, texture and drainage.

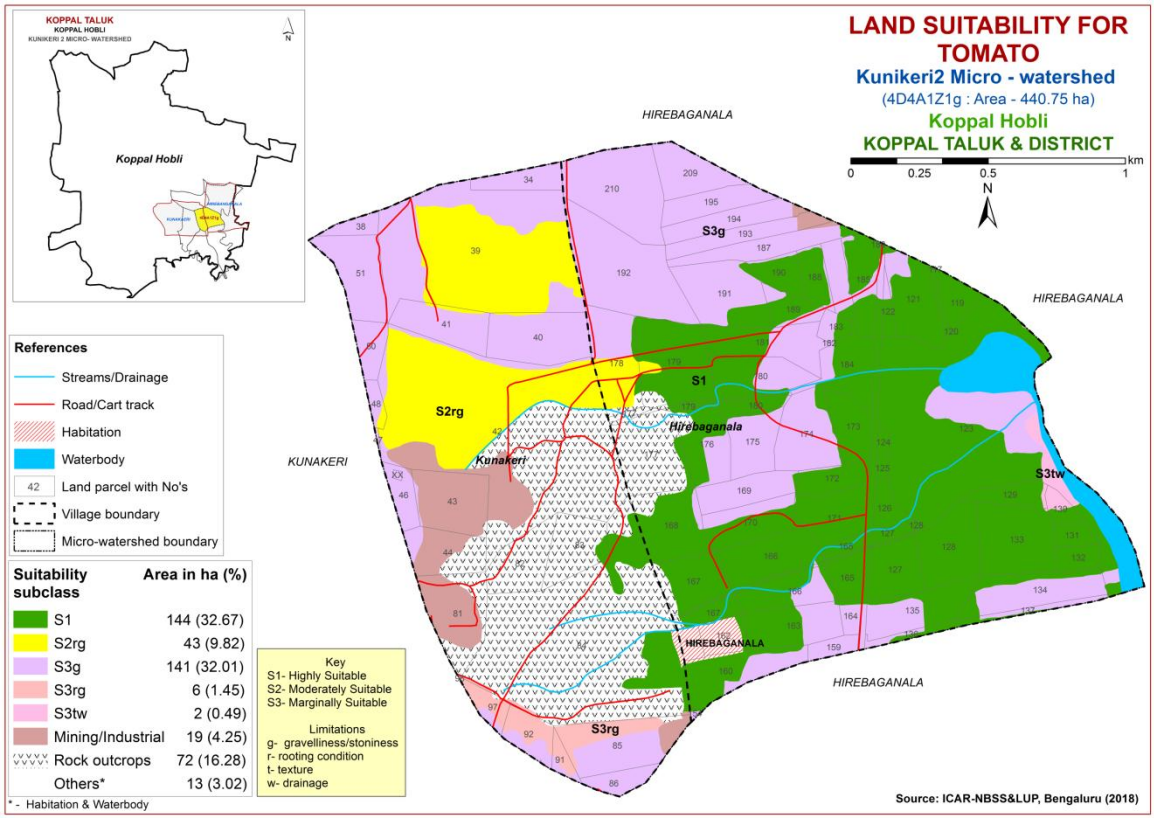


Fig. 7.10 Land Suitability map of Tomato

7.11 Land Suitability for Brinjal (*Solanum melongena*)

Brinjal is one of the most important vegetable crop grown in all the districts. The crop requirements for growing brinjal (Table 7.12) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing brinjal was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.11.

A minor area of <1 ha (<1%) is highly suitable (Class S1) for growing brinjal and are distributed in the negligible part of the microwatershed. Maximum area of about 221 ha (50%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed with minor limitations of texture, gravelliness and drainage. Marginally suitable lands (Class S3) for growing brinjal occur in an area of 115 ha (26%) and are distributed in the northern, southern and western part of the microwatershed with moderate limitations of rooting depth and gravelliness.

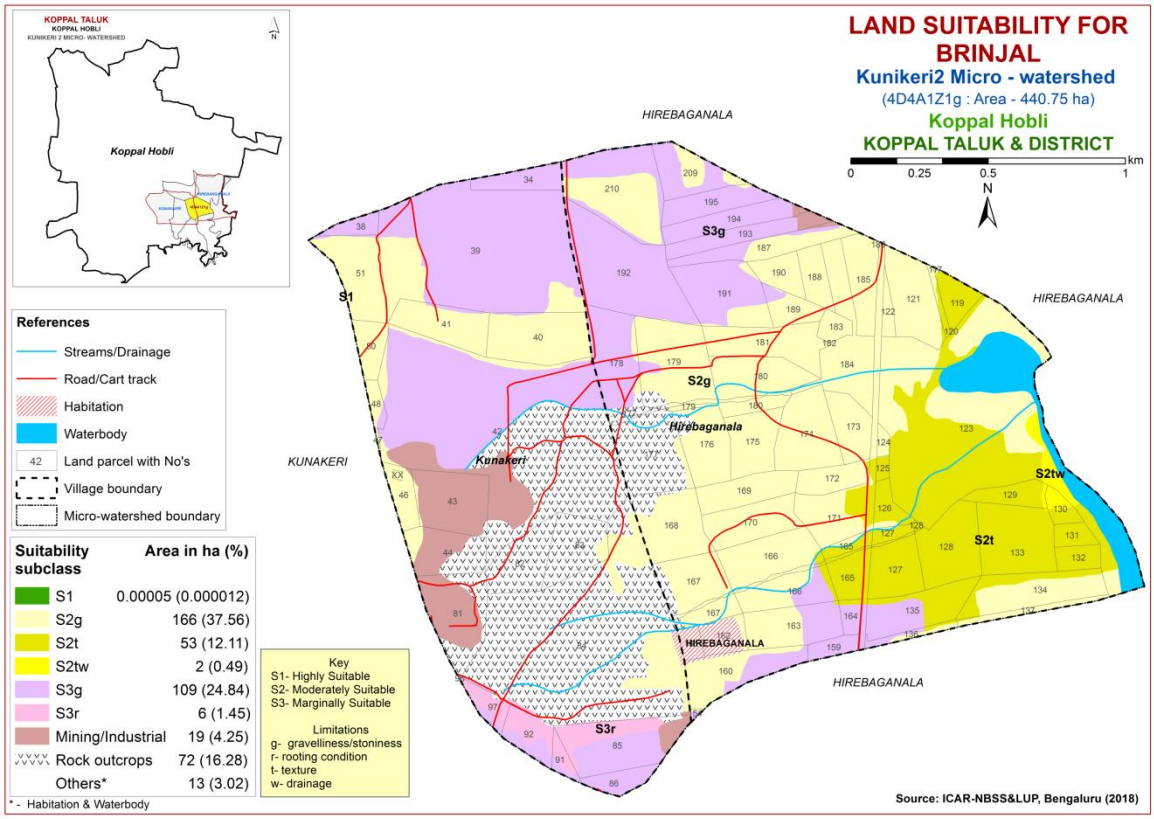


Fig. 7.11 Land Suitability map of Brinjal

7.12 Land Suitability for Onion (*Allium cepa*)

Onion is one of the most important vegetable crop grown in Raichur, Dharwad, Belgaum, Gulbarga, Bijapur, Bidar, Bellary, Chitradurga and Tumakuru districts. The crop requirements for growing onion (Table 7.13) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Onion was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.12.

A minor area of about <1 ha (<1%) is highly suitable (Class S1) for growing onion and are distributed in the negligible area in the microwatershed. Maximum area of 221 ha (50%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, texture and drainage. Marginally suitable lands (Class S3) occupy an area of 115 ha (26%) and are distributed in the northern, western and southern part of the microwatershed with moderate limitations of rooting depth and gravelliness.

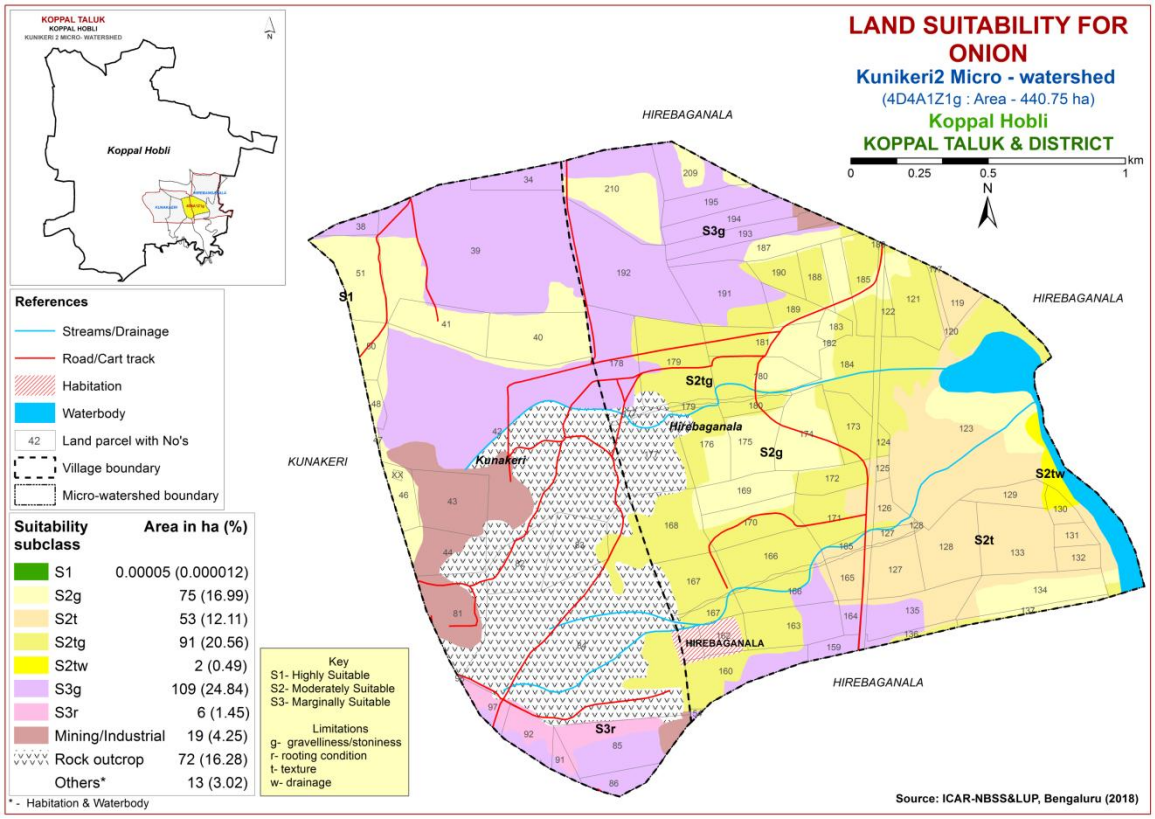


Fig. 7.12 Land Suitability map of Onion

7.13 Land Suitability for Bhendi (*Abelmoschus esculentus*)

Bhendi is one of the most important vegetable crop grown in all the districts. The crop requirements for growing bhendi (Table 7.14) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing bhendi was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.13.

A minor area of <1 ha (<1%) is highly suitable (Class S1) for growing bhendi and are distributed in the negligible part of the microwatershed. Maximum area of about 221 ha (50%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed with minor limitations of texture, gravelliness and drainage. Marginally suitable lands (Class S3) occur in an area of 115 ha (26%) and are distributed in the northern, southern and western part of the microwatershed with moderate limitations of rooting condition and gravelliness.

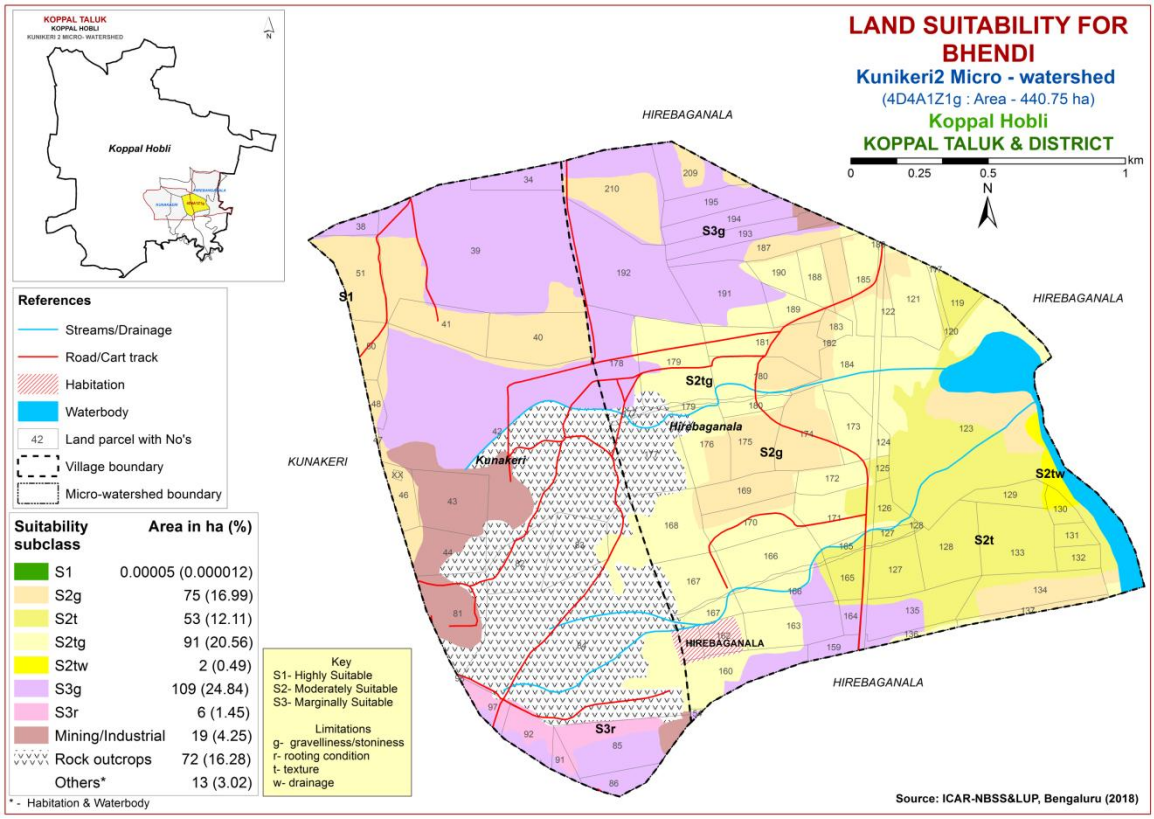


Fig. 7.13 Land Suitability map of Bhendi

7.14 Land Suitability for Drumstick (*Moringa oleifera)*

Drumstick is one of the most important vegetable crop grown in 2403 ha area in the State. The crop requirements for growing drumstick (Table 7.15) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing drumstick was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.14.

Maximum area of 144 ha (33%) is highly suitable (Class S1) for growing drumstick and are distributed in the major part of the microwaterhsed. An area of 77 ha (17%) is moderately suitable (Class S2) and are distributed in the northern, eastern, central and northwestern part of the microwatershed. They have minor limitations of gravelliness, texture and drainage. Marginally suitable (Class S3) lands cover an area of 110 ha (25%) and are distributed in the northern, southern and western part of the microwatershed. They have moderate limitations of gravelliness and rooting condition. Currently not suitable (Class N1) lands cover an area of 6 ha (1%) and are distributed in the southern part of the microwatershed with severe limitation of rooting condition.

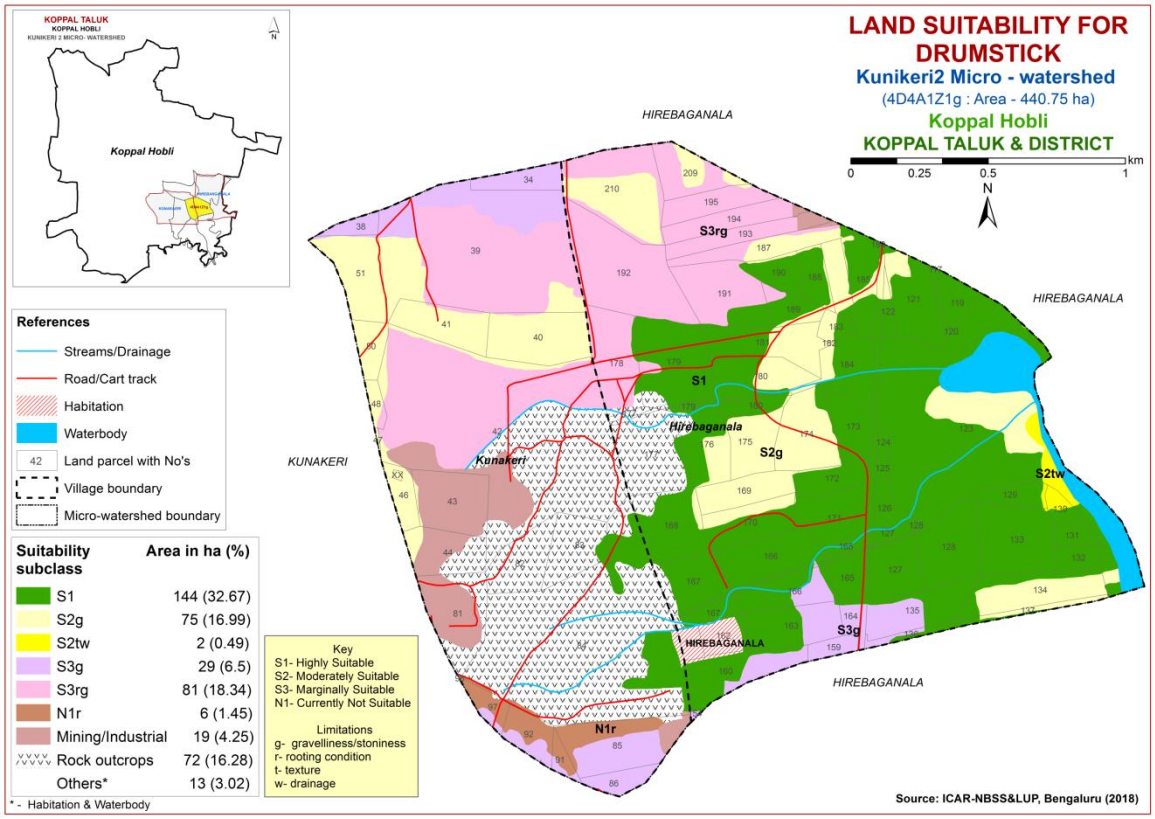


Fig. 7.14 Land Suitability map of Drumstick

7.15 Land Suitability for Mango (*Mangifera indica*)

Mango is one of the most important fruit crop grown in about 1.73 lakh ha in almost all the districts of the State. The crop requirements (Table 7.16) for growing mango were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mango was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.15.

Maximum area of 144 ha (33%) is highly (Class S1) suitable for growing mango and are distributed in the major part of the microwaterhsed. Moderately suitable (Class S2) lands occupy a minor area of <1 ha (<1%) and are distributed in the negligible part of the microwatershed. They have minor limitation of rooting condition. Marginally suitable (Class S3) lands cover an area of 105 ha (24%) and are distributed in all parts of the microwatershed. They have moderate limitations of texture, gravelliness, rooting condition and drainage. An area of 87 ha (20%) is currently not suitable (Class N1) for growing mango and occur in the northern, western and southern part of the microwatershed with severe limitations of gravelliness and rooting condition.

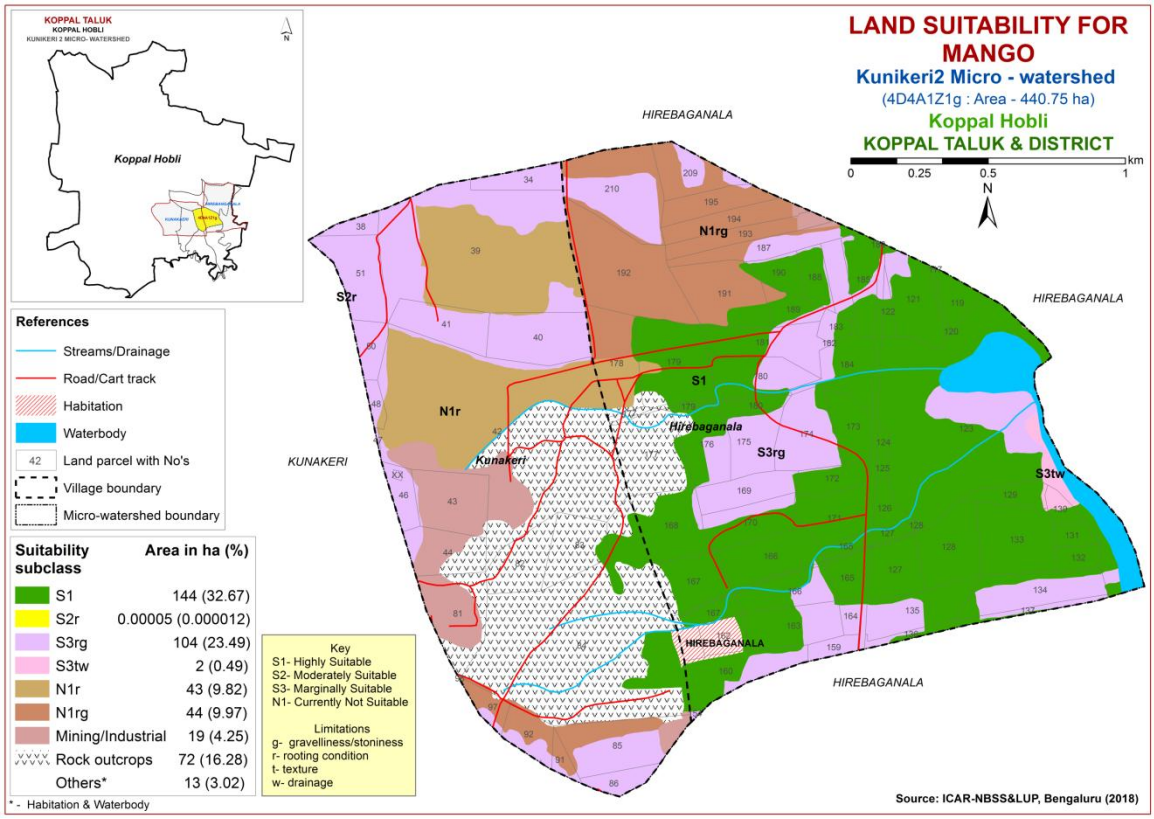


Fig. 7.15 Land Suitability map of Mango

7.16 Land suitability for Guava (*Psidium guajava*)

Guava is one of the most important fruit crop grown in an area of about 0.64 lakh ha in almost all the districts of the State. The crop requirements (Table 7.17) for growing guava were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing guava was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.16.

An area of 53 ha (12%) is highly suitable (Class S1) and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 120 ha (27%) and are distributed in the northern, central and southern part of the microwatershed. They have minor limitations of texture, rooting condition and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of 158 ha (36%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, rooting condition, texture and drainage. An area of about 6 ha (1%) area is currently not suitable (Class N1) for growing guava and occur in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

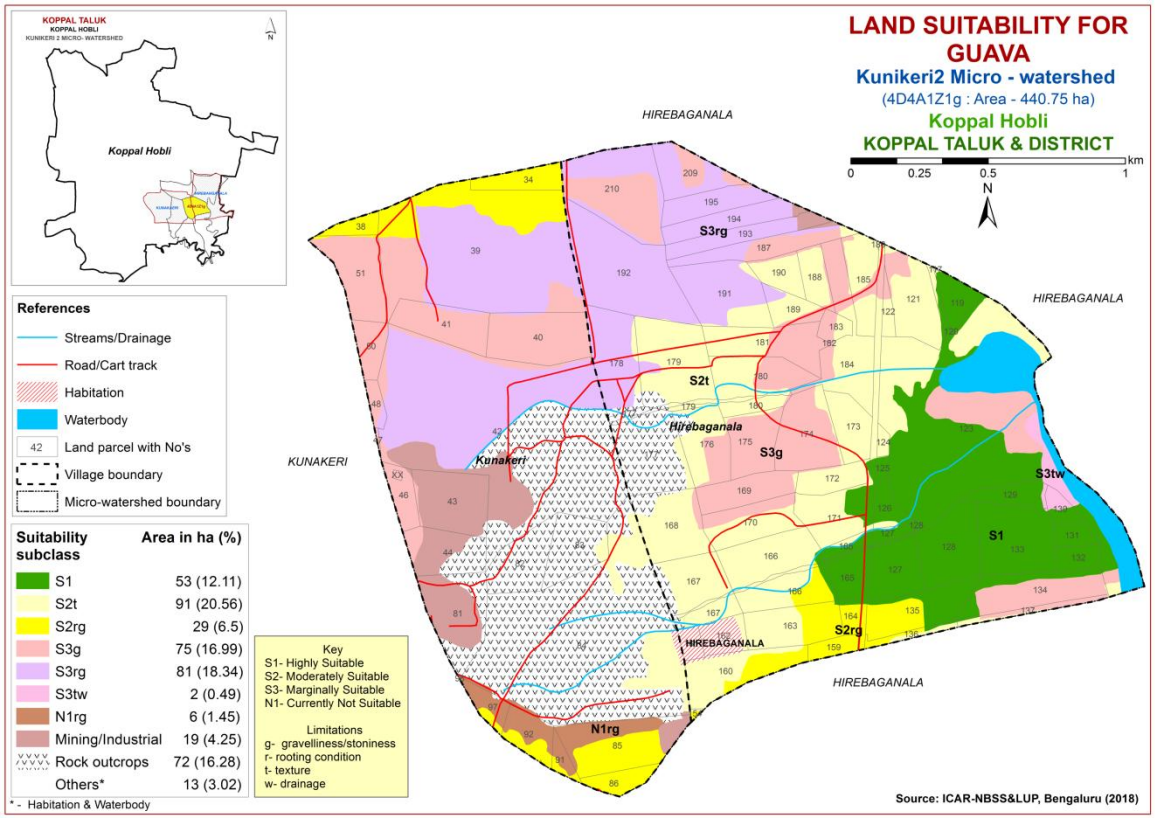


Fig. 7.16 Land Suitability map of Guava

7.17 Land Suitability for Sapota (*Manilkara zapota*)

Sapota is one of the most important fruit crop grown in an area of about 29373 ha in almost all the districts of the State. The crop requirements (Table 7.18) for growing sapota were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing sapota was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.17.

Maximum area of 144 ha (33%) is highly suitable (Class S1) and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 29 ha (7%) for growing sapota and are distributed in the northern and southern part of the microwatershed. They have minor limitations of rooting condition and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of 158 ha (36%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture, rooting condition and drainage. An area of 6 ha (1%) is currently not suitable (Class N1) for growing sapota and occur in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

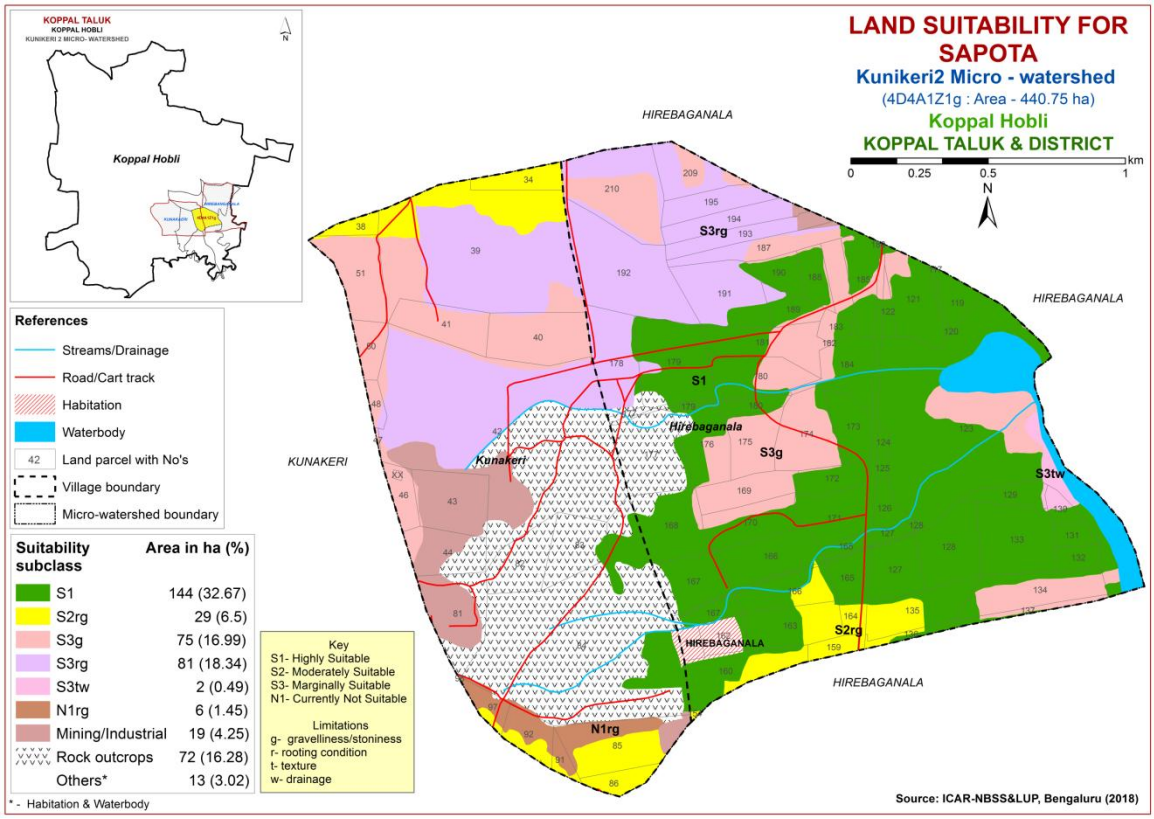


Fig. 7.17 Land Suitability map of Sapota

7.18 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of the commercially grown fruit crop in about 18488 ha in Karnataka mainly in Bijapur, Bagalkot, Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.19) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing pomegranate was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.18.

An area of 144 ha (33%) is highly suitable (Class S1) for growing pomegranate and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of 31 ha (7%) and are distributed in the northern, southern and eastern part of the microwatershed. They have minor limitations of texture, rooting condition, gravelliness and drainage. Maximum area of 156 ha (35%) is marginally suitable (Class S3) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting condition and gravelliness. An area of 6 ha (1%) is currently not suitable (Class N1) for growing pomegranate and are distributed in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

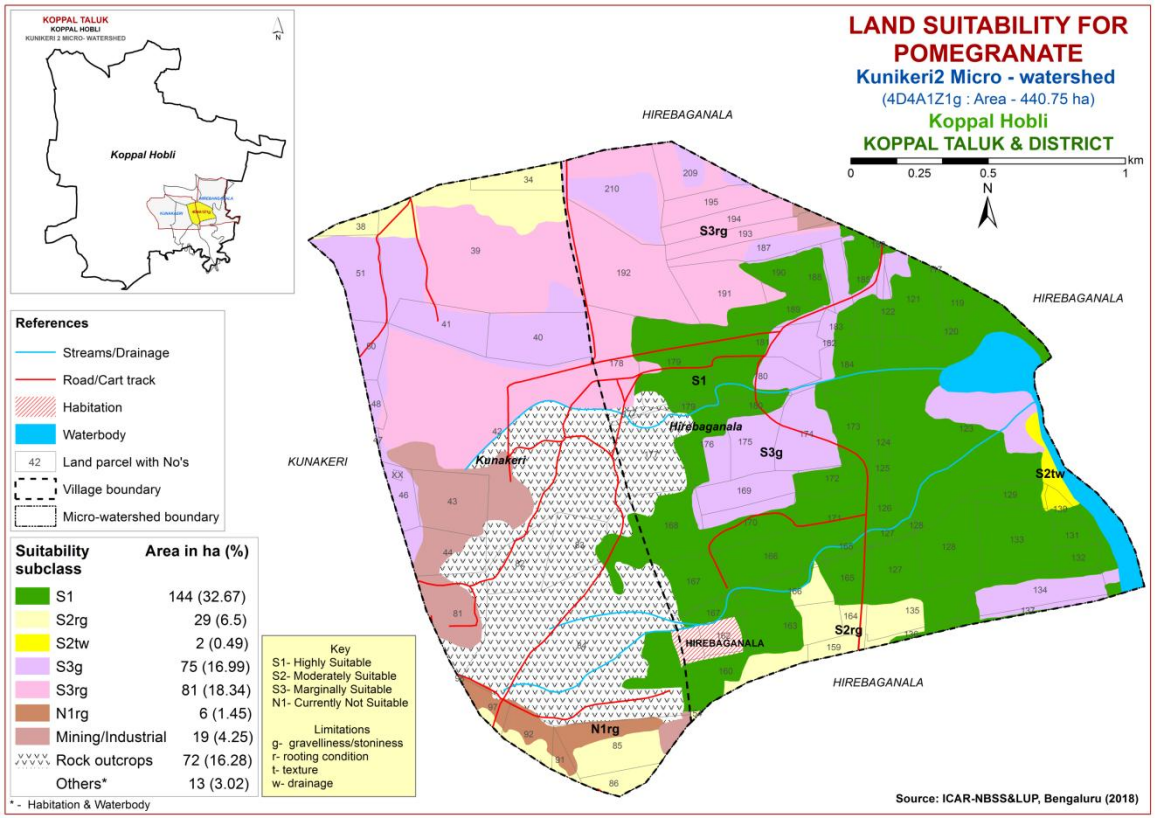


Fig. 7.18 Land Suitability map of Pomegranate

7.19 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in almost all the districts of the State. The crop requirements for growing musambi (Table 7.20) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing musambi was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.19.

An area of 144 ha (33%) is highly suitable (Class S1) for growing musambi and are distributed in the central and eastern part of the microwatershed. An area of 31 ha (7%) is moderately suitable (Class S2) and are distributed in the northern, eastern and southern part of the microwatershed. They have minor limitations of drainage, rooting condition and gravelliness. Marginally suitable (Class S3) lands occur in a maximum area of 156 ha (35%) and are distributed in the major part of the microwatershed with moderate limitations of rooting condition and gravelliness. An area of 6 ha (1%) is currently not suitable (Class N1) for growing musambi and are distributed in the southern part of the microwatershed. They have severe limitations of rooting condition and gravelliness.

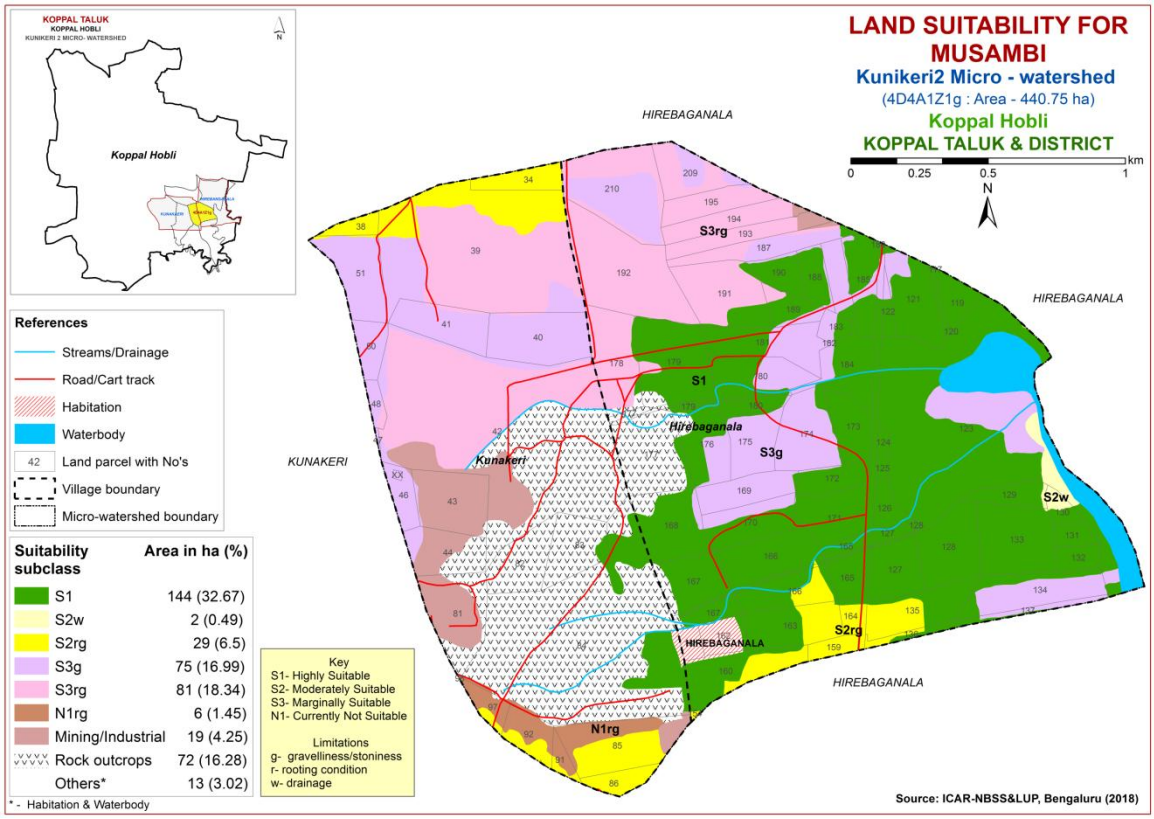


Fig. 7.19 Land Suitability map of Musambi

7.20 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in an area of 0.11 lakh ha in almost all the districts of the State. The crop requirements for growing lime (Table 7.21) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing lime was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.20.

An area of 144 ha (33%) is highly suitable (Class S1) for growing lime and are distributed in the central and eastern part of the microwatershed. An area of 31 ha (7%) is moderately suitable (Class S2) and are distributed in the northern, southern and eastern part of the microwatershed. They have minor limitations of drainage, rooting condition and gravelliness. Marginally suitable (Class S3) lands occur in a maximum area of 156 ha (35%) for growing lime and distributed in the major part of the microwatershed with moderate limitations of rooting condition and gravelliness. An area of 6 ha (1%) is currently not suitable (Class N1) and are distributed in the southern part of the microwatershed with severe limitation of rooting condition and gravelliness.

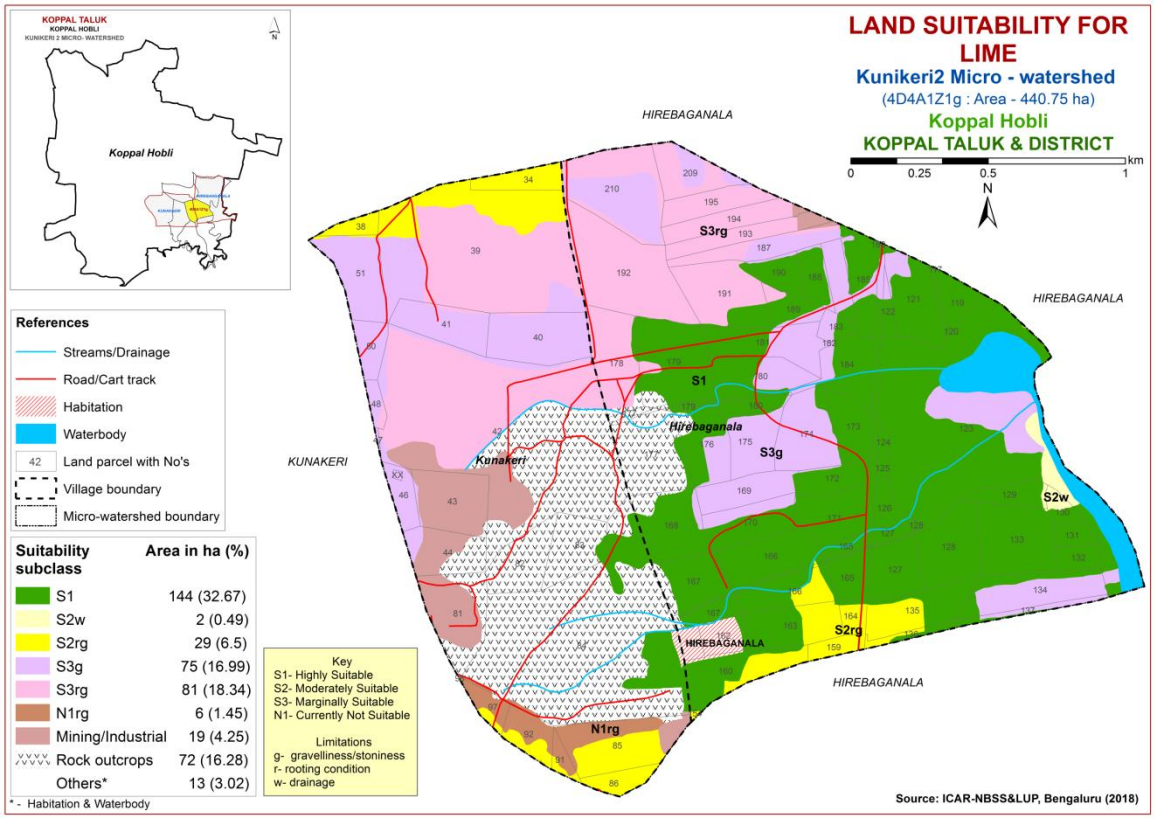


Fig. 7.20 Land Suitability map of Lime

7.21 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important medicinal crop grown in 151 ha area and distributed in almost all the districts of the State. The crop requirements for growing amla (Table 7.22) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing amla was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.21.

An area of 144 ha (33%) is highly suitable (Class S1) for growing amla and are distributed in the central and eastern part of the microwatershed. Maximum area of 186 ha (42%) has soils that are moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of rooting condition, gravelliness, texture and drainage. The marginally suitable (Class S3) lands cover an area of 6 ha (1%) and are distributed in the southern part of the microwatershed with moderate limitation of rooting condition.

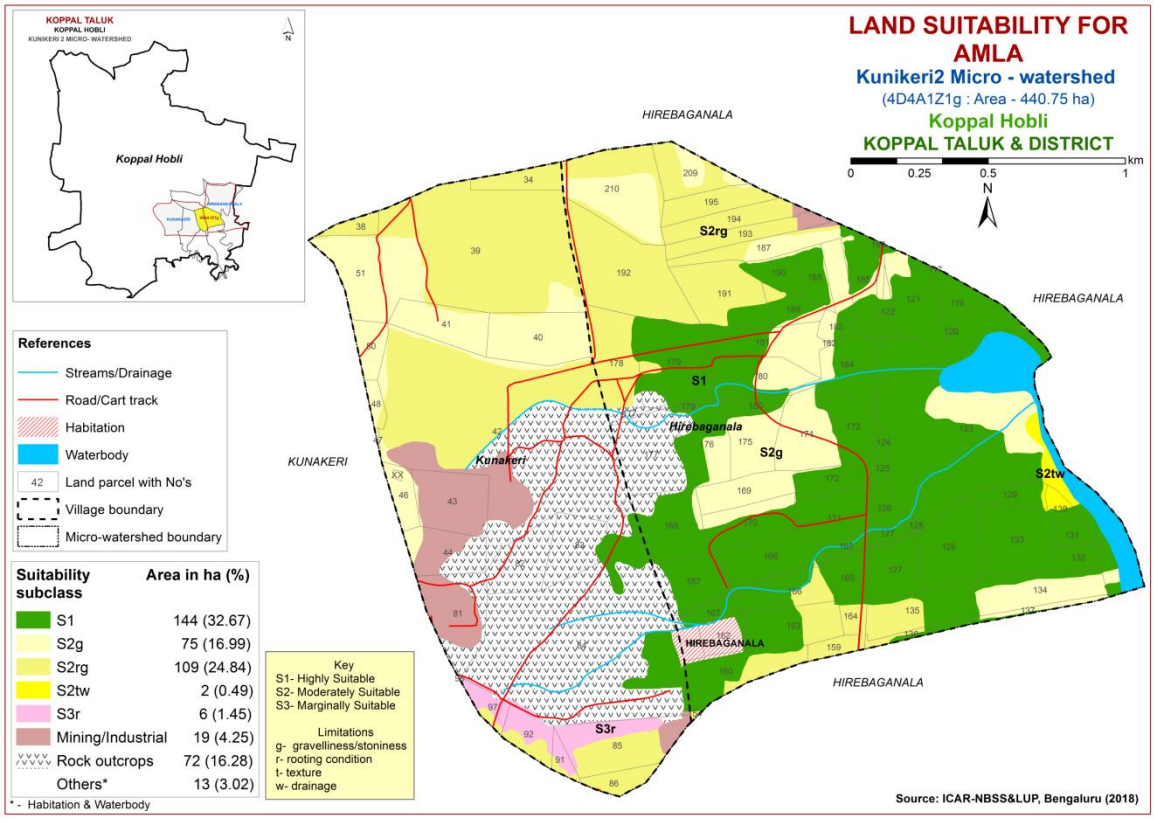


Fig. 7.21 Land Suitability map of Amla

7.22 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important nut crop grown in an area of 1.24 lakh ha in almost all the districts of the State. The crop requirements for growing cashew (Table 7.23) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cashew was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.22.

An area of 53 ha (12%) is highly suitable (Class S1) and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 120 ha (27%) and are distributed in the northern, central, northeastern and southern part of the microwatershed. They have minor limitations of texture, rooting condition and gravelliness. Marginally suitable (Class S3) lands occur in a maximum area of 156 ha (35%) for growing cashew and are distributed in the major part of the microwatershed with moderate limitations of gravelliness and rooting condition. An area of about 8 ha (2%) is currently not suitable (Class N1) for growing cashew and are distributed in the eastern and southern part of the microwaterhsed with severe limitations of texture, rooting condition and gravelliness.

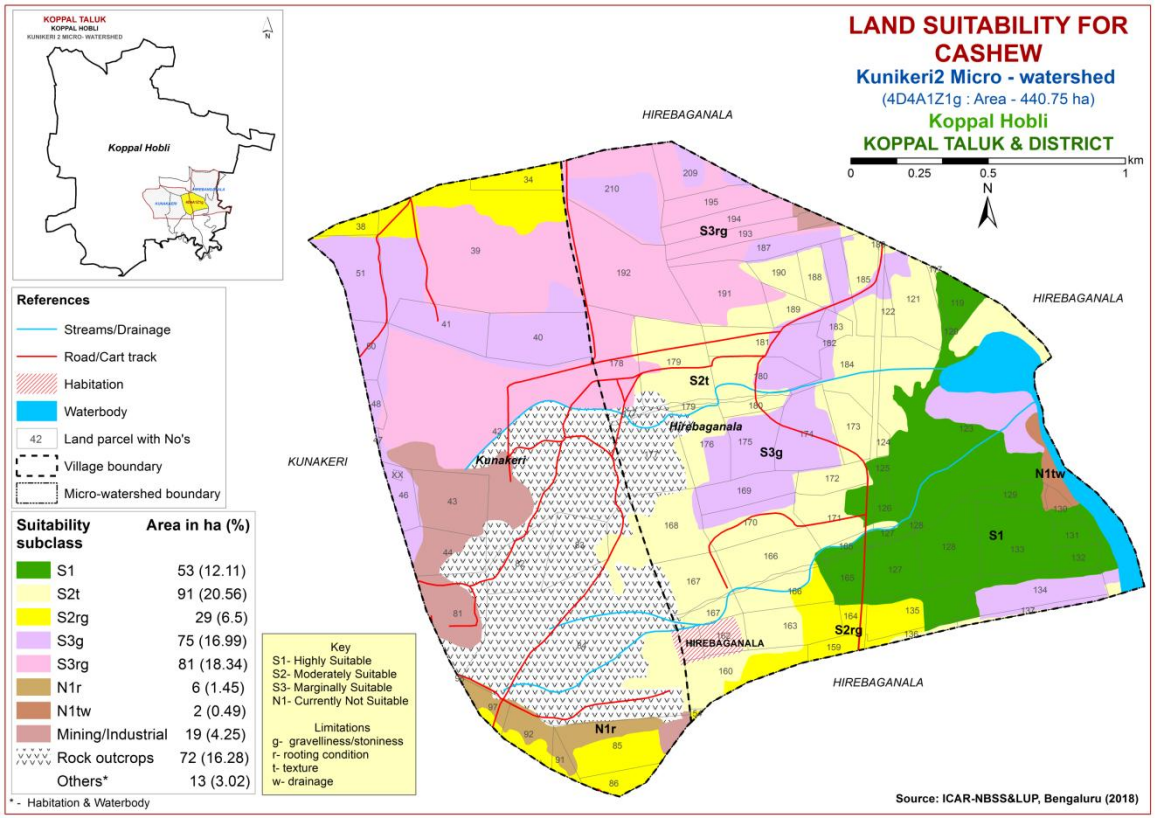


Fig. 7.22 Land Suitability map of Cashew

7.23 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is one of the most important fruit crop grown in 5368 ha in all the districts of the State. The crop requirements for growing jackfruit (Table 7.24) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jackfruit was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in figure 7.23.

An area of 144 ha (33%) is highly suitable (Class S1) and are distributed in the central and eastern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 29 ha (7%) and are distributed in the northern and southern part of the microwatershed. They have minor limitations of rooting condition and gravelliness. Marginally suitable (Class S3) lands cover a maximum area of 158 ha (36%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, rooting condition, texture and drainage. An area of 6 ha (1%) is currently not suitable (Class N1) for growing jackfruit and occur in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

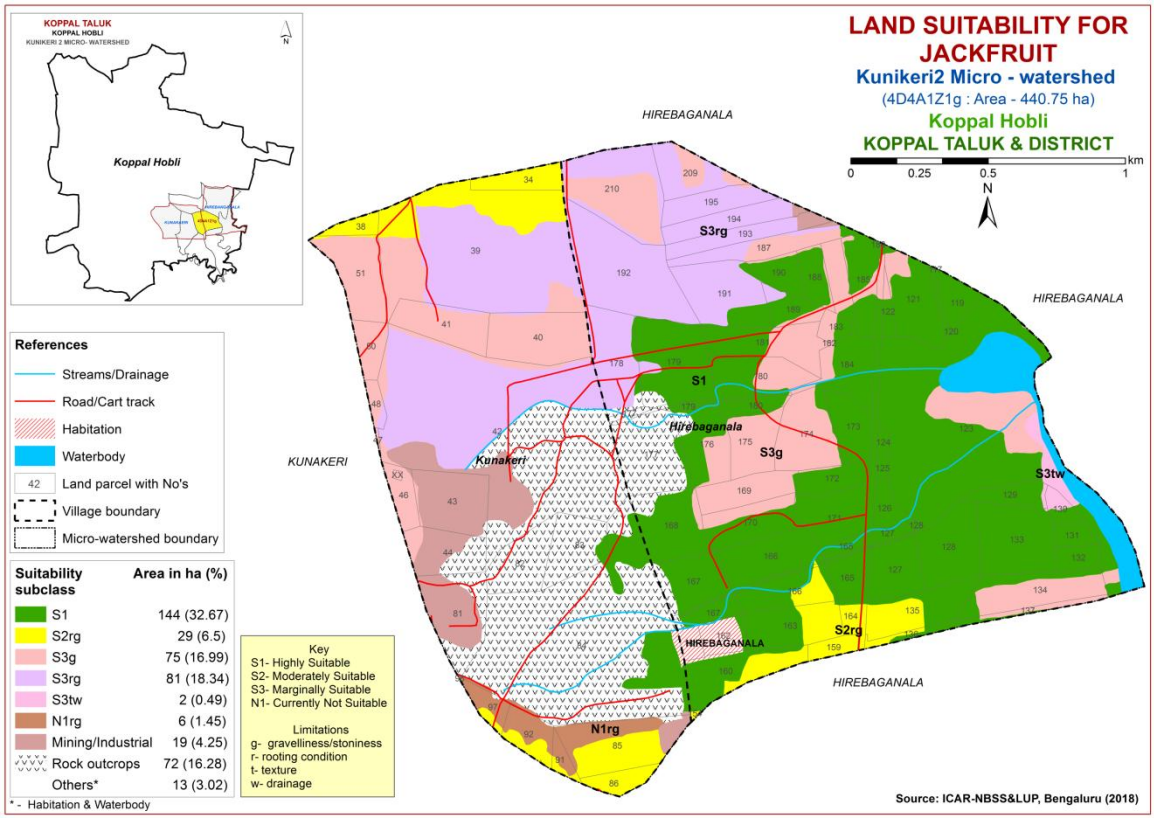


Fig. 7.23 Land Suitability map of Jackfruit

7.24 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is an important fruit crop grown in almost all the districts of the State. The crop requirements for growing jamun (Table 7.25) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jamun was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.24.

An area of 144 ha (33%) is highly suitable (Class S1) for growing jamun and are distributed in the central and eastern part of the microwatershed. An area of 31 ha (7%) is moderately suitable (Class S2) and occur in the northern, southern and eastern part of the microwatershed. They have minor limitations of rooting condition, gravelliness, texture and drainage. Marginally suitable (Class S3) lands cover a maximum area of 156 ha (35%) and are distributed in the major part of the microwatershed with moderate limitations of rooting condition and gravelliness. An area of 6 ha (1%) is currently not suitable (Class N1) for growing jamun and are distributed in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

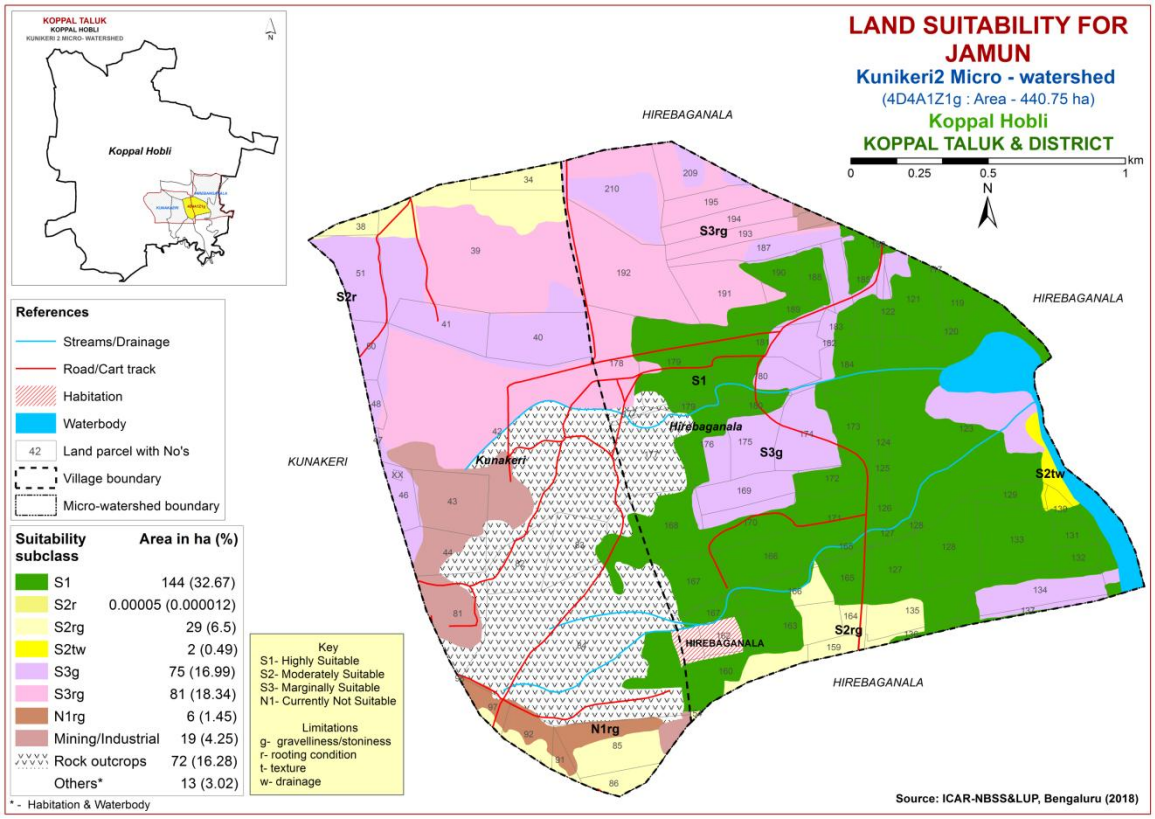


Fig. 7.24 Land Suitability map of Jamun

7.25 Land Suitability for Custard Apple (*Annona reticulata*)

Custard apple is one of the most important fruit crop grown in almost all the districts of the State. The crop requirements for growing custard apple (Table 7.26) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing custard apple was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure 7.25.

An area of 144 ha (33%) is highly suitable (Class S1) for growing custard apple and are distributed in the central and eastern part of the microwatershed. Maximum area of 186 ha (42%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, rooting condition and drainage. An area of 6 ha (1%) is marginally suitable (Class S3) for growing custard apple and are distributed in the southern part of the microwatershed with moderate limitation of rooting condition.

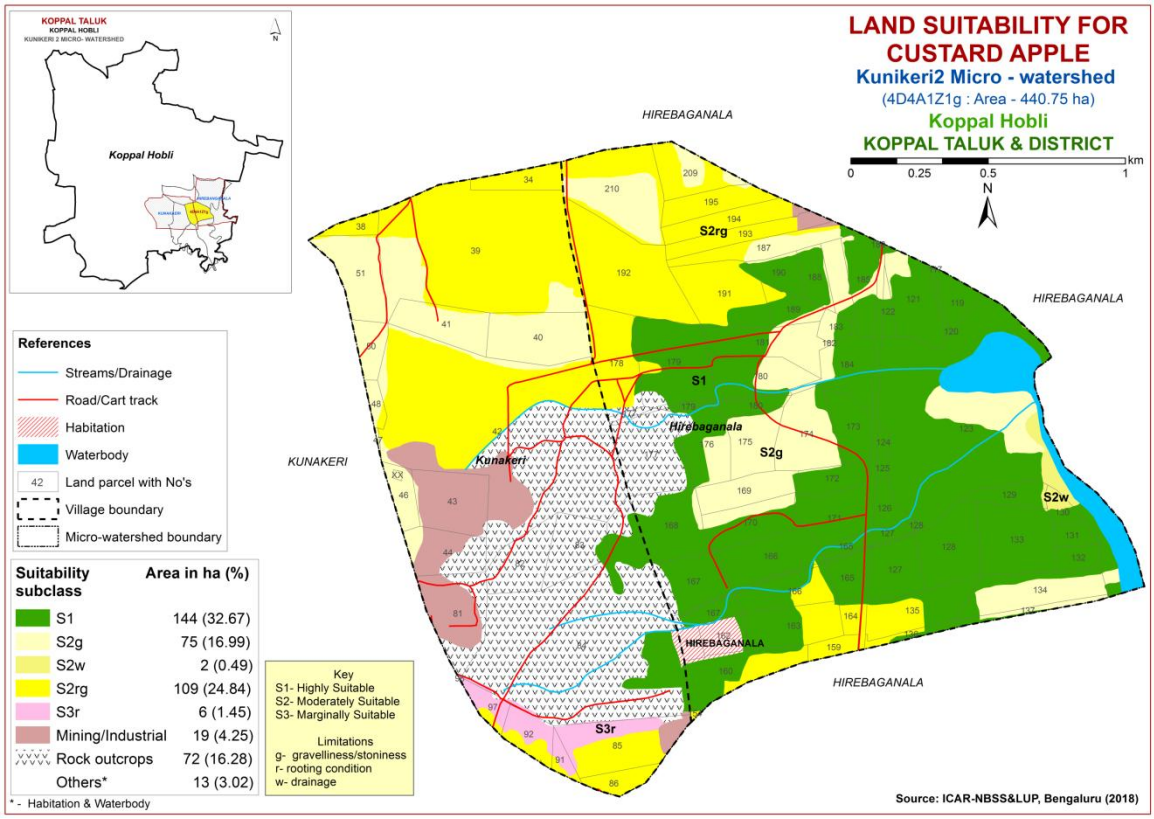


Fig. 7.25 Land Suitability map of Custard Apple

7.26 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is one of the most important spice crop grown in 14897 ha in all the districts of the State. The crop requirements for growing tamarind (Table 7.27) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tamarind was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.26.

Maximum area of 144 ha (33%) is highly suitable (Class S1) for growing tamarind and are distributed in the major part of the microwatershed. An area of 28 ha (6%) is moderately suitable (Class S2) and occur in the western and eastern part of the microwatershed. They have minor limitations of rooting condition, gravelliness, texture and drainage. An area of 78 ha (18%) is marginally suitable (Class S3) and occur in all parts of the microwatershed with moderate limitations of gravelliness and rooting condition. An area of 87 ha (20%) is currently not suitable (Class N1) and are distributed in the southern, northern and western part of the microwatershed with severe limitations of rooting condition and gravelliness.

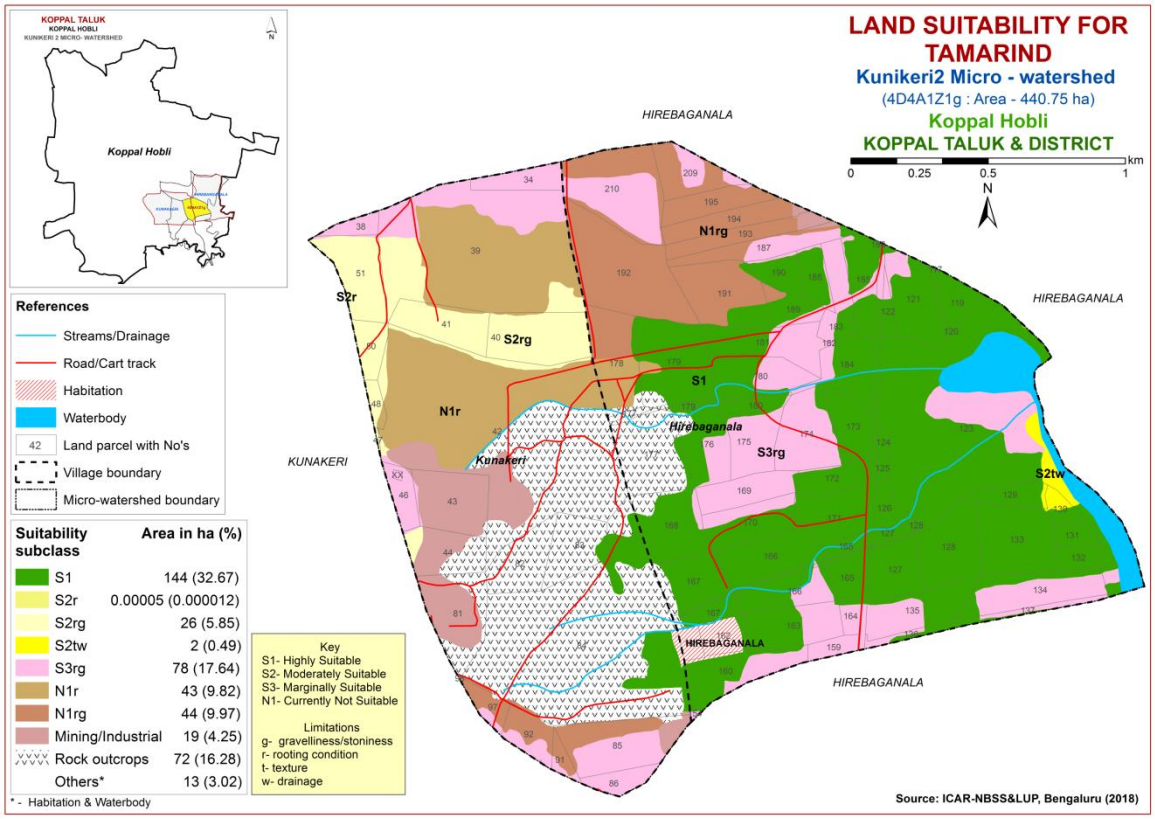


Fig. 7.26 Land Suitability map of Tamarind

7.27 Land Suitability for Mulberry (*Morus nigra*)

Mulberry is the most important leaf crop grown for rearing silkworms in about 1.66 lakh ha in all the districts of the State. The crop requirements for growing mulberry (Table 7.28) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing mulberry was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.27.

Maximum area of 144 ha (33%) is highly suitable (Class S1) for growing mulberry and are distributed in the major part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of 106 ha (24%) and are distributed in all parts of the microwatershed. They have minor limitations of gravelliness, drainage and texture. Marginally suitable (Class S3) lands cover an area of 81 ha (18%) and are distributed in the northern and western part of the microwatershed. They have moderate limitations of rooting condition and gravelliness. An area of 6 ha (1%) is currently not suitable (Class N1) and are distributed in the southern part of the microwatershed with severe limitation of rooting condition.

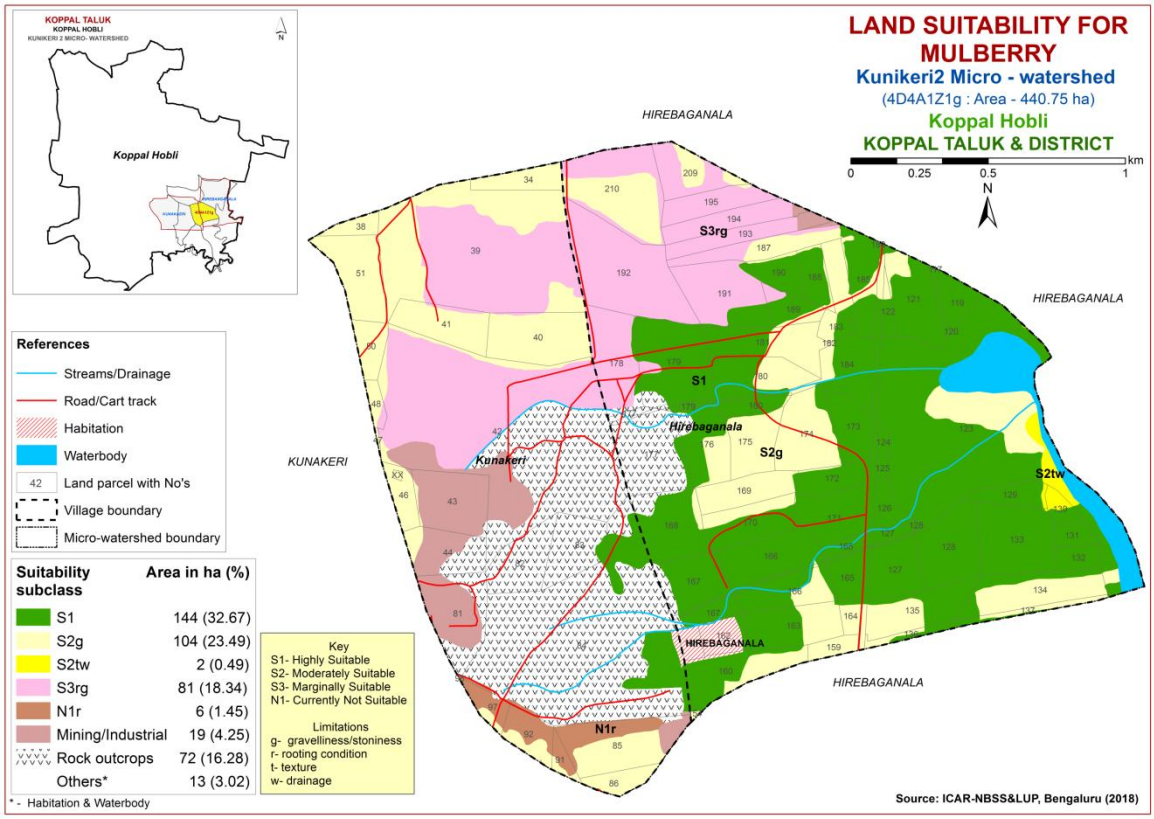


Fig. 7.27 Land Suitability map of Mulberry

7.28 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is one of the most important flower crop grown in an area of 1858 ha in almost all the districts of the State. The crop requirements for growing marigold (Table 7.29) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing marigold was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.28.

An area of 144 ha (33%) is highly suitable (Class S1) for growing marigold and are distributed in the central and eastern part of the microwatershed. An area of 45 ha (10%) is moderately suitable (Class S2) and are distributed in the eastern, western and northern part of the microwatershed. They have minor limitations of texture, drainage, rooting condition and gravelliness. An area of 147 ha (33%) is marginally suitable (Class S3) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

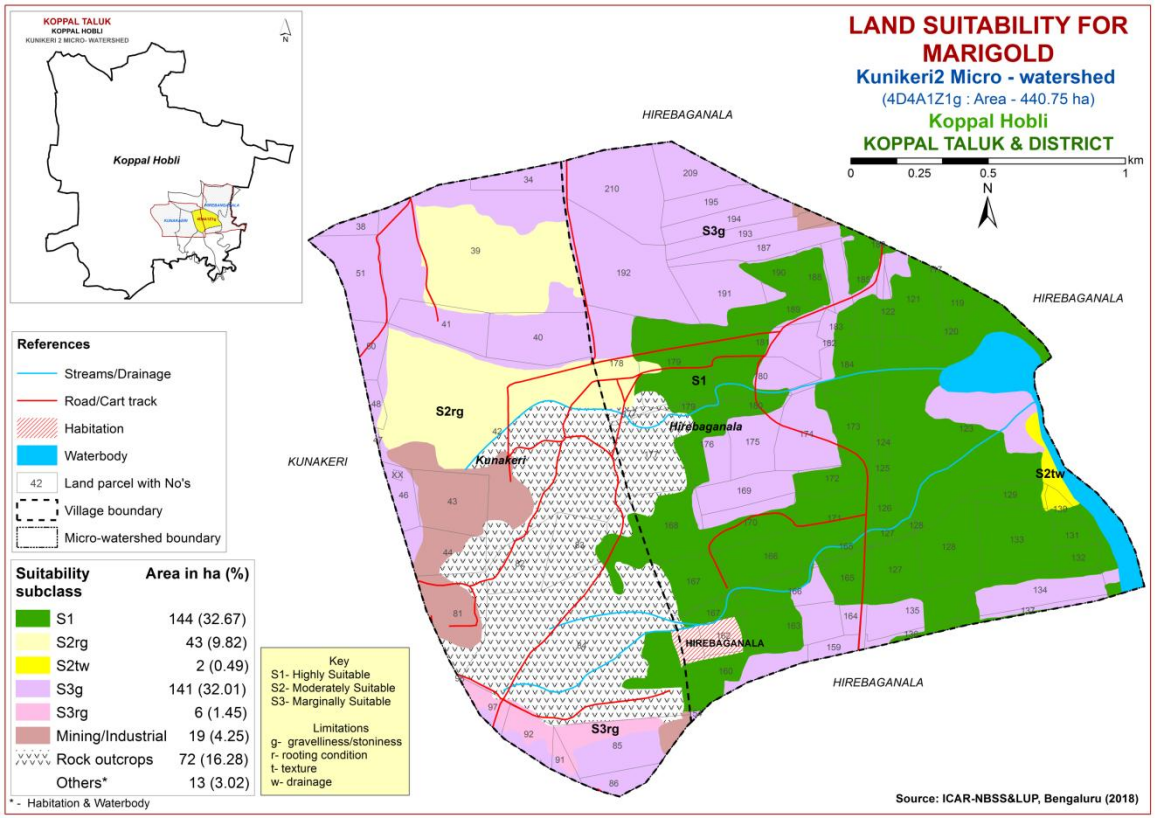


Fig. 7.28 Land Suitability map of Marigold

7.29 Land Suitability for Chrysanthemum (*Chrysanthemum indicum*)

Chrysanthemum is one of the most important flower crop grown in an area of 4978 ha in almost all the districts of the State. The crop requirements for growing chrysanthemum (Table 7.30) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing chrysanthemum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.29.

An area of 144 ha (33%) is highly suitable (Class S1) for growing chrysanthemum and are distributed in the central and eastern part of the microwatershed. An area of 45 ha (10%) is moderately suitable (Class S2) and are distributed in the eastern, northern and western part of the microwatershed. They have minor limitations of gravelliness, drainage, rooting condition and texture. Maximum area of 147 ha (33%) is marginally suitable (Class S3) for growing chrysanthemum and occur in the major part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

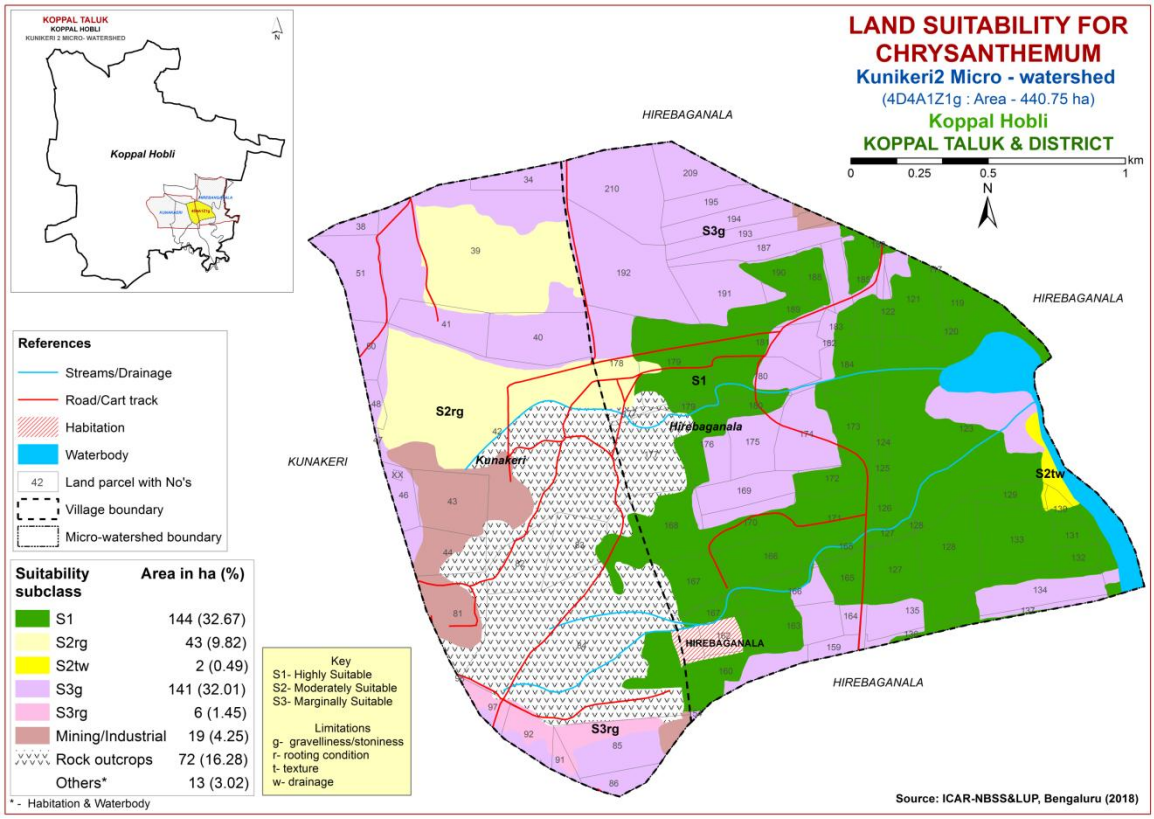


Fig. 7.29 Land Suitability map of Chrysanthemum

7. 30 Land Suitability for Jasmine *(Jasminum sp.)*

Jasmine is one of the most important flower crop grown in an area of 6146 ha in almost all the districts of the State. The crop requirements (Table 7.31) for growing jasmine were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jasmine was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.30.

An area of 144 ha (33%) is highly suitable (Class S1) for growing jasmine and are distributed in the central and eastern part of the microwatershed. An area of 43 ha (10%) is moderately suitable (Class S2) and occur in the northern and western part of the microwatershed. They have minor limitations of rooting condition and gravelliness. Maximum area of 149 ha (34%) is marginally suitable (Class S3) for growing jasmine and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, rooting condition, drainage and texture.

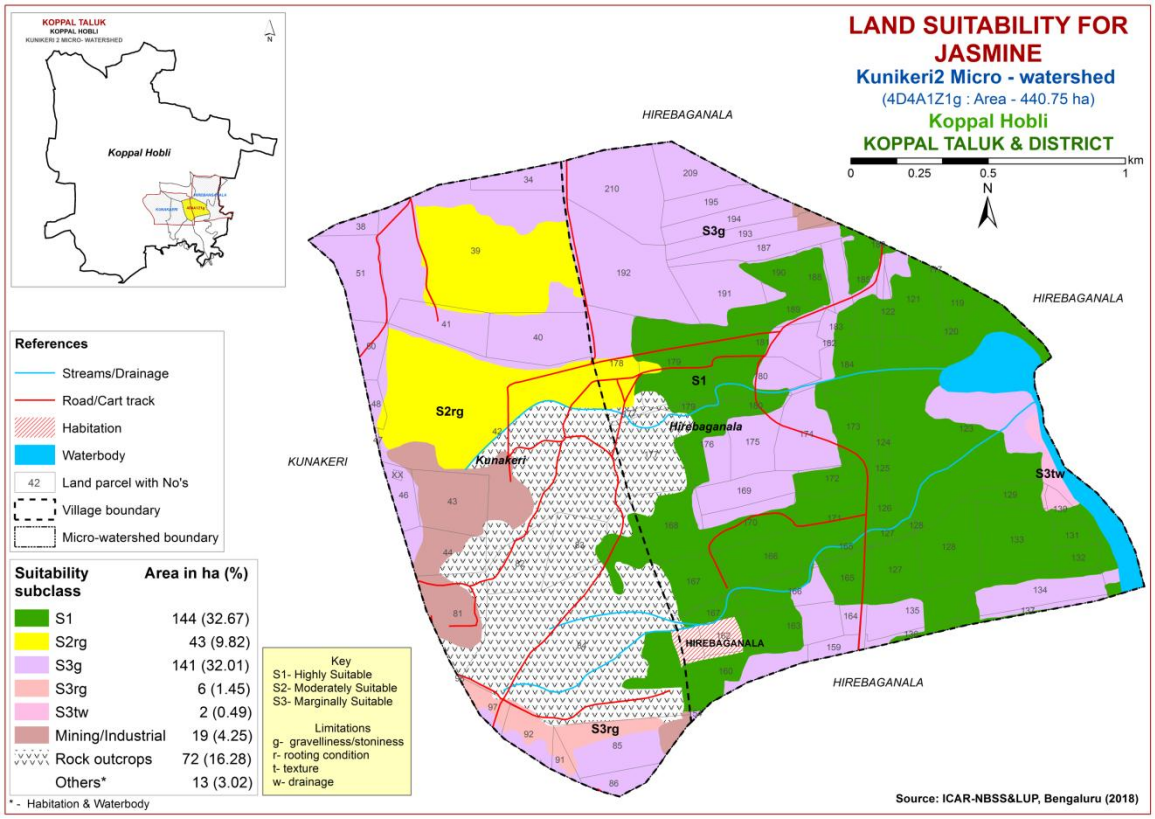


Fig. 7.30 Land Suitability map of Jasmine

7. 31 Land Suitability for Crossandra *(Crossandra in fundibuliformis)*

Crossandra is one of the most important flower crop grown in an area of 6146 ha in almost all the districts of the State. The crop requirements (Table 7.32) for growing crossandra were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing crossandra was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.31.

An area of 144 ha (33%) is highly suitable (Class S1) for growing crossandra and are distributed in the central and eastern part of the microwatershed. An area of 43 ha (10%) is moderately suitable (Class S2) and occur in the northern and western part of the microwatershed. They have minor limitations of rooting condition and gravelliness. Maximum area of 149 ha (34%) is marginally suitable (Class S3) for growing jasmine and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, rooting condition, texture and drainage.

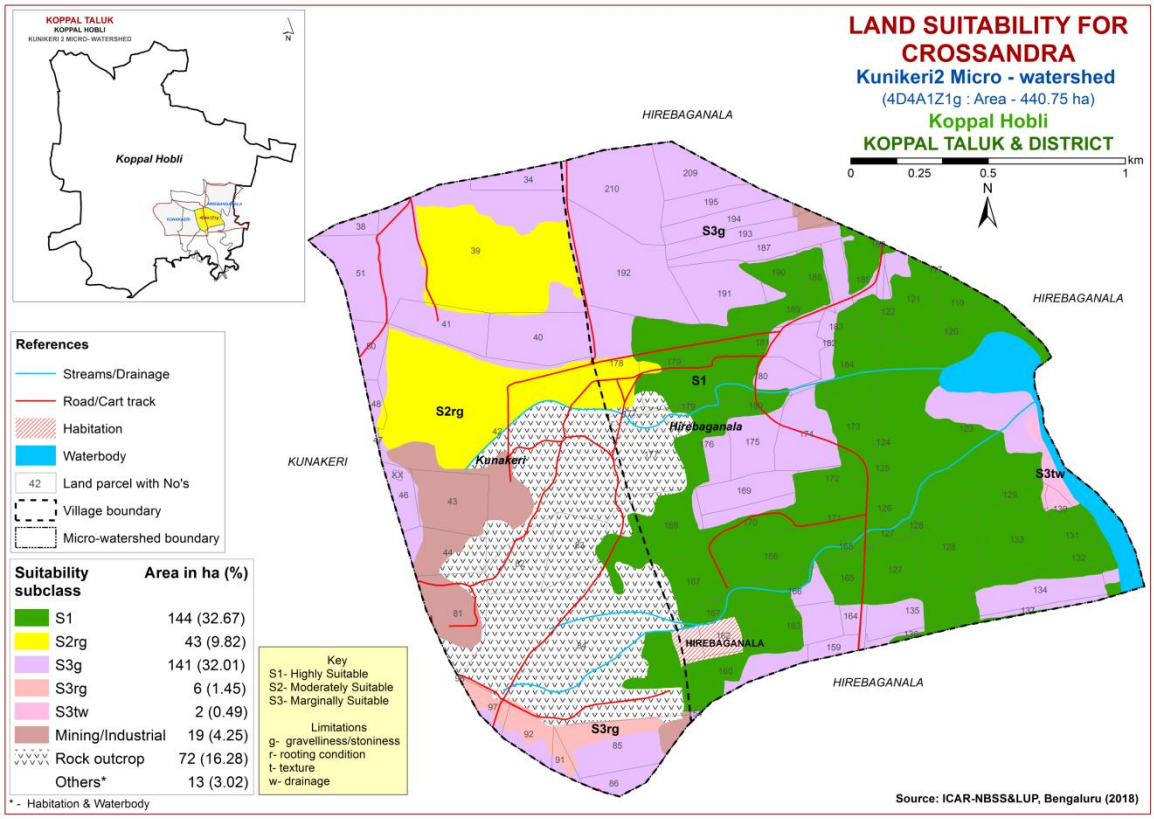


Fig. 7.31 Land Suitability map of Crossandra

Table 7.1 Soil-Site Characteristics of Kunikeri-2 Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drainage Class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m)	Slope (%)	Erosion	pH	EC	ESP	CEC [Cmol (p^+) kg^{-1}]	BS (%)
					Surf-ace	Sub-surface	Sur-face	Sub-surface								
BGTmB2g1	662	90	WD	25-50	scl	gc	15-35	>35	<50	1-3	Moderate	8.4	0.15	1.11	44.84	-
LKRiB2g1	662	90	WD	50-75	sc	gsc	-	40-60	50-100	1-3	Moderate	8.18	0.30	4.51	12.19	100
MKHcB2g2	662	90	WD	50-75	sc	gsc	35-60	>35	50-100	1-3	Moderate	7.38	0.09	1.49	14.84	93
HDHcA1g1	662	90	WD	75-100	sl	gsc	15-35	>35	50-100	0-1	Slight	6.54	0.07	7.11	5.84	84.7
HDHcB2g1	662	90	WD	75-100	sl	gsc	15-35	>35	50-100	1-3	Moderate	6.54	0.07	7.11	5.84	84.7
HDHhB2g1	662	90	WD	75-100	scl	gsc	15-35	>35	50-100	1-3	Moderate	6.54	0.07	7.11	5.84	84.7
KMHiB2	662	90	WD	100-150	sc	sc	-	<15	150-200	1-3	Moderate	7.2	0.19	0.54	15.07	100
BPRcA1	662	90	WD	100-150	sl	gsc-gc	-	>35	51-100	0-1	Slight	6.64	0.03	0.51	5.45	63.48
BPRhB2	662	90	WD	100-150	scl	gsc-gc	-	>35	51-100	1-3	Moderate	6.64	0.03	0.51	5.45	63.48
BPRhB2g1	662	90	WD	100-150	scl	gsc-gc	15-35	>35	51-100	1-3	Moderate	6.64	0.03	0.51	5.45	63.48
BPRhB2g2	662	90	WD	100-150	scl	gsc-gc	35-60	>35	51-100	1-3	Moderate	6.64	0.03	0.51	5.45	63.48
BPRiB2	662	90	WD	100-150	sc	gsc-gc	-	>35	51-100	1-3	Moderate	6.64	0.03	0.51	5.45	63.48
GDPcB2	662	90	WD	100-150	sl	gsc-gc	-	35-60	51-100	1-3	Moderate	7.88	0.10	2.87	7.8	97
GDPhB2	662	90	WD	100-150	scl	gsc-gc	-	35-60	51-100	1-3	Moderate	7.88	0.10	2.87	7.8	97
GDPiB2	662	90	WD	100-150	sc	gsc-gc	-	35-60	51-100	1-3	Moderate	7.88	0.10	2.87	7.8	97
RTRcB2	662	90	WD	>150	sl	c	-	-	150-200	1-3	Moderate	6.47	0.03	0.41	7.07	100
TSDiA1	662	90	MWD	>150	sc	c	-	-	>200	0-1	Slight	8.46	0.17	0.19	36.61	100

*Symbols and abbreviations are according to Field Guide for LRI under Sujala-III Project, Karnataka

Table 7.2 Land suitability criteria for Sorghum

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime1	Mean temperature in growing season	°C	26–30	30–34; 24–26	34–40; 20–24	>40; <20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristics					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red), c (black)	scl, cl	ls, sl	-
	pH	1:2.5	5.5-7.8	5.0-5.5 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	10-15
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.3 Land suitability criteria for Maize

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	30-34	35-38 26-30	38-40 26-20	
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc	c (red), c (black)	ls, sl	-
	pH	1:2.5	5.5-7.8	5.0-5.5 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	-
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.4 Land suitability criteria for Bajra

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-32	33-38 24-27	39-40 20-23	<20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm	500-750	400-500	200-400	<200
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl, scl, cl,sc,c (red)	C (black)	ls	-
	pH	1:2.5	6.0-7.8	5.0-5.5 7.8-9.0	5.5-6.0 >9.0	
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	15-35	35-60	>60	
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	1-3	3-5	5-10	>10

Table 7.5 Land suitability criteria for Groundnut

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	24–33	22–24; 33–35	20–22; 35–40	<20; >40
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl	sl,cl, sc	c (red), c (black), ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<35	35-60	>60	
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.6 Land suitability criteria for Sunflower

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	24–30	30–34; 20–24	34–38; 16–20	>38; <16
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	mod. Well drained	-	Poorly to very drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	cl, sc,c (red), c (black)	scl	ls, sl	-
	pH	1:2.5	6.5-7.8	7.8-8.4 5.5-6.5	8.4-9.0; 5.0-5.5	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.7 Land suitability criteria for Red gram

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	30-35(G) 20-25(AV) 15-18 (F&PS) 35-40(M)	25-30(G) 20-25 (AV) 12-15 (F&PS) 30-35(M)	20-25(G) 15-20(AV) 10-12 (F&PS) 25-30(M)	< 20 <15 <10 <25
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red)	c (black),sl, scl, cl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-9.0	5.0-5.5 >9.0	-
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-50	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<1.0	1.0-2.0	>2.0	
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.8 Land suitability criteria for Bengal gram

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	20–25	25–30; 15–20	30–35; 10–15	>35; <10
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. Well drained	Poorly drained	Very Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	C (black)	-	c (red), scl, cl, sc	ls, sl
	pH	1:2.5	6.0-7.8	5.0-6.0 7.8-9.0	>9.0	-
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	-
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.9 Land suitability criteria for Cotton

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	22-32	>32	<19	-
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well to moderately well	Poorly drained/Some what excessively drained	-	very poorly/ex cessively drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, c (red,black)	cl	scl	ls, sl
	pH	1:2.5	6.5-7.8	7.8-8.4	5.5-6.5 8.4->9.0	<5.5
	CEC	C mol (p+)Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	50-100	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	5-10	10-15	>15	
Erosion hazard	Slope	%	<3	3-5	-	>5

Table 7.10 Land suitability criteria for Chilli

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	25-32	33-35 20-25	35-38 <20	>38
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc	c (black), sl	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.11 Land suitability criteria for Tomato

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	25-28	29-32 20-24	15-19 33-36	<15 >36
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl, scl, cl, sc, c (red)	-	ls, c(black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.12 Land suitability criteria for Brinjal

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class				
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl, scl, cl, sc c (red)	-	ls, c (black)	-
	pH	1:2.5	6.0-7.3	7.3-8.4 5.0-6.0	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.13 Land suitability criteria for Onion

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	20-30	30-35	35-40	>40
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately /imperfectly	-	Poorly to V poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl,cl,sc,c (red)	-	c (Black),ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<1.0	1.0-2.0	2.0-4.0	<4
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.14 Land suitability criteria for Bhendi

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	25-28	29-32 20-24	15-19 33-36	<15 >36
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Imperfectly drained	Poorly to very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl,sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.15 Land suitability criteria for Drumstick

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, scl, cl, c (red)	sl, c (black)	ls	s
	pH	1:2.5	6.0-7.3	5.0-5.5 7.3-7.8	5.5-6.0 7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<35	35-60	60-80	>80
Soil toxicity	Salinity (EC saturation extract)	dS/m				
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-10	-	>10

Table 7.16 Land suitability criteria for Mango

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-32	24-27 33-35	36-40	20-24
	Min temp. before flowering	^{0}C	10-15	15-22	>22	-
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration	Days				
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	ls, sl, c (black)	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	75-100	<75
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.17 Land suitability criteria for Guava

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-32	33-36 24-27	37-42 20-23	
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	c (black), ls	-
	pH	1:2.5	6.0-7.8	5.0-6.0	7.8-8.4	>8.4
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.18 Land suitability criteria for Sapota

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-32	33-36 24-27	37-42 20-23	>42 <18
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	-	Poorly to very drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	ls, c (black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.19 Land suitability criteria for Pomegranate

Land use requirement			Rating			
Soil –site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N1)
Climatic regime	Mean temperature in growing season	°C	30-34	35-38 25-29	39-40 15-24	
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl,cl, sc, c (red)	c (black),sl	ls	-
	pH	1:2.5	5.5-7.8	7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.20 Land suitability criteria for Musambi

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-30	31-35 24-27	36-40 20-23	>40 <20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately drained	poorly	Very poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c	sl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.21 Land suitability criteria for Lime

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	28-30	31-35 24-27	36-40 20-23	>40 <20
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately drained	poorly	Very poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c	sl	ls	-
	pH	1:2.5	6.0-7.8	5.5-6.0 7.8-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.22 Land suitability criteria for Amla

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V. Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	c (black)	ls, sl	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15-35	35-60	60-80	-
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.23 Land suitability criteria for Cashew

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	32 to 34	28 to 32; 34 to 38	24 to 28; 38 to 40	<20; >40
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	moderately well drained	Poorly drained	Very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	sl, ls	c (black)
	pH	1:2.5	5.5-6.5	5.0-5.5 6.5-7.3	7.3-7.8	>7.8
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	<3	3-10	>10	-

Table 7.24 Land suitability criteria for Jackfruit

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. well	Poorly	V. Poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	-	sl, ls, c (black)	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10-

Table 7.25 Land suitability criteria for Jamun

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well	Mod. well	Poorly	V.Poorly
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c(red)	sl, c (black)	ls	-
	pH	1:2.5	6.0-7.8	5.0-6.0	7.8-8.4	>8.4
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	50-100	<50
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	>60
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.26 Land suitability criteria for Custard apple

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	Scl, cl, sc, c (red), c (black)	-	Sl, ls	-
	pH	1:2.5	6.0-7.3	5.5-6.0 7.3-8.4	5.0-5.5 8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15-35	35-60	60-80	-
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	>5	-

Table 7.27 Land suitability criteria for Tamarind

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl,sc, c (red)	sl, c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-7.8	7.8-8.4	>8.4
	CEC	C mol (p+)/ Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>150	100-150	75-100	<75
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	ds/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Table 7.28 Land suitability criteria for Mulberry

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	24–28	22–24; 28–32	32–38; 22–18	>38; <18
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sc, cl, scl	c (red)	c (black), sl, ls	-
	pH	1:2.5	5.5-7.3	5.0-5.5 7.8-8.4	7.3-8.4	>8.4
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>100	75-100	50-75	<50
	Stoniness	%				
	Coarse fragments	Vol %	0-35	35-60	60-80	>80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2	2-4	4-8	>8
	Sodicity (ESP)	%	<5	5-10	10-15	>15
Erosion hazard	Slope	%	0-3	3-5	5-10	>10

Note: Suitability evaluation only for Mulberry leaf not for Silk worm rearing

Table 7.29 Land suitability criteria for Marigold

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	>40 <10
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl, cl, sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.30 Land suitability criteria for Chrysanthemum

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	>40 <10
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	sl,scl, cl, sc, c (red)	c (black)	ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

Table 7.31 Land suitability criteria for Jasmine (irrigated)

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C	18-23	17-15 24-35	35-40 10-14	-
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V.Poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c (red)	sl	ls, c (black)	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

7.32 Land suitability criteria for Crossandra

Land use requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable (N1)**
Climatic regime	Mean temperature in growing season	°C				
	Mean max. temp. in growing season	°C				
	Mean min. tempt. in growing season	°C				
	Mean RH in growing season	%				
	Total rainfall	mm				
	Rainfall in growing season	mm				
Land quality	Soil-site characteristic					
Moisture availability	Length of growing period for short duration	Days				
	Length of growing period for long duration					
	AWC	mm/m				
Oxygen availability to roots	Soil drainage	Class	Well drained	Moderately well drained	-	Poorly to very poorly drained
	Water logging in growing season	Days				
Nutrient availability	Texture	Class	scl, cl, sc, c(red)	sl,	c (black),ls	-
	pH	1:2.5	6.0-7.3	5.0-6.0 7.3-8.4	8.4-9.0	>9.0
	CEC	C mol (p+)/Kg				
	BS	%				
	CaCO3 in root zone	%		<5	5-10	>10
	OC	%				
Rooting conditions	Effective soil depth	cm	>75	50-75	25-50	<25
	Stoniness	%				
	Coarse fragments	Vol %	<15	15-35	35-60	60-80
Soil toxicity	Salinity (EC saturation extract)	dS/m	<2.0	2-4	4-8	>8.0
	Sodicity (ESP)	%				
Erosion hazard	Slope	%	<3	3-5	5-10	>10

7.32 Land Management Units (LMUs)

The 17 soil map units identified in Kunikeri-2 Microwatershed have been grouped into 5 Land Management Units (LMUs) for the purpose of preparing a Proposed Crop Plan. Land Management Units are grouped based on the similarities in respect of the type of soil, the depth of the soil, the surface soil texture, gravel content, AWC, slope, erosion etc. and a Land Management Units map (Fig. 7.32) has been generated. These Land Management Units are expected to behave similarly for a given level of management.

The map units that have been grouped into five Land Management Units along with brief description of soil and site characteristics are given below.

LMU	Soil map unit number	Mapping unit	Soil and site characteristics
1	444	TSDiA1	Very deep, lowland clay soils
2	285, 201	RTRcB2, KMHiB2	Deep to very deep, red clay soils
3	220, 230, 231, 232, 239, 267, 268, 269,106, 111,123	BPRcA1, BPRhB2, BPRhB2g1, BPRhB2g2, BPRiB2, GDPcB2, GDPhB2, GDPiB2, HDHcA1g1, HDHcB2g1, HDHhB2g1	Moderately deep to deep, red gravelly sandy clay to clay soils
4	53, 86	LKRiB2, MKHhB2g2	Moderately shallow, red gravelly sandy clay to sandy clay loam soils
5	17	KGPhB2g1	Shallow, red sandy clay to sandy clay loam soils

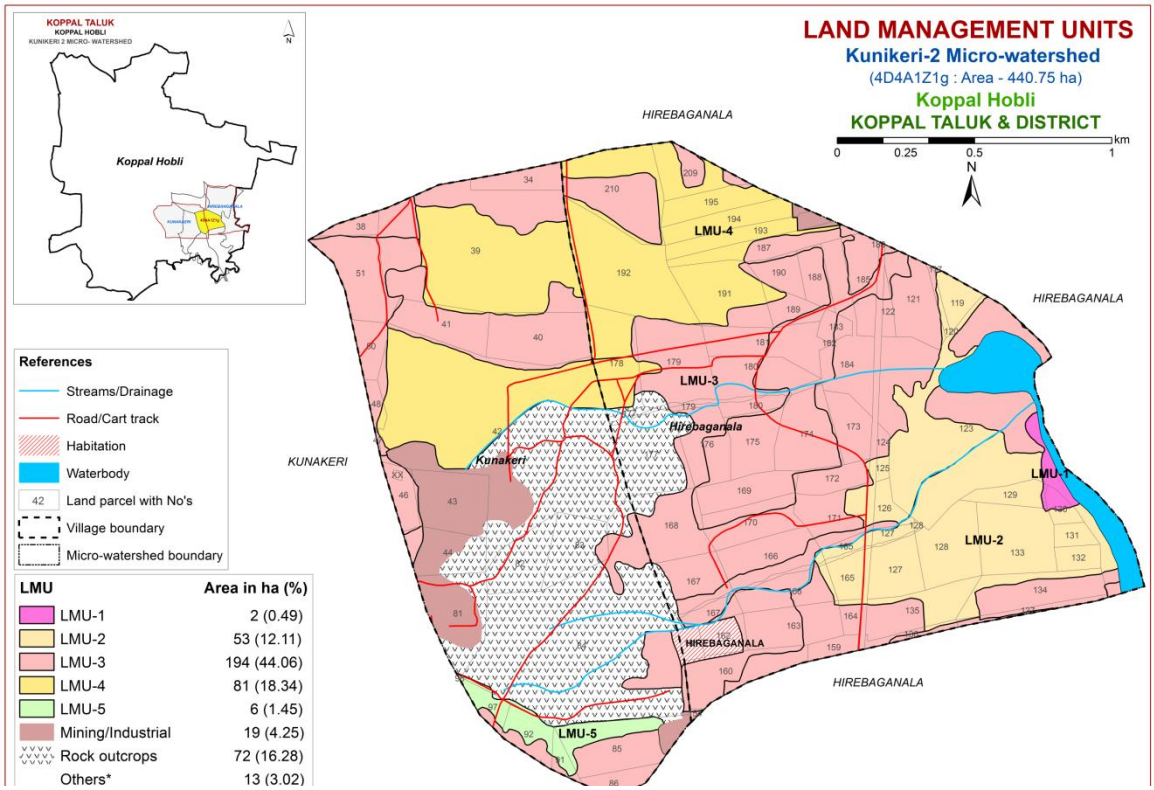


Fig 7.32 Land Management Units map of Kunikeri-2 Microwatershed

7.33 Proposed Crop Plan for Kunikeri-2 Microwatershed

After assessing the land suitability for the 31 crops, the proposed crop plan has been prepared for the 5 identified LMUs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 31 crops. The resultant proposed crop plan is presented in Table 7.33.

Table 7.33 Proposed Crop Plan for Kunikeri-2 Microwatershed

LMU	Soil Map Units	Survey Number	Soilcharacters	Field Crops	Horticulture Crops	Suitable Interventions
LMU 1 2 ha (<1%)	444.TSDiA1	**Hirebaganala:** 130,123	Very deep, lowland clay soils	Lowland Paddy, Maize, Cotton	**Fruit crops:** Custard Apple, Amla **Vegetable crops:** Brinjal, Tomato, Chillies, Drumstick, Coriander **Flower crops:** Marigold, Chrysanthemum, Jasmine	Providing proper drainage, addition of organic manures, green leaf manuring, suitable conservation practices
LMU 2 53 ha (12%)	285.RTRcB2 201.KMHiB2	**Hirebaganala:**119,120,123, 125,126,127,128,129,130,131, 132,133,135,165	Deep to very deep, red clay soils	Maize, Sorghum, Sunflower, Bajra, Finger millet, Groundnut, Red gram, Cowpea, Field bean, Castor, Mulberry	**Fruit crops:** Mango, Pomegranate, Guava, Sapota, Jackfruit, Jamun, Tamarind, Lime, Musambi, Amla, Custard apple, Cashew **Vegetable crops:** Drumstick, Tomato, Bhendi, Chilli, Brinjal, Onion, Curry leaves **Flower crops:** Marigold, Chrysanthemum, Jasmine, Crossandra	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
LMU 3 194 ha (44%)	220.BPRcA1 230.BPRhB2 231.BPRhB2g1 232.BPRhB2g2 239.BPRiB2 267.GDPcB2 268.GDPhB2 269.GDPiB2	**Hirebaganala:**117,121,122, 124,134,136,137,154,159,160,163,164,166,167,168,169,170,171,172,173,174,175, 176,179,180,181,182,183,184,185,186,187,188,189,190,210 **Kunakeri:**34,38,40,41,46,4	Moderately deep to deep, red gravelly sandy clay to clay soils	Groundnut, Bajra, Horse gram, Castor, Mulberry	**Fruit crops:** Musambi, Lime, Jamun, Jackfruit Amla, Custard apple, Tamarind **Vegetable crops:** Drumstick, Curry leaves	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)

LMU	Soil Map Units	Survey Number	Soilcharacters	Field Crops	Horticulture Crops	Suitable Interventions
	106.HDHcA1g1 111.HDHcB2g1 123.HDHhB2g1	7,48,50, 51,85,86				
LMU 4 81 ha (18%)	53.LKRiB2 86.MKHhB2g2	**Hirebaganala:**178,191,192, 193,194,195,209 **Kunakeri :**39,42	Moderately shallow, red gravelly sandy clay to sandy clay loam soils	Sorghum, Groundnut, Bajra, Castor	**Fruit crops:** Lime, Musambi, Amla, Cashew, Custard apple,	Drip irrigation, mulching, suitable soil and water conservation practices (Crescent Bunding with Catch Pit etc)
LMU 5 6 ha (1%)	17.KGPhB2g1	**Kunakeri :**91,92,97,98	Shallow, red sandy clay to sandy clay loam soils	Green gram, Black gram, Horse gram	**Agri-Silvi-Pasture:** Custard apple, Amla, Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra*	Use of short duration varieties, sowing across the slope and split application of nitrogen fertilizers

Chapter 8

SOIL HEALTH MANAGEMENT

8.1 Soil Health

Soil health is basic to plant health and plant health is basic to human and bovine health. Soil is fundamental to crop production. Without soil, no food could be produced nor would livestock be fed on a large scale. Because it is finite and fragile, soil is a precious resource that requires special care from its users.

Soil health or the capacity of the soil to function is critical to human survival. Soil health has been defined as: "the capacity of the soil to function as a living system without adverse effect on the ecosystem". Healthy soils maintain a diverse community of soil organisms that help to form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil, water and nutrient holding capacity and ultimately improve crop production and also contribute to mitigating climate change by maintaining or increasing its carbon content.

Functional interactions of soil biota with organic and inorganic components, air and water determine a soil's potential to store and release nutrients, and water to plants and to promote and sustain plant growth. Thus, maintaining soil health is vital to crop production and conserve soil resource base for sustaining agriculture.

The most important characteristics of a healthy soil are

- Good soil tilth
- Sufficient soil depth
- Good water storage and good drainage
- Adequate supply, but not excess of nutrients
- Large population of beneficial organisms
- Small proportion of plant pathogens and insect pests
- Low weed pressure
- Free of chemicals and toxins that may harm the crop
- Resistance to degradation
- Resilience when unfavourable conditions occur

Characteristics of Kunikeri-2 Microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of Giddadapalya (GDP) 91 (21%), Balapur (BPR) 75 (17%), Ranatur (RTR) 53 ha (12%, Mukhadahalli (MKH) 43 ha (10%), Lakkur (LKR) 38 ha (9%), Hooradhahalli (HDH) 28 ha (7%), Kaggalipura (KGP) 6 ha (1%), Thimmasandra (TSD) 2 ha (<1%) and Kumchahalli (KMH) occupy negligible area in the microwatershed.
- As per land capability classification, entire area in the microwatershed falls under arable land category (Class II & III). The major limitations identified in the arable lands were soil, drainage and erosion.

- On the basis of soil reaction, an area of 54 ha (12%) is slightly acid (pH 6.0-6.5), 63 ha (14%) under neutral (pH 6.5-7.3), 46 ha (10%) slightly alkaline (pH 7.3-7.8), 174 ha (39%) moderately alkaline (pH 7.8-8.4) and 1 ha (<1%) strongly alkaline (pH 8.4-9.0) in the microwatershed. Entire area in the microwatershed is acidic to neutral and alkaline in reaction.

Soil Health Management

The following actions are required to improve the current land husbandry practices that provide a sound basis for the successful adoption of sustainable crop production system.

Acid soils

Slightly acid soils cover an area of 54 ha.

1. Growing of crops suitable for a particular soil pH.
2. Ameliorating the soils through the application of amendments (liming materials).

Liming materials:

1. $CaCO_3$ (Calcium Carbonate). More than 90% use in India.
2. Dolomite [Ca Mg $(Co_3)_2$]
3. Quick lime (Cao)
4. Slaked lime [Ca $(OH)_2$]

For normal pH and pH-4.8 (35 t/ha) and pH 6 .0-7.0 (4 t/ha) lime is required.

Alkaline soils

Slightly to strongly alkaline soils cover an area of 221 ha.

1. Regular addition of organic manure, green manuring, green leaf manuring, crop residue incorporation and mulching needs to be taken up to improve the soil organic matter status.
2. Application of biofertilizers (Azospirullum, Azatobacter, Rhizobium).
3. Application of 25% extra N and P (125 % RDN&P).
4. Application of $ZnSO_4$ – 12.5 kg/ha (once in three years).
5. Application of Boron – 5 kg/ha (once in three years).

Neutral soils

Neutral soils cover about 63 ha area in the microwatershed.

1. Regular addition of organic manure, green manuring, green leaf manuring, crop residue incorporation and mulching needs to be taken up to improve the soil organic matter status.
2. Application of biofertilizers, (*Azospirullum, Azotobacter, Rhizobium*).
3. Application of 100 per cent RDF.
4. Need based micronutrient applications.

Besides the above recommendations, the best transfer of technology options are also to be adopted.

Soil Degradation

Soil erosion is one of the major factor affecting the soil health in the microwatershed. Out of total 441 ha area in the microwatershed, an area of about 18 ha (11%) is suffering from slight erosion and 319 ha (72%) is suffering from moderate erosion. The areas suffering from moderate erosion need immediate soil and water conservation and, other land development and land husbandry practices for restoring soil health.

Dissemination of Information and Communication of Benefits

Any large scale implementation of soil health management requires that supporting information is made available widely, particularly through channels familiar to farmers and extension workers. Given the very high priority attached to soil health especially by the Central Government on issuing Soil-Health Cards to all the farmers, media outlets like Regional, State and National Newspapers, Radio and Dooradarshan programs in local languages but also modern information and communication technologies such as Cellular phones and the Internet, which can be much more effective in reaching the younger farmers.

Inputs for Net Planning (Saturation Plan) and Interventions needed

Net planning (Saturation plan) in IWMP is focusing on preparation of

1. Soil and Water Conservation Treatment Plans for each plot or farm.
2. Productivity enhancement measures/ interventions for existing crops/livestock/other farm enterprises.
3. Diversification of farming mainly with perennial horticultural crops and livestock.
4. Improving livelihood opportunities and income generating activities.

In this connection, how various outputs of Sujala-III are of use in addressing these objectives of Net Planning are briefly presented below.

- **Soil Depth:** The depth of a soil decides the amount of moisture and nutrients it can hold, what crops can be taken up or not, depending on the rooting depth and the length of growing period available for raising any crop. Deeper the soil, better for a wide variety of crops. If sufficient depth is not available for growing deep rooted crops, either choose medium or short duration crops or deeper planting pits need to be opened and additional good quality soil brought from outside has to be filled into the planting pits.
- **Surface Soil Texture:** Lighter soil texture in the top soil means, better rain water infiltration, less run-off and soil moisture conservation, less capillary rise and less evaporation losses. Lighter surface textured soils are amenable to good soil tilth and are highly suitable for crops like groundnut, root vegetables (carrot, raddish, potato

etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.

- **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.
- **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion, drainage and soil are the major constraints in Kunikeri-2 Microwatershed.
- **Organic Carbon:** The OC content (an index of available Nitrogen) is low (<0.5%) in 4 ha (1%), medium (0.5-0.75%) in 72 ha (16%) and high (>0.75%) in 261 ha (59%). The areas that are low and medium in OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping.
- **Promoting green manuring:** Growing of green manuring crops costs Rs. 1250/ha (green manuring seeds) and about Rs. 2000/ha towards cultivation that totals to Rs. 3250/- per ha. On the other hand, application of organic manure @ 10 tons/ha costs Rs. 5000/ha. The practice needs to be continued for 2-3 years or more. Nitrogen fertilizer needs to be supplemented by 25% in addition to the recommended level in the area where OC is low and medium. For example, for rainfed maize, recommended level is 50 kg N per ha and an additional 12 kg /ha needs to be applied for all the crops grown in these plots.
- **Available Phosphorus:** An area of about 56 ha (13%) is medium (23-57 kg/ha) in available phosphorus. Hence for all the crops, 25% additional P-needs to be applied where it is medium. It is high (>57 kg/ha) in 281 ha (64%) in the microwatershed.
- **Available Potassium:** Available potassium is low (<145 kg/ha) in 58 ha (13%), medium (145-337 kg/ha) in 254 ha (58%) and high (>337 kg/ha) in 24 (5%) in the microwatershed. Additional 25% potassium needs to be applied in areas where it is low and medium.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. Available sulphur is low (<10 ppm) in 209 ha (47%) and medium (10-20 ppm) in 128 ha (29%) in the microwatershed. These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertitilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.
- **Available Boron:** An area of about 337 ha (76%) is low (<0.5 ppm) and <1 ha (<1%) is medium (0.5-1.0 ppm) in available boron content. The areas that are low and medium need to be applied with sodium borate @ 10 kg/ha as soil application or 0.2% borax as foliar spray to correct the deficiency.

- **Available Iron:** An area of 232 ha (53%) is deficient (<4.5 ppm) and 105 ha (24%) is sufficient (>4.5 ppm) in available iron in the microwatershed. To manage iron deficiency, iron sulphate@25 kg/ha needs to be applied for 2-3 years in the deficient areas.
- **Available Manganese:** Entire area in the microwatershed is sufficient (>1.0 ppm) in available manganese.
- **Available Copper:** Entire area is sufficient (>0.2 ppm) in available copper in the microwatershed.
- **Available Zinc:** An area of 160 ha (36%) is deficient (<0.6 ppm) in the microwatershed. Application of zinc sulphate @ 25 kg/ha is to be followed in areas that are deficient in available zinc. It is sufficient (>0.6 ppm) in an area of 176 ha (40%) in the microwatershed.
- **Soil Acidity:** The microwatershed has 54 ha (12%) area with soils that are slightly acid. These areas need application of lime (Calcium Carbonate).
- **Soil Alkalinity:** Entire area of the microwatershed has 221 ha (50%) soils that are slightly to strongly alkaline. These areas need application of gypsum and wherever calcium is in excess, iron pyrites and element sulphur can be recommended. Management practices like treating repeatedly with good quality water to drain out the excess salts and provision of subsurface drainage and growing of salt tolerant crops like Casuarina, Acasia, Neem, Ber etc, are recommended.
- **Land suitability for various crops:** Areas that are highly, moderately and marginally suitable and not suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth and salinity/alkalinity are the major constraints in various plots. With suitable management interventions, the productivity can be enhanced. In order to increase water holding capacity of light textured soils, growing of green manure crops and application of organic manure is recommended.

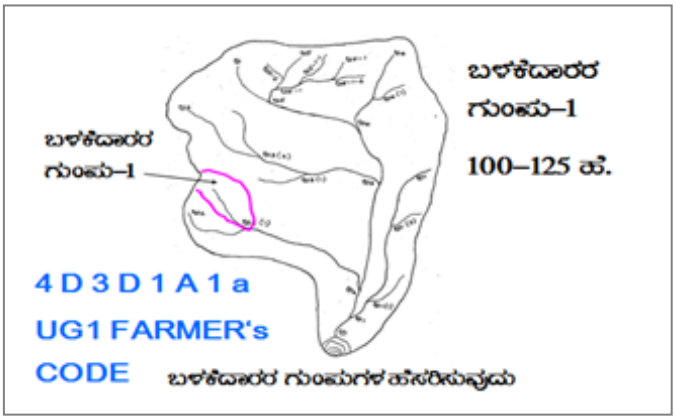
Chapter 9

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Kunikeri-2 Microwatershed, the land resource inventory database generated under Sujala-III project has been transformed as information through series of interpretative (thematic) maps using soil phase map as a base. The various thematic maps (1:7920 scale) generated were

- Soil depth
- Surface soil texture
- Available water capacity
- Soil slope
- Soil gravelliness
- Land capability
- Present land use and land cover
- Crop suitability maps
- Rainfall map
- Hydrology
- Water Resources
- Socio-economic data
- Contour plan with existing features- network of waterways, pothissa boundaries, cut up/ minor terraces etc.
- Cadastral map (1:7920 scale)
- Satellite imagery (1:7920 scale)

  Apart from these, Hand Level/ Hydro Marker/ Dumpy Level/ Total Station and Kathedars' List to be collected.



Steps for Survey and Preparation of Treatment Plan

The boundaries of Land User Groups' and Survey No. boundaries are traced in the field.

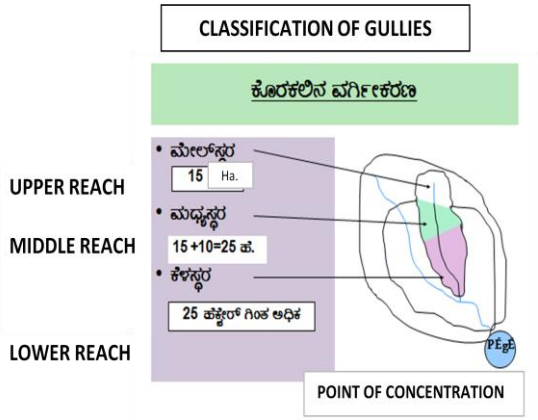
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge structures

9.1 Treatment Plan

The treatment plan recommended for arable lands is briefly described below.

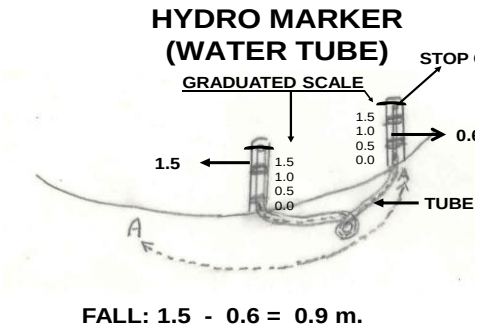
9.1.1 Arable Land Treatment

A. BUNDING

Steps for Survey and Preparation of Treatment Plan		USER GROUP-1
Cadastral map (1:7920 scale) is enlarged to a scale of 1:2500 scale Existing network of waterways, pothissa boundaries, grass belts, natural drainage lines/ watercourse, cut ups/ terraces are marked on the cadastral map to the scale Drainage lines are demarcated into		
Small gullies	(up to 5 ha catchment)	
Medium gullies	(5-15 ha catchment)	
Ravines	(15-25 ha catchment) and	
Halla/Nala	(more than 25ha catchment)	

Measurement of Land Slope

Land slope is estimated or determined by the study and interpretation of contours or by measurement in the field using simple instruments like Hand level or Hydromarker.



Vertical and Horizontal intervals between bunds as recommended by the Watershed Development Department.

Slope percentage	Vertical interval (m)	Corresponding Horizontal Distance (m)
2 - 3%	0.6	24
3 - 4%	0.9	21
4 - 5%	0.9	21
5 - 6%	1.2	21
6 - 7%	1.2	21

Note: i) The above intervals are maximum.

(ii) Considering the slope class and erosion status (A1… A= 0-1% slope, 1= slight erosion) the intervals have to be decided.

Bund length recording: Considering the contour plan and the existing grass belts/partitions, the bunds are aligned and lengths are measured.

Section of the Bund

Bund section is decided considering the soil texture class and gravelliness class (bg_0 ...b= loamy sand, g_0 = <15% gravel). The recommended sections for different soils are given below.

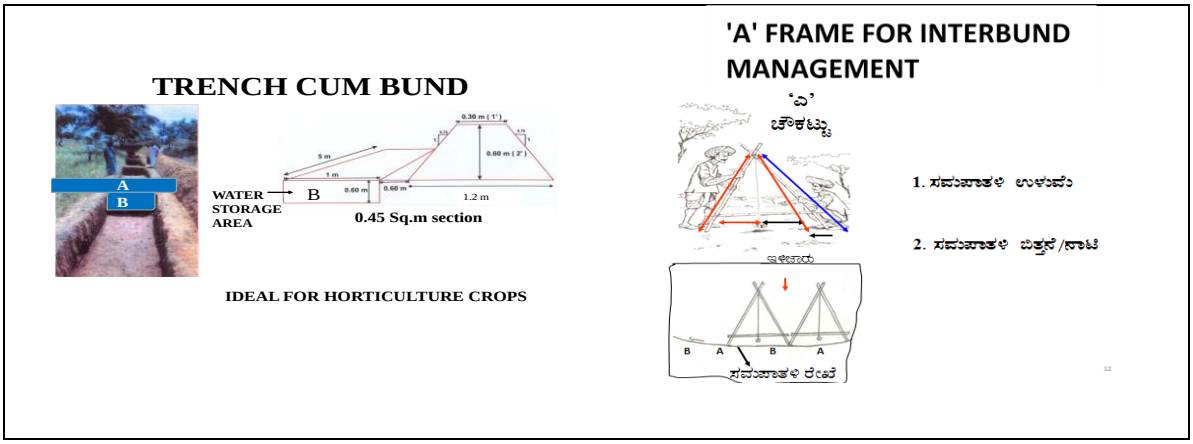
Recommended Bund Section

Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3	2.1	0.6	1.5:1	0.72	Very shallow black clayey soils	
0.45	2	0.75	01:01	0.92		
0.45	2.4	0.75	1.3:1	1.07	Shallow black clayey soils	
0.6	3.1	0.7	1.78:1	1.29	Medium black clayey soils	
0.5	3	0.85	1.47:1	1.49		

Formation of Trench cum Bund

Dimensions of the Borrow Pits/ Trenches to be excavated (machinery are decided considering the Bund Section).

Details of Borrow Pit dimensions are given below



Size of Borrow Pits/ Trench recommended for Trench cum Bund (by machinery)

Bund section	Bund length	Earth quantity	Pit				Berm (pit to pit)	Soil depth Class
m^2	m	m^3	L(m)	W(m)	D(m)	Quantity (m^3)	m	
0.375	6	2.25	5.85	0.85	0.45	2.24	0.15	Shallow
0.45	6	2.7	5.4	1.2	0.43	2.79	0.6	Shallow
0.45	6	2.7	5	0.85	0.65	2.76	1	Moderately Shallow
0.54	5.6	3.02	5.5	0.85	0.7	3.27	0.1	Moderately shallow
0.54	5.5	2.97	5	1.2	0.5	3	0.5	Shallow
0.72	6.2	4.46	6	1.2	0.7	5.04	0.2	Moderately shallow
0.72	5.2	3.74	5.1	0.85	0.9	3.9	0.1	Moderately deep

B. Waterways

a) Existing waterways are marked on the cadastral map (1:7920 scale) and their dimensions are recorded.

b) Considering the contour plan of the MWS, additional waterways/ modernization of the existing ones can be thought of.

c) The design details are given in the Manual.

C. Farm Ponds

Waterways and the catchment area will give an indication on the size of the Farm Pond. Location of the pond can be decided based on the contour plan/ field condition and farmers' need/desire.

D. Diversion Channel

Existing EPT/ CPT are marked on the cadastral map. Looking to the need, these can be modernized or fresh diversion channel can be proposed and runoff from this can be stored in *Gokatte*/ Recharge ponds.

9.1.2 Non-Arable Land Treatment

Depending on the gravelliness and crops preferred by the farmers, the concerned authorities can decide appropriate treatment plan. The recommended treatments may be Contour Trench, Staggered Trench, Crescent Bund, Boulder Bund or Pebble Bund.

9.1.3 Treatment of Natural Water Course/ Drainage Lines

a) The cadastral map has to be updated as regards the network of drainage lines (gullies/ *nalas/hallas*) and existing structures are marked to the scale and storage capacity of the existing water bodies are documented.
b) The drainage line will be demarcated into Upper Reach, Middle Reach and Lower Reach.
c) Considering the Catchment, *Nala* bed and bank conditions, suitable structures are decided.
d) Number of storage structures (Check dam/ *Nala* bund/ Percolation tank) will be decided considering the commitments and available runoff in water budgeting and quality of water in the wells and site suitability.
e) Detailed Leveling Survey using Dumpy Level / Total Station has to be carried out to arrive at the site-specific designs as shown in the Manual.
f) The location of ground water recharge structures are decided by examining the lineaments and fracture zones from geological maps.
g) Rainfall intensity data of the nearest Rain Gauge Station is considered for Hydrologic Designs.
h) Silt load to the Storage/Recharge Structures is reduced by providing vegetative, boulder and earthen checks in the natural water course. Location and design details are given in the Manual.

9.2 Recommended Soil and Water Conservation Measures

The appropriate conservation structures best suited for each of the land parcel/ survey number (Appendix-I) are selected based on the slope per cent, severity of erosion, amount of rainfall, land use and soil type. The different kinds of conservation structures recommended are

1. Graded / Strengthening of Bunds
2. Trench cum Bunds (TCB)
3. Trench cum Bunds / Strengthening
4. Crescent Bunds

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been prepared which shows the spatial distribution and extent of area. Maximum area of about 319 ha (72%) requires Trench cum Bunding and 18 ha (4%) requires Strengthening of existing bunds in the microwatershed. The conservation plan prepared may be presented to all the stakeholders including farmers and after including their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.

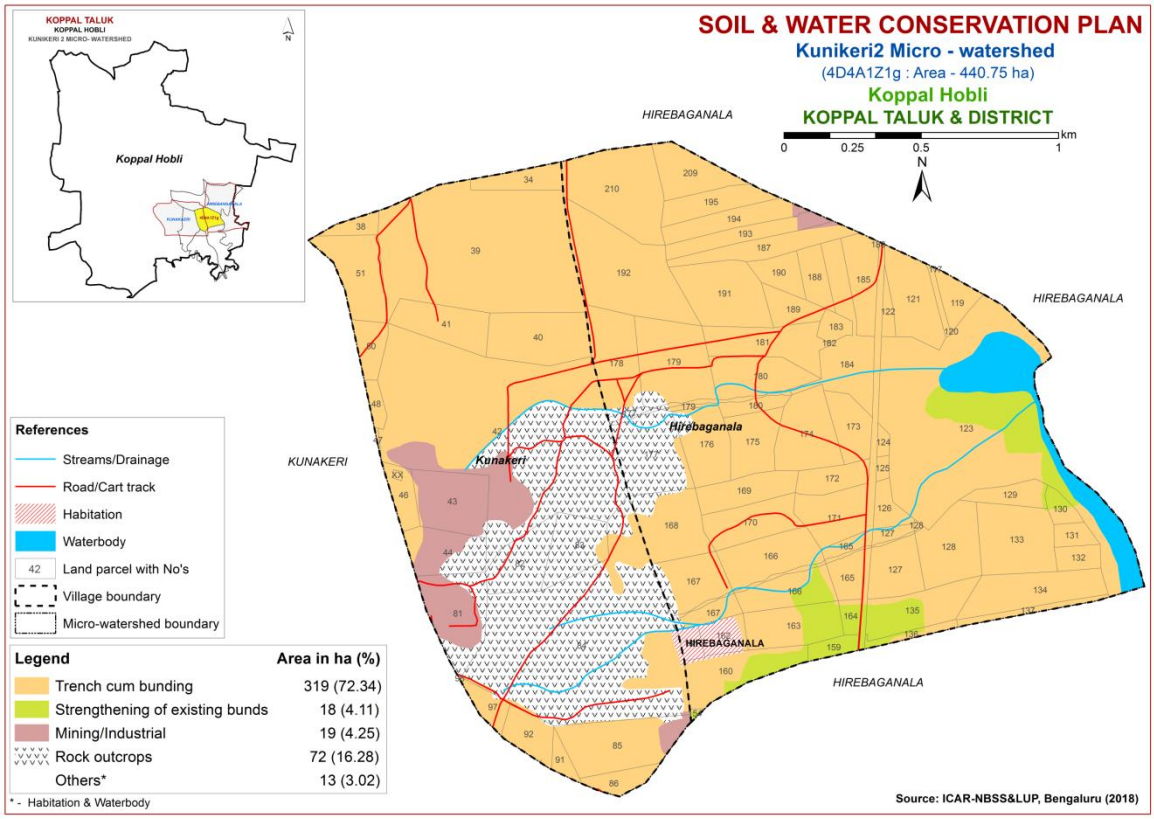


Fig. 9.1 Soil and Water Conservation Plan map of Kunikeri-2 Microwatershed

9.3 Greening of Microwatershed

As part of the greening programme in the watersheds, it is envisaged to plant a variety of horticultural and other tree plants that are edible, economical and produce lot of biomass which helps to restore the ecological balance in the watersheds. The lands that are suitable for greening programme are non-arable lands (land capability classes V, VI VII and VIII) and also the lands that are not suitable or marginally suitable for growing annual and perennial crops. The method of planting these trees is given below.

It is recommended to open the pits during the 1st week of March along the contour and heap the dug out soil on the lower side of the slope in order to harness the flowing water and facilitate weathering of soil in the pit. Exposure of soil in the pit also prevents spread of pests and diseases due to scorching sun rays. The pits should be filled with mixture of soil and organic manure during the second week of April and keep ready with sufficiently tall seedlings produced either in poly bags or in root trainer nurseries so that planting can be done during the 2nd or 3rd week of April depending on the rainfall.

The tree species suitable for the area considering rainfall, temperature and adaptability is listed below; waterlogged areas are recommended to be planted with species like Neral (*Sizyzium cumini*) and Bamboo. Dry areas are to be planted with species like Honge, Bevu, Seetaphal *etc*.

Dry Deciduous Species			Temp (°C)	Rainfall (mm)
1.	Bevu	*Azadiracta indica*	21–32	400 –1,200
2.	Tapasi	*Holoptelia integrifolia*	20-30	500 - 1000
3.	Seetaphal	*Anona Squamosa*	20-40	400 - 1000
4.	Honge	*Pongamia pinnata*	20 -50	500–2,500
5.	Kamara	*Hardwikia binata*	25 -35	400 - 1000
6.	Bage	*Albezzia lebbek*	20 - 45	500 - 1000
7.	Ficus	*Ficus bengalensis*	20 - 50	500–2,500
8.	Sisso	*Dalbargia Sissoo*	20 - 50	500 -2000
9.	Ailanthus	*Ailanthus excelsa*	20 - 50	500 - 1000
10.	Hale	*Wrightia tinctoria*	25 - 45	500 - 1000
11.	Uded	*Steriospermum chelanoides*	25 - 45	500 -2000
12.	Dhupa	*Boswella Serrata*	20 - 40	500 - 2000
13.	Nelli	*Emblica Officinalis*	20 - 50	500 -1500
14.	Honne	*Pterocarpus marsupium*	20 - 40	500 - 2000
Moist Deciduous Species			**Temp (°C)**	**Rainfall (mm)**
15.	Teak	*Tectona grandis*	20 - 50	500-5000
16.	Nandi	*Legarstroemia lanceolata*	20 - 40	500 - 4000
17.	Honne	*Pterocarpus marsupium*	20 - 40	500 - 3000
18.	Mathi	*Terminalia alata*	20 -50	500 - 2000
19.	Shivane	*Gmelina arboria*	20 -50	500 -2000
20.	Kindal	*T.Paniculata*	20 - 40	500 - 1500
21.	Beete	*Dalbargia latifolia*	20 - 40	500 - 1500
22.	Tare	*T. belerica*	20 - 40	500 - 2000
23.	Bamboo	*Bambusa arundinasia*	20 - 40	500 - 2500
24.	Bamboo	*Dendrocalamus strictus*	20 – 40	500 – 2500
25.	Muthuga	*Butea monosperma*	20 - 40	400 - 1500
26.	Hippe	*Madhuca latifolia*	20 - 40	500 - 2000
27.	Sandal	*Santalum album*	20 - 50	400 - 1000
28.	Nelli	*Emblica officinalis*	20 - 40	500 - 2000
29.	Nerale	*Sizyzium cumini*	20 - 40	500 - 2000
30.	Dhaman	*Grevia tilifolia*	20 - 40	500 - 2000
31.	Kaval	*Careya arborea*	20 - 40	500 - 2000
32.	Harada	*Terminalia chebula*	20 - 40	500 - 2000

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Appendix I

Kunikeri-2 (1Z1g) Microwatershed

Soil Phase Information

Village	Survey No	lArea (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Hirebaganala	117	0.02	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Sugarcane (Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	119	1.89	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIe	Trench cum bunding
Hirebaganala	120	0.01	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	121	5.21	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Sugarcane (Mz+Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	122	0.78	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	123	42.97	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Waterbody	Not Available	IIe	Trench cum bunding
Hirebaganala	124	0.45	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Sugarcane (Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	125	0.4	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Sugarcane (Sc)	Not Available	IIe	Trench cum bunding
Hirebaganala	126	1.53	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Sugarcane (Sc)	Not Available	IIe	Trench cum bunding
Hirebaganala	127	4.43	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	3 Borewell	IIe	Trench cum bunding
Hirebaganala	128	5.7	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Sugarcane (Mz+Sc)	Not Available	IIe	Trench cum bunding
Hirebaganala	129	2.07	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	130	1.12	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	131	1.17	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	132	1.43	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	133	6.74	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy+Maize (Pd+Mz)	Not Available	IIe	Trench cum bunding
Hirebaganala	134	6.09	BPRiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	135	5.14	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	1 Borewell	IIe	Trench cum bunding
Hirebaganala	136	0.99	HDHcA1g1	LMU-3	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Nearly level (0-1%)	Slight	Sugarcane (Sc)	Not Available	IIs	Graded bunding
Hirebaganala	137	1.18	BPRiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	154	0.13	HDHcA1g1	LMU-3	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Nearly level (0-1%)	Slight	Marigold (Mg)	Not Available	IIs	Graded bunding
Hirebaganala	159	1.16	HDHcA1g1	LMU-3	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Nearly level (0-1%)	Slight	Current fallow (Cf)	Not Available	IIs	Graded bunding

Village	Survey No	lArea (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Hirebaganala	160	5.45	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	161	0.89	Habitation	Others	Others	Others	Others	Others	Others	Others	Current fallow (Cf)	Not Available	Others	Others
Hirebaganala	162	2.05	Habitation	Others	Others	Others	Others	Others	Others	Others	Current fallow (Cf)	Not Available	Others	Others
Hirebaganala	163	4.89	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	164	0.89	HDHcA1g1	LMU-3	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Nearly level (0-1%)	Slight	Paddy (Pd)	Not Available	IIs	Graded bunding
Hirebaganala	165	2.61	RTRcB2	LMU-2	Very deep (>150 cm)	Sandy loam	Non gravelly (<15%)	High (151-200 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy (Pd)	Not Available	IIe	Trench cum bunding
Hirebaganala	166	9.02	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Current fallow (Bj+Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	167	5.83	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	168	5.76	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	169	3.61	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Teak (Te)	Not Available	IIIes	Trench cum bunding
Hirebaganala	170	4.48	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	171	4.34	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Maize (Bj+Mz)	1 Borewell	IIIes	Trench cum bunding
Hirebaganala	172	2.41	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	173	3.07	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Sugarcane (Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	174	5.72	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Teak (Mz+Tk)	Not Available	IIIes	Trench cum bunding
Hirebaganala	175	3.97	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	176	4.65	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	177	7.01	RO	RO	RO	RO	RO	RO	RO	RO	Maize (Mz)	Not Available	RO	RO
Hirebaganala	178	5.99	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	179	7.97	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Maize (Cf+Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	180	5.77	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Maize (Cf+Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	181	5.3	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Redgram (Mz+Rg)	Not Available	IIIes	Trench cum bunding
Hirebaganala	182	0.02	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding

Village	Survey No	lArea (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Hirebaganala	183	1.06	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	184	6.59	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	185	3.58	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	186	0.02	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize (Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	187	3.97	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Sugarcane (Mz+Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	188	2.06	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	189	2.11	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	190	2.09	GDPiB2	LMU-3	Deep (100-150 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIIes	Trench cum bunding
Hirebaganala	191	6.71	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Current fallow (Bj+Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	192	11.7	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Hirebaganala	193	3.25	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Maize+Teak (Bj+Mz+Te)	Not Available	IIIes	Trench cum bunding
Hirebaganala	194	3.52	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Maize+Teak (Bj+Mz+Te)	Not Available	IIIes	Trench cum bunding
Hirebaganala	195	3.21	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Maize (Bj+Mz)	Not Available	IIIes	Trench cum bunding
Hirebaganala	209	3.97	LKRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Sugarcane (Mz+Sc)	Not Available	IIIes	Trench cum bunding
Hirebaganala	210	9.55	BPRhB2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Teak (Cf+Te)	Not Available	IIIes	Trench cum bunding
Kunakeri	34	2.37	HDHhB2g1	LMU-3	Moderately deep (75-100 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra (Bj)	Not Available	IIes	Trench cum bunding
Kunakeri	38	1.16	HDHcB2g1	LMU-3	Moderately deep (75-100 cm)	Sandy loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIes	Trench cum bunding
Kunakeri	39	30.1	MKHhB2g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay loam	Very gravelly (35-60%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Mango (Bj+Mn)	Not Available	IIIes	Trench cum bunding
Kunakeri	40	6.6	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bunding
Kunakeri	41	4.57	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Mango (Mn)	Not Available	IIIes	Trench cum bunding
Kunakeri	42	45.74	MKHhB2g2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay loam	Very gravelly (35-60%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Industrial area (Cf+Ia)	Not Available	IIIes	Trench cum bunding
Kunakeri	43	5.7	MI	MI	MI	MI	MI	MI	MI	MI	Industrial area (Ia)	Not Available	MI	MI
Kunakeri	44	4.37	MI	MI	MI	MI	MI	MI	MI	MI	Industrial area (Ia)	Not Available	MI	MI
Kunakeri	46	1.88	BPRhB2g2	LMU-3	Deep (100-150 cm)	Sandy clay loam	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding

Village	Survey No	lArea (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kunakeri	47	0.09	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Kunakeri	48	0.89	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Kunakeri	50	2.02	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Kunakeri	51	5.32	BPRhB2g1	LMU-3	Deep (100-150 cm)	Sandy clay loam	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Bajra+Maize (Bj+Mz)	Not Available	IIIes	Trench cum bunding
Kunakeri	81	6.43	MI	MI	MI	MI	MI	MI	MI	MI	Industrial area (Ia)	Not Available	MI	MI
Kunakeri	82	4.39	RO	RO	RO	RO	RO	RO	RO	RO	Industrial area (Ia)	Not Available	RO	RO
Kunakeri	83	4.35	RO	RO	RO	RO	RO	RO	RO	RO	Industrial area (Ia)	Not Available	RO	RO
Kunakeri	84	38.85	RO	RO	RO	RO	RO	RO	RO	RO	Industrial area (Ia)	Not Available	RO	RO
Kunakeri	85	7.4	HDHhB2g1	LMU-3	Moderately deep (75-100 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIes	Trench cum bunding
Kunakeri	86	1.74	HDHhB2g1	LMU-3	Moderately deep (75-100 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIes	Trench cum bunding
Kunakeri	91	0.91	KGPhB2g1	LMU-5	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Industrial area (Ia)	Not Available	IIIes	Trench cum bunding
Kunakeri	92	2.64	KGPhB2g1	LMU-5	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Kunakeri	97	1.57	KGPhB2g1	LMU-5	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding
Kunakeri	98	0	KGPhB2g1	LMU-5	Shallow (25-50 cm)	Sandy clay loam	Gravelly (15-35%)	Very Low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Trench cum bunding

MI-mining/industrial

Appendix II

Kunikeri-2 (1Z1g) Microwatershed

Soil Fertility Information

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Hirebag anala	117	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	119	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	120	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	121	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	122	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	123	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	124	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	125	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	126	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	127	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	128	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	129	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	130	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	131	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	132	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	133	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	134	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	135	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	136	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	137	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Low (<145 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	154	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	159	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Hirebag anala	160	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	161	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Hirebag anala	162	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Hirebag anala	163	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	164	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	165	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	166	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	167	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	168	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	169	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	170	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	171	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	172	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	173	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	174	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	175	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	176	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	177	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Hirebag anala	178	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	179	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	180	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Medium (10 – 20 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	181	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	182	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	183	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Hirebag anala	184	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	185	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	186	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	187	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	188	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	189	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	190	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	191	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	192	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Hirebag anala	193	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	194	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	195	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	209	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Hirebag anala	210	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	High (> 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	34	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	38	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	39	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	40	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	41	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	42	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	43	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	44	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	46	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	47	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kunakeri	48	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	50	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	51	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	81	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	82	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	83	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	84	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	85	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	86	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (> 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Sufficient (> 0.6 ppm)
Kunakeri	91	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	High (> 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	92	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	97	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Medium (145 – 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kunakeri	98	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Low (< 0.5 %)	Medium (23 – 57 kg/ha)	Low (<145 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (>4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Appendix III

Kunikeri-2 (1Z1g) Microwatershed

Soil Suitability Information

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion
Hireba ganala	117	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	119	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	120	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	121	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	122	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	123	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	124	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	125	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	126	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	127	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	128	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	129	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	130	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	131	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	132	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	133	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	134	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2gt	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	135	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	136	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion
Hireba ganala	137	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2gt	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	154	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g
Hireba ganala	159	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g
Hireba ganala	160	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	161	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Hireba ganala	162	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others	Others
Hireba ganala	163	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	164	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g
Hireba ganala	165	S1	S2t	S1	S1	S1	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t	S2t	S1	S1	S1	S2t
Hireba ganala	166	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	167	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	168	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	169	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	170	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	171	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	172	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	173	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	174	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	175	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	176	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	177	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion
Hireba ganala	178	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	179	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	180	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	181	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	182	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	183	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	184	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	185	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	186	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	187	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Hireba ganala	188	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	189	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	190	S1	S1	S1	S1	S2t	S1	S1	S1	S2t	S1	S1	S1	S1	S1	S2t	S1	S1	S2t	S1	S1	S1	S1	S1	S1	S1	S2tg	S2g	S1	S1	S1	S2tg
Hireba ganala	191	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	192	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	193	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	194	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	195	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	209	N1rg	S3rg	S3rg	S3rg	S3rg	S3g	N1rg	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S3rg	S3g	S3g	S3g	S3g	S3rg	S2rg	S3g	S3g	S3g	S3g	S3rg	S3rg	S3g
Hireba ganala	210	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunak eri	34	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion
Kunakeri	38	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g
Kunakeri	39	N1r	S2rg	S3rg	S2rg	S3rg	S2rg	N1r	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2rg	S3g	S3g	S2rg	S3rg	S3rg	S3g
Kunakeri	40	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	41	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	42	N1r	S2rg	S3rg	S2rg	S3rg	S2rg	N1r	S3rg	S2rt	S3rg	S3rg	S2rg	S3rg	S2rg	S3rg	S3rg	S3rg	S2rg	S2rg	S2rg	S2rg	S2rg	S3rg	S2rg	S2rg	S3g	S3g	S2rg	S3rg	S3rg	S3g
Kunakeri	43	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	44	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	46	S3rg	S3g	S3g	S3g	S3g	S3g	S3rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	47	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	48	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	50	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	51	S3rg	S3g	S3g	S3g	S3g	S3g	S2rg	S3g	S3g	S3g	S3g	S2g	S3g	S2g	S3g	S3g	S3g	S2g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g	S2g	S3g	S2g	S2g	S2g
Kunakeri	81	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial	Mining/Industrial
Kunakeri	82	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	83	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	84	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO	RO
Kunakeri	85	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g

Village	Survey Number	Mango	Maize	Sapota	Sorghum	Guava	Cotton	Tamarind	Lime	Bengal gram	Sunflower	Red gram	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Bhendi	Brinjal	Crossandra	Drumstick	Mulberry	Onion
Kunakeri	86	S3rg	S3g	S2rg	S3g	S2rg	S3rg	S3rg	S2rg	S3g	S3rg	S3g	S2rg	S2rg	S2rg	S2rg	S2rg	S2rg	S2g	S3g	S3g	S3g	S3g	S2rg	S2g	S3g	S3g	S3g	S3g	S3g	S2g	S3g
Kunakeri	91	N1rg	S3rg	N1rg	S3rg	N1rg	S3rt	N1rg	N1rg	S3rt	S3rg	N1rg	S3r	N1rg	S3r	N1r	N1rg	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3r	S3rg	S3r	S3r	S3rg	N1r	N1r	S3r
Kunakeri	92	N1rg	S3rg	N1rg	S3rg	N1rg	S3rt	N1rg	N1rg	S3rt	S3rg	N1rg	S3r	N1rg	S3r	N1r	N1rg	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3r	S3rg	S3r	S3r	S3rg	N1r	N1r	S3r
Kunakeri	97	N1rg	S3rg	N1rg	S3rg	N1rg	S3rt	N1rg	N1rg	S3rt	S3rg	N1rg	S3r	N1rg	S3r	N1r	N1rg	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3r	S3rg	S3r	S3r	S3rg	N1r	N1r	S3r
Kunakeri	98	N1rg	S3rg	N1rg	S3rg	N1rg	S3rt	N1rg	N1rg	S3rt	S3rg	N1rg	S3r	N1rg	S3r	N1r	N1rg	N1rg	S3rg	S3rg	S3rg	S3rg	S3rg	N1rg	S3r	S3rg	S3r	S3r	S3rg	N1r	N1r	S3r

RO-ROCK OUTCROPS

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

CONTENTS

LIST OF TABLES

Chapter 1

FINDINGS OF THE SOCIO-ECONOMIC SURVEY

- *The survey was conducted in Kunikeri-2 is located at North latitude 15^0 18' 9.483" and 15^0 16' 46.442" and East longitude 76^0 14' 59.98" and 76^0 13' 26.382" covering an area of about 440.89 ha coming under Kunakeri and Hirebaganala villages of Koppal taluk.*
- *Socio-economic analysis of Kunikeri-2 micro watersheds of Karkihalli sub-watershed, Koppala taluk & District indicated that, out of the total sample of 34 total respondents, 11 (32.35 %) were marginal, 10 (29.41%)were small, 6 (17.65 %) were Semi medium and 2 (5.88 %) were medium farmers.*
- *The population characteristics of households indicated that, there were 73 (56.15%) men and 57 (43.85 %) were women.*
- *Majority of the respondents (40.00%) were in the age group of 16-35 years.*
- *Education level of the sample households indicated that, there were 46.15 per cent illiterates, 52.31 per cent pre university education and 3.08 per cent attained graduation.*
- *About, 82.35 per cent of household heads practicing agriculture and 20.59 per cent of the household heads were engaged as agricultural labourers.*
- *Agriculture was the major occupation for 59.23 per cent of the household members.*
- *In the study area, 88.24 per cent of the households possess katcha house and 0.00 per cent possess pucca house.*
- *The durable assets owned by the households showed that, 88.24 per cent possess TV, 2.94 per cent possess mixer grinder, 85.29 per cent possess mobile phones and 23.53 per cent possess motor cycles.*
- *Farm implements owned by the households indicated that, 14.71 per cent of the households possess plough, 2.94 per cent possess tractor and 2.94 per cent possess sprayer.*
- *Regarding livestock possession by the households, 14.71 per cent possess local cow and 2.94 per cent possess buffalo.*
- *The average labour availability in the study area showed that, own labour men available in the micro watershed was 2.33, women available in the micro watershed was 2.90, hired labour (men) available was 11.37 and hired labour (women) available was 10.4.*
- *Out of the total land holding of the sample respondents 90.79 per cent (42.23 ha) of the area is under dry condition and the remaining 9.21 per cent area is irrigated land.*
- *There were 2.00 live bore wells and 1.00 dry bore wells among the sampled households.*

- *Bore/open well was the major source of irrigation for 5.88 per cent of the households.*
- *The major crops grown by sample farmers are Maize, Bajra, Cowpea and Sunflower and cropping intensity was recorded as 93.02 per cent.*
- *The per hectare cost of cultivation for Maize, Bajra, Cowpea, Sunflower and 0 was Rs.28244.35 , 30308.95, 8072.04 and 41631.88 with benefit cost ratio of 1:1.40, 1: 1.20, 1: 4.20 and 1: 2.30 respectively.*
- *Further, 2.94 per cent of the households have opined that the green fodder was adequate.*
- *The average annual gross income of the farmers was Rs. 57382.35 in micro-watershed, of which Rs. 44852.94 comes from agriculture.*
- *Sampled households have grown 5 horticulture trees and 22 forestry trees together in the fields and back yards.*
- *Regarding marketing channels, 88.24 per cent of the households have sold agricultural produce to the local/village merchants.*
- *Further, 88.24 per cent of the households have used tractor for the transport of agriculture commodity.*
- *Majority of the farmers (73.53%) have experienced soil and water erosion problems in the watershed and 8.82 per cent of the households were interested towards soil testing.*
- *Fire was the major source of fuel for domestic use for 100.00 per cent of the households.*
- *Piped supply was the major source for drinking water for 94.12 per cent of the households.*
- *Electricity was the major source of light for 100.00 per cent of the households.*
- *In the study area, 97.06 per cent of the households possess toilet facility.*
- *Regarding possession of PDS card, 100.00 per cent of the households possessed BPL card.*
- *Households opined that, the requirement of cereals (100.00%), pulses (97.06%) and oilseeds (20.59%) are adequate for consumption.*
- *Farming constraints experienced by households in the micro watersheds were lower fertility status of the soil (85.29%) wild animal menace on farm field (11.76%), frequent incidence of pest and diseases (70.59%), high cost of fertilizers and plant protection chemicals (38.24%), high rate of interest on credit (20.59%), low price for the agricultural commodities (52.94%), lack of marketing facilities in the area (29.41%), inadequate extension services (5.88%), lack of transport for safe transport of the agricultural produce to the market(23.53%) and Less rainfall (2.94%).*

Chapter 2

INTRODUCTION

Soil and water are the two precious natural resources which are essential for crop production and existence of life on earth. Rainfed agriculture is under severe stress due to various constraints related to agriculture like uneven and erratic distribution of rainfall, indiscriminate use of fertilizers, chemicals and pesticides, adoption of improper land management practices, soil erosion, decline in soil fertility, decline in ground water resources leading to low crop productivity. The area under rainfed agriculture has to be managed effectively using the best available practices to enhance the production of food, fodder and fuel. This is possible if the land resources are characterized at each parcel of land through detailed land resource inventory using the best available techniques of remote sensing, GPS and GIS. The watershed development programs are aimed at the sustainable distribution of its resources and the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal and human communities within a watershed boundary.

World Bank funded KWDP II, SUJALA III project was implemented in with Broad objective of demonstrating more effective watershed management through greater integration of programmes related to rain-fed agriculture, innovative and science based approaches and strengthen institutional capacities and If successful, it is expected that the systems and tools could be mainstreamed into the overall IWMP in the State of Karnataka and in time, throughout other IWMP operations in India. With this background the socio-economic survey has been carried out with following specific objectives:

1. To understand the demographic features of the households in the micro-watershed
2. To understand the extent of family labour available and additional employment opportunities available within the village.
3. To know the status of assets of households in the micro-watershed for suggesting possible improvements.
4. To study the cropping pattern, cropped area and productivity levels of different households in micro-watershed.
5. To determine the type and extent of livestock owned by different categories of HHs
6. Availability of fodder and level of livestock management.

Scope and importance of survey

Survey helps in identification of different socio-economic and resource use-patterns of farmers at the Micro watershed. Household survey provides demographic features, labor force, and levels of education; land ownership and asset position (including livestock and other household assets) of surveyed households; and cropping patterns, input intensities, and average crop yields from farmers' fields. It also discusses crop utilization and the degree of commercialization of production in the areas; farmers' access to and utilization of credit from formal and informal sources; and the level of adoption and use of soil, water, and pest management technologies.

Chapter 3

METHODOLOGY

The description of the methods, components selected for the survey and procedures followed in conducting the baseline survey are furnished under the following heads.

1. Description of the study area

Koppal district is an administrative district in the state of Karnataka in India. In the past Koppal was referred to as 'Kopana Nagara'. Koppal, now a district headquarters is ancient Kopana a major holy place of the Jainas. The district occupies an area of 7,190 km² and has a population of 1,196,089, which 16.58% were urban as of 2001. The Koppal district was formed after split of Raichur district.

Geographers are very particular about the physiography or relief of a region. It plays a very important role in the spatial analysis of agricultural situation of the study area. The undulating topography with black cotton soil shrips, cut across by numerous nalas or streams is the major characteristic feature of the study region. Three physiographic divisions have made considering the local conditions of landforms and crops grown in the district. On the basis of physiography, Koppal district can be divided into three major divisions. They are (a) Koppal & Yelburga plateau, (b) Maidan division, (c) Tungabhadra valley. The district is part of Krishna basin the main streams draining the area are Maskinala, Ilkal-nadi and Hirenala. These are Ephemaral in nature, these come under Tungabhadra sub-basin. The drainage exhibit dentritic to subdentric with drainage density varies from 1.4 to7.0kms/sq.km.

According to the 2011 census Koppal district has a population of 1,391,292, roughly equal to the nation of Swaziland or the US state of Hawaii. This gives it a ranking of 350th in India (out of a total of 640). The district has a population density of 250 inhabitants per square kilometre (650/sq mi). Its population growth rate over the decade 2001-2011 was 16.32%.Koppal has a sex ratio of 983 females for every 1000 males, and a literacy rate of 67.28%.

2. Locale of the survey and description of the micro-watershed and

The study was conducted in Kunikeri-2 micro-watershed (Karkihalli sub-watershed, Koppala taluk & District) is located at North latitude 15^0 18’ 9.483” and 15^0 16’ 46.442” and East longitude 76^0 14’ 59.98" and 76^0 13’ 26.382”covering an area of about 440.89 ha bounded by under Kunakeri and Hirebaganala Villages.

3. Selection of the respondents for the study

The micro-watershed is marked with 320 square meters grids. One farmer from every alternate grid in the micro-watershed was selected for the study and interviewed for socio-economic data. Totally 34 households were interviewed for the survey.

4. The parameters considered for socio-economic survey of households

Two forms of data were collected from the micro-watershed which includes primary data from the farm households and secondary data about the villages under the micro-watershed jurisdiction.

The following parameters were considered for the primary data collection about the socio-economic data of the households, (1) Demographic information, (2) Farm and durable assets owned by households, (3) Livestock possession, (4) Labour availability, (5) Level of migration in the village, Land holding, (7) Cropping pattern, (8) Source of irrigation, (9) Borrowing status, (10) Cost of cultivation of major crops, (11) Economics of subsidiary activities, (12) Fodder availability, (13) Family annual income from different sources, (14) Horticulture and forestry species grown, (15) Additional investment capacity, (16) Marketing practices, (17) Status of soil and water conservation structure, (18) Access to basic needs and (19) Constraints and suggestion.

The following parameters were considered for the secondary data regarding the villages under the micro-watershed jurisdiction, (1) Number of villages in each micro-watershed jurisdiction, (2) Village wise number of households, (3) Geographical area of the villages, (4) Cultivable are a including rainfed and irrigated, (5) Number and type of house in each village, (6) Human and livestock population, (7) Facilities in the village such as roads, transport facility for conveyance, drinking water supply, street light and (8) Community based organizations in the villages.

5. Development of interview schedule and data collection

Taking into the consideration the objectives of the survey, an interview schedule was prepared after thorough consultation with the experts in the field of social sciences. A comprehensive interview schedule covering all the major parameters for measuring the socio-economic situation was developed.

6. Tools used to analyze the data

The statistical components such as frequency and percentage were used to analyze the data.

Abbreviations used in the report

LL=Landless
MF=Marginal Farmers
SF=Small farmers
SMF=Semi medium farmers
MDF=Medium farmers
LF=Large Farmers

Chapter 4

FINDINGS OF THE SURVEY

This chapter deals with systematic presentation of results of the survey. Keeping in view the objectives, the salient features of the survey are presented under the following headings.

Households sampled for socio-economic survey: The data on households sampled for socio economic survey in Kunikeri-2 Micro watershed is presented in Table 1 and it indicated that 34 farmers were sampled in Kunikeri-2 micro-watershed among households surveyed 11 (32.35%) were marginal, 10 (29.41%) were small, 6 (17.65 %) were semi medium and 2 (5.88 %) were medium farmers. 5 landless farmers were also interviewed for the survey.

Table 1. Households sampled for socio economic survey in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Farmers	5	14.7	11	32.4	10	29.4	6	17.7	2	5.88	34	100

Population characteristics: The population characteristics of households sampled for socio-economic survey in Kunikeri-2 Micro watershed is presented in Table 2. The data indicated that, there were 73 (56.15%) men and 57 (43.85%) were women.

Table 2. Population characteristics in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (19)		MF (41)		SF (39)		SMF (22)		MDF (9)		All (130)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Men	10	52.6	23	56	22	56	13	59.1	5	55.6	73	56.2
2	Women	9	47.4	18	44	17	44	9	40.9	4	44.4	57	43.9
Total		19	100	41	100	39	100	22	100	9	100	130	100
Average		3.8		3.7		3.9		3.7		4.5		3.8	

Age wise classification of population: The age wise classification of household members in Kunikeri-2 Micro watershed is presented in Table 3. The indicated that, 25 (19.23%) of population were 0-15 years of age, 52 (40.00%) were 16-35 years of age, 34(26.15%) were 36-60 years of age and 19 (14.62 %) were above 61 years of age.

Table 3: Age wise classification of members of the household in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (19)		MF (41)		SF (39)		SMF (22)		MDF (9)		All (130)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	0-15 years of age	2	10.5	10	24.4	10	25.6	2	9.09	1	11	25	19.23
2	16-35 years of age	6	31.6	17	41.5	16	41	10	45.45	3	33	52	40
3	36-60 years of age	8	42.1	6	14.6	9	23.1	7	31.82	4	44	34	26.15
4	> 61 years	3	15.8	8	19.5	4	10.3	3	13.64	1	11	19	14.62
Total		19	100	41	100	39	100	22	100	9	100	130	100

Education level of household members: Education level of household members in Kunikeri-2 Micro watershed is presented in Table 4. The results indicated that, there were 46.15 per cent of illiterates, 23.85 per cent of them had primary school education, 3.85 per cent middle school education, 10.77 per cent high school education, 6.92 per cent of them had PUC education, 0.77 per cent of them had Diploma, 3.08 per cent attained graduation, and 2.31 them had other education.

Table 4. Education level of members of the household in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (19)		MF (41)		SF (39)		SMF (22)		MDF (9)		All (130)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Illiterate	10	52.6	13	31.7	17	43.6	12	54.6	8	88.89	60	46.2
2	Primary School	7	36.8	11	26.8	10	25.6	2	9.09	1	11.11	31	23.9
3	Middle School	1	5.26	3	7.32	1	2.56	0	0	0	0	5	3.85
4	High School	1	5.26	6	14.6	4	10.3	3	13.6	0	0	14	10.8
5	PUC	0	0	3	7.32	3	7.69	3	13.6	0	0	9	6.92
6	Diploma	0	0	0	0	1	2.56	0	0	0	0	1	0.77
7	ITI	0	0	2	4.88	1	2.56	0	0	0	0	3	2.31
8	Degree	0	0	2	4.88	1	2.56	1	4.55	0	0	4	3.08
9	Others	0	0	1	2.44	1	2.56	1	4.55	0	0	3	2.31
Total		19	100	41	100	39	100	22	100	9	100	130	100

Occupation of head of households: The data regarding the occupation of the household heads in Kunikeri-2 Micro watershed is presented in Table 5. The results indicate that, 82.35 per cent of household's heads were practicing agriculture and 20.59 per cent of the household heads were agricultural Labour.

Table 5: Occupation of heads of households in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	0	0	10	91	9	90	7	117	2	100	28	82.35
2	Agricultural Labour	5	100	1	9.1	1	10	0	0	0	0	7	20.59
Total		5	100	11	100	10	100	7	100	2	100	35	100

Table 6: Occupation of members of the household in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (19)		MF (41)		SF (39)		SMF (22)		MDF (9)		All (130)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	0	0	26	63.4	24	61.54	19	86.36	8	89	77	59.2
2	Agricultural Labour	16	84.2	2	4.88	2	5.13	0	0	0	0	20	15.4
3	Government Service	0	0	0	0	0	0	1	4.55	0	0	1	0.77
4	Private Service	0	0	0	0	2	5.13	0	0	0	0	2	1.54
5	Student	3	15.8	12	29.3	10	25.64	1	4.55	1	11	27	20.8
6	Children	0	0	1	2.44	1	2.56	1	4.55	0	0	3	2.31
Total		19	100	41	100	39	100	22	100	9	100	130	100

Occupation of the members of the household: The data regarding the occupation of the household members in Kunikeri-2 Micro watershed is presented in Table 6. The results

indicate that, agriculture was the major occupation for 59.23 per cent of the household members, 15.38 per cent were agricultural labour, 0.77 per cent were working in government sector, 1.54 per cent were working private services, 20.77 per cent were working in pursuing education and 2.31 per cent were children's.

Institutional Participation of household members: The data regarding the institutional participation of the household members in Kunikeri-2 Micro watershed is presented in Table 7. The results show that, out of the total family members in the households 100 per cent were not participating in any of the institutions.

Table 7: Institutional Participation of household member in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (19)		MF (41)		SF (39)		SMF (22)		MDF (9)		All (130)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	No Participation	19	100	41	100	39	100	22	100	9	100	130	100
Total		19	100	41	100	39	100	22	100	9	100	130	100

Type of house owned: The data regarding the type of house owned by the households in Kunikeri-2 Micro watershed is presented in Table 8. The results indicate that, 8.82 percent possess thatched house and 88.24 per cent of the households possess katcha house.

Table 8. Type of house owned by households in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Thatched	0	0	1	9.1	2	20	0	0	0	0	3	8.82
2	Katcha	5	100	10	91	8	80	6	100	1	50	30	88.24
Total		5	100	11	100	10	100	6	100	1	100	33	100

Durable assets owned by the households: The data regarding the Durable Assets owned by the households in Kunikeri-2 Micro watershed is presented in Table 9. The results shows that, 88.24 per cent possess TV, 23.53 per cent possess motor cycle, 2.94 per cent possess Landline Phone and DVD/VCD player, 85.29 per cent possess mobile phones.

Table 9. Durable assets owned by households in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Television	4	80	10	91	8	80	6	100	2	100	30	88.24
2	DVD/VCD Player	1	20	0	0	0	0	0	0	0	0	1	2.94
3	Mixer/Grinder	0	0	0	0	0	0	0	0	1	50	1	2.94
4	Motor Cycle	2	40	2	18	2	20	1	17	1	50	8	23.53
5	Mobile Phone	3	60	10	91	9	90	5	83	2	100	29	85.29

Average value of durable assets: The data regarding the average value of durable assets owned by the households in Kunikeri-2 Micro watershed is presented in Table 10. The result shows that, the average value of television was Rs.8666.00, DVD/VCD player was Rs.1000, mixer grinder was Rs.1500.00, motor cycle was Rs. 37875.00, Landline Phone was Rs. 3000.00 and mobile phone was Rs.2600.00.

Table 10. Average value of durable assets owned in Kunikeri-2 micro-watershed

Average Value (Rs.)

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Television	9000	9000	9000	9000	4000	8666
2	DVD/VCD Player	1000	0	0	0	0	1000
3	Mixer/Grinder	0	0	0	0	1500	1500
4	Motor Cycle	48500	46000	19500	45000	30000	37875
5	Landline Phone	0	3000	0	0	0	3000
6	Mobile Phone	4000	2500	2944	2000	1500	2600

Farm implements owned: The data regarding the farm implements owned by the households in Kunikeri-2 Micro watershed is presented in Table 11. About 14.71 per cent possess plough, 2.94 per cent possess power tiller, tractor and Sprayer, 38.24 per cent possess Weeder.

Table 11. Farm implements owned in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Plough	0	0	1	9.09	0	0	3	50	1	50	5	14.71
2	Power Tiller	0	0	0	0	0	0	0	0	1	50	1	2.94
3	Tractor	0	0	0	0	0	0	0	0	1	50	1	2.94
4	Sprayer	0	0	0	0	0	0	0	0	1	50	1	2.94
5	Weeder	0	0	5	45.5	5	50	2	33.3	1	50	13	38.24
6	Blank	5	100	5	45.5	5	50	1	16.7	1	50	17	50

Average value of farm implements: The data regarding the average value of farm Implements owned by the households in Kunikeri-2 Micro watershed is presented in Table 12. The results show that the average value of plough was Rs.1260.00, power tiller was Rs.25000, sprayer was Rs.5000.00, weeder was Rs.82.00 and tractor Rs. 500000.

Table 12. Average value of farm implements in Kunikeri-2 micro-watershed

Average Value (Rs.)

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Plough	0	1200	0	1200	1500	1260
2	Power Tiller	0	0	0	0	25000	25000
3	Tractor	0	0	0	0	500000	500000
4	Sprayer	0	0	0	0	5000	5000
5	Weeder	0	54	50	275	50	82

Livestock possession by the households: The data regarding the Livestock possession by the households in Kunikeri-2 Micro watershed is presented in Table 13. The results indicate that, 14.71 per cent possess local cow, 2.94 per cent possess buffalo and goat.

Table 13. Livestock possession by households in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Local cow	0	0	3	27	2	20	0	0	0	0	5	14.71
2	Buffalo	0	0	0	0	0	0	1	17	0	0	1	2.94
3	Goat	0	0	0	0	0	0	0	0	1	50	1	2.94

Average Labour availability: The data regarding the average labour availability in Kunikeri-2 Micro watershed is presented in Table 14. The indicated that, own labour men available in the micro watershed was 2.33, women available in the micro watershed was 2.90, hired labour (men) available was 11.37 and hired labour (women) available was 10.4.

Table 14. Average labour availability in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Hired labour Female	10	9.18	11.4	12.5	6	10.4
2	Own Labour Female	2	2	3.4	4.17	2	2.9
3	Own labour Male	2	2	2.4	3	2	2.33
4	Hired labour Male	10	10	13.6	12.5	5	11.37

Adequacy of hired labour: The data regarding the adequacy of hired labour in Kunikeri-2 Micro watershed is presented in Table 15. The results indicate that, 85.29 per cent of the household opined that hired labour was adequate.

Table 15. Adequacy of hired labour in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Adequate	1	20	11	100	10	100	6	100	1	50	29	85.3

Distribution of land (ha): The data regarding the distribution of land (ha) in Kunikeri-2 Micro watershed is presented in Table 16. The results indicate that, 38.34 ha (90.79%) of dry land and 3.89 ha (9.21 %) of irrigated land.

Table 16. Distribution of land (ha) in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Dry	0	0	6.05	100	14.37	100	13.06	90.52	4.86	65.8	38.34	90.79
2	Irrigated	0	0	0	0	0	0	1.37	9.48	2.52	34.2	3.89	9.21
Total		0	100	6.05	100	14.37	100	14.42	100	7.38	100	42.23	100

Average value of land (ha): The data regarding the average land value (Rs./ha) in Kunikeri-2 Micro watershed is presented in Table 17. The results show that the average value of dry land was Rs.260089.20 and the average value of irrigated land was Rs.308428.72.

Table 17. Average value of land (ha) in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Dry	0	375869.6	271199.3	252665.8	102916.7	260089.2
2	Irrigated	0	0	0	292307.7	317175	308428.7

Table 18. Status of bore wells in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	De-functioning	0	0	0	0	1	1
2	Functioning	0	0	0	1	1	2

Status of bore wells: The data regarding the status of bore wells in Kunikeri-2 Micro watershed is presented in Table 18. The results indicate that, there were 1 De-

functioning and 2 functioning bore wells among the sampled households in micro watershed.

Source of irrigation: The data regarding the source of irrigation in Kunikeri-2 Micro watershed is presented in Table 19. The results that bore well were major source of irrigation for 5.88 per cent of the households.

Table 19. Source of irrigation in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Bore Well	0	0	0	0	0	0	1	16.7	1	50	2	5.88

Depth of water (Avg. In meters): The data regarding the depth of water in Kunikeri-2 Micro watershed is presented in Table 20. The results revealed that, the depth of bore well was 6.90 meter.

Table 20. Depth of water (Avg. In meters) in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Bore Well	0	0	0	17.78	64.01	6.9

Irrigated Area (ha): The data regarding the irrigated area (ha) in Kunikeri-2 Micro watershed is presented in Table 21. The results indicate that, the availability of irrigation water was used for kharif crops was 3.89 ha.

Table 21. Irrigated Area (ha) in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Kharif	0	0	0	1.37	2.52	3.89
Total		0	0	0	1.37	2.52	3.89

Cropping pattern: The data regarding the cropping pattern in Kunikeri-2 Micro watershed is presented in Table 22. The results indicate that, farmers have grown bajra (21.5 ha), maize (17.79 ha), cowpea (2.52 ha) and sunflower (0.40 ha).

Table 22. Cropping pattern in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Kharif - Bajra	0	2.68	9.81	9.01	0	21.5
2	Kharif - Maize	0	2.97	4.57	5.38	4.86	17.79
3	Kharif - Cowpea	0	0	0	0	2.52	2.52
4	Kharif - Sunflower	0	0.4	0	0	0	0.4
Total		0	6.05	14.38	14.4	7.38	42.21

Cropping intensity: The data regarding the cropping intensity in Kunikeri-2 Micro watershed is presented in Table 23. The results indicate that, the cropping intensity was 93.02 per cent.

Table 23. Cropping intensity (%) in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Cropping Intensity	0	100	100	81.97	100	93.02

Cost of Cultivation of Maize: The data regarding the cost of cultivation (Rs/ha) of Maize in Kunikeri-2 micro watershed is presented in Table 24.a. The results indicate that, the total cost of cultivation (Rs/ha) for Maize was Rs. 28244.35. The gross income realized by the farmers was Rs. 39299.44. The net income from Maize cultivation was Rs.11055.09, thus the benefit cost ratio was found to be 1:1.40.

Table 24(a). Cost of Cultivation of Maize in Kunikeri-2 micro-watershed

Sl.N	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	38.27	6421.34	22.73
2	Bullock		Pairs/day	1.02	613.86	2.17
3	Tractor		Hours	4.5	3558.05	12.6
4	Machinery		Hours	0.38	301.25	1.07
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	10.83	1213.07	4.29
7	FYM		Quintal	2.84	520.1	1.84
8	Fertilizer + micronutrients		Quintal	6.9	5821.68	20.61
9	Pesticides (PPC)		Kgs / liters	1.11	1114.17	3.94
10	Irrigation		Number	0	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	186.33	0.66
14	Land revenue and Taxes			0	3.16	0.01
II	**Cost B1**					
16	Interest on working capital				1040.39	3.68
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				20793.41	73.62
III	**Cost B2**					
18	Rental Value of Land				338.89	1.2
19	**Cost B2 = (Cost B1 + Rental value)**				21132.3	74.82
IV	**Cost C1**					
20	Family Human Labour			20.24	4543.46	16.09
21	**Cost C1 = (Cost B2 + Family Labour)**				25675.77	90.91
V	**Cost C2**					
22	Risk Premium				0.92	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				25676.68	90.91
VI	**Cost C3**					
24	Managerial Cost				2567.67	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				28244.35	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		30.74	35610.88	
		b) Main Crop Sales Price (Rs.)			1158.33	
	By Product	e) Main Product (q)		11.01	3688.57	
		f) Main Crop Sales Price (Rs.)			335	
b.	Gross Income (Rs.)				39299.44	
c.	Net Income (Rs.)				11055.09	
d.	Cost per Quintal (Rs./q.)				918.72	
e.	Benefit Cost Ratio (BC Ratio)				1:1.4	

Cost of Cultivation of Bajra: The data regarding the cost of cultivation (Rs/ha) of Bajra in Kunikeri-2 micro watershed is presented in Table 24.b. The results indicate that, the total cost of cultivation (Rs/ha) for Bajra was Rs. 30308.95. The gross income realized by the farmers was Rs. 35844.20. The net income from Bajra cultivation was Rs.5535.25, thus the benefit cost ratio was found to be 1:1.20.

Table 24(b). Cost of Cultivation of Bajra in Kunikeri-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	31.91	5300.55	17.49
2	Bullock		Pairs/day	1.4	838.3	2.77
3	Tractor		Hours	3.54	2829.59	9.34
4	Machinery		Hours	0.07	56.52	0.19
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	18.84	2362.12	7.79
7	FYM		Quintal	2.72	543.68	1.79
8	Fertilizer + micronutrients		Quintal	8.22	7230.21	23.86
9	Pesticides (PPC)		Kgs / liters	1.31	1312.9	4.33
10	Irrigation		Number	0	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	5.55	0.02
14	Land revenue and Taxes			0	3.34	0.01
II	**Cost B1**					
16	Interest on working capital				1373.99	4.53
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				21856.75	72.11
III	**Cost B2**					
18	Rental Value of Land				375	1.24
19	**Cost B2 = (Cost B1 + Rental value)**				22231.75	73.35
IV	**Cost C1**					
20	Family Human Labour			23.23	5320.84	17.56
21	**Cost C1 = (Cost B2 + Family Labour)**				27552.59	90.91
V	**Cost C2**					
22	Risk Premium				1	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				27553.59	90.91
VI	**Cost C3**					
24	Managerial Cost				2755.36	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				30308.95	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		23.54	32367.88	
		b) Main Crop Sales Price (Rs.)			1375	
	By Product	e) Main Product (q)		11.12	3476.32	
		f) Main Crop Sales Price (Rs.)			312.5	
b.	Gross Income (Rs.)				35844.2	
c.	Net Income (Rs.)				5535.25	
d.	Cost per Quintal (Rs./q.)				1287.54	
e.	Benefit Cost Ratio (BC Ratio)				1:1.2	

Cost of Cultivation of Cowpea: The data regarding the cost of cultivation (Rs/ha) of Cowpea in Kunikeri-2 micro watershed is presented in Table 24.c. The results indicate, the total cost of cultivation (Rs/ha) for Cowpea was Rs.8072.04. The gross income realized by the farmers was Rs. 33501.61. The net income from Cowpea cultivation was Rs. 25429.56, thus the benefit cost ratio was found to be 1:4.20.

Table 24(c). Cost of Cultivation of Cowpea in Kunikeri-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	7.53	1407.46	17.44
2	Bullock		Pairs/day	0	0	0
3	Tractor		Hours	0	0	0
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	7.14	570.91	7.07
7	FYM		Quintal	0.4	396.47	4.91
8	Fertilizer + micronutrients		Quintal	2.78	2319.34	28.73
9	Pesticides (PPC)		Kgs / liters	0.4	396.47	4.91
10	Irrigation		Number	3.96	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	0	0
14	Land revenue and Taxes			0	1.65	0.02
II	**Cost B1**					
16	Interest on working capital				441.98	5.48
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				5534.29	68.56
III	**Cost B2**					
18	Rental Value of Land				0	0
19	**Cost B2 = (Cost B1 + Rental value)**				5534.29	68.56
IV	**Cost C1**					
20	Family Human Labour			9.12	1803.93	22.35
21	**Cost C1 = (Cost B2 + Family Labour)**				7338.22	90.91
V	**Cost C2**					
22	Risk Premium				0	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				7338.22	90.91
VI	**Cost C3**					
24	Managerial Cost				733.82	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				8072.04	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		9.52	33303.37	
		b) Main Crop Sales Price (Rs.)			3500	
	By Product	e) Main Product (q)		0.4	198.23	
		f) Main Crop Sales Price (Rs.)			500	
b.	Gross Income (Rs.)				33501.61	
c.	Net Income (Rs.)				25429.56	
d.	Cost per Quintal (Rs./q.)				848.33	
e.	Benefit Cost Ratio (BC Ratio)				1:4.2	

Cost of Cultivation of Sunflower: The data regarding the cost of cultivation (Rs/ha) of Sunflower in Kunikeri-2 micro watershed is presented in Table 24.d. The results indicate that, the total cost of cultivation (Rs/ha) for Sunflower was Rs. 41631.88. The gross income realized by the farmers was Rs.96330.00. The net income from Sunflower cultivation was Rs. 54698.12, thus the benefit cost ratio was found to be 1:2.30.

Table 24(d). Cost of Cultivation of Sunflower in Kunikeri-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	9.88	2223	5.34
2	Bullock		Pairs/day	2.47	1482	3.56
3	Tractor		Hours	0	0	0
4	Machinery		Hours	0	0	0
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	9.88	6422	15.43
7	FYM		Quintal	4.94	988	2.37
8	Fertilizer + micronutrients		Quintal	9.88	10374	24.92
9	Pesticides (PPC)		Kgs / liters	2.47	2470	5.93
10	Irrigation		Number	0	0	0
11	Repairs			0	0	0
12	Msc. Charges (Marketing costs etc)			0	0	0
13	Depreciation charges			0	4.94	0.01
14	Land revenue and Taxes			0	3.29	0.01
II	**Cost B1**					
16	Interest on working capital				2430.6	5.84
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				26397.83	63.41
III	**Cost B2**					
18	Rental Value of Land				333.33	0.8
19	**Cost B2 = (Cost B1 + Rental value)**				26731.17	64.21
IV	**Cost C1**					
20	Family Human Labour			54.34	11115	26.7
21	**Cost C1 = (Cost B2 + Family Labour)**				37846.17	90.91
V	**Cost C2**					
22	Risk Premium				1	0
23	**Cost C2 = (Cost C1 + Risk Premium)**				37847.17	90.91
VI	**Cost C3**					
24	Managerial Cost				3784.72	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				41631.88	100
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		12.35	37050	
		b) Main Crop Sales Price (Rs.)			3000	
	By Product	e) Main Product (q)		98.8	59280	
		f) Main Crop Sales Price (Rs.)			600	
b.	Gross Income (Rs.)				96330	
c.	Net Income (Rs.)				54698.12	
d.	Cost per Quintal (Rs./q.)				3371	
e.	Benefit Cost Ratio (BC Ratio)				1:2.3	

Adequacy of fodder: The data regarding the adequacy of fodder in Kunikeri-2 Micro watershed is presented in Table 25. The results indicate that, 2.94 percent of them opined it was sufficient.

Table 25. Adequacy of fodder in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Adequate-Green Fodder	0	0	0	0	0	0	0	0	1	50	1	2.94

Average annual gross income: The data regarding the annual gross income in Kunikeri-2 Micro watershed is presented in Table 26. The results indicate that, the farmers have annual gross income of Rs. 57382.35 in micro-watershed, of which Rs. 44852.94 is from agriculture itself.

Table 26. Average annual gross income in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Service/salary	0	0	5000	0	0	1470.59
2	Wage	0	10000	11600	10000	20000	9588.24
3	Agriculture	0	39090.9	47300	81333.3	67000	44852.9
4	Dairy Farm	0	1363.64	0	4166.67	0	1176.47
5	Goat Farming	0	0	0	0	5000	294.12
	Income(Rs.)	0	50454.6	63900	95500	92000	57382.4

Average annual Expenditure: The data regarding the average annual expenditure in Kunikeri-2 Micro watershed is presented in Table 27. The results indicate that, the farmers have annual gross expenditure of Rs. 211957.58 in micro-watershed, of which Rs. 24676.47 is from agriculture itself.

Table 27. Average annual Expenditure in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (11)	SF (10)	SMF (6)	MDF (2)	All (34)
1	Service/salary	0	0	10000	0	0	294.12
2	Wage	0	9166.67	11200	10000	9000	4676.47
3	Agriculture	0	18090.9	28333.3	49166.7	45000	24676.5
4	Dairy Farm	0	5000	0	10000	0	441.18
5	Goat Farming	0	0	0	0	7000	205.88
	Total	0	32257.6	49533.3	69166.7	61000	211958

Table 28. Horticulture species grown in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Coconut	0	0	0	0	0	0	0	0	3	0	3	0
2	Mango	0	0	0	0	0	0	2	0	0	0	2	0

***F= Field B=Back Yard**

Horticulture species grown: The data regarding horticulture species grown in Kunikeri-2 Micro watershed is presented in Table 28. The results indicate that, the total number of

horticultural trees grown (both field and backyard) by the sampled households were coconut (3) and Mango (2).

Forest species grown: The data regarding forest species grown in Kunikeri-2 Micro watershed is presented in Table 29. The results indicate that, households have planted 21 neem trees and 1 banyan trees together in both field and backyard.

Table 29. Forest species grown in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Neem	0	0	0	0	6	0	0	0	15	0	21	0
2	Banyan	0	0	0	0	0	0	0	0	1	0	1	0

***F= Field B=Back Yard**

Marketing of agricultural produce: The data regarding marketing of the agricultural produce in Kunikeri-2 Micro watershed is presented in Table 30. The results indicated that, 84 percent of output of bajra was sold in the market; 58 percent of output of cowpea, 99 58 percent of output of maize and 8058 percent of output of sunflower was sold in the market.

Table 30. Marketing of agricultural produce in Kunikeri-2 micro-watershed

Sl.No	Crops	Output obtained (q)	Output retained (q)	Output sold (q)	Output sold (%)	Avg. Price obtained (Rs/q)
1	Bajra	474	74	400	84	1375
2	Cow Pea	24	10	14	58	3500
3	Maize	446	5	441	99	1158
4	Sunflower	5	1	4	80	3000

Marketing channels used for sale of agricultural produce: The data regarding marketing channels used for sale of agricultural produce in Kunikeri-2 Micro watershed is presented in Table 31. The results indicated that, 88.24 cent of the households have sold agricultural produce to the local/village merchants.

Table 31. Marketing channels used for sale of agricultural produce in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Local/village Merchant	0	0	11	100	10	100	7	117	2	100	30	88.24

Table 32. Mode of transport of agricultural produce in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Tractor	0	0	11	100	10	100	7	117	2	100	30	88.24

Mode of transport of agricultural produce: The data regarding mode of transport of agricultural produce in Kunikeri-2 Micro watershed is presented in Table 32. The results indicated that, 88.24 cent of the households have used tractor.

Incidence of soil and water erosion problems: The data regarding incidence of incidence of soil and water erosion problems in Kunikeri-2 Micro watershed is presented in Table 33. The results indicate that, 73.53 per cent of the households have experienced soil and water erosion problems.

Table 33. Incidence of soil and water erosion problems in Kunikeri-2 micro-watershed

Sl.N	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Soil and water erosion problems in the farm	0	0	11	100	8	80	6	100	0	0	25	73.53

Interest towards soil testing: The data regarding Interest shown towards soil testing in Kunikeri-2 Micro watershed is presented in Table 34. The results indicated that, 8.82 per cent of the households were interested towards soil testing.

Table 34. Interest regarding soil testing in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Interest in soil test	0	0	0	0	3	30	0	0	0	0	3	8.82

Usage pattern of fuel for domestic use: The data on usage pattern of fuel for domestic use in Kunikeri-2 Micro watershed is presented in Table 35. The results indicated that, firewood was the major source of fuel for domestic use for 100.00 per cent of the households.

Table 35. Usage pattern of fuel for domestic use in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Fire Wood	5	100	11	100	10	100	6	100	2	100	34	100

Source of drinking water: The data on source of drinking water in Kunikeri-2 Micro watershed is presented in Table 36. The results indicated that, piped supply of water was the major source for drinking water for 94.12 per cent of the households followed by bore well water (5.88%).

Table 36. Source of drinking water in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Piped supply	5	100	11	100	10	100	5	83.3	1	50	32	94.12
2	Bore Well	0	0	0	0	0	0	1	16.7	1	50	2	5.88

Source of light: The data on source of light in Kunikeri-2 Micro watershed is presented in Table 37. The results indicated that, electricity was the major source of light for 100.00 per cent of the households

Table 37. Source of light in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Electricity	5	100	11	100	10	100	6	100	2	100	34	100

Existence of sanitary toilet facility: The data on availability of toilet facility in Kunikeri-2 Micro watershed is presented in Table 38. The results indicated that, 97.06 per cent of the households possess toilets.

Table 38. Existence of sanitary toilet facility in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Sanitary toilet facility	5	100	10	91	10	100	6	100	2	100	33	97.1

Possession of PDS card: The data regarding possession of PDS card in Kunikeri-2 Micro watershed is presented in Table 39. The results indicated that, 100.00per cent of the households possessed BPL card.

Table 39. Possession of PDS card in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	BPL	5	100	11	100	10	100	6	100	2	100	34	100

Participation in NREGA programme: The data regarding Participation in NREGA programme in Kunikeri-2 Micro watershed is presented in Table 40. The results indicated that, only 5.88 percent of the participate have participated in NREGA programme.

Table 40. Participation in NREGA programme in Kunikeri-2 micro-watershed

Sl.No	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Participation in NREGA programme	0	0	1	9.09	0	0	0	0	1	50	2	5.88

Table 41. Adequacy of food items in Kunikeri-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (11)		SF (10)		SMF (6)		MDF (2)		All (34)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cereals	5	100	11	100	10	100	6	100	2	100	34	100
2	Pulses	4	80	11	100	10	100	6	100	2	100	33	97.06
3	Oilseed	1	20	3	27.3	2	20	0	0	1	50	7	20.59
4	Vegetables	5	100	8	72.7	9	90	6	100	1	50	29	85.29
5	Fruits	2	40	3	27.3	2	20	2	33.3	0	0	9	26.47
6	Milk	5	100	11	100	9	90	6	100	1	50	32	94.12
7	Egg	5	100	10	90.9	10	100	5	83.3	0	0	30	88.24
8	Meat	2	40	3	27.3	3	30	1	16.7	1	50	10	29.41

Adequacy of food items: The data regarding adequacy of food items in Kunikeri-2 Micro watershed is presented in Table 41. The results indicated that, the extent of adequacy of food items for cereals, pulses, Oilseeds and vegetables were 100.00, 97.06, 20.59, 85.29 per cent respectively, similarly for Fruits (26.47%), milk (94.12%), Egg (88.24%), and Meat (29.41%).

Inadequacy of food items: The data regarding in adequacy of food items in Kunikeri-2 Micro watershed is presented in Table 42. The results indicated that, the extent of in adequacy of food items for pulses, Oilseeds and vegetables were 2.94, 79.41, 8.82 and 2.94 per cent respectively, similarly for fruits (61.76%), milk (2.94%), egg (5.88%) and meat (2.94%).

Table 42. Inadequacy of food items in Kunikeri-2 micro-watershed

Sl. No.	**Particulars**	**LL** (5)		**MF** (11)		**SF** (10)		**SMF** (6)		**MDF** (2)		**LF** (0)		**All (34)**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1	Pulses	1	20	0	0	0	0	0	0	0	0	0	0	1	2.94
2	Oilseed	4	80	8	72.7	8	80	6	100	1	50	0	0	27	79.41
3	Vegetables	0	0	2	18.2	0	0	0	0	1	50	0	0	3	8.82
4	Fruits	2	40	6	54.6	8	80	4	66.7	1	50	0	0	21	61.76
5	Milk	0	0	0	0	0	0	0	0	1	50	0	0	1	2.94
6	Egg	0	0	0	0	0	0	0	0	2	100	0	0	2	5.88
7	Meat	0	0	0	0	0	0	0	0	1	50	0	0	1	2.94

Table 43. Farming constraints experienced in Kunikeri-2 micro-watershed

SN	**Particulars**	**MF** (11)		**SF** (10)		**SMF** (6)		**MDF** (2)		**All (34)**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
1	Lower fertility status of the soil	11	100	11	110	6	100	1	50	29	85.29
2	Wild animal menace on farm field	1	9.09	2	20	0	0	1	50	4	11.76
3	Frequent incidence of pest and diseases	11	100	8	80	4	66.6	1	50	24	70.59
4	High cost of Fertilizers and plant protection chemicals	5	45.4	6	60	2	33.3	0	0	13	38.24
5	High rate of interest on credit	1	9.09	2	20	2	33.3	2	100	7	20.59
6	Low price for the agricultural commodities	7	63.6	7	70	2	33.3	2	100	18	52.94
7	Lack of marketing facilities in the area	3	27.2	3	30	3	50	1	50	10	29.41
8	Inadequate extension services	1	9.09	1	10	0	0	0	0	2	5.88
9	Lack of transport for safe transport of the Agril produce to the market.	3	27.2	1	10	3	50	1	50	8	23.53
10	Less rainfall	0	0	0	0	0	0	1	50	1	2.94

Farming constraints: The data regarding farming constraints experienced by households in Kunikeri-2 Micro watershed is presented in Table 43. The results indicated that, lower fertility status of the soil was the constraint experienced by (85.29 %) per cent of the households, wild animal menace on farm field (11.76%), frequent incidence of pest and diseases (70.59%), high cost of fertilizers and plant protection chemicals (38.24%), high rate of interest on credit (20.59%), low price for the agricultural commodities (52.94 %),

lack of marketing facilities in the area (29.41%), inadequate extension services (5.88 %), lack of transport for safe transport of the agricultural produce to the market (23.53%), less rainfall (2.94%).

Chapter 5

SUMMARY AND IMPLICATIONS

In order to assess the socio-economic condition of the farmers in the watershed 34 households located in the micro watershed were interviewed for the survey. The study was conducted in Kunikeri-2 micro-watershed (Karkihalli sub-watershed, Koppala taluk & District) is located at North latitude 15^0 18' 9.483" and 15^0 16' 46.442" and East longitude 76^0 14' 59.98" and 76^0 13' 26.382"covering an area of about 440.89 ha bounded by under Kunakeri and Hirebaganala Villages.

Socio-economic analysis indicated that, out of the total sample of 34 respondents, 11 (32.35%) were marginal, 10(29.41%) were small and 6 (17.65%) were semi medium and 2 (5.88%) were medium farmers. The population characteristics of households indicated that, there were 73 (56.15%) men and 57 (43.85%) were women. Majority of the respondents (40.00%) were in the age group of 35-60 years. Education level of the sample households indicated that, majority there were 46.15 per cent illiterates and only 3.08 per cent attained graduation. About, 82.35 per cent of household heads practicing agriculture and 20.59 per cent of the household heads were engaged as agricultural labourers. Agriculture was the major occupation for 59.23 per cent of the household members.

In the study area, 88.24 per cent of the households possess katcha house. The durable assets owned by the households showed that, 88.24 per cent possess TV, 2.94 per cent possess mixer grinder and 85.29 per cent possess mobile phones. Farm implements owned by the households indicated that, 14.71 per cent of the households possess plough and only 2.94 per cent sprayer. Regarding livestock possession by the households, 14.71 per cent possess local cow and 2.94 per cent possess buffalo respectively.

The average labour availability in the study area showed that**,** own labour men available in the micro watershed was 2.33, women available in the micro watershed was 2.90, hired labour (men) available was 11.37 and hired labour (women) available was 10.4.

Out of the total land holding of the sample respondents (42.23 ha), 90.79 per cent of the area is under dry condition and the remaining 9.21 per cent area is irrigated land. There were 2.00 bore wells among the sampled households. Bore well was the major source of irrigation for 5.88 per cent of the households. The major crops grown by sample farmers are Maize, Bajra, Cowpea and Sunflower and cropping intensity was recorded as 93.02 per cent.

The per hectare cost of cultivation for Maize, Bajra, Cowpea and Sunflower was Rs.28244.35 , 30308.95, 8072.04 and 41631.88 with benefit cost ratio of 1:1.40, 1: 1.20, 1: 4.20 and 1: 2.30 respectively.

Further, 2.94 per cent of the households have opined that the green fodder was adequate.

The average annual gross income of the farmers was Rs. 57382.35 in micro-watershed, of which Rs. 44852.94 comes from agriculture.

The total number of horticultural trees grown (both field and backyard) by the sampled households were coconut (3) and Mango (2) and the forest species are grown 21 neem trees and 1 banyan trees together in both field and backyard.

Regarding marketing channels, 88.24 per cent of the households have sold agricultural produce to the local/village merchants. Further, 88.24 per cent of the households have used tractor for the transport of agriculture commodity.

Majority of the farmers (73.53 %) have experienced soil and water erosion problems in the watershed and 8.82 per cent of the households were interested towards soil testing.

Firewood connection was the major source of fuel for domestic use for 100.00 per cent of the households. Piped supply was the major source for drinking water for 94.12 per cent of the households. Electricity was the major source of light for 100.00 per cent of the households. In the study area, 97.06 per cent of the households possess toilet facility. Regarding possession of PDS card, 100.00 per cent of the households possessed BPL card. Cereals (100.00%), pulses (97.06%), oilseeds (20.59%) were adequate for consumption.

Farming constraints experienced by households in the micro watersheds were lower fertility status of the soil (85.29%) wild animal menace on farm field (11.76%), frequent incidence of pest and diseases (70.59%), high cost of fertilizers and plant protection chemicals (38.24%), high rate of interest on credit (20.59%), low price for the agricultural commodities (52.94%), lack of marketing facilities in the area (29.41%), inadequate extension services (5.88%), lack of transport for safe transport of the agricultural produce to the market (23.53%), Less rainfall (2.94%).

Implications of the survey

- ✓ Result indicated that, there were 46.15 per cent were illiterate hence, extension methodologies such as demonstration, street play, drama, video shows will be effective in dissemination of the technologies in the micro watershed.
- ✓ The data indicate that, 88.24 per cent of the households possess katcha house. Hence, the development department while implementing the watershed plan should focus on agriculture to enhance the productivity of major crops in the area to increase the income of the farmers.
- ✓ Results indicated that the local institutional participation of the household members in the micro watershed is minimal hence, activities like membership campaign,

awareness creation about the benefits of membership in local institutions and strengths of organized groups must be conveyed.

- ✓ Majority of the households in the watershed have experience in use of mobile phones, and television hence, these mass media can be effectively utilized for transfer of technology as well as for information dissemination.
- ✓ The farm machinery/implement possession in the micro watershed was found to be minimum the reasons may lack of knowledge or lack of financial ability which can be addressed through training on use of different farm implements, providing information on different sources of finance for purchase of farm implements.
- ✓ The possession of livestock such as crossbred cow found is less hence, farmers must be made aware of the benefits of crossbred cow in increased milk production.
- ✓ The possession of livestock such as sheep, goat and poultry was found to be low hence, farmers may be informed the role of subsidiary enterprises in enhancing the income and information on financial support for subsidiary activities.
- ✓ Households possess 38.34ha (90.79 %) of dry land and 3.89ha (9.21 %) of irrigated land hence, the availability of the dry land agricultural technologies such as short duration crops, high yielding drought resistance crop varieties, drip irrigation technology and subsidy information will be helpful for the farmers to enhance the productivity of land and as well as farmers income.
- ✓ Few of the bore well in micro watershed found non functional hence, farmers may be trained on possibility of bore well rejuvenation.
- ✓ Bore well was major source of irrigation for 5.88 per cent of the households. hence, in order to increase the area under irrigation as well as to increase the water use efficiency farmers may trained on drip irrigation and provide the information on subsidy for drip irrigation equipment's along with the information on different agencies which provides the financial assistance for drip irrigation.
- ✓ The total number of horticultural trees grown (both field and backyard) by the sampled households were coconut (3) and Mango (2) and the forest species are grown 21 neem trees and 1 banyan trees together in both field and backyard. Hence, production technologies related to these crops can be made available to the farmers for better adoption.
- ✓ The cropping intensity in the micro watershed was found to be (93.02 %) hence, care must be taken by the implementing agency to bring uncultivated land into cultivation through suitable measures.
- ✓ Many of the household members have borrowed loan from cooperative banks which has higher rate of interest hence, farmers may be sensitized on the different sources of credit with lesser interest rate such SHGs etc.
- ✓ The results indicated the non availability of both green and dry fodder throughout the year hence, fodder development activities can be taken up in the micro watershed.

- ✓ The average annual gross income of the households Rs.44852.94 from agriculture and Rs. 9588.24 from wages and. Agriculture was found to be the major source of income for households hence; the development activities should focus on productivity enhancement, marketing arrangements and agricultural technology dissemination to have a direct impact on the farmers.
- ✓ The cultivation of forest species is found minimal hence, information and production technology related to agro-forestry and integrated farming system.
- ✓ The data indicated that, 73.53 per cent of the households have experienced soil and water erosion problems. Hence, those farmers who reported the soil and water erosion problems may be given attention while implementation of the watershed development plan.
- ✓ The data indicated that, 8.82 per cent of the households have interest in soil testing hence, farmers must be provided with the information on various institutions which are involved in soil testing for the benefit of the farmers.
- ✓ Except summer ploughing the adoption of other soil and water conservation structures is minimum hence, the farmers in the micro watershed should be sensitized on the use of different conservation structures for soil water conservation.
- ✓ Cereals and pulses found be adequate for per cent of the households respectively hence, farm households and the farm women must be trained on importance of balanced nutrition and role of vegetable, milk, egg, meat in balanced diet.
- ✓ Lower fertility status of the soil (85.29%), wild animal menace on farm field (11.76%), frequent incidence of pest and diseases (70.59%), high cost of fertilizers and plant protection chemicals (38.24%), high rate of interest on credit (20.59%), low price for the agricultural commodities (52.94%), lack of marketing facilities in the area (29.41%), inadequate extension services (5.88%), lack of transport for safe transport of the agricultural produce to the market (23.53%) were the major farming constraints experienced hence, these constraints must be addressed immediately for the welfare of the farmers. Awareness to be created among the farmers to approach nearest KVKs/RSKs and other developmental departments for technical and for subsidized inputs and utilize the well established regulated markets, approaching the contract firms, direct markets to avoid the involvement of middlemen.