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

JABBALGUDDA-2 (4D3A9I1c) MICRO WATERSHED

Irakallagada Hobli, 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 Jabbalgudda-2 microwatershed in Koppal Taluk, Koppal 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:28-09-2019 Director, ICAR - NBSS&LUP Nagpur

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PART-A

LAND RESOURCE INVENTORY

Contents

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The land resource inventory of Jabbalgudda-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 521 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 99 per cent is covered by soils and 1 per cent by others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 10 soil series and 11 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 6 per cent of the soils are shallow (25-50 cm), 5 per cent of the soils are moderately shallow (50-75 cm), <1 per cent of the soils are moderately deep (75-100 cm), 5 per cent soils are deep (100-150 cm) and 9 per cent area has very deep (>150 cm) soils.*
- *Entire area of about 12 per cent area has loamy soils and 17 per cent area has clayey soils at the surface at the surface.*
- *About 17 per cent of the area has non-gravelly (<15%) soils and 12 per cent gravelly (15-35 % gravel) soils.*
- *About 10 per cent are very low (<50 mm/m), 5 per cent low (51-100 mm/m), 0.05 per cent medium (101-150 mm/m), 4 per cent high (151-200 mm/m) and 9 per cent very high (>200 mm/m) in available water capacity.*

- *An area of about 3 per cent has nearly level sloping (0-1%) and 26 per cent has very gently sloping (1-3%) lands.*
- *An area of about 14 per cent has soils that are slightly eroded (e1) and 15 per cent moderately eroded (e2) lands.*
- *An area of about 3 per cent are slightly acid (pH 6.0-6.5), 15 per cent are neutral (pH 6.5-7.3), 10 per cent are slightly alkaline (pH 7.3-7.8) and 1 per cent moderately alkaline (pH 7.8-8.4) 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 medium (0.5-0.75%) in about 24 per cent and high (>0.75%) in about 5 per cent of the soils.*
- *Available phosphorus is medium (23-57 kg/ha) in about 18 per cent and 11 per cent is high (>57 kg/ha) in the microwatershed.*
- *About 10 per cent of the soils are medium (145-337 kg/ha) and 19 per cent are high (>337 kg/ha) in available potassium content.*
- *Available sulphur is low (<10 ppm) in 29 per cent and <1 per cent are medium (10-20 ppm) in the microwatershed.*
- *Available boron is low (0.5 ppm) in entire area of about 29 per cent area in soils.*
- *Available iron is deficient (<4.5 ppm) in entire area of about 29 per cent.*
- *Available zinc is deficient (<0.6 ppm) in entire area of about 29 per cent.*
- *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	*42 (8)*	*55 (11)*		*Sapota*	*21 (4)*	*0.28 (<1)*
Maize	-	*97 (19)*		*Pomegranate*	*21 (4)*	*49 (9)*
Bajra	-	*76 (15)*		*Musambi*	*42 (8)*	*28 (5)*
Groundnut	*21 (4)*	*27 (5)*		*Lime*	*42 (8)*	*28 (5)*
Sunflower	*42 (8)*	*28 (5)*		*Amla*	*37 (7)*	*60 (12)*
Red gram	*21 (4)*	*49 (9)*		*Cashew*	*21 (4)*	*53 (5)*
Bengalgram	*29 (6)*	*68 (13)*		*Jackfruit*	*21 (4)*	*0.28 (<1)*
Cotton	*42 (8)*	*55 (11)*		*Jamun*	*21 (4)*	*49 (9)*
Chilli	*21 (4)*	*43 (8)*		*Custard apple*	*42 (8)*	*55 (11)*
Tomato	*21 (4)*	*43 (8)*		*Tamarind*	*21 (4)*	*49 (9)*
Brinjal	-	*97 (19)*		*Mulberry*	*21 (4)*	*33 (6)*
Onion	-	*63 (11)*		*Marigold*	*21 (4)*	*76 (15)*
Bhendi	-	*97 (19)*		*Chrysanthemum*	*21 (4)*	*76 (15)*
Drumstick	*21 (4)*	*49 (9)*		*Jasmine*	*21 (4)*	*27 (5)*
Mango	*21 (4)*	*20 (4)*		*Crossandra*	*21 (4)*	*27 (5)*
Guava	*21 (4)*	*0.28 (<1)*				

- *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 Jabbalgudda-2 Microwatershed in Koppal Taluk, Koppal 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 Jabbalgudda-2 Microwatershed is located in the central part of northern Karnataka in Koppal Taluk, Koppal District, Karnataka State (Fig. 2.1). It comprises of parts of Jabbaragudda villages. It lies between $15^0$26' – $15^0$27' North latitudes and $76^0$20' – $76^0$22' East longitudes and covers an area of 521 ha. It is surrounded by Jabbaragudda village on the southern side.

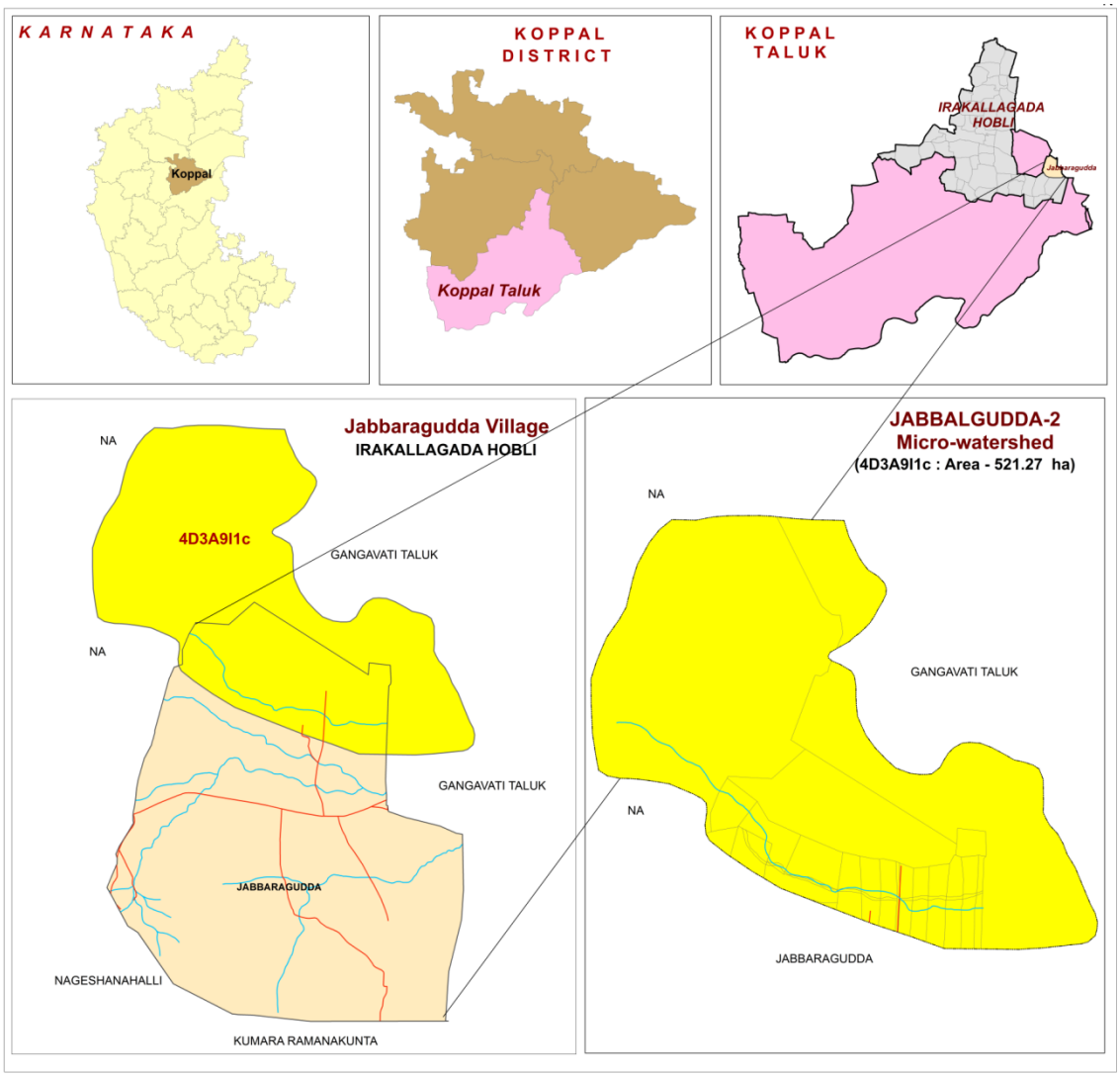


Fig. 2.1 Location map of Jabbalgudda-2 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss and alluvium (Figs. 2.2a and b). 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. The thickness of the alluvium generally is limited to less than a meter, except in river valleys where it is very deep extending to tens of meters. Such soils are transported and represent palaeo black soils originally formed at higher elevation, but now occupying river valleys.

Fig. 2.2 a Granite and granite gneiss rocks

Fig. 2.2 b Alluvium

2.3 Physiography

Physiographically, the area has been identified as granite gneiss and alluvial landscapes 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 522 to 552 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**	

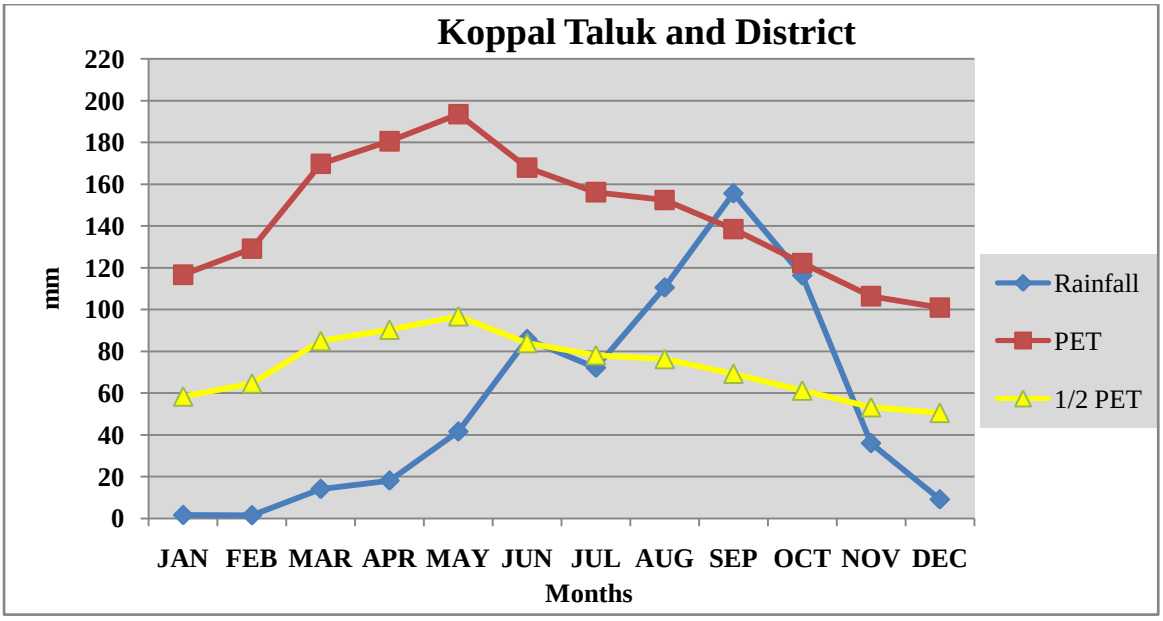


Fig. 2.3 Rainfall distribution in Koppal Taluk and District

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 Jabbalgudda-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 Jabbalgudda-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.

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

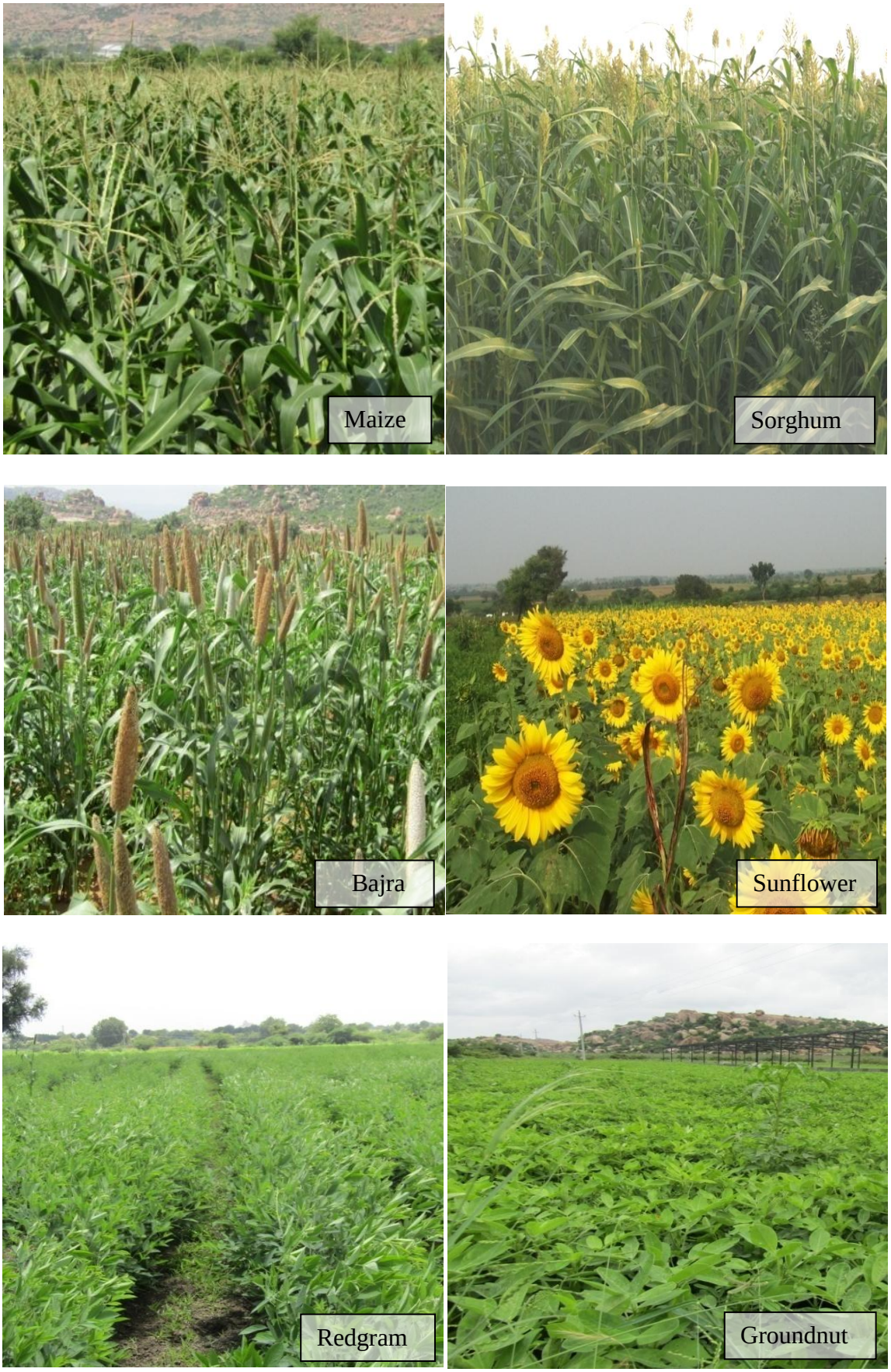


Fig. 2.5 (a) Different crops and cropping systems in Jabbalgudda-2 Microwatershed

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

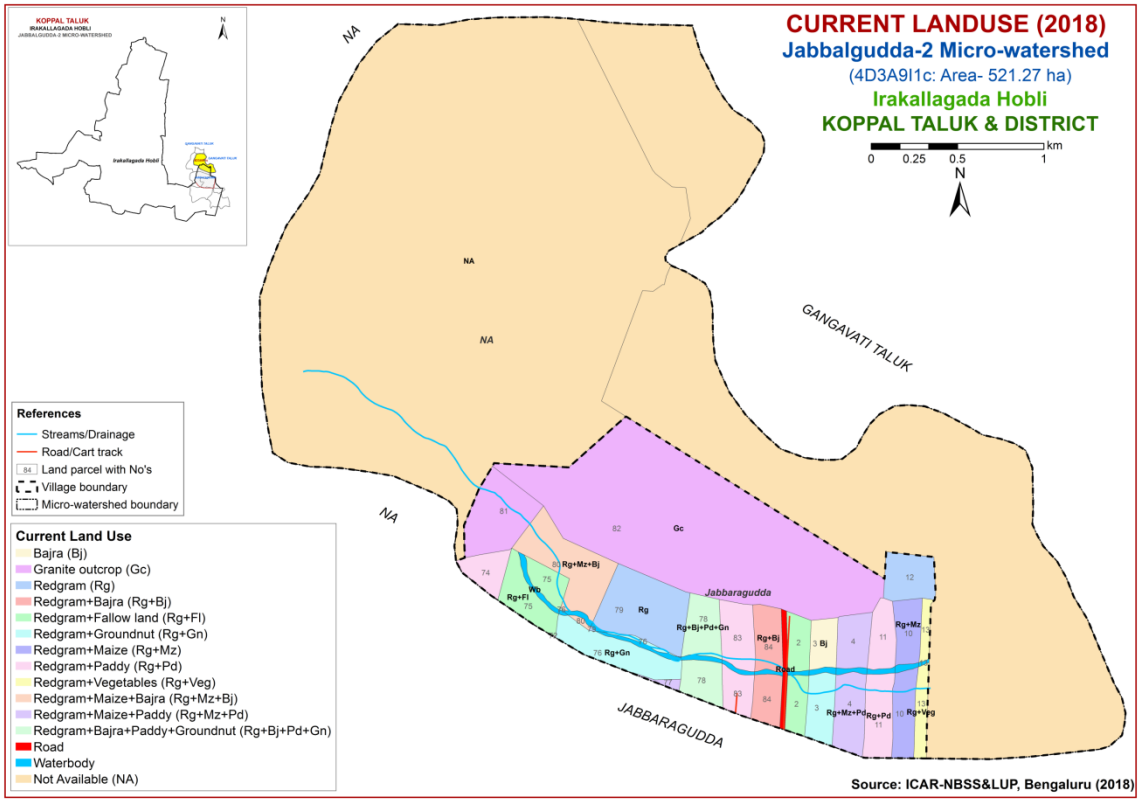


Fig. 2.6 Current Land Use – Jabbalgudda-2 Microwatershed

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 Jabbalgudda-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 521 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 and alluvial 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)

DSe Alluvial landscape

Dse 1 Summit

Dse 11 Nearly level Summit with dark grey tone
Dse 12 Nearly level Summit with medium grey tone
Dse 13 Nearly level Summit with whitish grey tone
Dse 14 Nearly level Summit with whitish tone (Calcareousness)
Dse 15 Nearly level Summit with pinkish grey tone
Dse 16 Nearly level Summit with medium pink tone
Dse 17 Nearly level Summit with bluish white tone
Dse 18 Nearly level Summit with greenish grey tone

Dse 2 Very genetly sloping

Dse 21 Very gently sloping, whitish tone
Dse 22 Very gently sloping, greyish pink tone
Dse 23 Very gently sloping, whitish grey tone
Dse 24 Very gently sloping, medium grey tone
Dse 25 Very gently sloping, medium pink tone
Dse 26 Very gently sloping, dark grey tone
Dse 27 Very gently sloping, bluish grey tone
Dse 28 Very gently sloping, greenish grey tone
Dse 29 Very gently sloping, Pinkish grey

Dsa 25 – Nearly Level Lands

Dsa 251- Nearly level, Grayish green tone
Dsa 252- Nearly level, Bluish grey tone
Dsa 253- Nearly level, Light green tone
Dsa 254- Nearly level, Medium green tone
Dsa 255- Nearly level, Greenish pink tone
Dsa 256- Nearly level, Whitish green
Dsa 257- Nearly level, Pink tone
Dsa 258- Nearly level, Whitish grey tone
Dsa 259- Nearly level, Grayish Pink

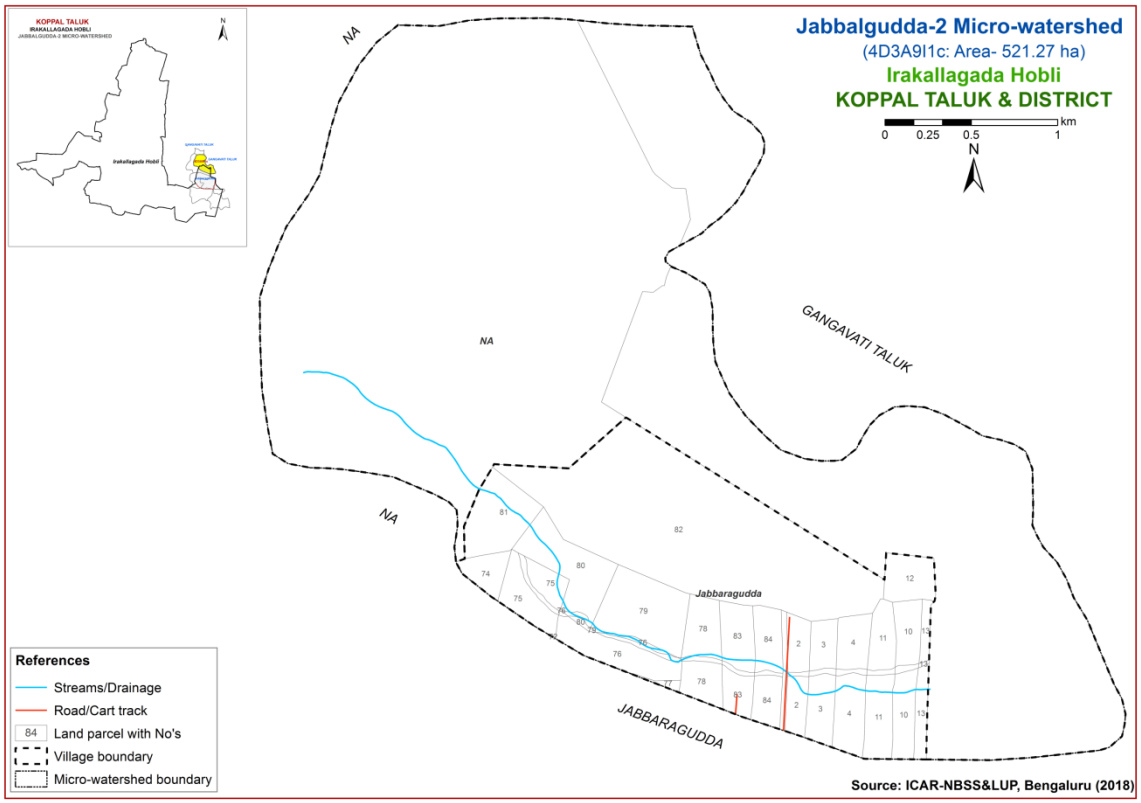


Fig. 3.1 Scanned and Digitized Cadastral map of Jabbalgudda-2 Microwatershed

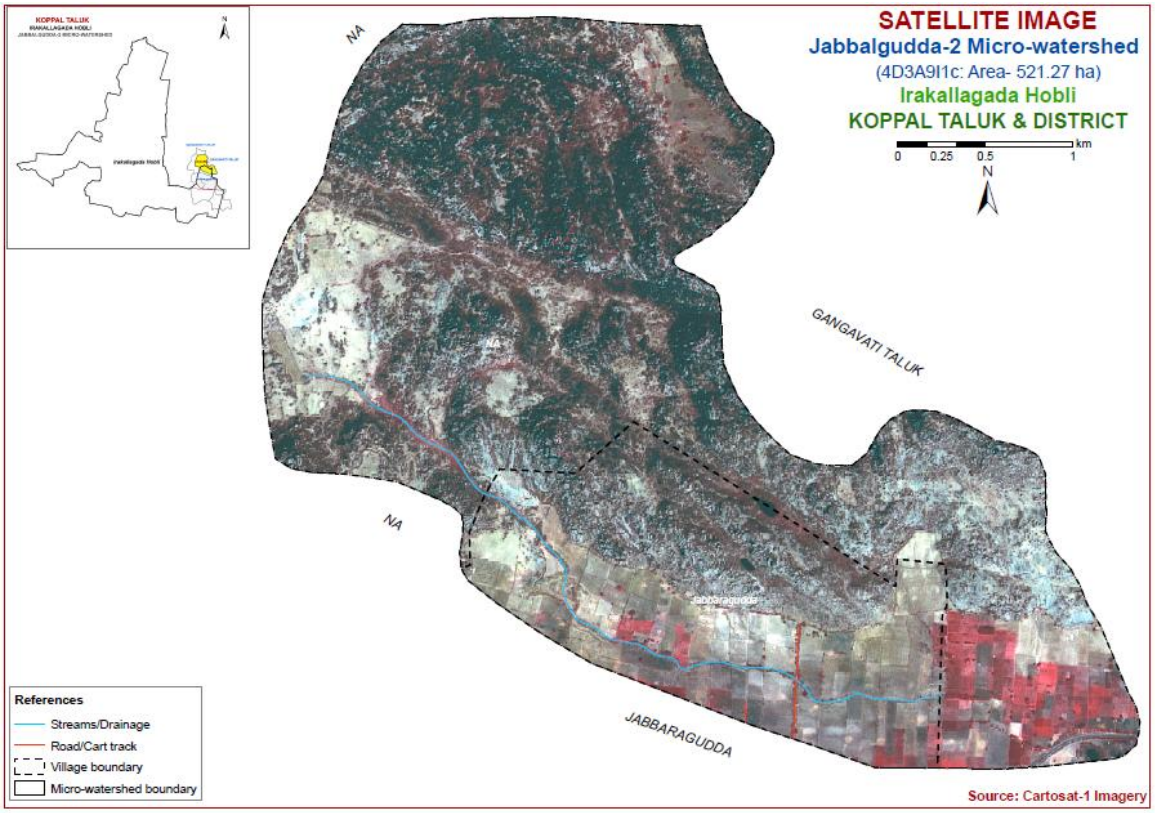


Fig. 3.2 Satellite Image of Jabbalgudda-2 Microwatershed

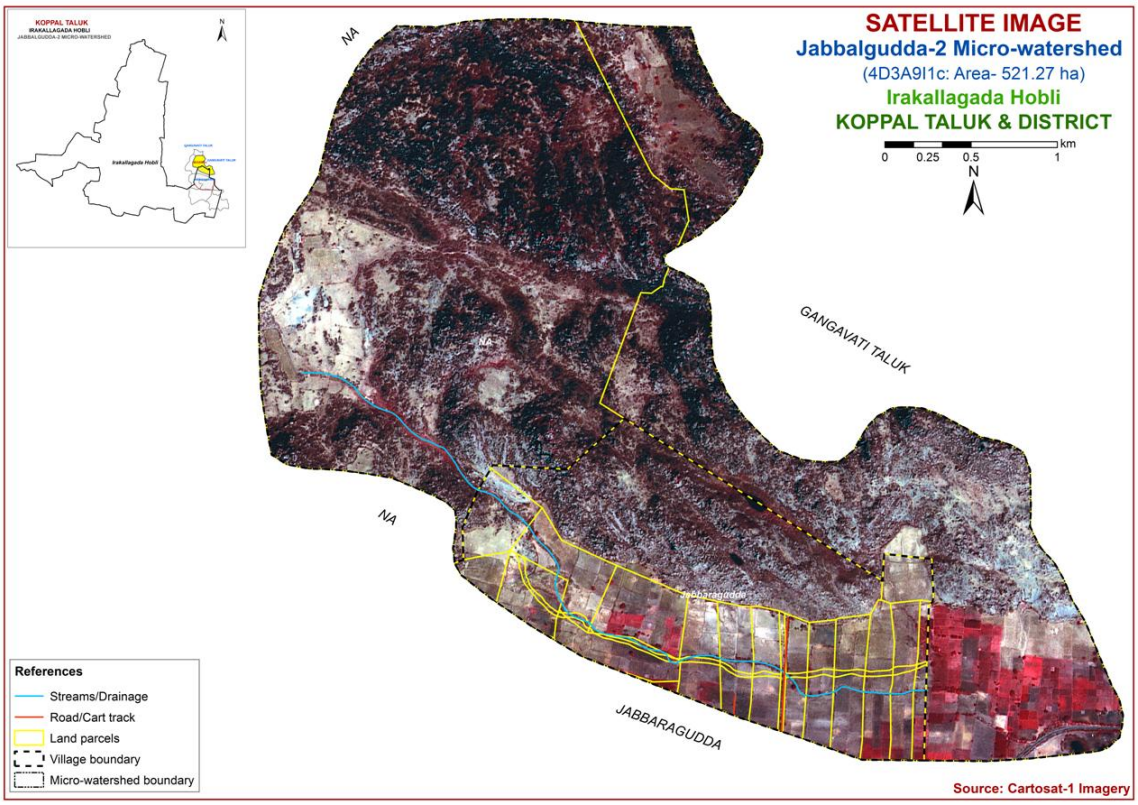


Fig. 3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Jabbalgudda-2 Microwatershed

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).

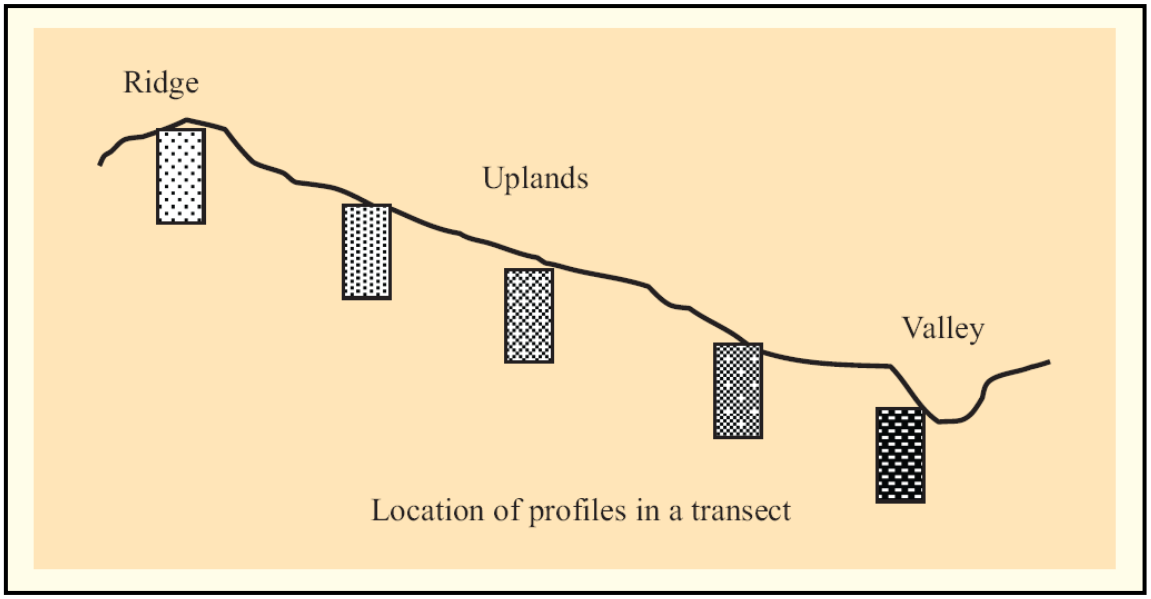


Fig. 3.4 Location of profiles in a transect

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, 10 soil series were identified in Jabbalgudda-2 Microwatershed.

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

Sl. No	Soil Series	Depth (cm)	Colour (moist)	Texture	Gravel (%)	Horizon sequence	Calcareo-usness
Soils of Granite gneiss Landscape							
1	Kaggalipura (KGP)	25-50	2.5YR2.5/4,3/4, 3/6	gsc	15-35	Ap-Bt-Cr	
2	Harve (HRV)	25-50	2.5YR3/4,3/6 5YR3/3,4/4,3/4	gscl	>35	Ap-Bt-Cr-	
3	Chikkasavanur (CSR)	25-50	7.5YR3/2,3/3,3/4	scl	<15	Ap-Bw-Cr	-
4	Honnenahalli (HNH)	50-75	7.5YR3/3,4/310YR3/3	sc	-	Ap-Bw-Cr	-
5	Huliyapura (HLP)	75-100	7.5YR3/3,4/6 10YR4/6	scl	-	Ap-Bw-C	-
6	Thimmasandra (TSD)	>150	10YR2/12/2,3/1, 3/2,4/1, 4/2,4/3	c	-	Ap-Bw	
7	Kavalakkeri (KLR)	>150	10YR2/1,3/1, 3/2 7.5YR2.5/1,3/2	sc	-	Ap-Bw	e-es
8	Ranatur (RTR)	>150	2.5YR2.5/3,2.5/4, 3/3,4/6	c	-	Ap-Bt	
Soils of Alluvial Landscape							
9	Gatareddihal (GRH)	100-150	10YR 2/1, 3/1, 2.5Y 4/3, 5/4	c	<15	Ap-Bss-BC-C	es
10	Kavalur (KVR)	100-150	10 YR 2/2, 3/1, 3/2, 3/3, 4/4	c		Ap-Bss-Bck-Cr	es-ev

3.4 Soil Mapping

The area under each soil series was further separated into 11 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 11 mapping units representing 10 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 11 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 2017 from Jabbalgudda-2 farmer's fields (42 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 Jabbalgudda-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 dark reddish brown to dark red, sandy clay loam to sandy clay soils occurring on nearly level to moderately sloping uplands under cultivation		**30 (5.69)**
14		KGPcB1g1	Sandy loam surface, slope 1-3%, slight erosion, gravelly (15-35%)	30 (5.69)
	HRV	Harve soils are shallow (25-50 cm), well drained, dark red to dark reddish brown, red gravelly sandy clay loamy soils occurring on nearly level to gently sloping uplands under cultivation		**2 (0.48)**
31		HRViB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	2 (0.48)
	CSR	Chikkasavanur soils are shallow (25-50 cm), well drained, have dark brown to light yellowish brown, red sandy clay loam soils occurring on nearly level to very gently sloping uplands under cultivation		**21 (4.11)**
37		CSRhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	5 (1.0)
39		CSRiB2	Sandy clay surface, slope 1-3%, moderate erosion	16 (3.11)
	HNH	Honnenahalli soils are moderately deep (50-75 cm), moderately well drained, have brown to dark brown sandy clay soils occurring on nearly level to very gently sloping lowlands under cultivation		**27 (5.26)**
464		HNHhB2g1	Sandy clay loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	27 (5.26)
	HLP	Huliyapura soils are moderately deep (75-100 cm), well drained, have dark yellowish brown to dark brown, black sandy clay soils occurring on very gently sloping lowlands under cultivation		**0 (0.05)**
438		HLPiB2	Sandy clay surface, slope 1-3%, moderate erosion	0 (0.05)
	TSD	Thimmasandra soils are very deep (>150 cm), moderately well drained, have very dark brown to very dark grayish		**8 (1.54)**

Soil map unit No*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
		brown, black clay soils occurring on nearly level to very gently sloping lowlands under cultivation		
445		TSDiB1	Sandy clay surface, slope 1-3%, slight erosion	8 (1.54)
	KLR	Kavalakkeri soils are very deep soils (>150 cm), moderately well drained, have black to dark reddish brown calcareous sandy clay to clay soil occurring on nearly level to very gently sloping low lands under cultivation		**16 (3.07)**
473		KLRmA1	Clay surface, slope 1-3%, slight erosion	16 (3.07)
	RTR	Ranatur soils are very deep (>150 cm), well drained, have dark reddish brown to dark red clay soils occurring on nearly level to very gently sloping uplands under cultivation		**21 (4.03)**
288		RTRiB2	Sandy clay surface, slope 1-3%, moderate erosion	21 (4.03)
Soils of Alluvial landscape				
	GRH	Gatareddihal soils are deep (100-150 cm), moderately well drained, have light olive brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping plains under cultivation		**5 (1.03)**
373		GRHmB2	Clay surface, slope 1-3%, moderate erosion	5 (1.03)
	KVR	Kavalur soils are deep (100-150 cm), moderately well drained, have dark yellowish brown to very dark grayish brown, calcareous cracking black clay soils occurring on nearly level to very gently sloping plains under cultivation		**20 (3.76)**
388		KVRmB1	Clay surface, slope 1-3%, slight erosion	20 (3.76)
999		Rock outcrops		370 (70.98)

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

3.6 Land Management Units

The 11 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 Jabbalgudda-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 use classes are expected to behave similarly for a given level of management.

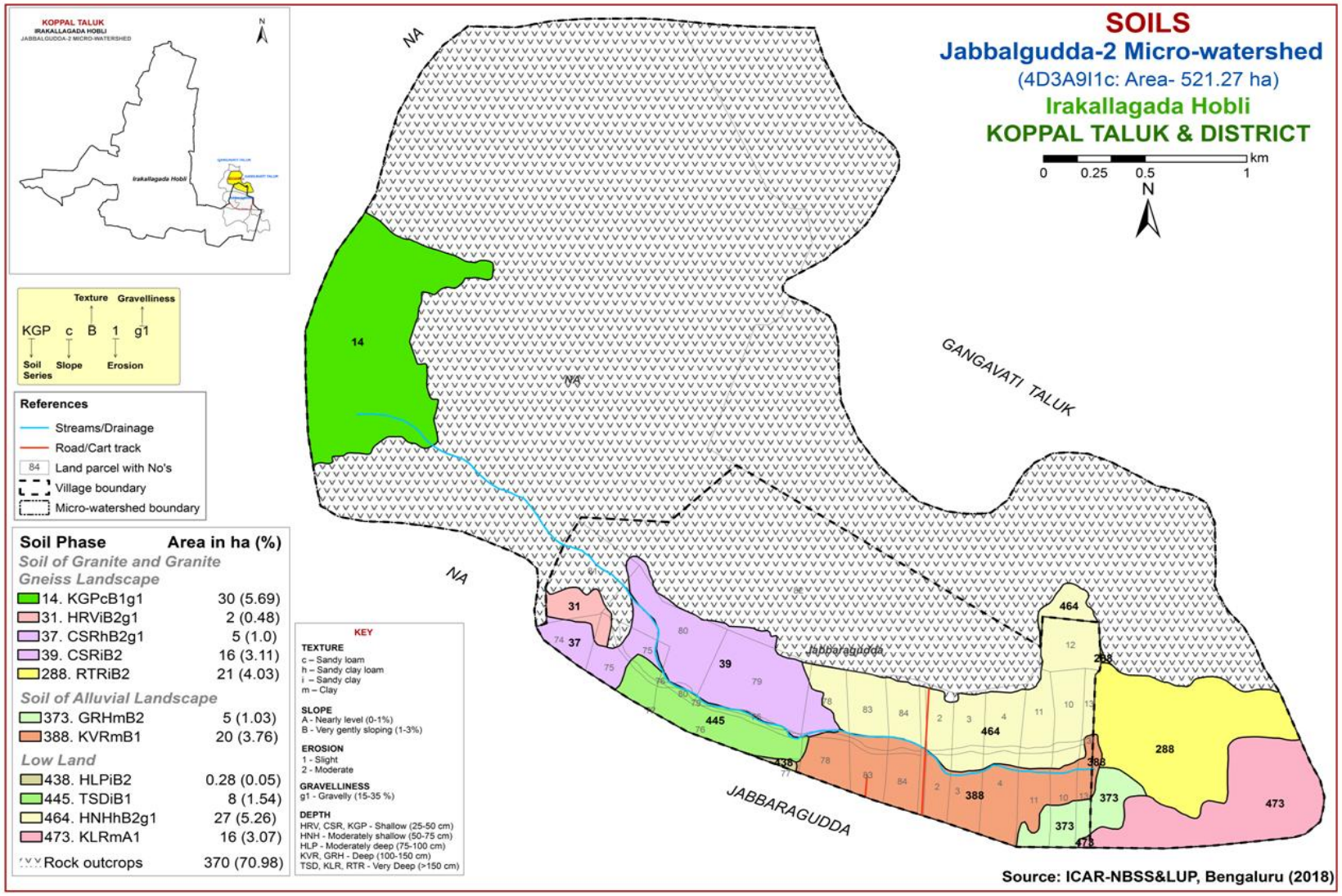


Fig 3.5 Soil Phase or Management Units-Jabbalgudda-2 Microwatershed

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Jabbalgudda-2 Microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss and alluvial landscapes based on geology. In all, 10 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 10 soil series identified followed by 11 soil phases (management units) mapped (Fig. 3.4) are furnished below. The physical and chemical characteristics of soil series identified in Jabbalgudda-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, eight soil series are identified and mapped. Of these, Kaggalipura (KGP) series occupies a minor area of 30 ha (6%), Honnenahalli (HNH) 27 ha (5%), Chikkasavanur (CSR) 21 ha (4%), Ranatur (RTR) 21 ha (4%), Kavalakkeri (KLR) 16 ha (3%), Thimmasandra (TSD) 8 ha (2%), Harve (HRV) 2 ha (<1%) and Huliyapura (HLP) occur a minor area of <1% 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: Kaggalipura soils are shallow (25-50 cm), well drained, have brown to dark reddish brown gravelly sandy clay soils. They have developed from granite gneiss and occur on very gently sloping uplands. The Kaggalipura series has been tentatively 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 Harve (HRV) Series: Harve soils are shallow (25-50 cm), well drained, have reddish brown to dark red sandy clay loam soils. They have developed from granite gneiss and occur on very gently to moderately sloping uplands. The Harve series has been classified as a member of the Loamy-skeletal, mixed isohyperthermic, (Paralithic) family of Rhodustalfs .

The thickness of the solum ranges from 28 to 48 cm. The thickness of A-horizon ranges from 12 to 17 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 loam with 20 to 60 per cent gravel. The thickness of B-horizon ranges from 16 to 32 cm. Its colour is in 2.5 YR and 5 YR hue with value 3 to 4 and chroma 4 to 6. Its texture is sandy clay loam with gravel content of more than 35 per cent. The available water capacity is very low (<50 mm/m). Only one phase was identified and mapped. Only one phase was identified and mapped.

Landscape and soil profile characteristics of Harve (HRV) Series

4.1.3 Chikkasavanur (CSR) Series: Chikkasavanur soils are shallow (25-50 cm), well drained, have dark brown to light yellowish brown sandy clay loam soils. They have developed from granite gneiss and occur on very gently sloping uplands. The Chikkasavanur series has been tentatively classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 32 to 49 cm. The thickness of A horizon ranges from 12 to 23 cm. Its colour is in 7.5 YR and 10 YR hue with value 2.5 to 4 and chroma 3 to 6. The texture varies from sandy loam to clay with 10 to 20 per cent gravel. The thickness of B horizon ranges from 16 to 32 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 and chroma 2 to 4. Its texture is sandy clay loam with gravel content of < 15 per cent. The available water capacity is low (50-100 mm/m). Two phases were identified and mapped.

Landscape and soil profile characteristics of Chikkasavanur (CSR) Series

4.1.4 Honnenahalli (HNH) Series: Honnenahalli soils are moderately deep (50 to 75 cm), well drained, have brown to dark brown sandy clay soils. They have developed from weathered granite gneiss and occur on nearly level to very gently sloping lowlands. The Honnenahalli series has been tentatively classified as a member of the fine-loamy, mixed, isohyperthermic family of Typic Haplustepts.

The thickness of the solum ranges from 52 to 74 cm. The thickness of A horizon ranges from 12 to 21 cm. Its colour is in 7.5 YR and 10 YR hue with value 3 and chroma 3 to 4. The texture varies from sandy clay loam to sandy loam with 5 to 10 per cent gravel. The thickness of B horizon ranges from 45 to 62 cm. Its colour is in 7.5 YR and 10 YR hue with value 3 and chroma 3 to 4. Its texture is sandy clay. The available water capacity is medium (100-150 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Honnenahalli (HNH) Series.

4.1.5 Huliyapura (HLP) Series: Huliyapura soils are moderately deep (75-100 cm), well drained, have dark- strong brown to dark yellowish brown sandy clay loam soils. They have developed from weathered granite gneiss and occur on very gently sloping low lands under cultivation. The Huliyapura series has been classified as a member of fine-loamy, mixed, isohyperthermic, Typic Haplustepts.

The thickness of the solum ranges from 75 to 98 cm. The thickness of A-horizon ranges from 18 to 22 cm. Its colour is in 5 YR and 10 YR hue with value 3 to 4 and chroma 4. The texture is sandy clay loam. The thickness of B-horizon ranges from 56 to 75 cm. Its colour is in 5 YR, 7.5 YR and10 YR hue with value 3 to 4 and chroma 2 to 6. Its texture is sandy clay. The available water capacity is low (50-100 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Huliyapura (HLP) Series.

4.1.6 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 and mapped.

Landscape and soil profile characteristics of Thimmasandra (TSD) Series

4.1.7 Kavalakkeri (KLR) Series: Kavalakkeri soils are very deep (>150 cm), moderately well drained, black to very dark brown calcareous cracking sandy clay soils. They have developed from granite gneiss and occur on nearly level to very gently sloping lowlands under cultivation. The Kavalakkeri series has been classified as a member of the fine loamy, mixed, isohyperthermic (calc) family of Fluventic Haplustepts.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 18 to 29 cm. Its colour is in 7.5 and 10YR hue with value 3 to 4 and chroma 2 to 4. The texture is sandy clay. The thickness of B horizon ranges from 131-155 cm. Its colour is in 7.5YR and 10 YR hue with value 2 to 4 and chroma 1 to 4. Its texture is sandy clay to clay. The available water capacity is very high (>200mm/). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Kavalakkeri (KLR) 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 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

4.2 Soils of Alluvial landscape

In this landscape, two soil series have been identified and mapped. Of these, Gatareddihal (GRH) series occupies an area of 5 ha (1%) and Kavalur (KVR) occur an area of about 20 ha (4%) in the microwatershed. The brief description of soil series along with the soil phases identified and mapped is given below.

4.2.1Gatareddihal (GRH) Series: Gatareddihal soils are deep (100-150 cm), moderately well drained have black or dark grey to light olive brown, calcareous sodic clay soils. They are developed from alluvium and occur on nearly level to very gently sloping plains under cultivation. The Gatareddihal series has been classified as a member of the very fine, smectitic, isohyperthermic family of Sodic Haplusterts.

The thickness of the solum ranges from 102 to 149 cm. The thickness of A-horizon ranges from 12 to 19 cm. Its colour is in 7.5 YR, 10 YR hue with value 3 to 4 and chroma 1 to 6. The texture is sandy clay loam to clay. The thickness of B-horizon ranges from 86 to 117 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 and chroma 2 to 6. Texture is clay with less than 15 per cent gravel. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Gatareddihal (GRH) Series

4.2.2 Kavalur (KVR) series: Kavalur soils are deep (100-150 cm), moderately well drained, have dark yellowish brown to very dark brown and very dark gray, calcareous black cracking clay soils They have developed from alluvium and occur on very gently sloping uplands. The Kavalur series has been classified as a member of the Fine smectitic, isohyperthermic (calc) family of Typic Haplusterts.

The thickness of the solum is 113 to 143 cm. The thickness of A horizon ranges from 9 to 24 cm. Its colour is in 10 YR hue with value 3 and chroma 1. The texture is clay with no gravel. The thickness of B horizon ranges from 89 to 134 cm. Its colour is in 10

YR hue with value 3 and chroma 1. Its texture is clay. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Landscape and soil profile characteristics of Kavalur (KVR) series

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

Series Name: Harve (HRV) **Pedon:** R-10
Location: $15^0$25'11.63"N, $76^0$22'03.65"E Jabbaragudda village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Loamy-skeletal, mixed isohyperthermic, (Paralithic) 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
0-15	Ap	65.64	9.07	25.28	29.04	12.99	9.00	3.48	11.15	50	scl	12.87	4.81
15-29	Bt1	56.13	7.75	36.12	27.81	11.43	7.21	1.44	8.24	60	sc	15.69	6.24
29-47	Bt2	63.42	6.53	30.05	32.38	13.93	7.48	5.74	3.89	60	scl	15.41	9.29

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}							%	%
0-15	6.05	-	-	0.21	0.93	-	8.89	1.96	0.50	0.08	11.43	11.24	0.44	100.00	0.73
15-29	5.99	-	-	0.15	0.29	-	9.72	2.75	0.51	0.09	13.07	12.71	0.35	100.00	0.74
29-47	6.07	-	-	0.11	0.38	-	9.35	2.47	0.49	0.06	12.36	12.71	0.42	97.29	0.44

Contd,,,

Series Name: Honnenahalli (HNH) **Pedon:** R-9
Location: $15^0$31'26"N, $76^0$15'55.0"E Hosura village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine-loamy, 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
0-20	Ap	45.73	27.63	26.65	18.85	8.75	5.25	5.77	7.11	15	scl	16.95	8.71
20-35	Bw1	53.87	20.02	26.11	20.95	12.07	8.05	6.81	5.99	15	scl	15.94	8.39
35-50	Bw2	61.98	12.47	25.54	24.38	15.60	9.09	7.33	5.58	15	scl	15.27	9.04
50-70	Bw3	62.35	10.44	27.21	28.81	13.48	8.13	6.28	5.66	10	scl	17.44	9.25

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}							%	%
0-20	7.94	-	-	0.99	1.24	-	14.78	2.59	0.10	0.38	17.85	18.00	0.68	99.15	2.13
20-35	7.68	-	-	0.09	0.81	-	15.03	3.02	0.10	0.32	18.46	18.40	0.70	100.34	1.72
35-50	7.63	-	-	0.06	0.48	-	14.28	2.91	0.10	0.28	17.56	17.50	0.69	100.37	1.61
50-70	7.67	-	-	0.06	0.48	-	13.78	2.29	0.13	0.36	16.56	18.20	0.67	90.99	1.96

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

Contd,,,

Series Name: Kavalakeri (KLR) **Pedon :** R-5
Location: $15^0$27'55.2"N, $76^0$15'48.0" E Kenchanadoni village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine, mixed, isohyperthermic (calc) Fluventic 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
0-21	Ap	41.67	28.70	29.62	6.62	10.58	5.70	8.00	10.76	-	cl	22.02	15.06
21-40	Bw1	32.23	29.16	38.61	3.76	4.03	3.04	8.24	13.16	-	cl	26.28	19.49
40-70	Bw2	37.41	26.13	36.46	7.52	6.25	4.62	8.61	10.42	-	cl	26.65	18.87
70-106	Bw3	46.43	18.15	35.42	13.93	14.29	5.98	5.98	6.25	-	sc	22.83	17.66
106-137	Bw4	55.64	12.91	31.45	10.59	8.16	12.67	11.46	12.76	-	scl	24.04	12.85
137-162	Bw5	47.16	16.68	36.16	2.88	4.80	5.68	17.12	16.68	-	sc	30.46	16.24

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	7.11	-	-	0.33	0.82	8.84	-	-	0.10	0.67	-	19.50	0.66	100.00	3.42
21-40	7.50	-	-	0.32	0.40	6.63	-	-	0.15	0.99	-	23.20	0.60	100.00	4.26
40-70	7.68	-	-	0.33	0.34	8.19	-	-	0.09	1.18	-	21.90	0.60	100.00	5.38
70-106	7.82	-	-	0.23	0.42	6.50	-	-	0.07	1.36	-	21.80	0.62	100.00	6.23
106-137	7.86	-	-	0.23	0.32	3.57	-	-	0.08	0.95	-	17.30	0.55	100.00	5.47
137-162	7.75	-	-	0.31	0.38	3.90	-	-	0.09	1.01	-	22.10	0.61	100.00	4.55

Contd,,,

Soil Series: Ranatur (RTR), **Pedon:** RM-87
Location: $13^0$21'49.0"N, $76^0$38'06"E, (4B3D4L2a), J C Pura village, Chikkanayakanahalli taluk, Tumakuru 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
0-17	Ap	84.16	9.46	6.38	2.22	18.57	26.14	24.32	12.92	-	ls	-	-
17-47	Bt1	51.14	8.30	40.56	1.66	13.49	14.52	13.59	7.88	-	sc	-	-
47-89	Bt2	51.99	11.01	37.00	1.94	13.99	15.32	13.18	7.56	-	sc	-	-
89-123	Bt3	51.58	9.07	39.35	3.47	14.50	14.61	11.64	7.35	-	sc	-	-
123-152	Bt4	47.89	8.88	43.23	2.27	12.36	14.21	11.12	7.93	-	sc	-	-
152-198	Bt5	43.37	13.17	43.45	2.48	9.83	13.25	10.87	6.94	-	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}							%	%
0-17	5.08	-	-	0.03	0.52	0.00	3.68	0.72	0.06	0.19	4.65	9.21	1.44	50.50	2.06
17-47	6.28	-	-	0.03	0.48	0.00	3.93	0.72	0.08	0.07	4.80	7.92	0.20	60.59	0.94
47-89	6.42	-	-	0.03	0.40	0.00	4.40	0.74	0.08	0.06	5.28	7.52	0.20	70.15	0.79
89-123	6.50	-	-	0.02	0.32	0.00	4.44	0.76	0.09	0.07	5.36	7.82	0.20	68.58	0.93
123-152	6.52	-	-	0.02	0.28	0.00	4.40	0.71	0.09	0.07	5.26	8.22	0.19	64.00	0.81
152-198	7.09	-	-	0.02	0.24	0.00	6.10	0.98	0.10	0.20	7.38	9.60	0.22	76.89	2.09

Contd,,,

Series Name: Gatareddihal (GRH) Pedon**:** R-7
Location: $15^0$14’20.8”N, $76^0$04’28.4” E Gudlanur village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Very fine, smectitic, isohyperthermic Sodic Haplusterts

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	20.07	19.71	60.23	1.76	3.75	3.64	3.42	7.50	-	c	41.70	29.56
18-51	Bss1	15.11	17.47	67.42	3.16	3.04	2.25	3.38	3.27	-	c	59.43	38.52
51-80	Bss2	13.19	18.74	68.07	1.80	2.93	2.37	3.04	3.04	-	c	60.69	40.91
80-107	Bss3	17.54	19.50	62.96	2.46	4.13	3.24	4.25	3.46	-	c	57.25	37.31
107-131	BC	9.42	17.48	73.10	1.48	1.82	1.36	1.93	2.84	-	c	64.62	43.98

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	9.08	-	-	0.23	0.33	6.89	-	-	0.70	6.36	-	63.21	1.05	100.00	7.11
18-51	9.19	-	-	0.61	0.49	9.10	-	-	0.54	14.20	-	66.05	0.98	100.00	15.98
51-80	9.27	-	-	0.56	0.29	9.36	-	-	0.49	14.75	-	65.63	0.96	100.00	17.07
80-107	9.28	-	-	0.57	0.39	9.62	-	-	0.44	14.64	-	63.95	1.02	100.00	17.49
107-131	9.04	-	-	1.08	0.31	8.32	-	-	0.52	16.40	-	68.36	0.94	100.00	17.30

Contd,,,

Series Name: Kavalura (KVR), **Pedon:** A2/RM-9
Location: $15^0$18'86.8"N, $75^0$56'56.3"E, Kavalura village, Koppal Taluk and District
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine, smectitic, isohyperthermic (calc) Typic Haplusterts

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
0-24	Ap	36.18	17.80	46.02	7.04	7.47	6.62	9.28	5.76	10	c	28.20	18.75
24-50	Bss1	38.79	15.36	45.85	6.25	6.25	9.70	10.67	5.93	05	c	27.16	18.81
50-85	Bss2	36.80	14.66	48.54	9.63	8.23	7.03	7.58	4.33	<5	c	30.16	22.17
85-124	Bss3	22.66	17.24	60.09	4.18	3.85	5.28	5.06	4.29	<5	c	40.34	31.42

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}							%	%
0-24	8.4	-	-	0.265	0.2	8.04	-	-	0.97	0.65		43.25	0.94		0.60
24-50	9.27	-	-	0.23	0.37	8.04	-	-	0.31	3.21		41.66	0.91		3.08
50-85	9.44	-	-	0.297	0.41	8.64	-	-	0.35	6.43		43.99	0.91		5.85
85-124	9.37	-	-	0.46	0.41	11.40	-	-	0.42	7.99		51.09	0.85		6.26

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 16 soil map units identified in the Jabbalgudda-2 Microwatershed are grouped under two land capability classes and seven land capability subclasses (Fig. 5.1).

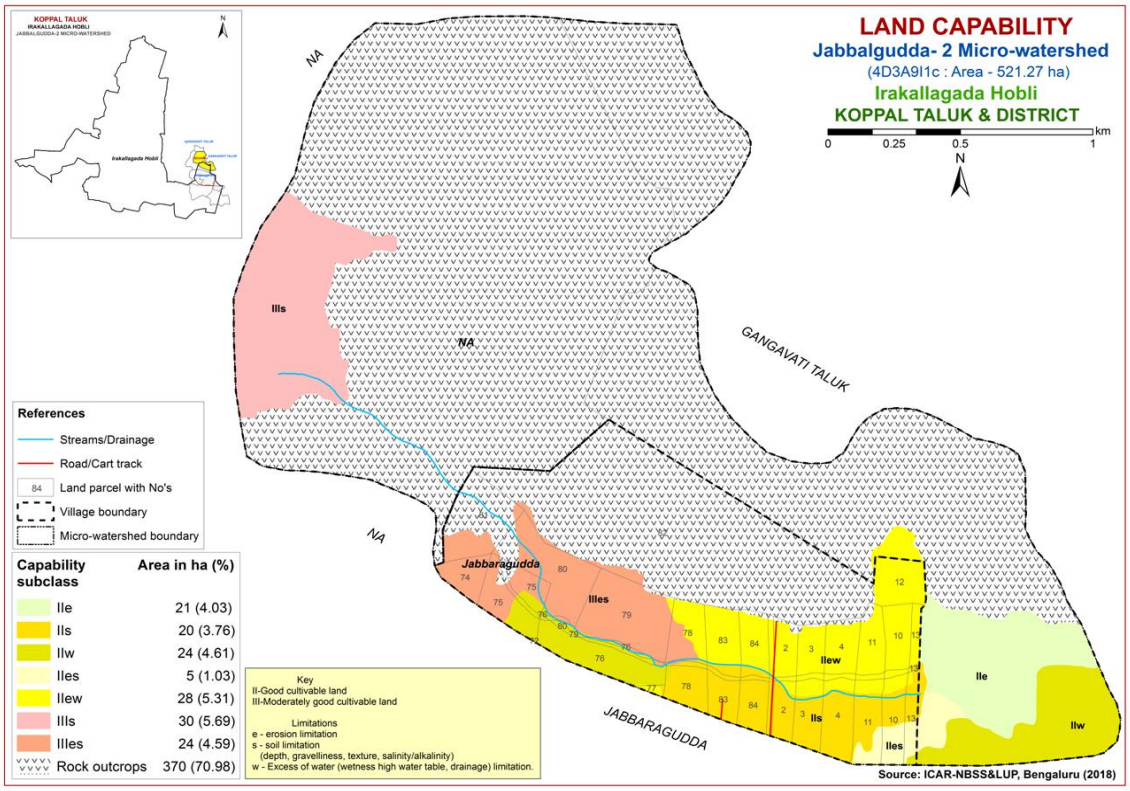


Fig. 5.1 Land Capability map of Jabbalgudda-2 Microwatershed

Entire area of the microwatershed is suitable for agriculture. Maximum area of 98 ha (19%) are good lands (Class II) that have minor limitations and require moderate conservation practices and are distributed in the major part of the microwatershed. Moderately good lands (Class III) cover an area of 54 ha (10%) and are distributed in the western and southern part of the microwatershed with moderate problems of soil that require special conservation practices. The other miscellaneous areas cover about 71 per cent is rock outcrops that have very severe limitations that preclude them for any crop productivity, but well suited for wildlife, recreation and installation of wind mills.

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).

Shallow (25-50 cm) soils occupy an area of 54 ha (6%) and are distributed in the western and southern part of the microwatershed. An area of 27 ha (5%) is moderately shallow (50-75 cm) and are distributed in the northern part of the microwatershed. Moderately deep soils (75-100 cm) occupy a minor area of 0.27 ha (<1%) and occur in the southern part of the microwatershed. Deep (100-150 cm) to very deep (>150 cm) soils occupy an area of 70 ha (13%) and are distributed in the major part of the microwatershed.

The most problem lands with an area of about 54 ha (6%) 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 minor area about 70 ha (13%) where all climatically adapted long duration crops be grown.

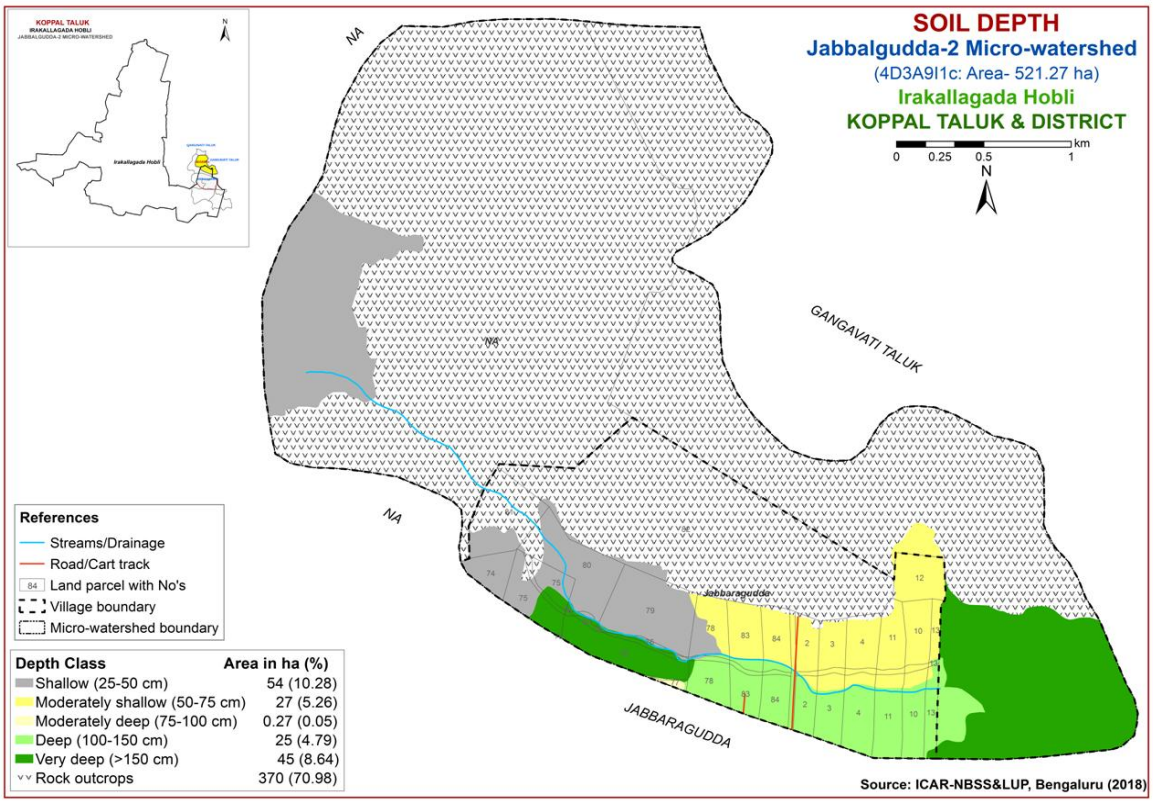


Fig. 5.2 Soil Depth map of Jabbalgudda-2 Microwatershed

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.

An area of about 89 ha (17%) has soils that are loamy soils at the surface and are distributed in the southern, northern and western part of the microwatershed. Maximum area of 89 ha (17%) is clayey soils at the surface and are distributed in the major part of the microwatershed (Fig. 5.3).

The most productive lands 89 ha (17%) 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 63 ha (12%) are loamy soils which also have high potential for AWC, nutrient availability but have no drainage or other physical problems compared to loamy soils.

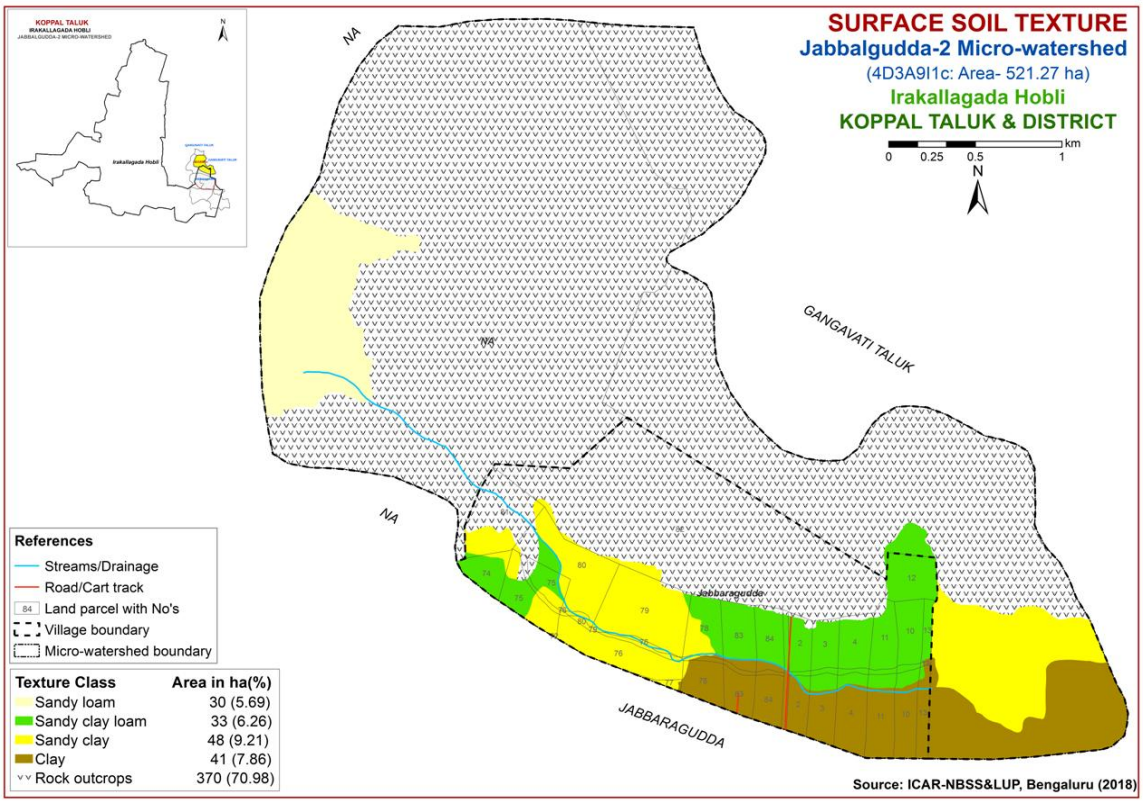


Fig. 5.3 Surface Soil Texture map of Jabbalgudda-2 Microwatershed

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 87 ha (17%) and are distributed in the major part of the microwatershed. An area of 65 ha (12%) is covered by gravelly (15-35% gravel) soils and are distributed in the northern, southern and western part of the microwatershed (Fig. 5.4).

The most productive lands with respect to gravelliness are found to be 17%. 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%) cover 65 ha (12%) where only short or medium duration crops can be grown.

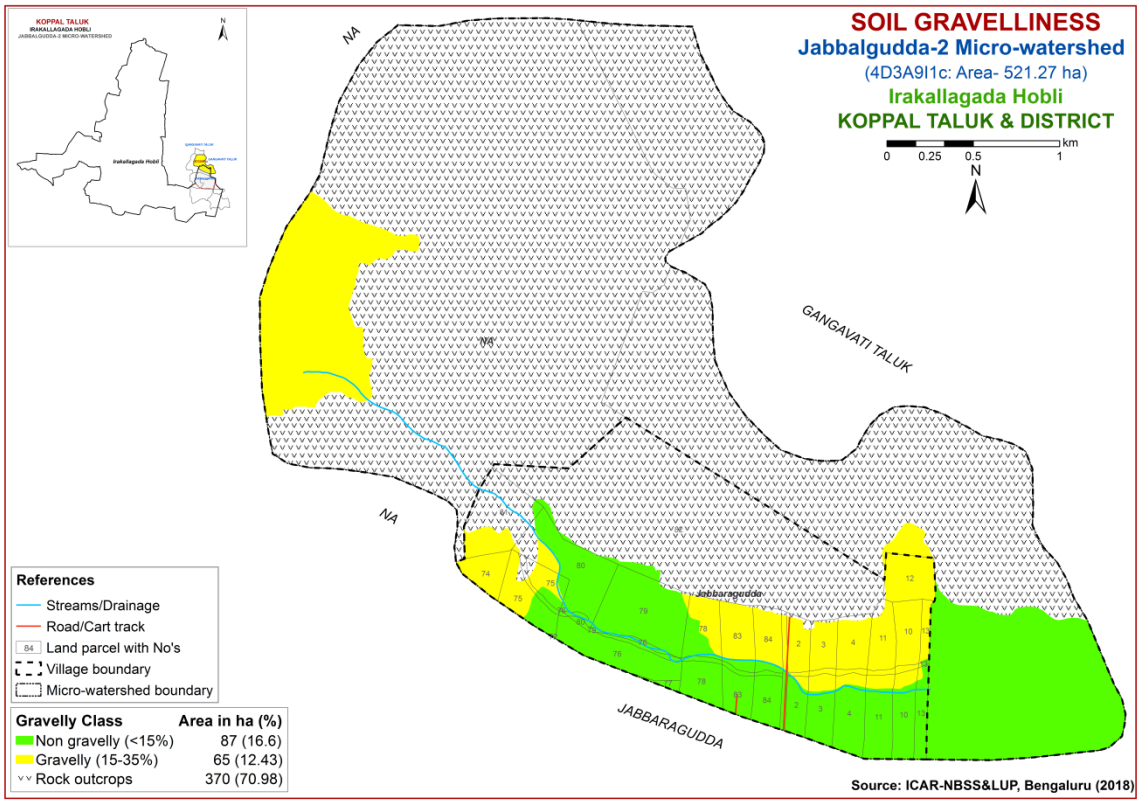


Fig. 5.4 Soil Gravelliness map of Jabbalgudda-2 Microwatershed

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 54 ha (10%) are very low (<50 mm/m) in available water capacity and are distributed in the western and southern part of the microwatershed. An area of about 27 ha (5%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the northern part of the microwatershed. Soils with medium available water capacity (101-150 mm/m) occupy a minor area of 0.28 ha (<1%) and are distributed in the southern part of the microwatershed. An area of about 70 ha (13%) is high (151-200 mm/m) to very high (>200 mm/m) in available water capacity and are distributed in the major part of the microwatershed.

An area of about 54 ha (10%) 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 70 ha (13%) that have very high AWC, where all climatically adapted long duration crops can be grown.

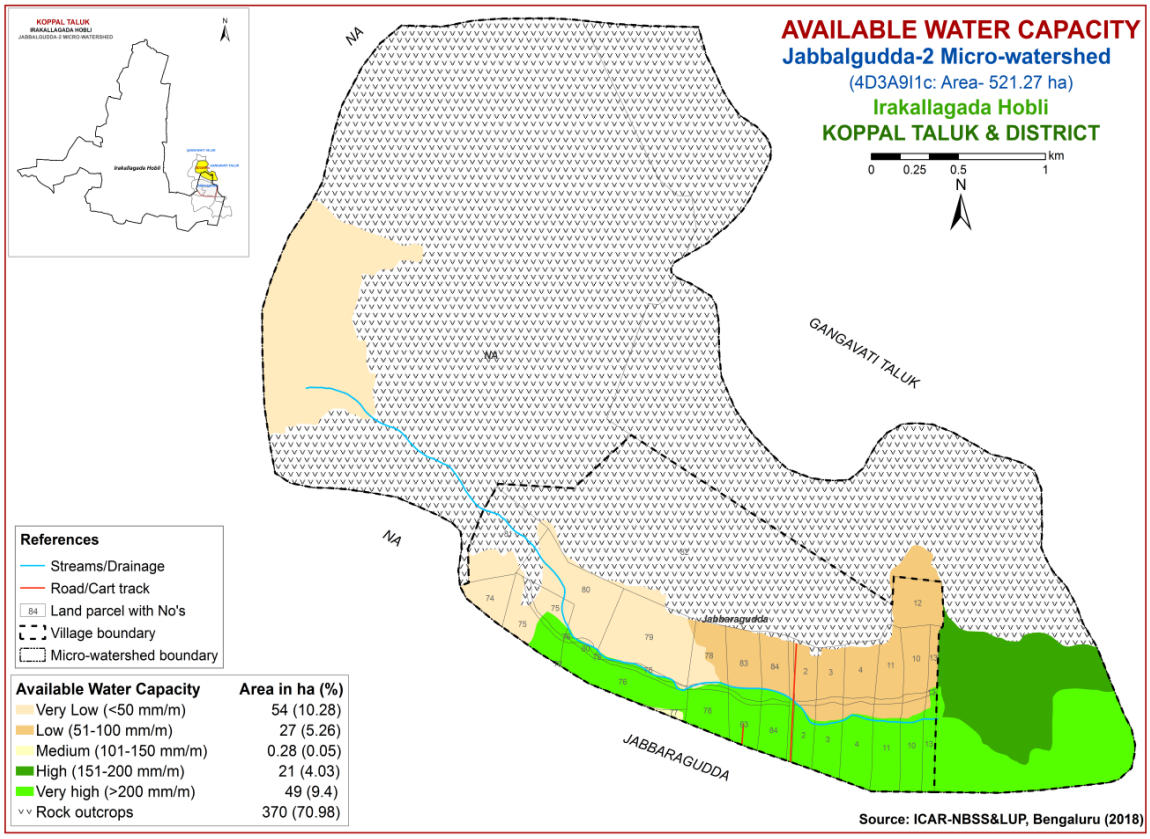


Fig. 5.5 Soil Available Water Capacity map of Jabbalgudda-2 Microwatershed

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 16 ha (3%) is nearly level (0-1% slope) and are distributed in the eastern part of the microwatershed. Maximum area of about 135 ha (26%) falls under very gently sloping (1-3% slope) and are distributed in all parts of the microwatershed.

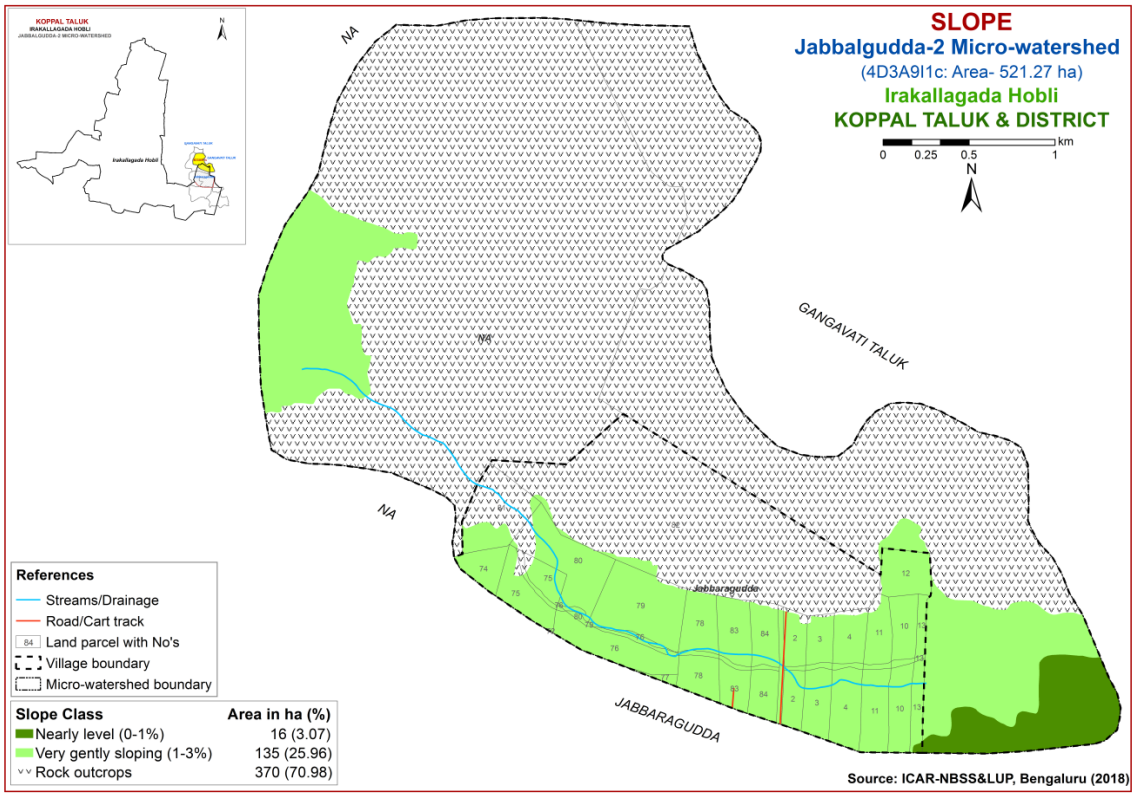


Fig. 5.6 Soil Slope map of Jabbalgudda-2 Microwatershed

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 73 ha (14%) and are distributed in the western, eastern and southern part of the microwatershed. Moderately eroded (e2 Class) soils cover an area of 78 ha (15%) and are distributed in the major part of the microwatershed.

An area of about 78 ha (15%) 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.

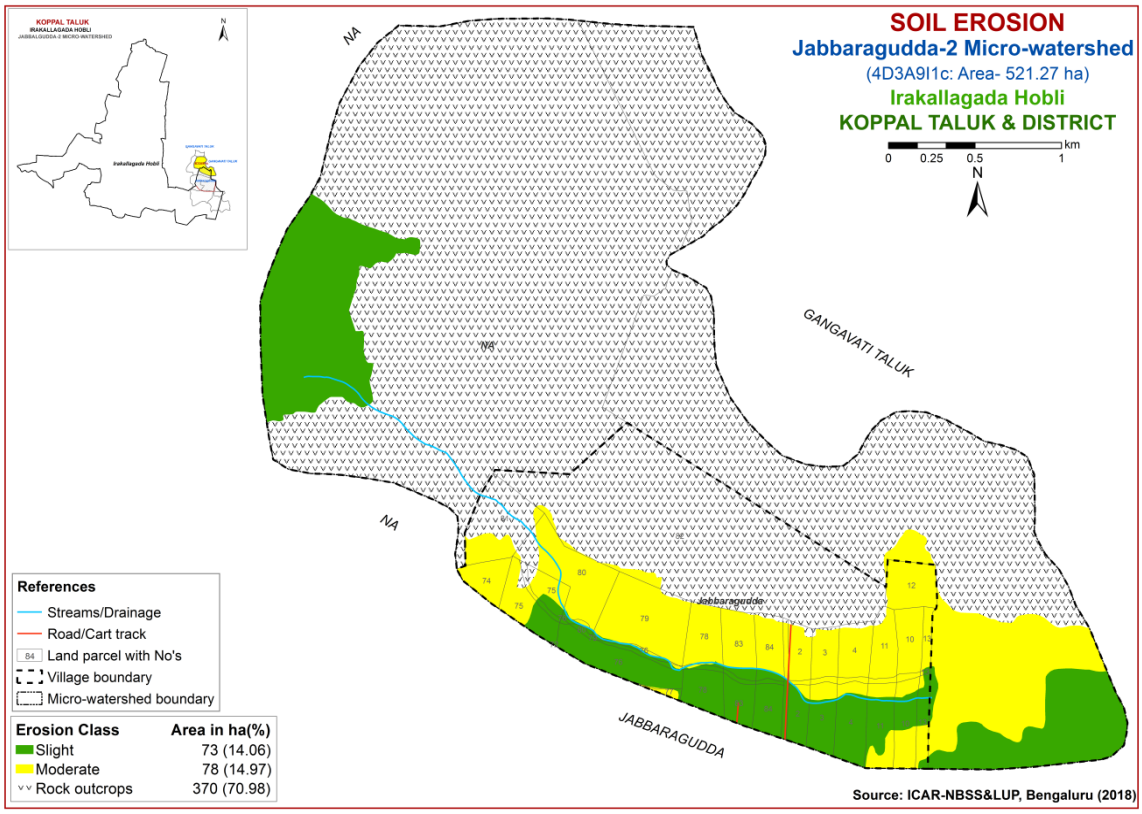


Fig. 5.7 Soil Erosion map of Jabbalgudda-2 Microwatershed

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 2017 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 Jabbalgudda-2 Microwatershed for soil reaction (pH) showed that an area of 15 ha (3%) is slightly acid (pH 6.0-6.5) and are distributed in the western, eastern and southern part of the microwatershed. A maximum area of 79 ha (15%) is neutral (pH 6.5-7.3) and are distributed in the major part of the microwaterhsed. Slightly alkaline (pH 7.3-7.8) soils cover an area of 51 ha (10%) and are distributed in the central and southern part of the microwatershed. An area of 6 ha (1%) is moderately alkaline (pH 7.8-8.40) and are distributed in the southern part of the microwatershed. Thus, major soils in the microwatershed are acid is 15 ha, neutral is 79 ha and alkaline in reaction covering 57 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 medium (0.5-0.75%) in organic carbon covering a maximum area of 127 ha (24%) and is distributed in the major part of the microwatershed. An area of 24 ha (5%) is high (>0.75%) in organic carbon and are distributed in the southern part of the microwatershed (Fig. 6.3).

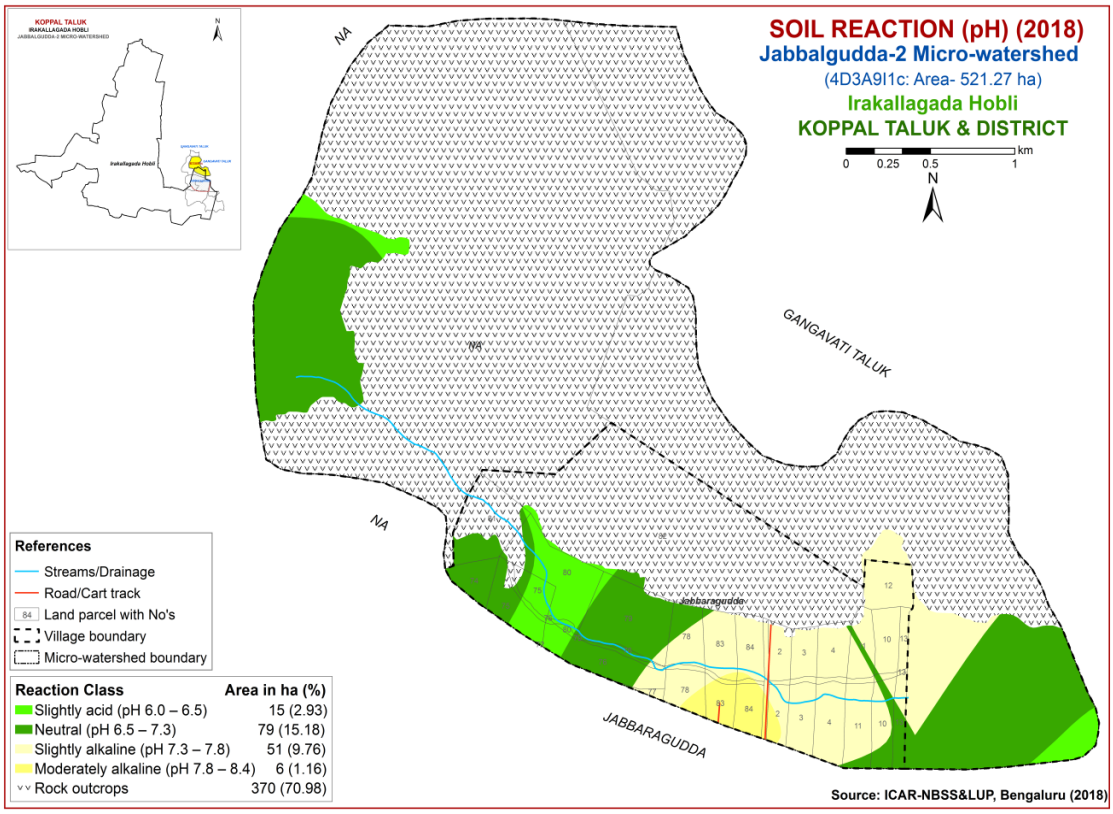


Fig. 6.1 Soil Reaction (pH) map of Jabbalgudda-2 Microwatershed

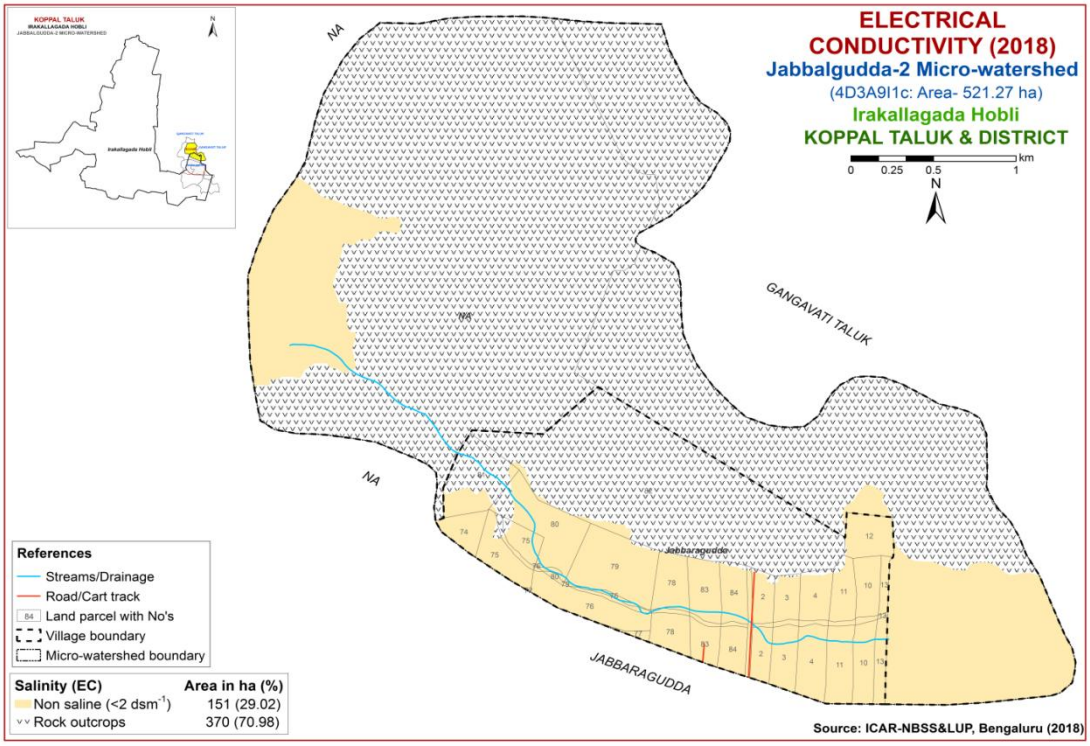


Fig. 6.2 Electrical Conductivity (EC) map of Jabbalgudda-2 Microwatershed

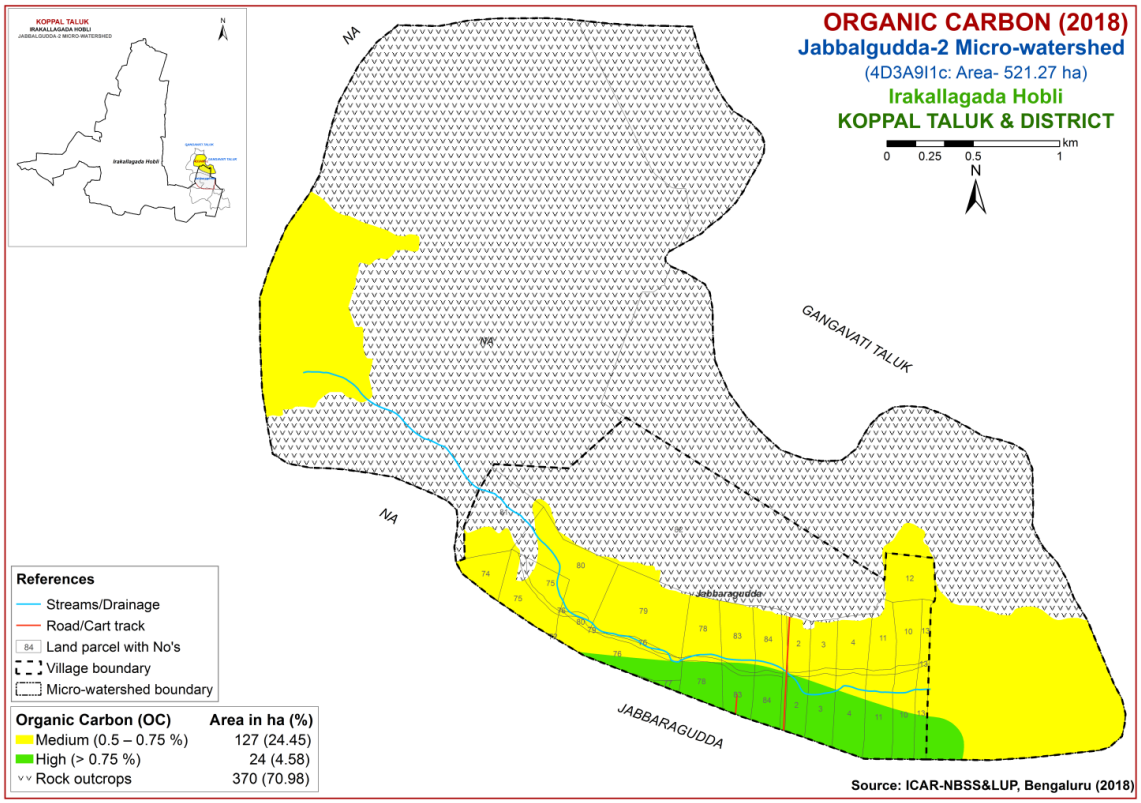


Fig. 6.3 Soil Organic Carbon map of Jabbalgudda-2 Microwatershed

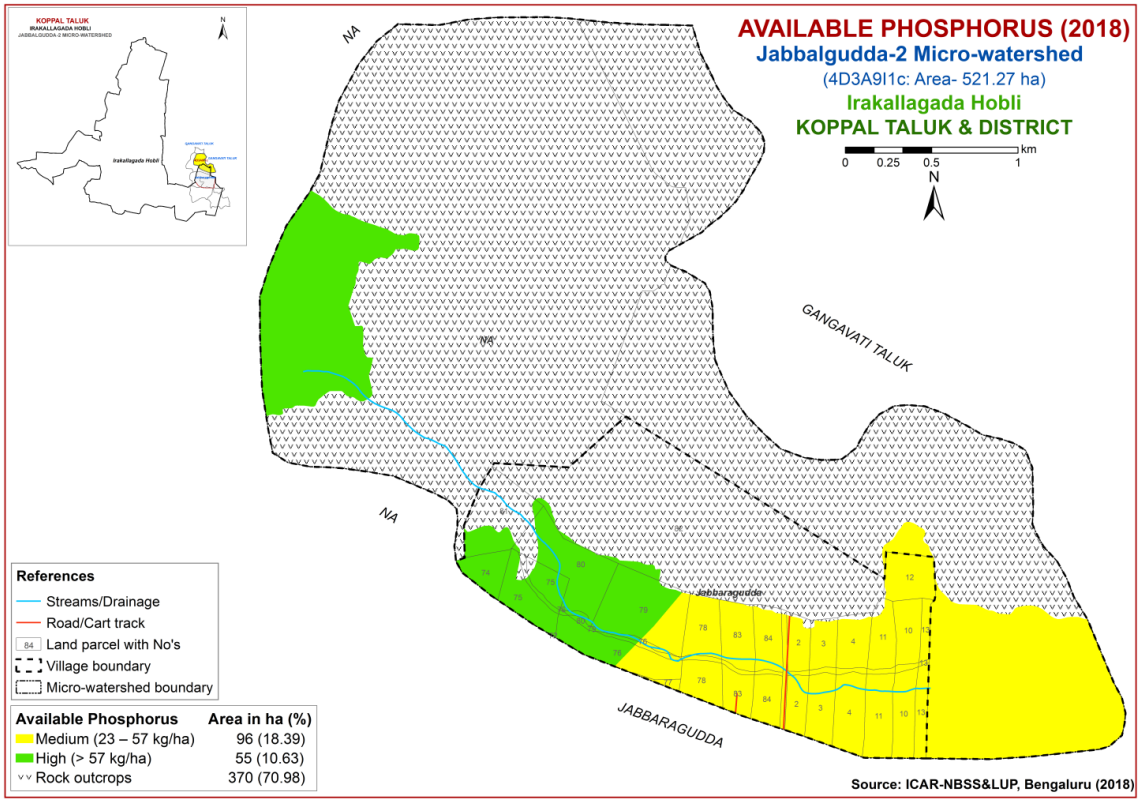


Fig. 6.4 Soil Available Phosphorus map of Jabbalgudda-2 Microwatershed

6.4 Available Phosphorus

Maximum area of 96 ha (18%) is medium (23-57 kg/ha) and are distributed in the major part of the microwatershed. An cultivated area of about 55 ha (11%) is high (>57 kg/ha) in available phosphorus and is distributed in the western and southern part of the microwatershed (Fig. 6.4).

6.5 Available Potassium

An area of 53 ha (10%) is medium (145-337 kg/ha) and are distributed in the western and southern part of the microwatershed. Maximum area of about 98 ha (19%) is high (>337 kg/ha) and are distributed in all parts of the microwatershed (Fig. 6.5).

6.6 Available Sulphur

Soils that are low (<10 ppm) in available sulphur content cover an area of 149 ha (29%) and are distributed in the major part of the microwatershed. Medium in available sulphur content (10-20 ppm) occur an area of 3 ha (<1%) and are distributed in the western part of the microwatershed (Fig. 6.6). The areas that are low and medium in available sulphur need to be applied with magnesium sulphate or gypsum or factomphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.

6.7 Available Boron

Available boron content is low (<0.5 ppm) in entire area of 151 ha (29%) and are distributed in all parts of the microwatershed (Fig. 6.7).

6.8 Available Iron

Available iron content is deficient (<4.5 ppm) in an entire area of 151 ha (29%) 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).

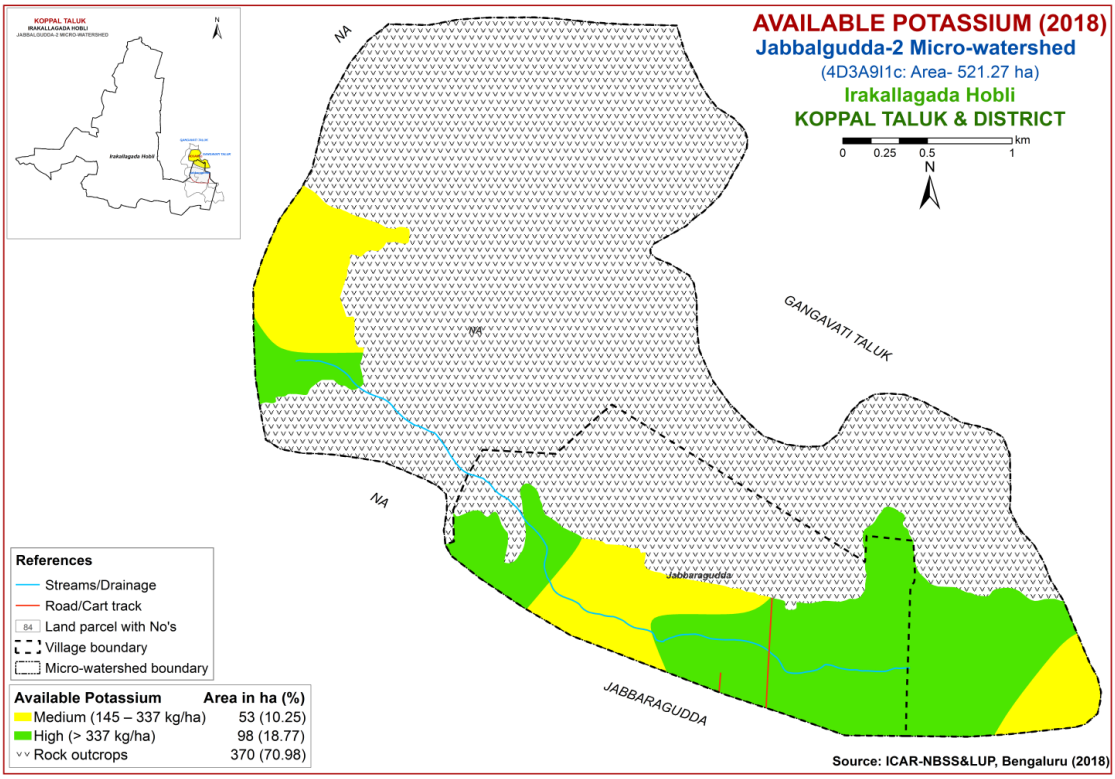


Fig. 6.5 Soil Available Potassium map of Jabbalgudda-2 Microwatershed

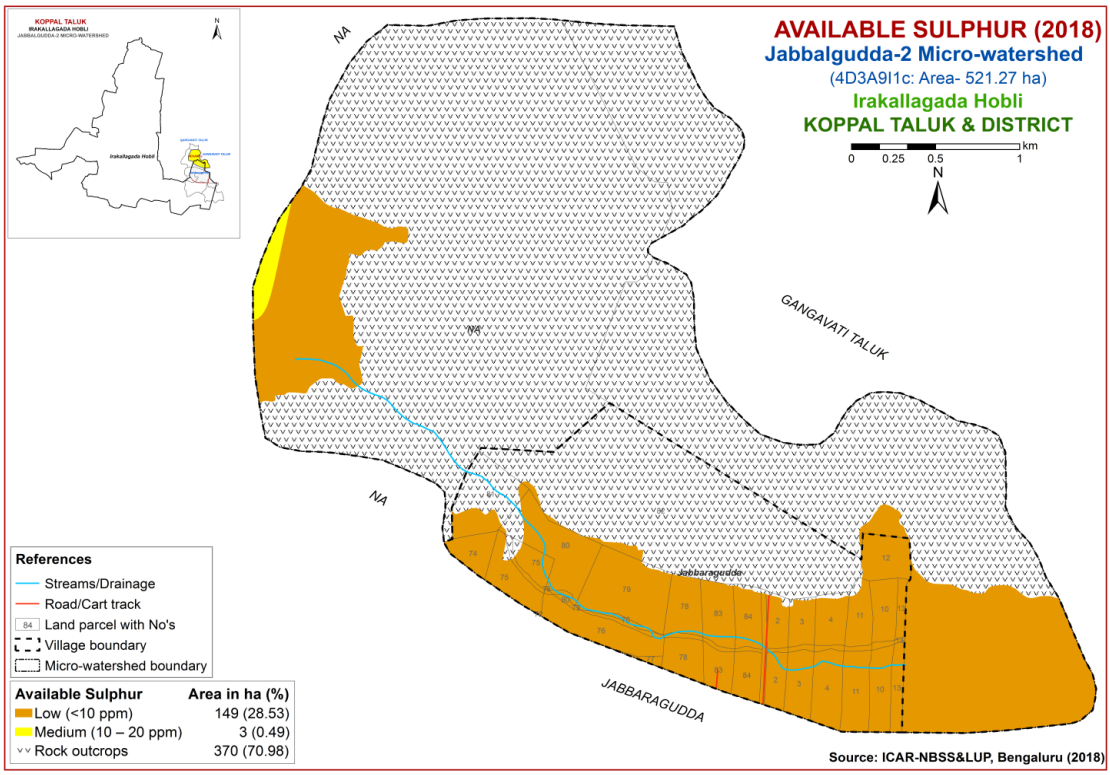


Fig. 6.6 Soil Available Sulphur map of Jabbalgudda-2 Microwatershed

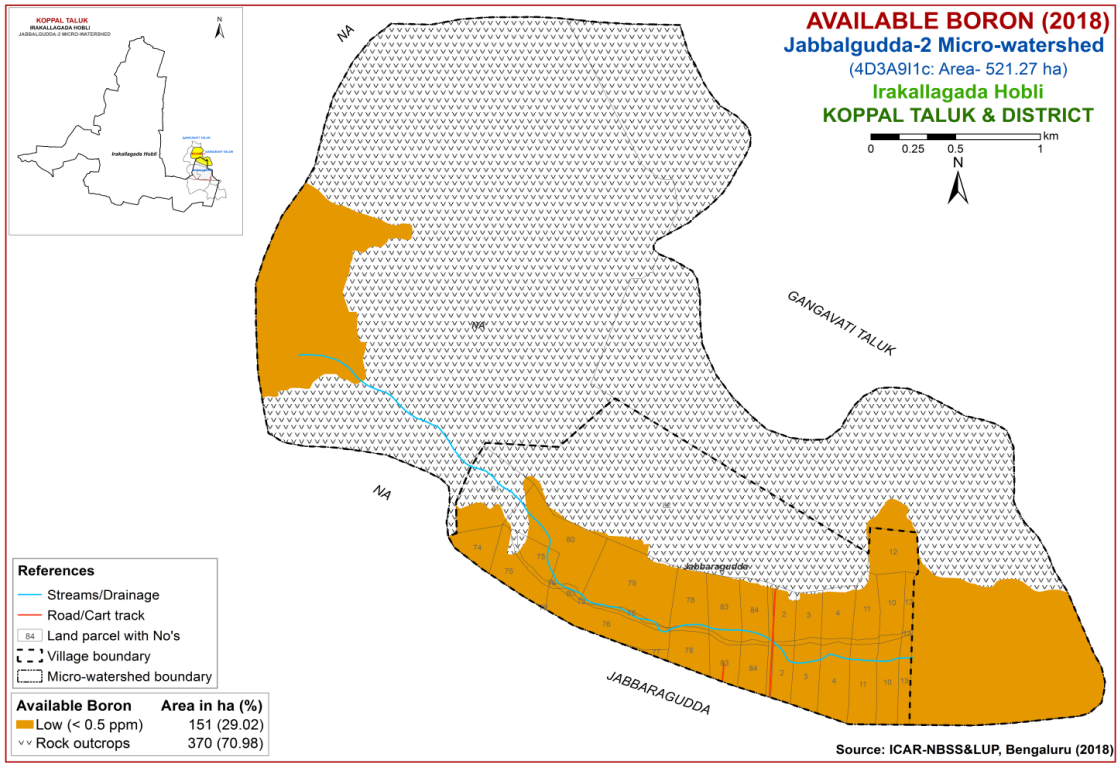


Fig. 6.7 Soil Available Boron map of Jabbalgudda-2 Microwatershed

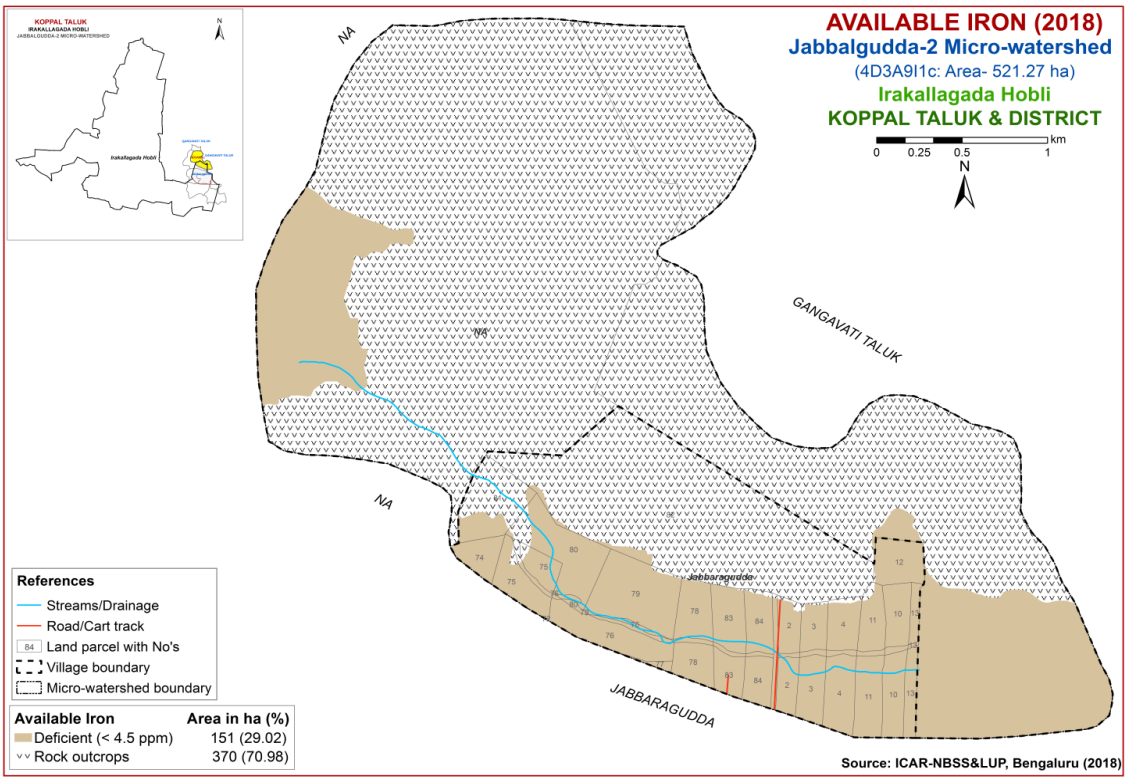


Fig. 6.8 Soil Available Iron map of Jabbalgudda-2 Microwatershed

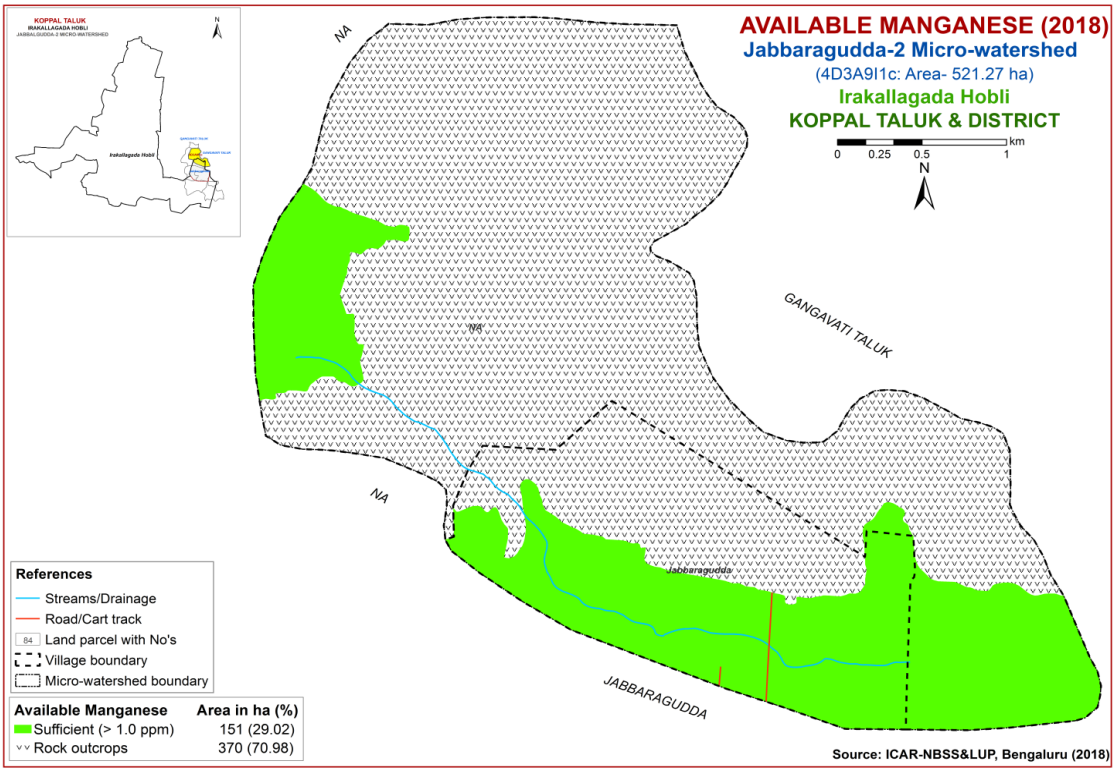


Fig. 6.9 Soil Available Manganese map of Jabbalgudda-2 Microwatershed

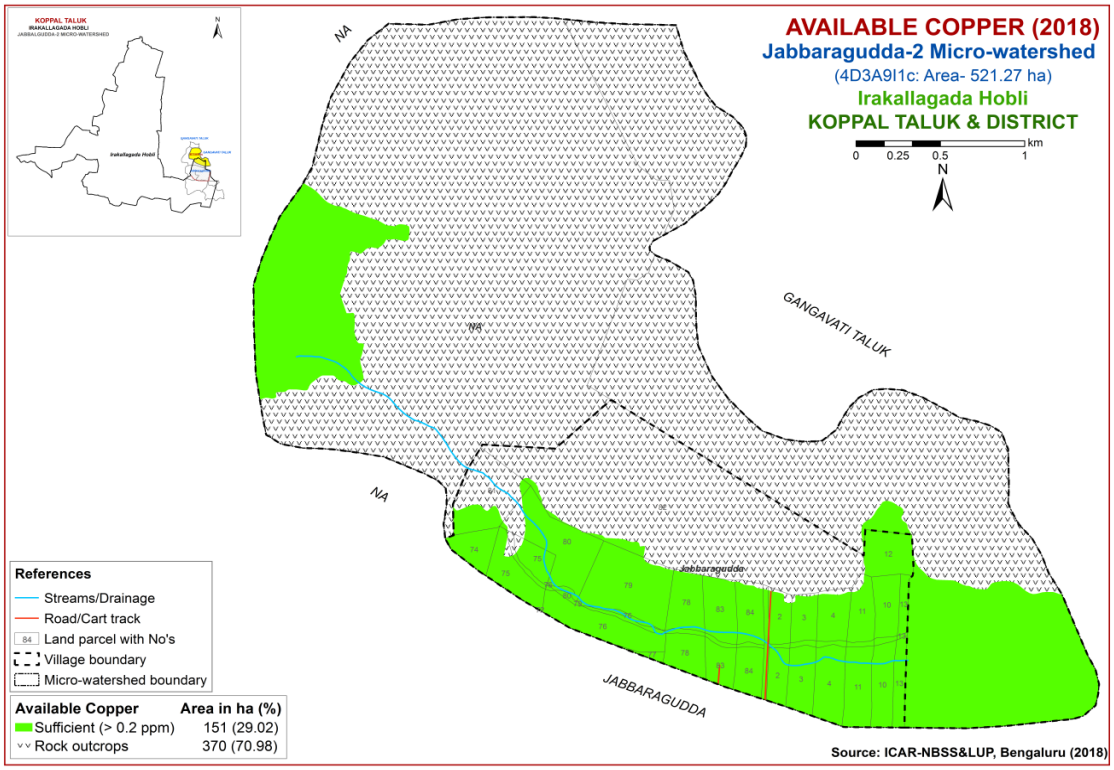


Fig. 6.10 Soil Available Copper map of Jabbalgudda-2 Microwatershed

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in entire area of the microwatershed (Fig. 6.11).

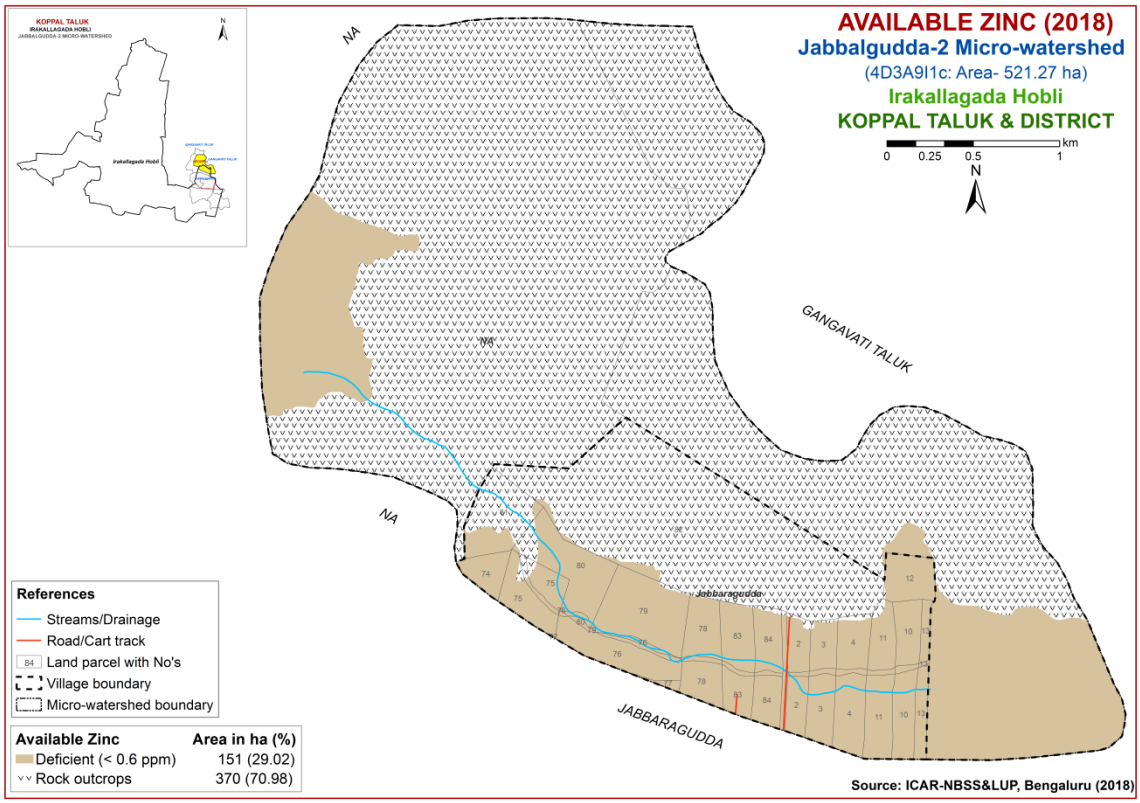


Fig. 6.11 Soil Available Zinc map of Jabbalgudda-2 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Jabbalgudda-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. 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 42 ha (8%) is highly suitable (Class S1) lands for growing sorghum and are distributed in the eastern part of the microwatershed. Maximum area of 55 ha (11%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of calcareousness, drainage and rooting

condition. An area of about 53 ha (10%) is marginally suitable (Class S3) for growing sorghum and are distributed in the western and southern part of the microwatershed with moderate limitations of gravelliness and rooting condition.

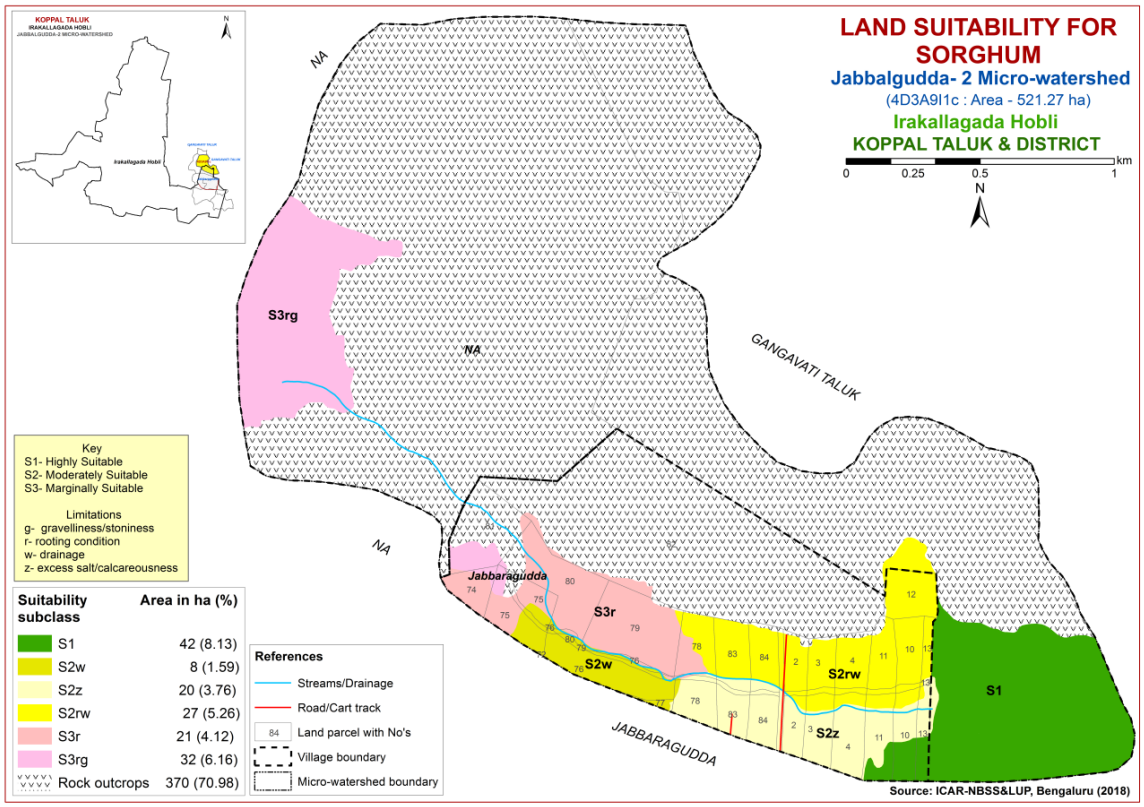


Fig. 7.1 Land Suitability map of Sorghum

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.

There are no highly suitable (Class S1) lands for growing maize in the microwatershed. Maximum area of 97 ha (19%) is moderately suitable (Class S2) for growing maize and are distributed in the major part of the microwatershed with minor limitations of calcareousness, rooting condition and drainage and texture. Marginally suitable (Class S3) lands cover an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

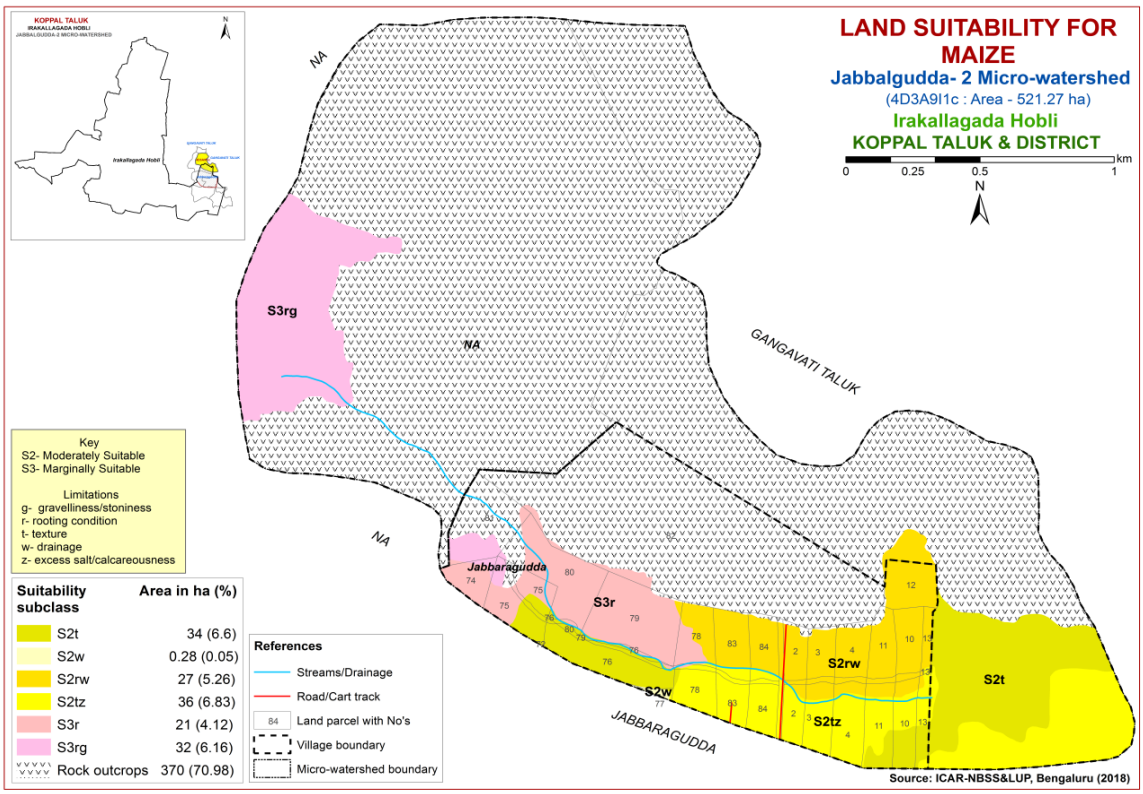


Fig. 7.2 Land Suitability map of Maize

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.

There are no highly suitable (Class S1) lands for growing bajra and in the microwatershed. Maximum area of 76 ha (15%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed with minor limitations of texture, drainage, rooting condition and calcareousness. Marginally suitable (Class S3) lands cover an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

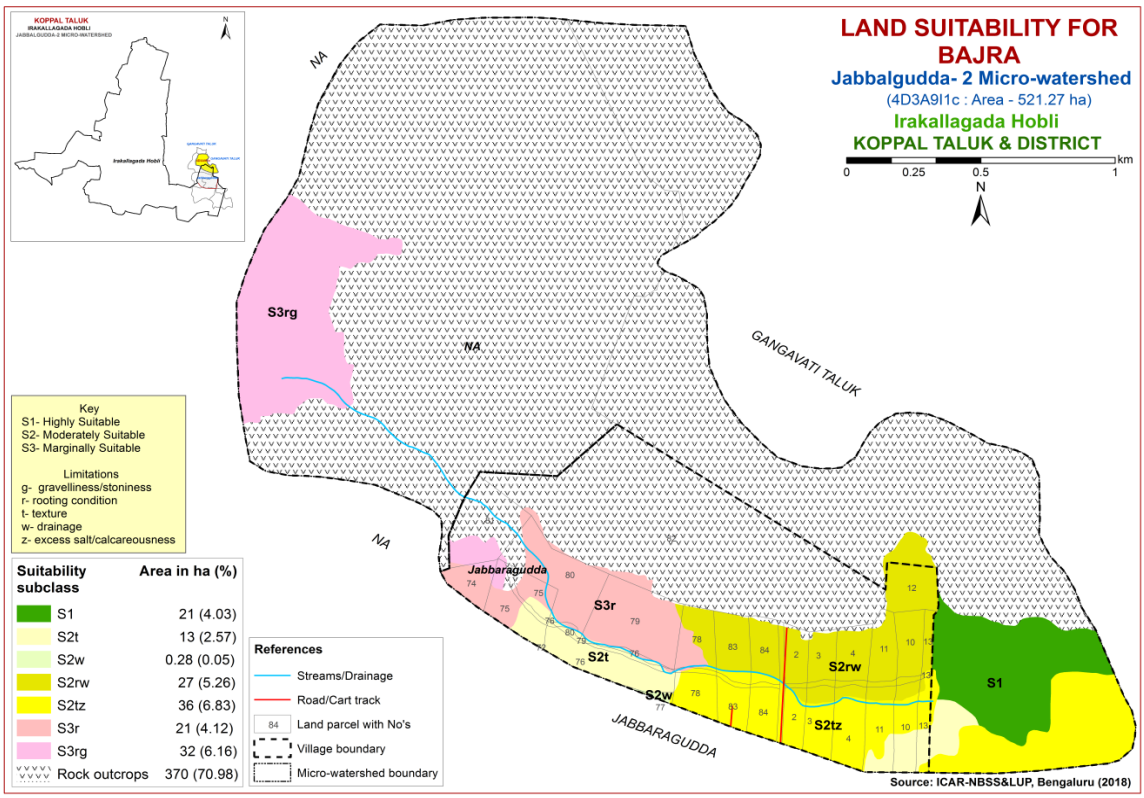


Fig. 7.3 Land Suitability map of Bajra

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 21 ha (4%) is highly (Class S1) suitable for growing groundnut and are distributed in the eastern part of the microwatershed. Maximum area of 27 ha (5%) is moderately (Class S2) suitable and are distributed in the central part of the microwatershed with minor limitations of rooting condition, drainage and texture. Marginally suitable (Class S3) lands occur in a maximum area of 102 ha (24%) for growing groundnut and are distributed in all parts of the microwatershed. They have moderate limitations of gravelliness, rooting condition, drainage, calcareousness and texture

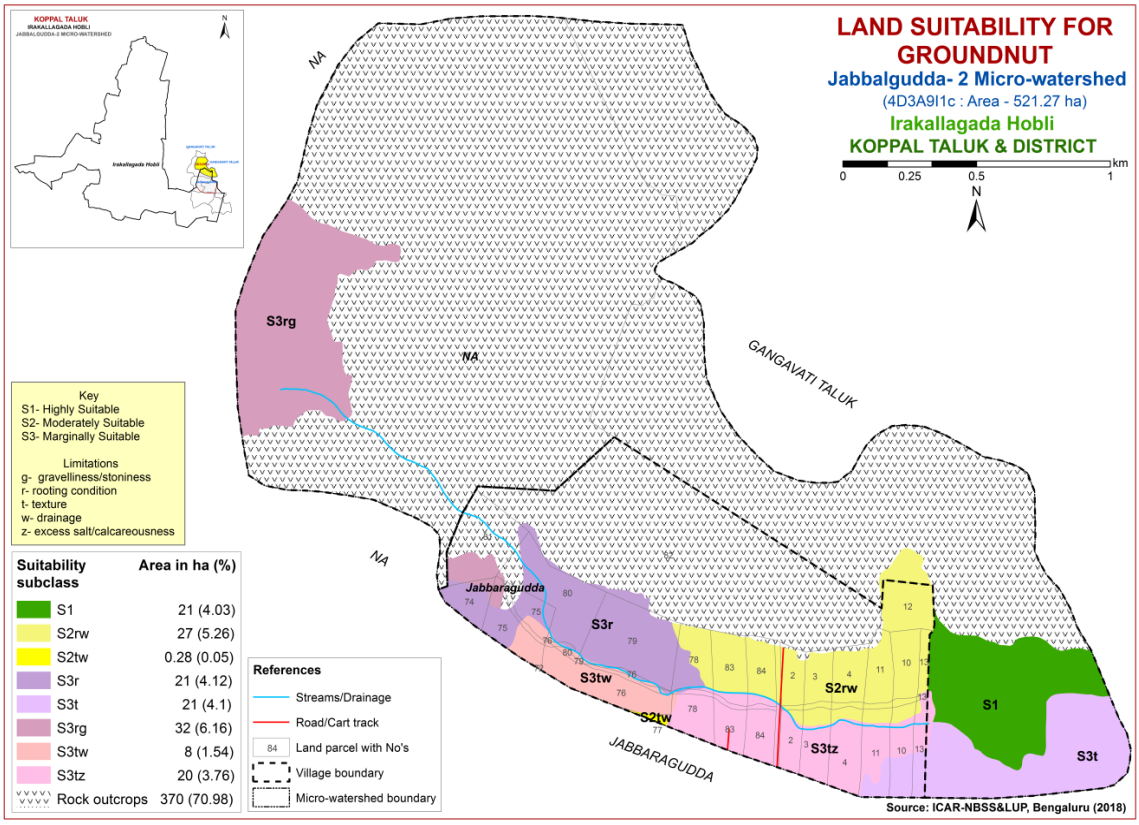


Fig. 7.4 Land Suitability map of Groundnut

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 42 ha (8%) is highly suitable (Class S1) lands for growing sunflower and are distributed in the eastern part of the microwatershed. An area of 28 ha (5%) is moderately suitable (Class S2) and are distributed in the southern part of the microwatershed. They have minor limitations of drainage, calcareousness and rooting condition. An area of 57 ha (11%) is marginally suitable (Class S3) for growing sunflower and distributed in the northern and western part of the microwatershed with moderate limitations of rooting condition, drainage and gravelliness. Currently not suitable (Class N1) lands cover an area of 23 ha (5%) and are distributed in the southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

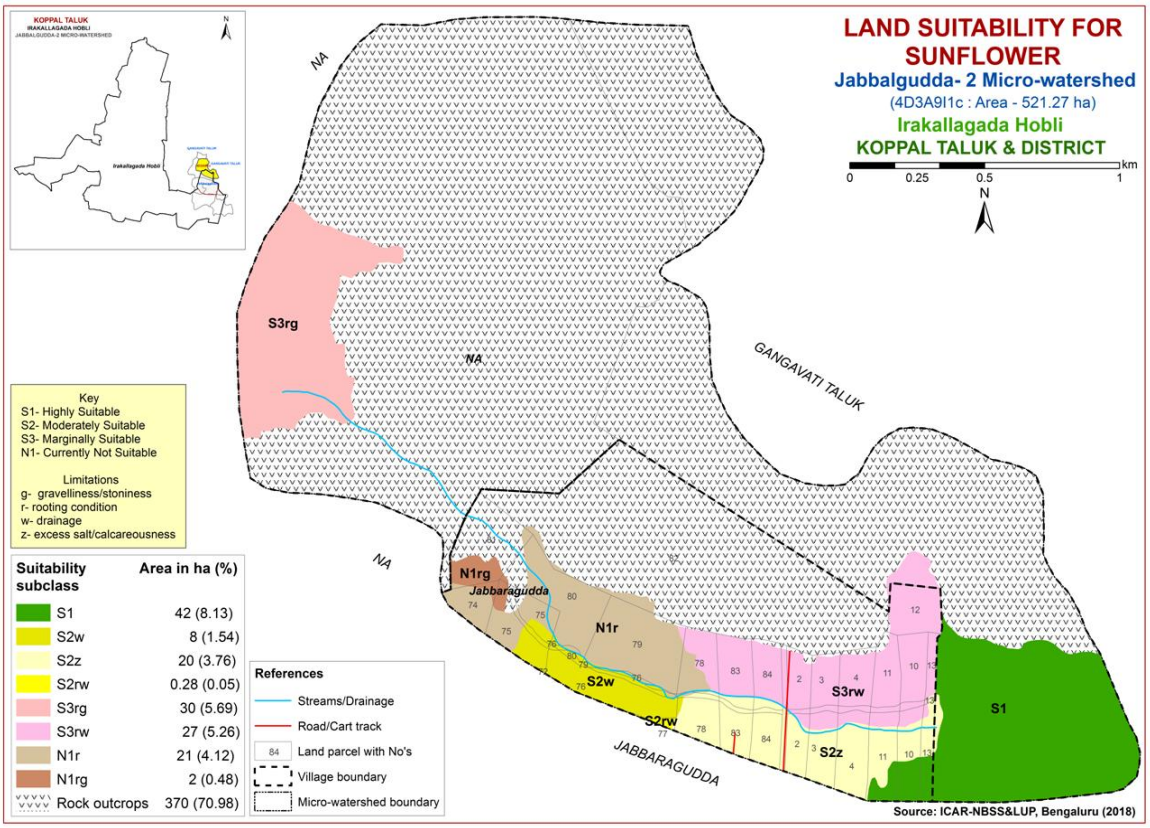


Fig. 7.5 Land Suitability map of Sunflower

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 21 ha (4%) is highly suitable (Class S1) lands growing redgram and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy a maximum area of 49 ha (9%) and are distributed in the southern and eastern part of the microwatershed with minor limitations of condition, drainage, texture and calcareousness. Marginally suitable (Class S3) lands cover an area of 27 ha (5%) and are distributed in the northern part of the microwatershed. They have moderate limitations of drainage and rooting condition. Currently not suitable (Class N1) lands cover an area of 53 ha (10%) for growing redgram and are distributed in the western and southern part of the microwatershed with severe limitations of gravelliness and rooting condition.

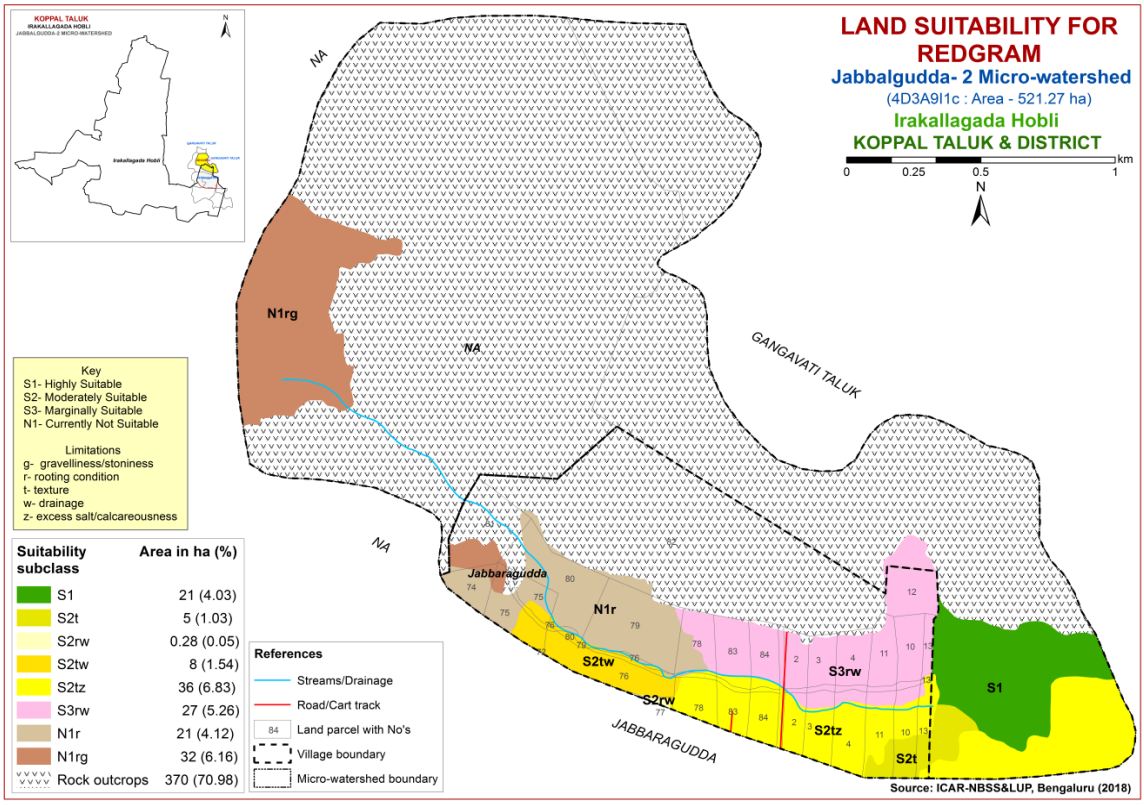


Fig. 7.6 Land Suitability map of Redgram

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 29 ha (6%) is highly suitable (Class S1) lands available for growing bengalgram and are distributed in the southern and eastern part of the microwatershed. Moderately suitable lands (Class S2) occupy a maximum area of 68 ha (13%) and are distributed in the southern, northern and eastern part of the microwatershed with minor limitations of texture, drainage, rooting condition and calcareousness. Marginally suitable (Class S3) lands cover an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed. They have moderate limitations of rooting condition and texture.

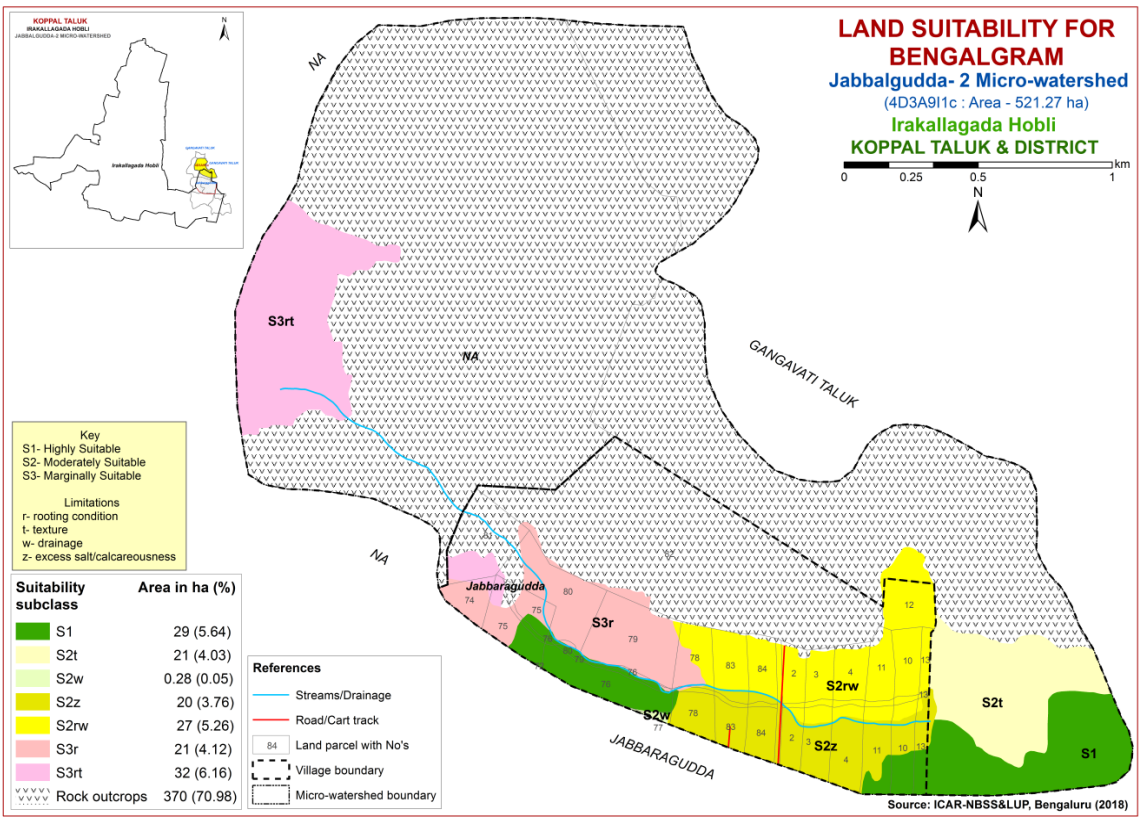


Fig. 7.7 Land Suitability map of Bengalgram

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 42 ha (8%) is highly suitable (Class S1) lands for growing cotton and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy a maximum area of 55 ha (11%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting condition, calcareousness and drainage. Marginally suitable (Class S3) lands cover an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed. They have moderate limitations of texture and rooting condition.

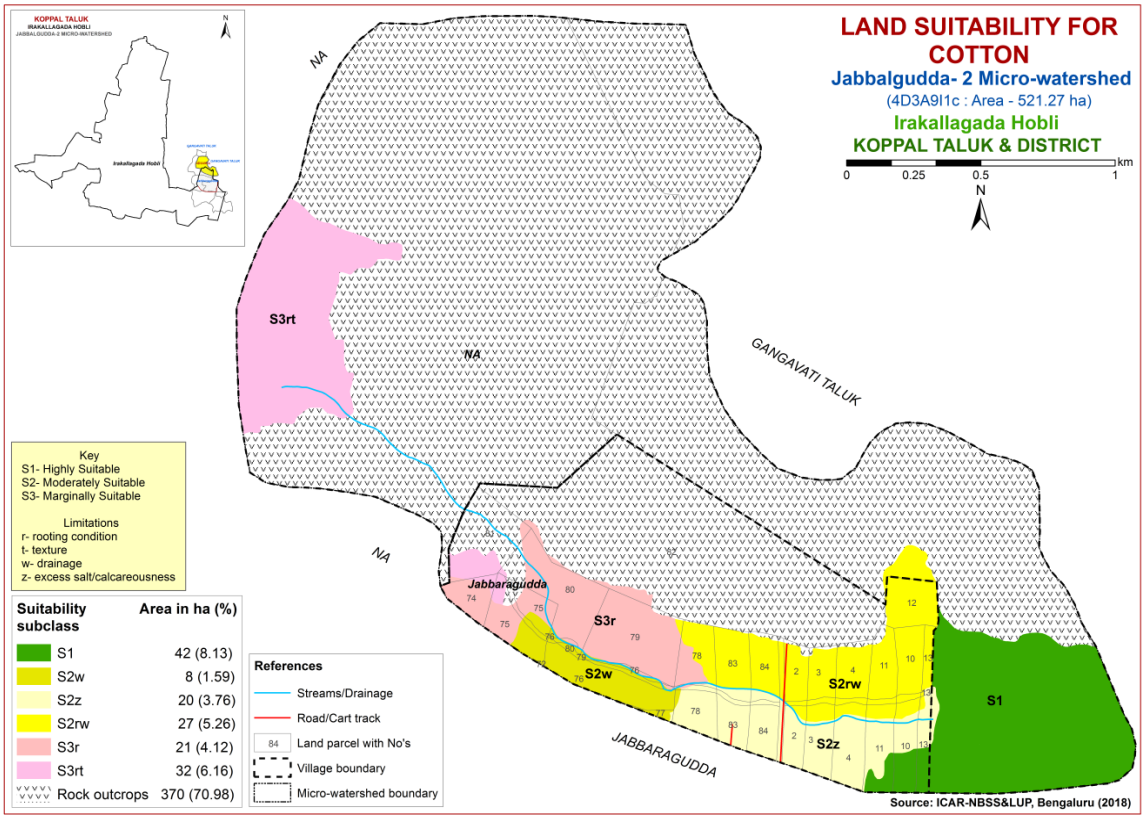


Fig. 7.8 Land Suitability map of Cotton

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 21 ha (4%) is highly (Class S1) and are distributed in the eastern part of the microwatershed. Moderately (Class S2) suitable lands occur in an area of 43 ha (8%) and are distributed in the southern, northern and eastern part of the microwatershed. They have minor limitations of rooting condition, texture, drainage and calcareousness. Marginally suitable (Class S3) lands cover a maximum area of about 86 ha (17%) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture, calcareousness, drainage and rooting condition.

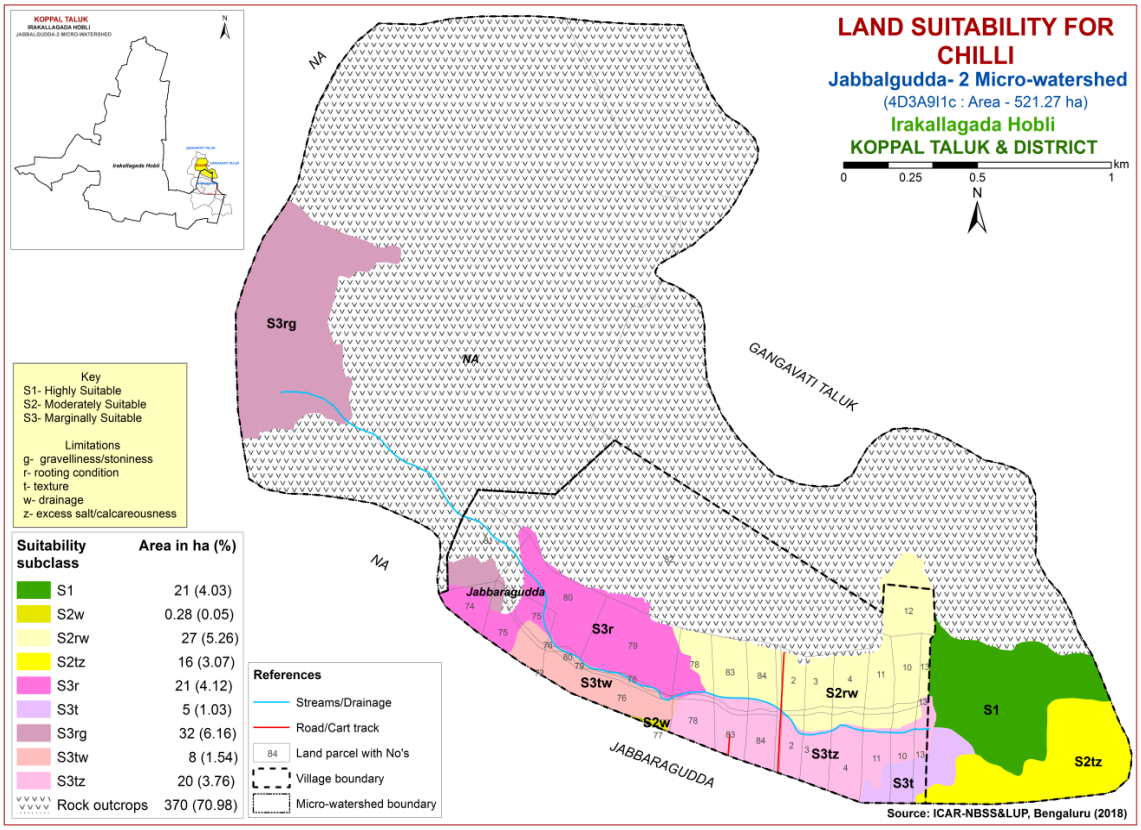


Fig. 7.9 Land Suitability map of Chilli

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 21 ha (4%) is highly (Class S1) for growing tomato and are distributed in the eastern part of the microwatershed. Moderately (Class S2) suitable lands occur in an area of 43 ha (8%) and are distributed in the southern, northern and eastern part of the microwatershed. They have minor limitations of rooting condition, texture, drainage and calcareousness. Marginally suitable (Class S3) lands occupy a maximum area of 86 ha (17%) and are distributed in all parts of the microwatershed with moderate limitations of gravelliness, rooting condition, texture, drainage and calcareousness.

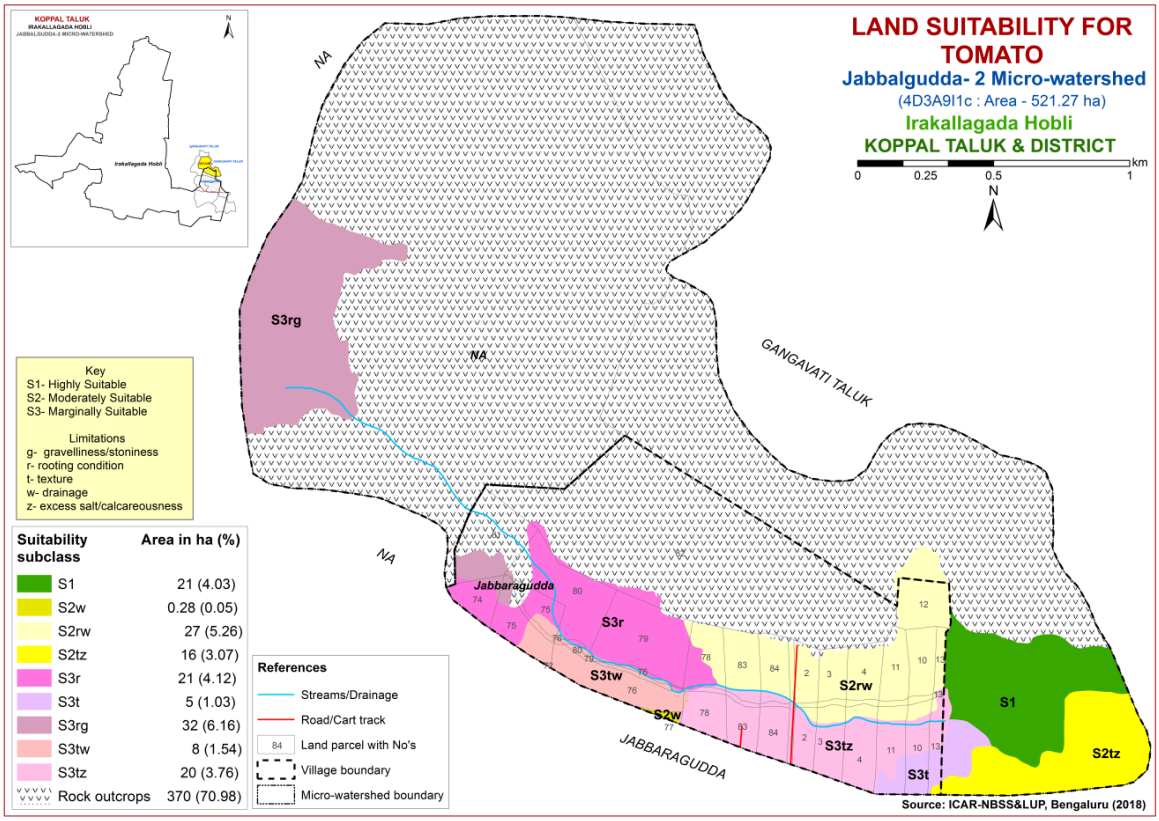


Fig. 7.10 Land Suitability map of Tomato

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.

There are no highly suitable (Class S1) for growing brinjal in the microwatershed. Maximum area of about 97 ha (19%) is moderately suitable (Class S2) for growing brinjal and are distributed in the major part of the microwatershed with minor limitations of texture, calcareousness, drainage and rooting condition. Marginally suitable lands (Class S3) occur in an area of 53 ha (10%) and are distributed in the western, southern part of the microwatershed with moderate limitations of rooting condition and gravelliness.

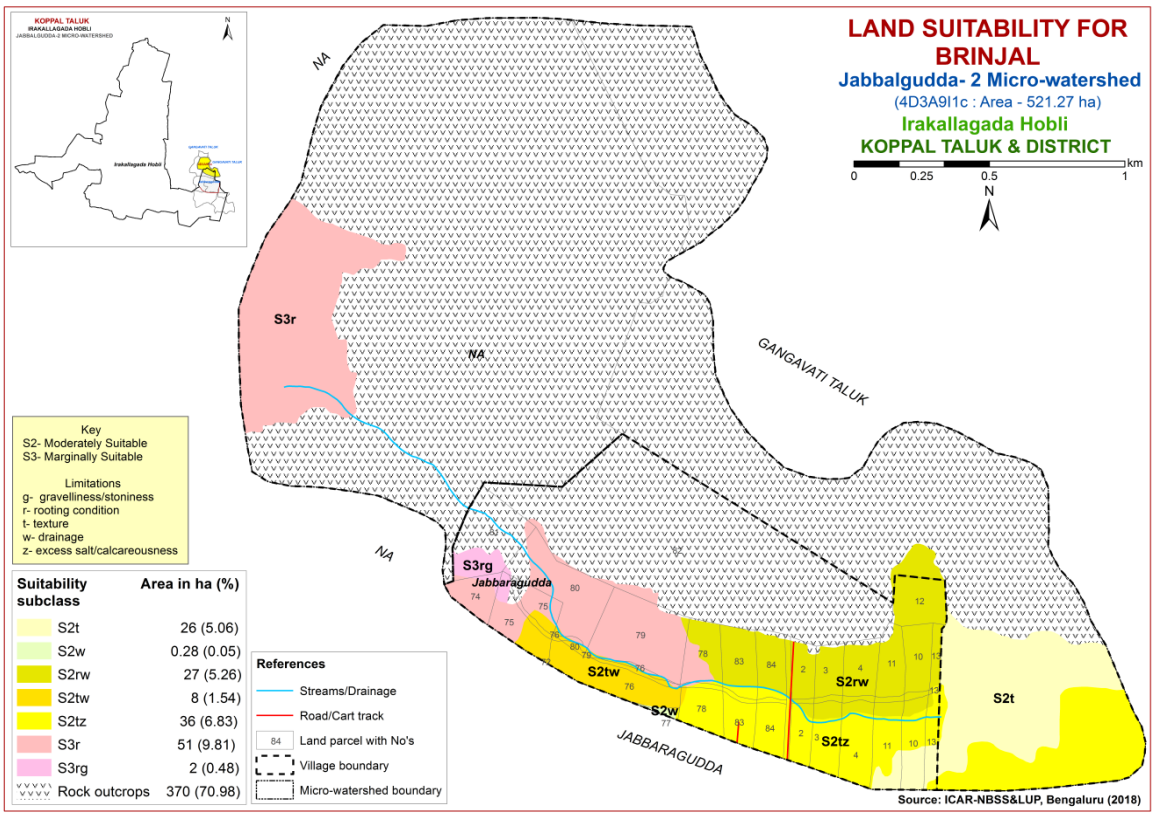


Fig. 7.11 Land Suitability map of Brinjal

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.

There are no highly (Class S1) suitable for growing onion in the microwatershed. An area of 63 ha (11%) is moderately suitable (Class S2) and are distributed in the southern, eastern and northern part of the microwatershed. They have minor limitations of texture, rooting condition and drainage. Marginally suitable lands (Class S3) for growing onion occupy a maximum area of 94 ha (18%) and are distributed in all parts of the microwatershed with moderate limitations of rooting depth, gravelliness, calcareousness and texture.

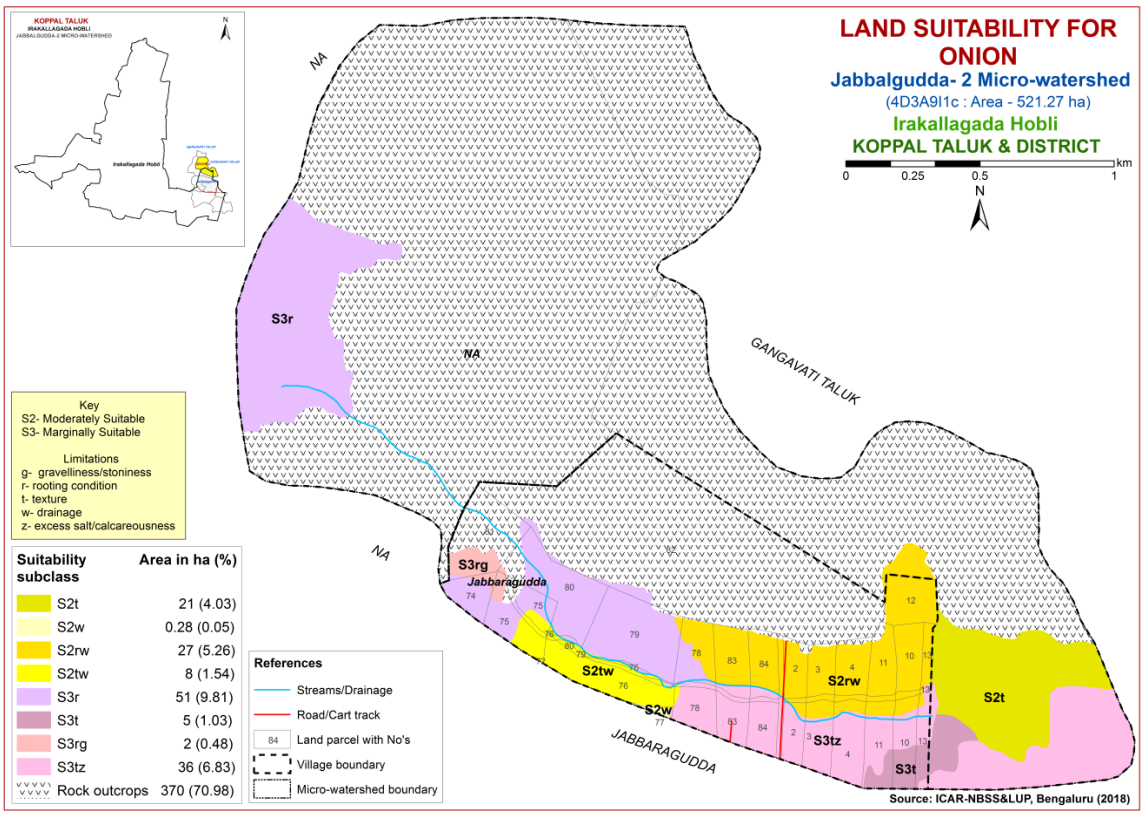


Fig. 7.12 Land Suitability map of Onion

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.

There are no highly suitable (Class S1) for growing bhendi in the microwatershed. Maximum area of about 97 ha (19%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed with minor limitations of texture, calcareousness, drainage and rooting condition. Marginally suitable lands (Class S3) occur in an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed with moderate limitations of rooting condition and gravelliness.

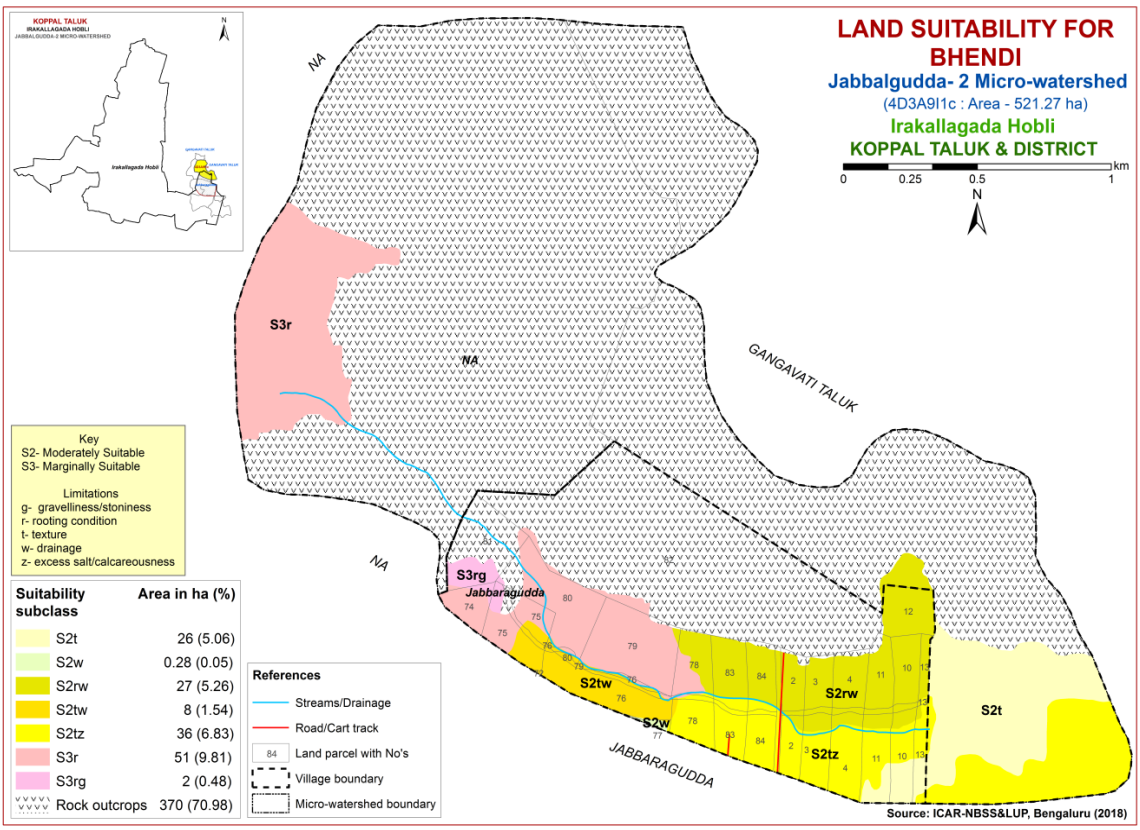


Fig. 7.13 Land Suitability map of Bhendi

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.

An area of 21 ha (4%) is highly suitable (Class S1) lands for growing drumstick and are distributed in the eastern part of the microwatershed. An area of 49 ha (9%) is moderately suitable (Class S2) and are distributed in the southern and eastern part of the microwatershed. They have minor limitations of texture, rooting condition, drainage and calcareousness. Marginally suitable (Class S3) lands cover an area of 27 ha (5%) and are distributed in the northern part of the microwatershed. They have moderate limitations of drainage and rooting condition. Currently not suitable (Class N1) lands cover an area of 53 ha (10%) and are distributed in the western and southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

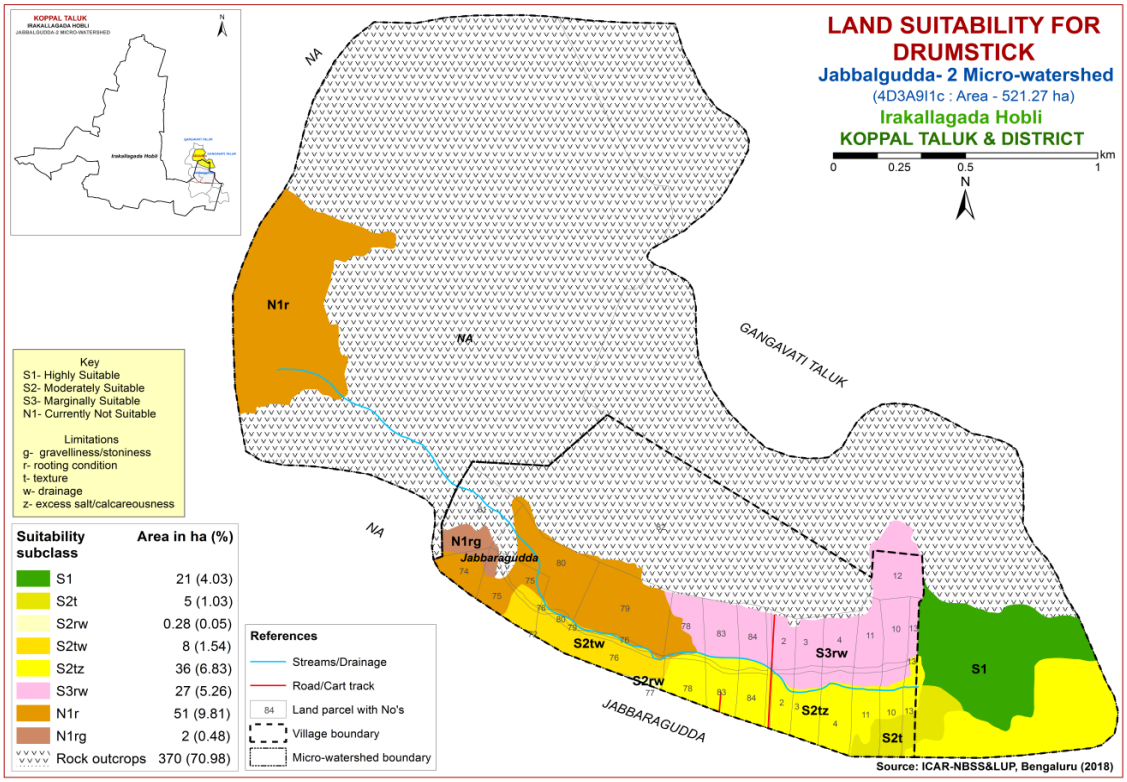


Fig. 7.14 Land Suitability map of Drumstick

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.

An area of 21 ha (4%) is highly (Class S1) suitable for growing mango and in the microwatershed. Moderately (Class S2) suitable lands occur in an area of 20 ha (4%) and are distributed in the eastern part of the microwaterhsed. Marginally suitable (Class S3) lands cover an area of 29 ha (6%) and are distributed in the southern and eastern part of the microwatershed. They have moderate limitations of drainage, rooting condition, texture and calcareousness. An area of 80 ha (16%) is currently not suitable (Class N1) for growing mango and occur in the major part of the microwatershed with severe limitations of gravelliness, drainage and rooting condition.

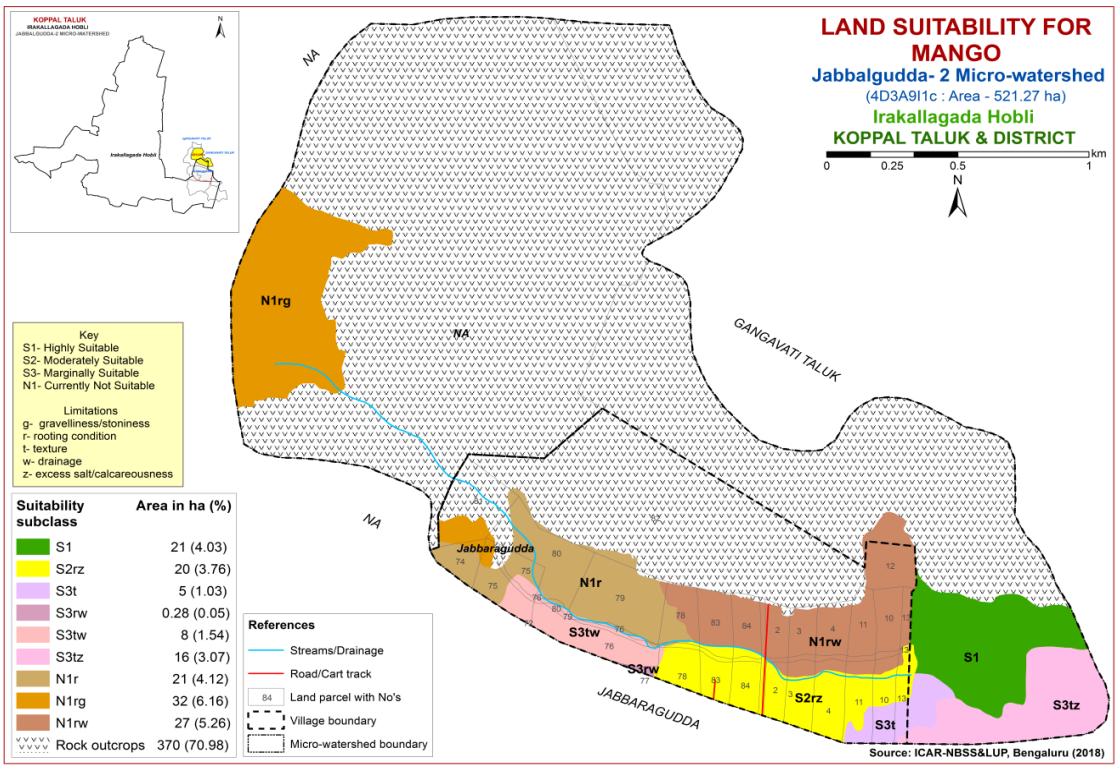


Fig. 7.15 Land Suitability map of Mango

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 21 ha (4%) is highly (Class S1) suitable for growing guava and are distributed in the eastern part of the microwatershed. Moderately (Class S2) suitable lands occur in a minor area of 0.28 ha (<1%) and are distributed in the southern part of the microwatershed. Marginally suitable (Class S3) lands cover a maximum area of 76 ha (15%) and are distributed in major part of the microwatershed. They have moderate limitations of drainage, texture, rooting condition and calcareousness. An area of about 53 ha (10%) area is currently not suitable (Class N1) for growing guava and occur in the western and southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

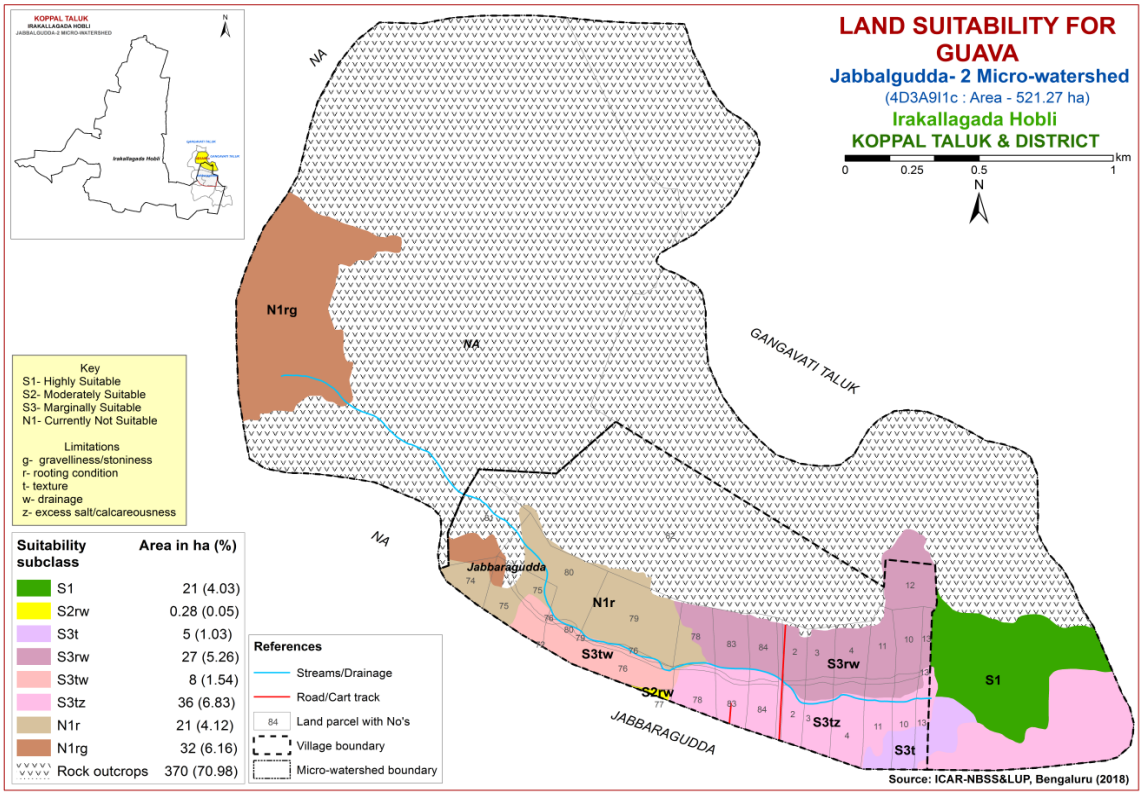


Fig. 7.16 Land Suitability map of Guava

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.

An area of 21 ha (4%) is highly (Class S1) suitable for growing sapota and are distributed in the eastern part of the microwatershed. Moderately (Class S2) suitable lands occur in a minor area of 0.28 ha (<1%) and are distributed in the southern part of the microwatershed. Maximum area of about 76 ha (15%) is marginally suitable (Class S3) and are distributed in the major part of the microwaterhsed. They have minor limitations of drainage, texture, calcareousness and rooting condition. An area of 53 ha (10%) is currently not suitable (Class N1) for growing sapota and occur in the western and southern part of the microwatershed with severe limitations of gravelliness and rooting condition.

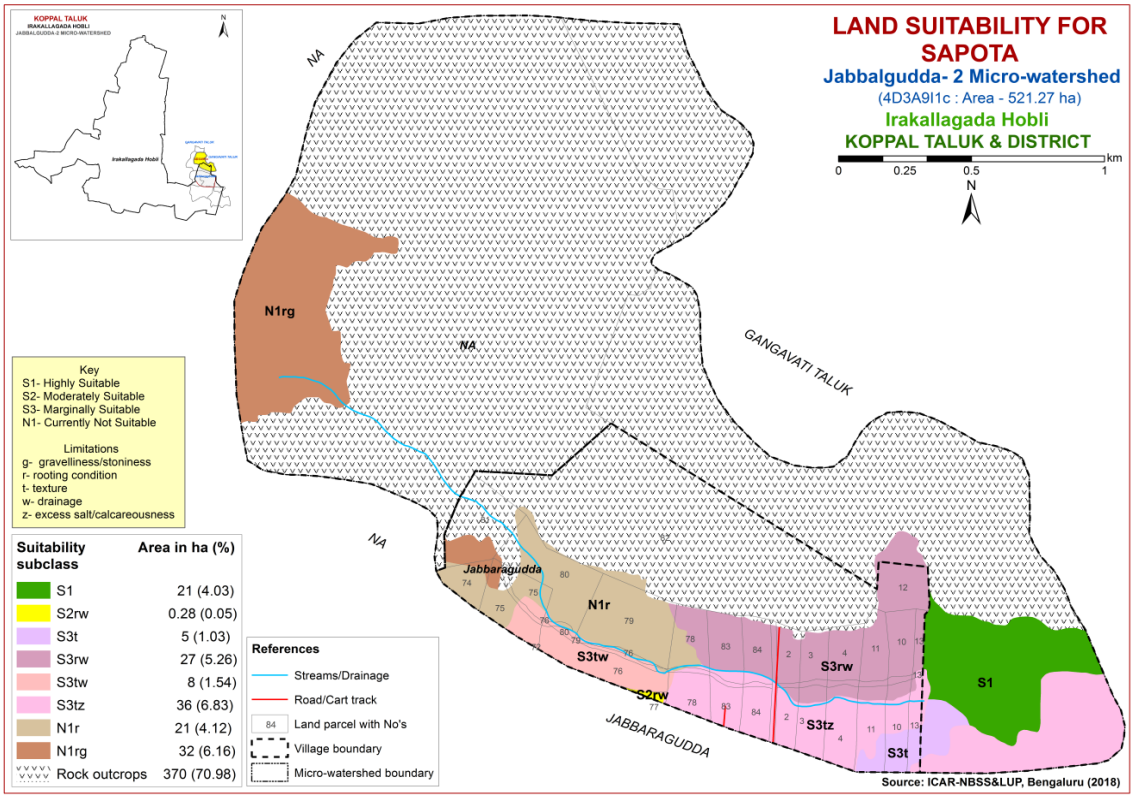


Fig. 7.17 Land Suitability map of Sapota

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 21 ha (4%) is highly suitable (Class S1) lands for growing pomegranate and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy a maximum area of 49 ha (9%) and are distributed in the southern and eastern part of the microwatershed. They have minor limitations of texture, rooting condition, drainage and calcareousness. An area of 27 ha (5%) is marginally suitable (Class S3) and are distributed in the northern part of the microwatershed. They have moderate limitations of rooting condition and drainage. An area of 53 ha (10%) is currently not suitable (Class N1) for growing pomegranate and are distributed in the western and southern part of the microwatershed with severe limitations of gravelliness and rooting condition.

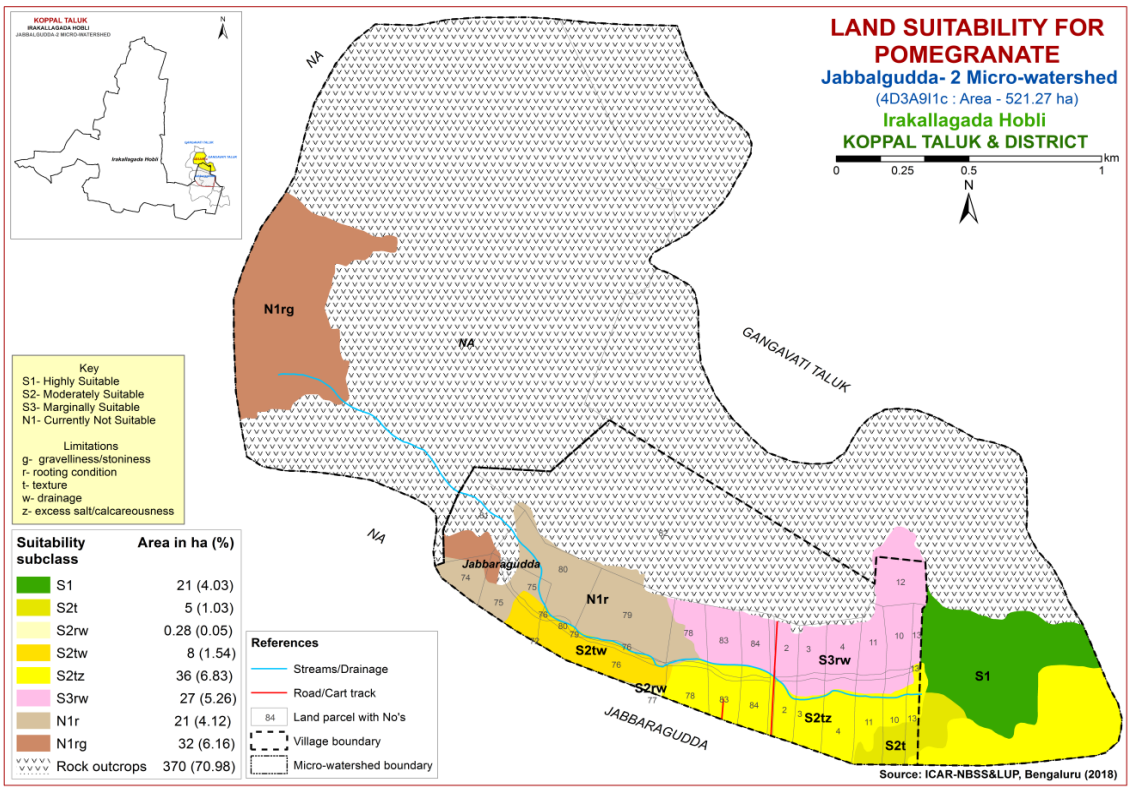


Fig. 7.18 Land Suitability map of Pomegranate

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 42 ha (8%) is highly suitable (Class S1) lands for growing musambi and are distributed in the eastern part of the microwatershed. An area of 28 ha (5%) is moderately suitable (Class S2) and are distributed in the southern part of the microwatershed. They have minor limitations of calcareousness, rooting condition and drainage. Marginally suitable (Class S3) lands occur in an area of 27 ha (5%) and are distributed in the northern part of the microwatershed with moderate limitations of rooting condition and drainage. Maximum area of 53 ha (10%) is currently not suitable (Class N1) for growing musambi and are distributed in the major part of the microwatershed. They have severe limitations of gravelliness and rooting condition.

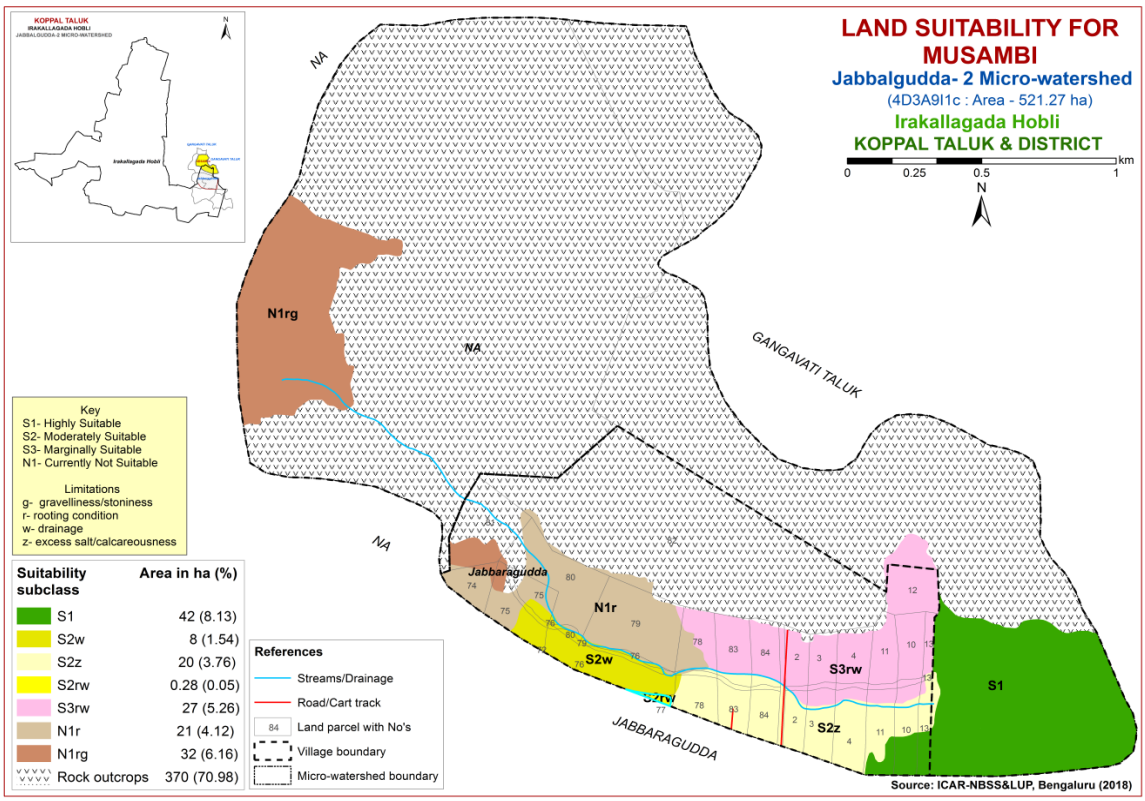


Fig. 7.19 Land Suitability map of Musambi

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 42 ha (8%) is highly suitable (Class S1) lands for growing lime and are distributed in the eastern part of the microwatershed. An area of 28 ha (5%) is moderately suitable (Class S2) and are distributed in the southern part of the microwatershed. They have minor limitations of calcareousness, rooting condition and drainage Marginally suitable (Class S3) lands occur in an area of 27 ha (5%) for growing lime and distributed in the northern part of the microwatershed with moderate limitations of rooting condition and drainage. Maximum area of 53 ha (10%) is currently not suitable (Class N1) for growing lime and are distributed in the western and southern part of the microwatershed with severe limitations of gravelliness and rooting condition.

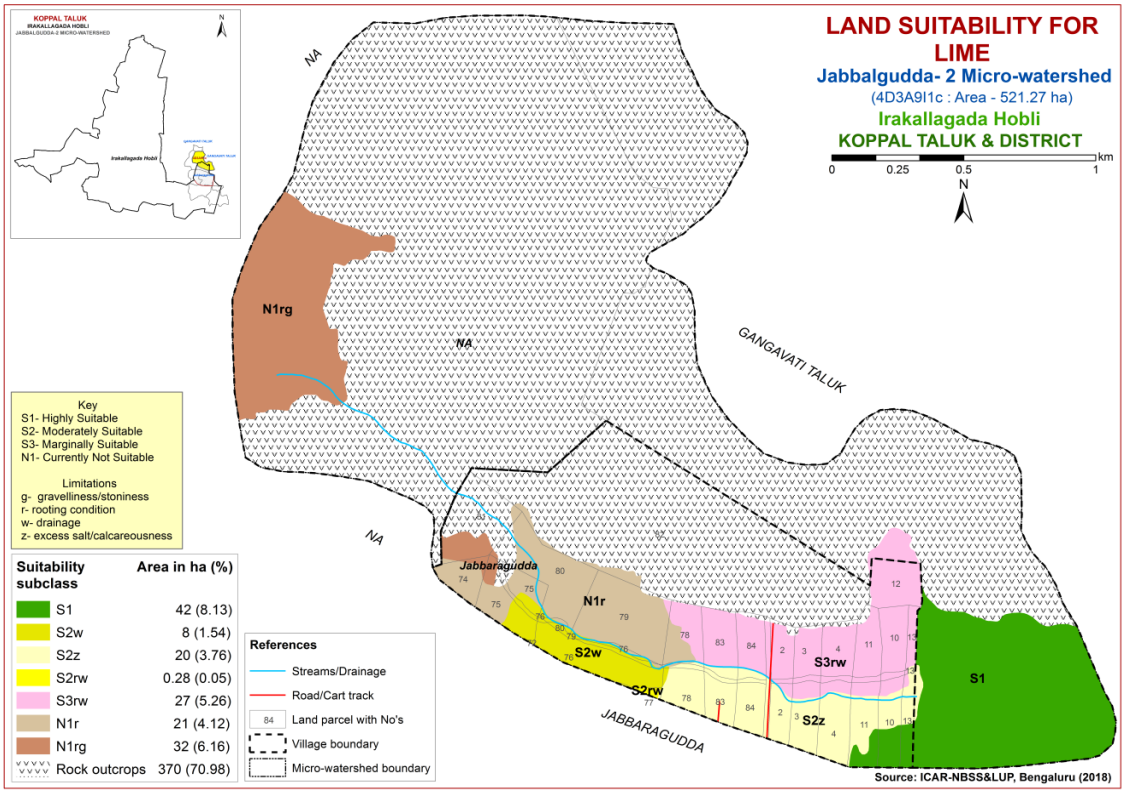


Fig. 7.20 Land Suitability map of Lime

7.21 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important fruit and 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 37 ha (7%) highly suitable (Class S1) lands for growing amla and are distributed in the eastern part of the microwatershed. An area of 60 ha (12%) has soils that are moderately suitable (Class S2) and are distributed in the southern and northern part of the microwatershed. They have minor limitations of texture, rooting condition and drainage and calcareousness. The marginally suitable (Class S3) lands cover an area of 53 ha (10%) and occur in the western and southern part of the microwatershed with moderate limitations of rooting condition and gravelliness.

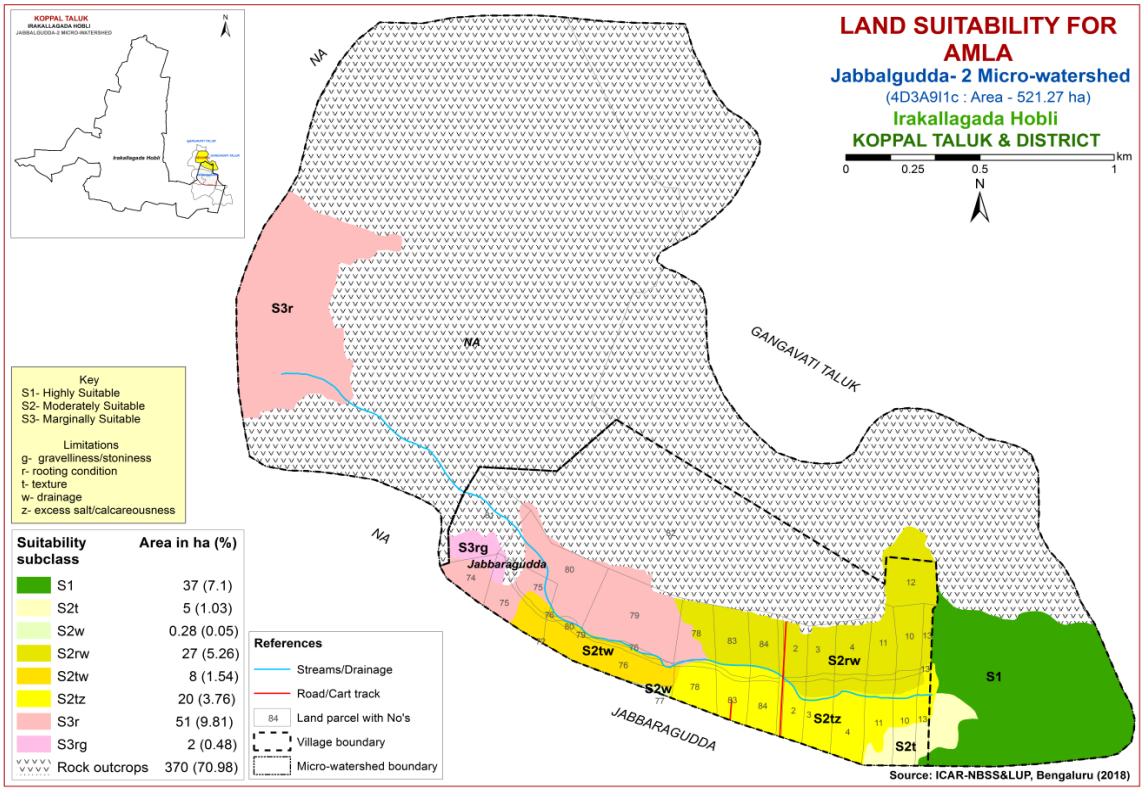


Fig. 7.21 Land Suitability map of Amla

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 21 ha (4%) is highly (Class S1) suitable for growing cashew and are distributed in the eastern part of the microwatershed. An area of 53 ha (5%) is currently not suitable (Class N1) for growing cashew and are distributed in the northern part of the microwatershed with severe limitations of rooting condition and drainage. Maximum area of 102 ha (20%) and are distributed in the major part of the microwatershed with severe rooting condition, texture, gravelliness, drainage and calcareousness.

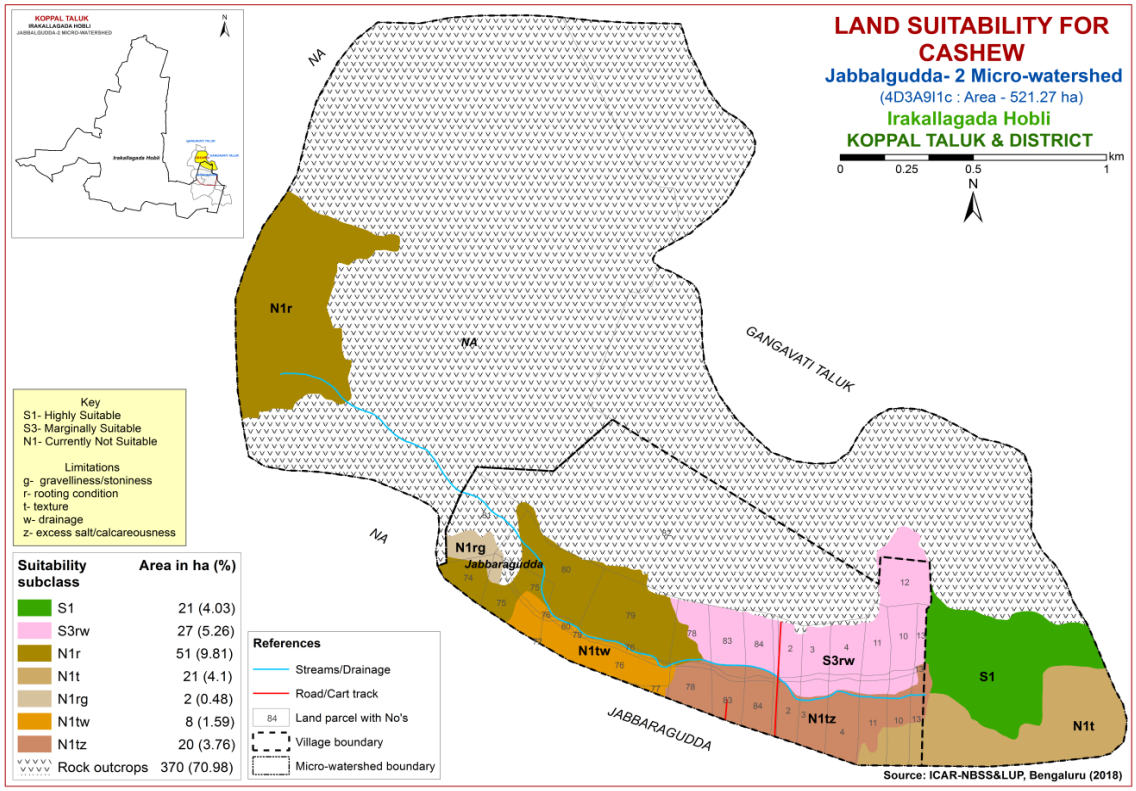


Fig. 7.22 Land Suitability map of Cashew

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 21 ha (4%) is highly (Class S1) suitable lands suitable for growing jackfruit and are distributed in the eastern part of the microwatershed. A minor area of about 0.28 ha (<1%) is moderately suitable (Class S2) and are distributed in the southern part of the microwatershed. They have moderate limitations of rooting condition and drainage. Maximum area of 76 ha (15%) is marginally suitable (Class S3) and occur in the major part of the microwatershed with moderate limitations of drainage, texture, calcareousness and rooting condition. An area of 53 ha (10%) is currently not suitable (Class N1) and are distributed in the western and southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

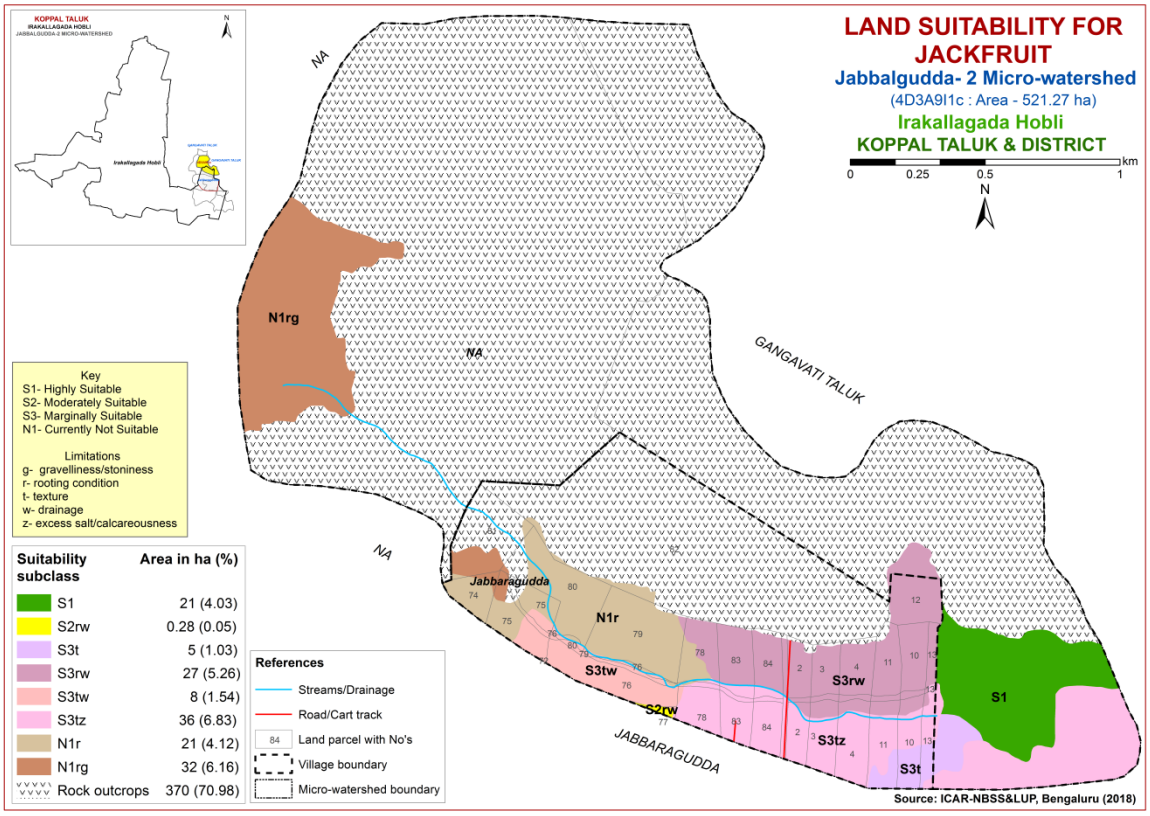


Fig. 7.23 Land Suitability map of Jackfruit

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 21 ha (4%) is highly suitable (Class S1) lands for growing jamun and are distributed in the eastern part of the microwatershed. An area of 49 ha (9%) is moderately suitable (Class S2) and occur in the eastern and southern part of the microwatershed. They have minor limitations of rooting condition, texture, drainage and calcareousness. Marginally suitable (Class S3) lands cover an area of 28 ha (5%) and are distributed in the northern part of the microwatershed with moderate limitations of rooting condition and drainage. An area of 53 ha (10%) is currently not suitable (Class N1) for growing jamun and are distributed in the major part of the microwatershed with severe limitations of gravelliness and rooting condition.

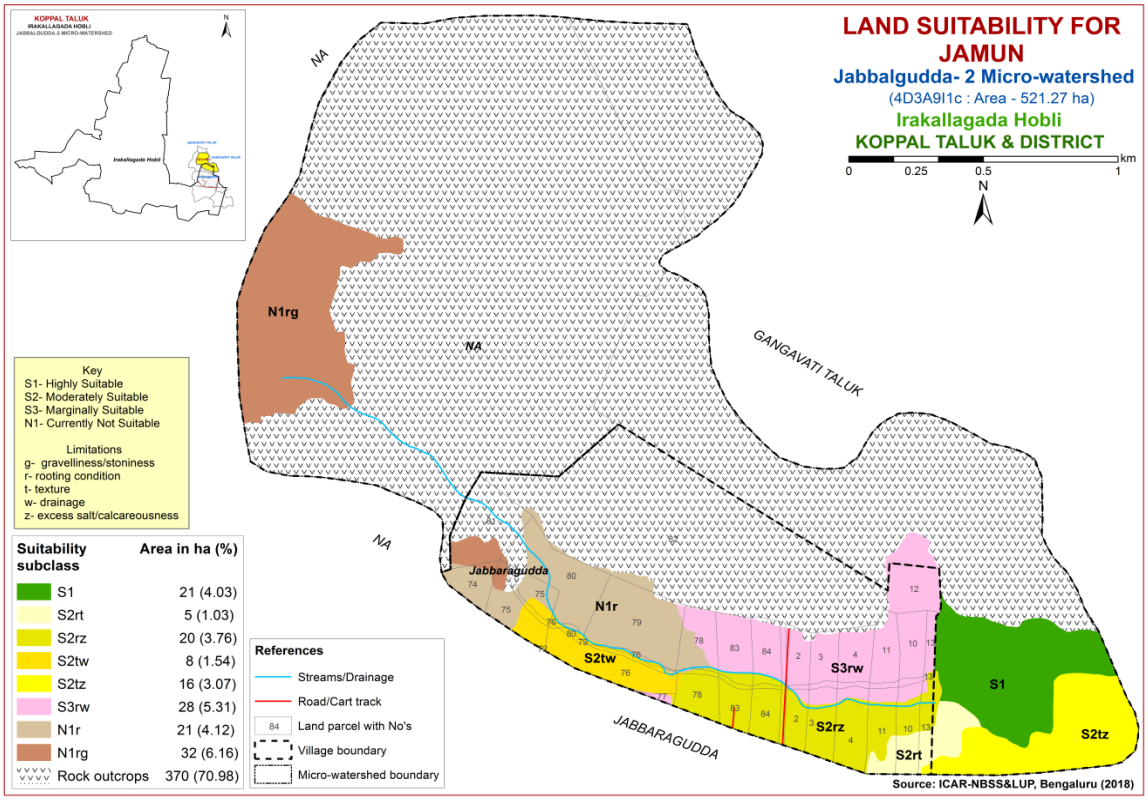


Fig. 7.24 Land Suitability map of Jamun

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 42 ha (8%) is highly (Class S1) suitable lands for growing custard apple and are distributed in the eastern part of the microwatershed. Maximum area of 55 ha (11%) is moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of rooting condition, drainage and calcareousness. An area of 53 ha (10%) is marginally suitable (Class S3) for growing custard apple and are distributed in the western and southern part of the microwatershed with moderate limitations of gravelliness and rooting condition.

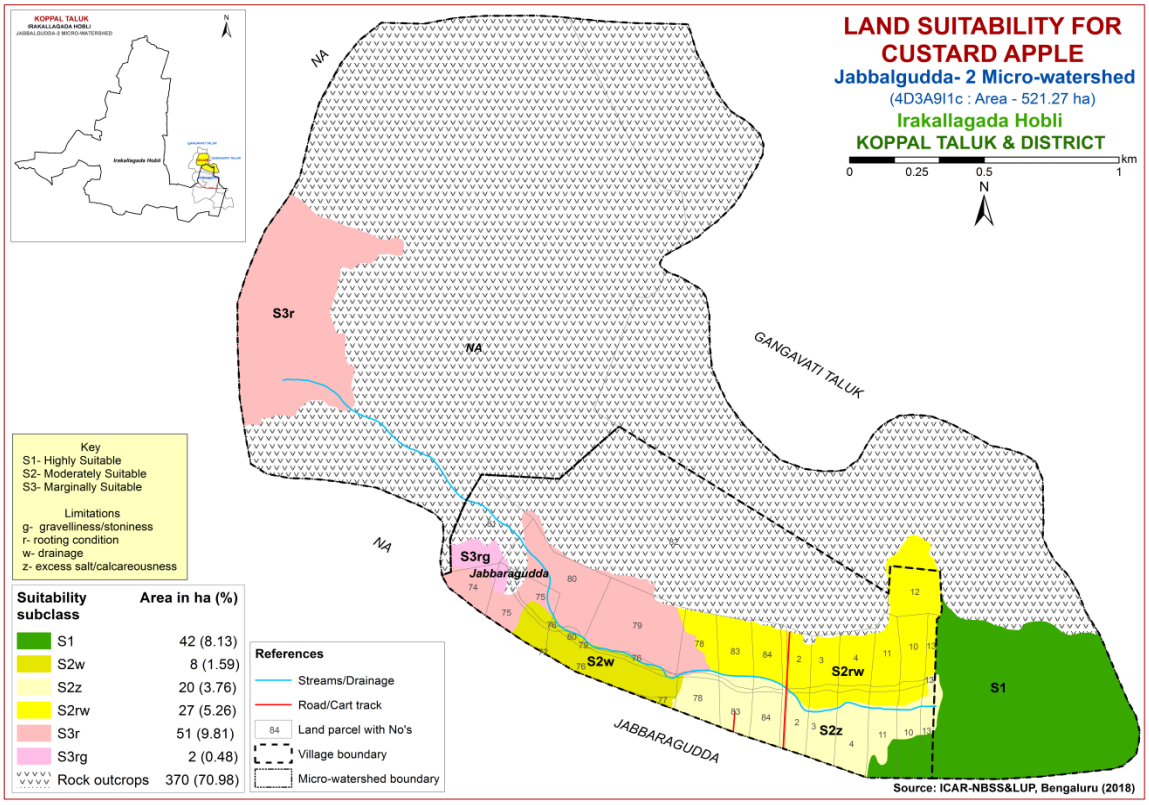


Fig. 7.25 Land Suitability map of Custard Apple

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.

An area of 21 ha (4%) is highly (Class S1) suitable lands for growing tamarind and are distributed in the eastern part of the microwatershed. Maximum area of 49 ha (9%) is moderately suitable (Class S2) and occur in the southern and eastern part of the microwatershed. They have minor limitations of rooting condition, texture, drainage and calcareousness. A minor area of 0.28 ha (<1%) is marginally suitable (Class S3) and occur in the southern part of the microwatershed with moderate limitations of rooting condition and drainage. A maximum area of 80 ha (16%) is currently not suitable (Class N1) and are distributed in the major part of the microwatershed with severe limitations of rooting condition, drainage and gravelliness.

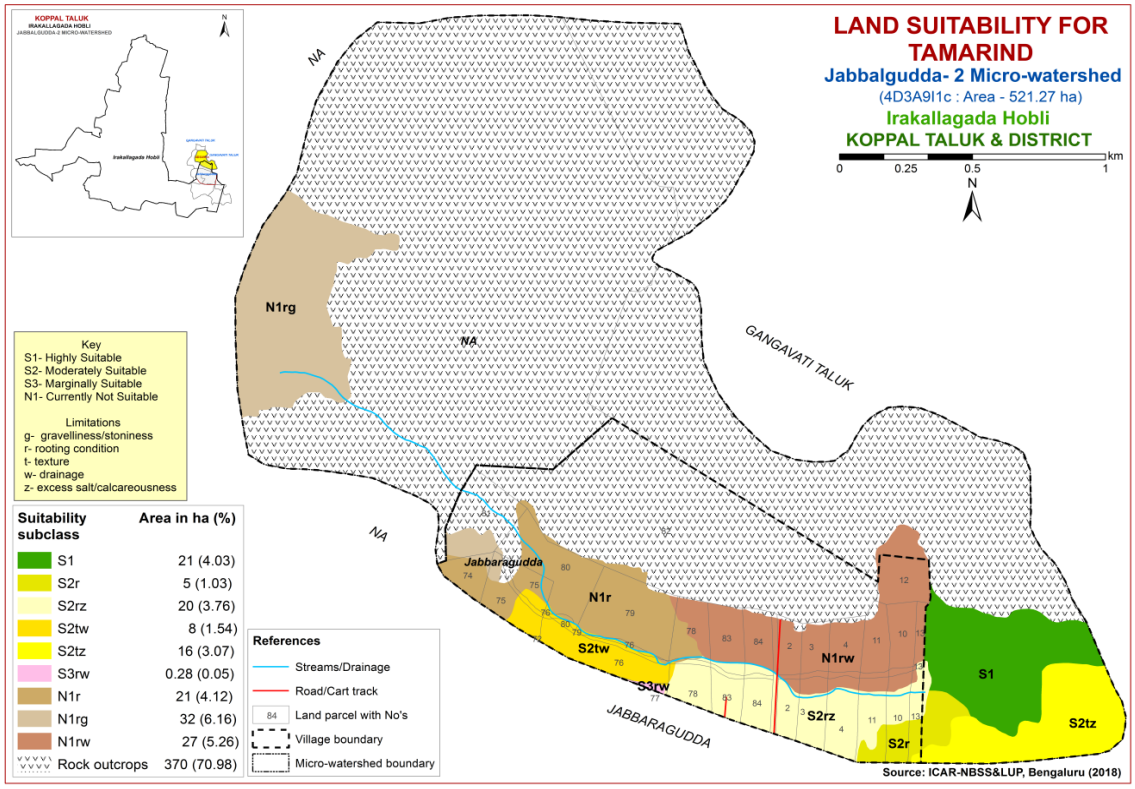


Fig. 7.26 Land Suitability map of Tamarind

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.

An area of 21 ha (4%) is highly suitable (Class S1) lands for growing mulberry and are distributed in the eastern part of the microwatershed. Moderately suitable (Class S2) lands occupy an area of 33 ha (6%) and are distributed in the southern part of the microwatershed. They have minor limitations of calcareousness, drainage, rooting condition and texture. Marginally suitable (Class S3) lands cover a maximum area of 43 ha (8%) and are distributed in the northern and eastern part of the microwatershed. They have moderate limitations of rooting condition, calcareousness, drainage and texture. An area of 53 ha (10%) is currently not suitable (Class N1) and are distributed in the western and southern part of the microwatershed with severe limitations of rooting condition and gravelliness.

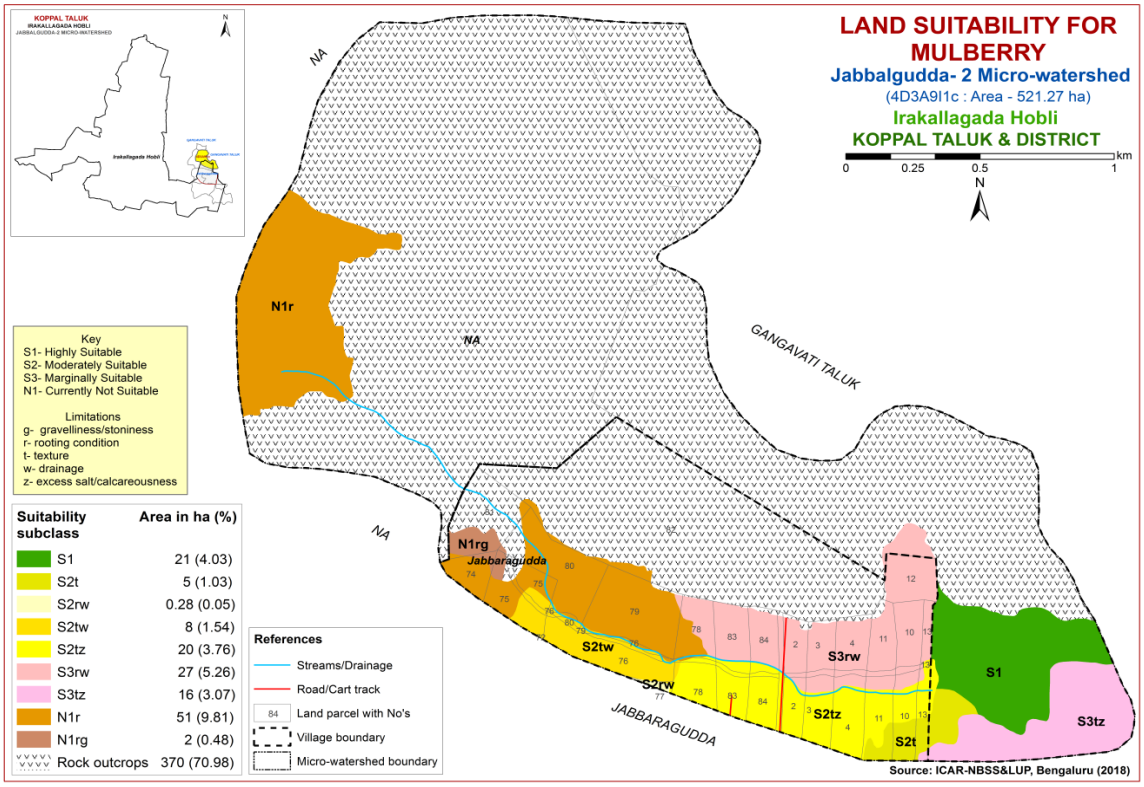


Fig. 7.27 Land Suitability map of Mulberry

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 21 ha (4%) is highly suitable (Class S1) lands for growing marigold and are distributed in the eastern part of the microwatershed. Maximum area of 76 ha (15%) is moderately suitable (Class S2) for growing marigold and are distributed in the major part of the microwatershed. They have minor limitations of texture, rooting condition, drainage and calcareousness. An area of 53 ha (10%) is marginally suitable (Class S3) for growing marigold and are distributed in the western and southern part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

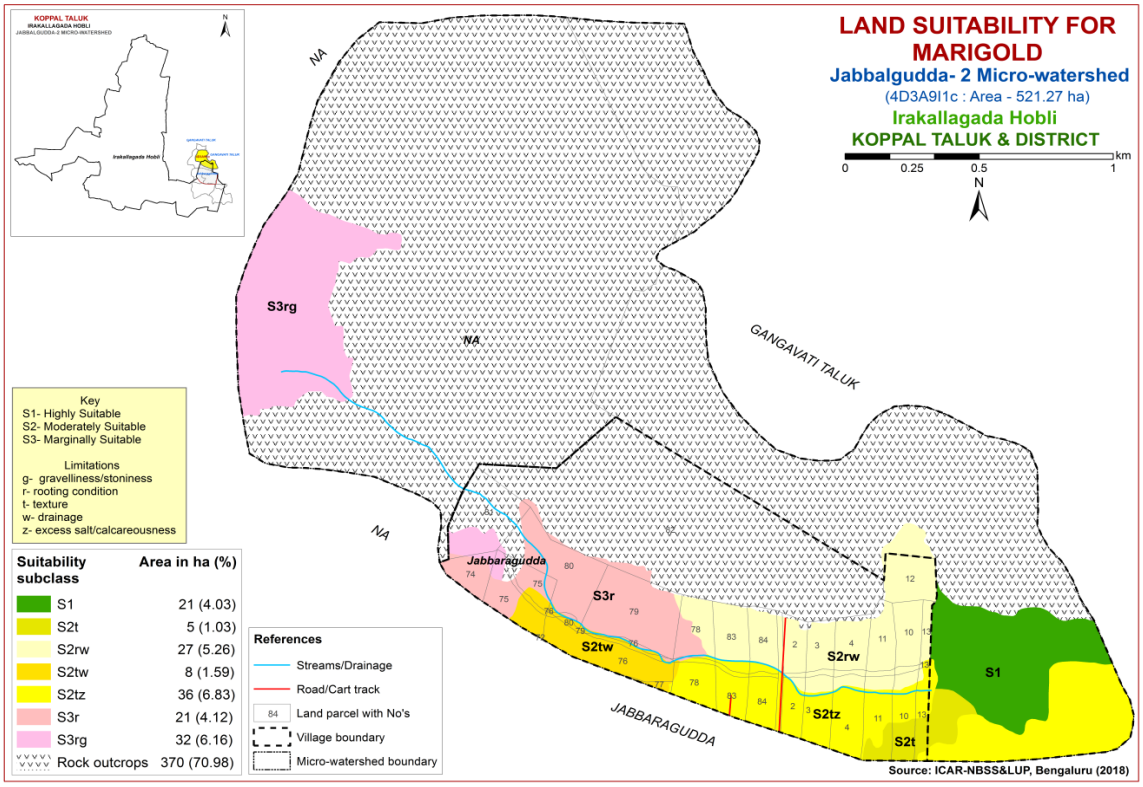


Fig. 7.28 Land Suitability map of Marigold

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 21 ha (4%) is highly suitable (Class S1) lands for growing chrysanthemum and are distributed in the eastern part of the microwatershed. Maximum area of 76 ha (15%) is moderately suitable (Class S2) for growing chrysanthemum and are distributed in the major part of the microwatershed. They have minor limitations of calcareousness, rooting condition, drainage and texture. An area of 53 ha (10%) is marginally suitable (Class S3) and occur in the western and southern part of the microwatershed. They have moderate limitations of gravelliness and rooting condition.

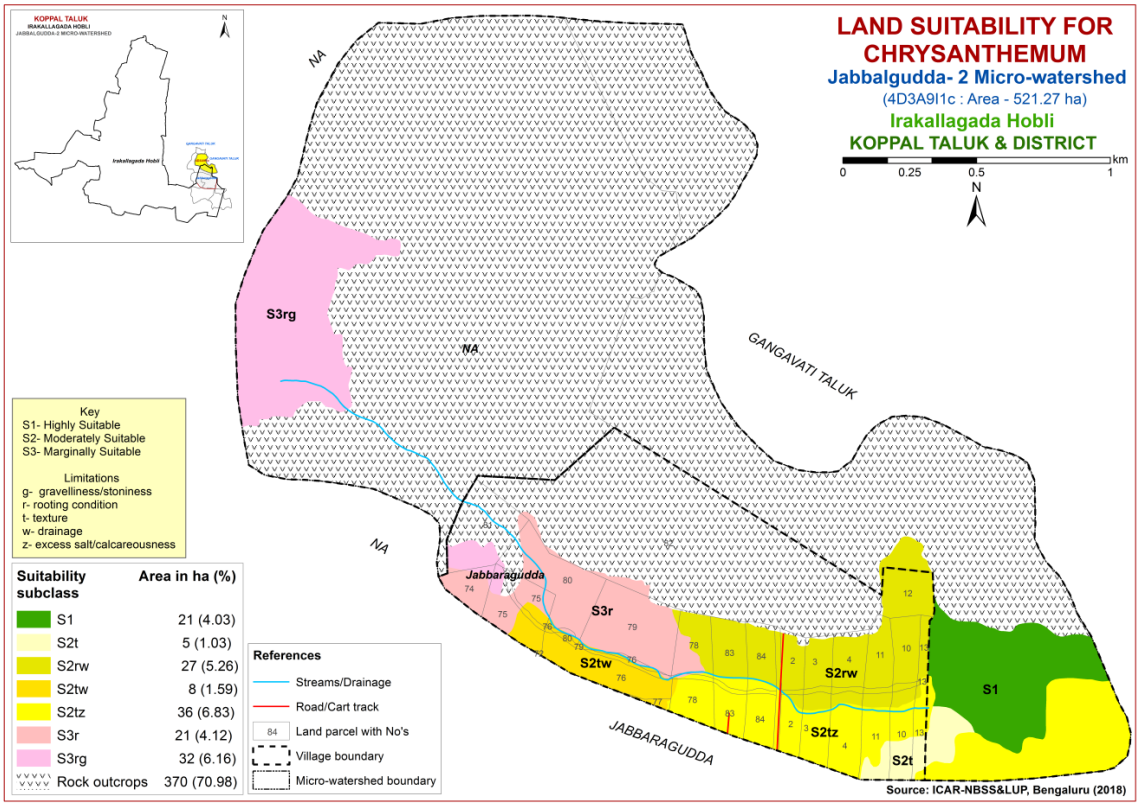


Fig. 7.29 Land Suitability map of Chrysanthemum

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 21 ha (4%) is highly suitable lands (Class S1) for growing jasmine and are distributed in the eastern part of the microwatershed. An area of 27 ha (5%) is moderately suitable (Class S2) and occur in the northern part of the microwatershed. They have minor limitations of rooting condition, texture and drainage. A maximum area of 105 ha (20%) is marginally suitable (Class S3) for growing jasmine and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, texture, rooting condition, drainage and calcareousness.

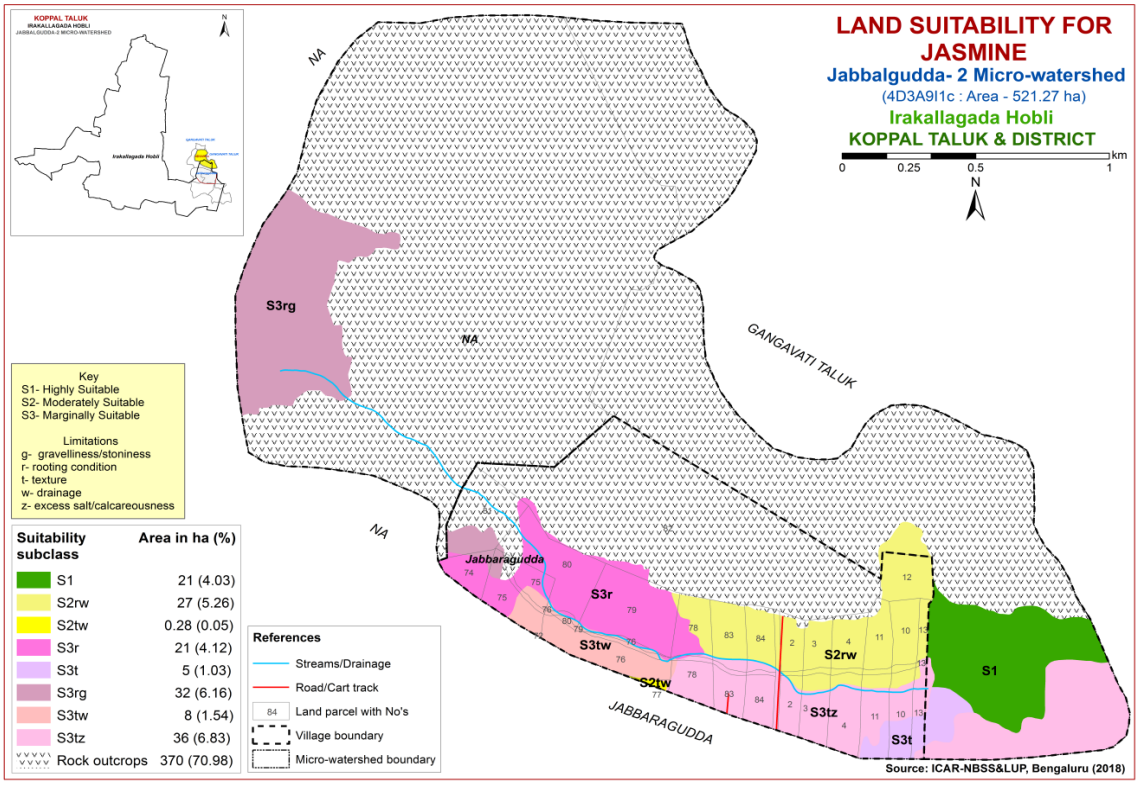


Fig. 7.30 Land Suitability map of Jasmine

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 21 ha (4%) is highly suitable lands (Class S1) for growing crossandra and are distributed in the eastern part of the microwatershed. An area of 27 ha (5%) is moderately suitable (Class S2) for growing crossandra and occur in the northern part of the microwatershed. They have minor limitations of texture, rooting condition and drainage. A maximum area of 102 ha (20%) is marginally suitable (Class S3) and are distributed in the major part of the microwatershed. They have moderate limitations of gravelliness, rooting condition, texture, drainage and calcareousness.

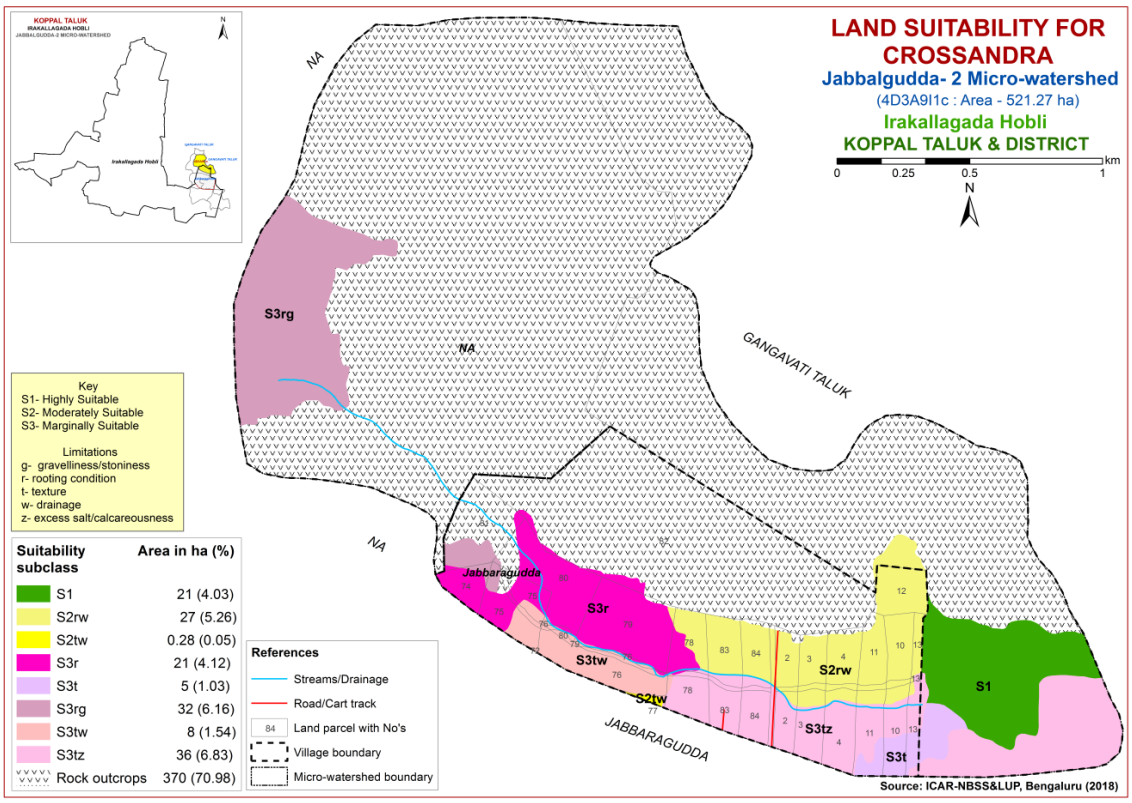


Fig. 7.31 Land Suitability map of Crossandra

Table 7.1 Soil-Site Characteristics of Jabbalgudda-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								
KGPcB1g1	662	90	WD	25-50	sl	gsc	15-35	15-35	50-100	1-3	Slight	-	-	-	-	-
HRViB2g1	662	90	WD	25-50	sc	gscl	15-35	>35	<50	1-3	Moderate	6.05	0.21	0.73	11.24	100
CSRhB2g1	662	90	WD	25-50	scl	scl	15-35	<15	50-100	1-3	Moderate	-	-	-	-	-
CSRiB2	662	90	WD	25-50	sc	scl	-	<15	50-100	1-3	Moderate	-	-	-	-	-
HNHhB2g1	662	90	MWD	50-75	scl	sc	15-35	-	100-150	1-3	Moderate	7.94	0.99	2.13	18.0	99.15
HLPiB2	662	90	WD	75-100	sc	scl	-	-	50-100	1-3	Moderate	-	-	-	-	-
TSDiB1	662	90	MWD	>150	sc	c	-	-	>200	1-3	Slight	8.46	0.17	0.19	36.61	100
KLRmA1	662	90	MWD	>150	c	sc	-	-	>200	1-3	Slight	7.11	0.33	3.42	19.50	100
RTRiB2	662	90	WD	>150	sc	c	-	-	150-200	1-3	Moderate	5.08	0.03	2.06	9.21	50.50
GRHmB2	662	90	MWD	100-150	c	c	-	<15	>200	1-3	Moderate	9.08	0.23	7.11	63.21	100
KVRmB1	662	90	MWD	100-150	c	c	-	-	>200	1-3	Slight	8.4	0.26	0.60	43.25	-

*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 11 soil map units identified in Jabbalgudda-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	438, 445, 473	HLPiB2, TSDiB1, KLRmA1	Moderately deep to very deep, sandy clay to clay lowland soils
2	373, 388	GRHmB2, KVRmB1	Deep calcareous black clay soils
3	288	RTRiB2	Very deep, red clay soils
4	464	HNHhB2g1	Moderately shallow, sandy clay lowland soils
5	14, 31, 37, 39	KGPcB1g1, HRViB2g1, CSRhB2g1, CSRiB2	Shallow, red sandy clay to sandy clay loam soils

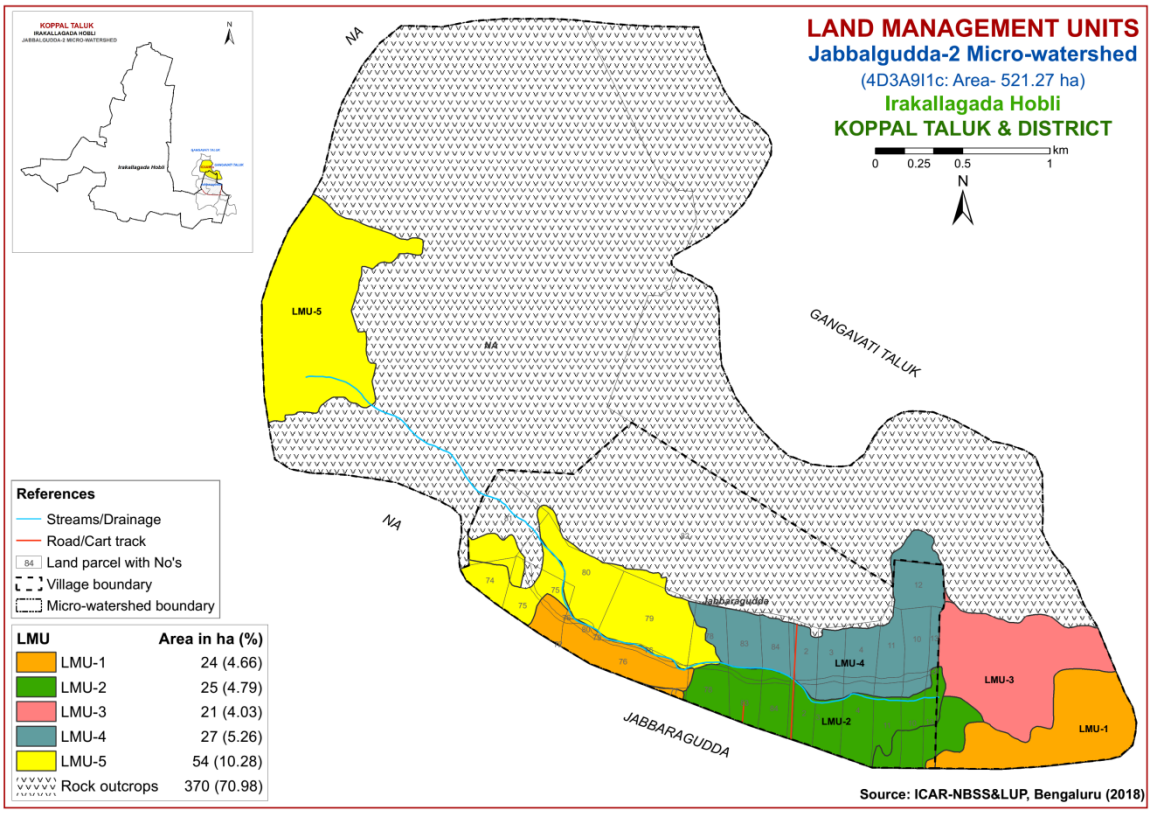


Fig 7.32 Land Management Units map of Jabbalgudda-2 Microwatershed

7.33 Proposed Crop Plan for Jabbalgudda-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 Jabbalgudda-2 Microwatershed

LMU	Soil Map Units	Survey Number	Soil characters	Field Crops	Horticulture Crops	Suitable Interventions
LMU 1 24 ha (5%)	438.HLPiB2 445.TSDiB1 473.KLRmA1	**Jabbaragudda:** 72,76,77	(Moderately deep to very deep, sandy clay to clay lowland soils	Maize, sorghum, bajra, cotton	**Fruit crops:** Custard Apple, Amla, Musambi, Lime **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 24 ha (5%)	373.GRHmB2 388.KVRmB1	**Jabbaragudda:** 4,78,84	Deep calcareous black clay soils	Maize, Sorghum, Sunflower, Cotton, Bengal gram, Safflower, Linseed, Bajra , Soyabean	**Fruit crops:** Mango, Sapota, Pomegranate, Jamun, Lime, Musambi, Tamarind, Amla, Custard apple **Vegetables:** Drumstick, Chilli, Coriander, Tomato, Bhendi **Flowers:** Marigold, Chrysanthemum, Crossandra, Jasmine	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
LMU 3 21 ha (4%)	288.RTRiB2	**Yammigudda:** xx	Very deep, red clay soils	Maize, Sorghum, Sunflower, Bajra, Finger millet, Groundnut, Red gram, Cowpea, Field bean, Castor, Mulberry	**Fruit crops:** Pomegranate, Guava, Sapota, Jackfruit, Tamarind, Lime, Musambi, Amla, Custard apple **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 4 27 ha (5%)	464.HNHhB2g1	**Jabbaragudda:** 2,3,10,11,12,13, 83	Moderately shallow, sandy clay lowland soils	Maize, Bajra	**Fruit crops:** Custard Apple, Amla **Vegetable crops:** Brinjal, Tomato, Chillies, Coriander, Cabbage, Onion	Providing proper drainage, addition of organic manures, green leaf manuring, suitable conservation practices
LMU 5 54 ha (10%)	14.KGPcB1g1 31.HRViB2g1 37.CSRhB2g1 39.CSRiB2	**Jabbaragudda:** 74,75,79,80	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 Jabbalgudda-2 Microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of Kaggalipura (KGP) 30 ha (6%), Honnenahalli (HNH) 27 ha (5%), Chikkasavanur (CSR) 21 ha (4%), Ranatur (RTR) 21 ha (4%), Kavalur (KVR) 20 ha (4%), Kavalakkeri (KLR) 16 ha (3%), Thimmasandra (TSD) 8 ha (2%), Gatareddihal (GRH) 5 ha (1%), Harve (HRV) 2 ha (<1%) and Huliyapura (HLP) occupy a minor area of about <1% 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 and erosion.

- On the basis of soil reaction, an area of about 15 ha (3%) is slightly acid (pH 6.0-6.5), 79 ha (15%) is neutral (pH 6.5-7.3), 51 ha (10%) is slightly alkaline (pH 7.3-7.8) and about 6 ha (1%) is moderately alkaline (pH 7.8-8.4) in the microwatershed. Entire area in the microwatershed is slightly acid to moderately 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

An area of 15 ha is under acid soils.

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

Moderately to very strongly alkaline soils cover an area of 57 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 79 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 521 ha area in the microwatershed, an area of about 73 ha (14%) is suffering from slight erosion and 78 ha (15%) 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 and soil are the major constraints in Jabbalgudda-2 Microwatershed.
- **Organic Carbon:** The OC content (an index of available Nitrogen) is medium (0.5-0.75%) in 127 ha (24%) and 24 ha (5%) is high (>0.75%). 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 127 ha area where OC is 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 96 ha (18%) 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 an area of 55 ha (11%) in the microwatershed.
- **Available Potassium:** Available potassium is medium (145-337 kg/ha) in 53 ha (10%) in the microwatershed. Additional 25% potassium needs to be applied in areas where it is medium and low. It is high (>337 kg/ha) in an area of 99 ha (19%) in the microwatershed.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. Available sulphur is low (<10 ppm) in 149 ha (29%) and medium (10-20 ppm) in 3 ha (<1%) 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 entire area of about 151 ha (29%) is low (<0.5 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:** It is deficient (<4.5 ppm) in entire area of 151 ha (29%) in the microwatershed. To manage iron deficiency, iron sulphate@25 kg/ha needs to be applied for 2-3 years.
- **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:** It is deficient (<0.6 ppm) in entire area of 151 ha (29%) area in the microwatershed. Application of zinc sulphate @ 25 kg/ha is to be followed in areas that are deficient in available zinc.
- **Soil acidity:** The microwatershed has 15 ha (3%) area with soils that are slightly acid. These areas need application of lime (Calcium Carbonate).
- **Soil alkalinity:** The microwatershed has 57 ha (11%) soils that are slightly to moderately 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.

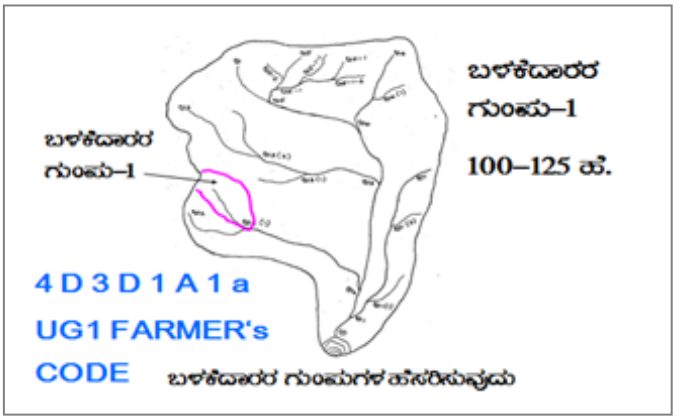
Chapter 9

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Jabbalgudda-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.

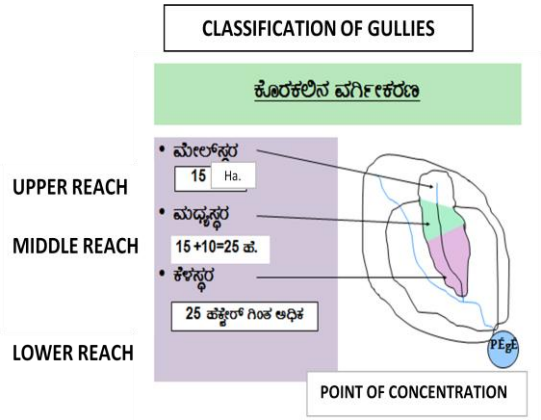
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

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

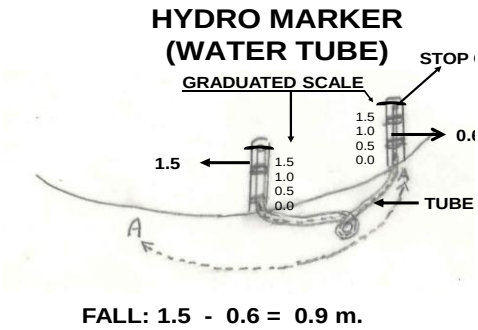
9.1.1 Arable Land Treatment

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.

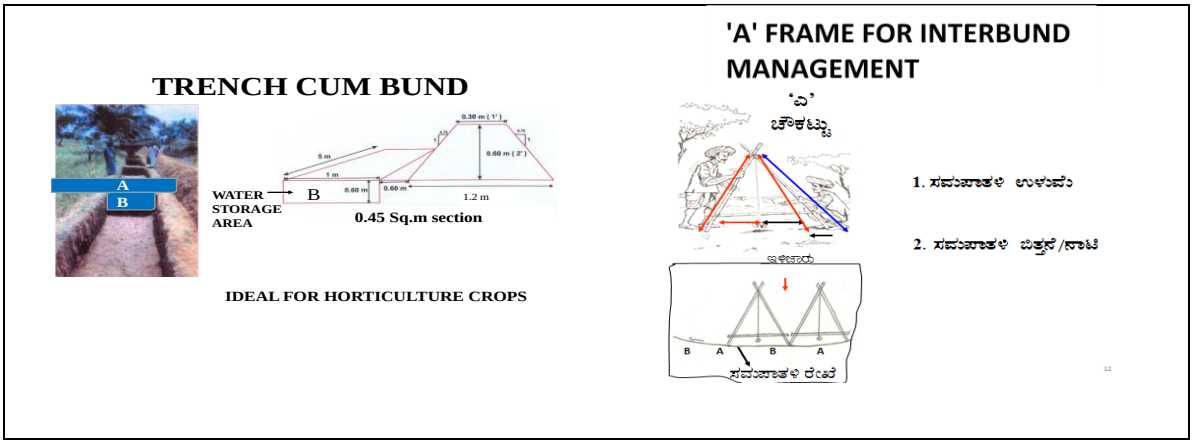
Recommended Bund Section

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. 9.2) showing soil and water conservation plan with different kinds of structures recommended has been prepared which shows the spatial distribution and extent of area. A maximum area of about 75 ha (14%) requires Trench cum Bunding, 61 ha (12%) area requires Graded Bunding and about 16 ha (3%) area required Strengthening of existing bunds/bunding 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.

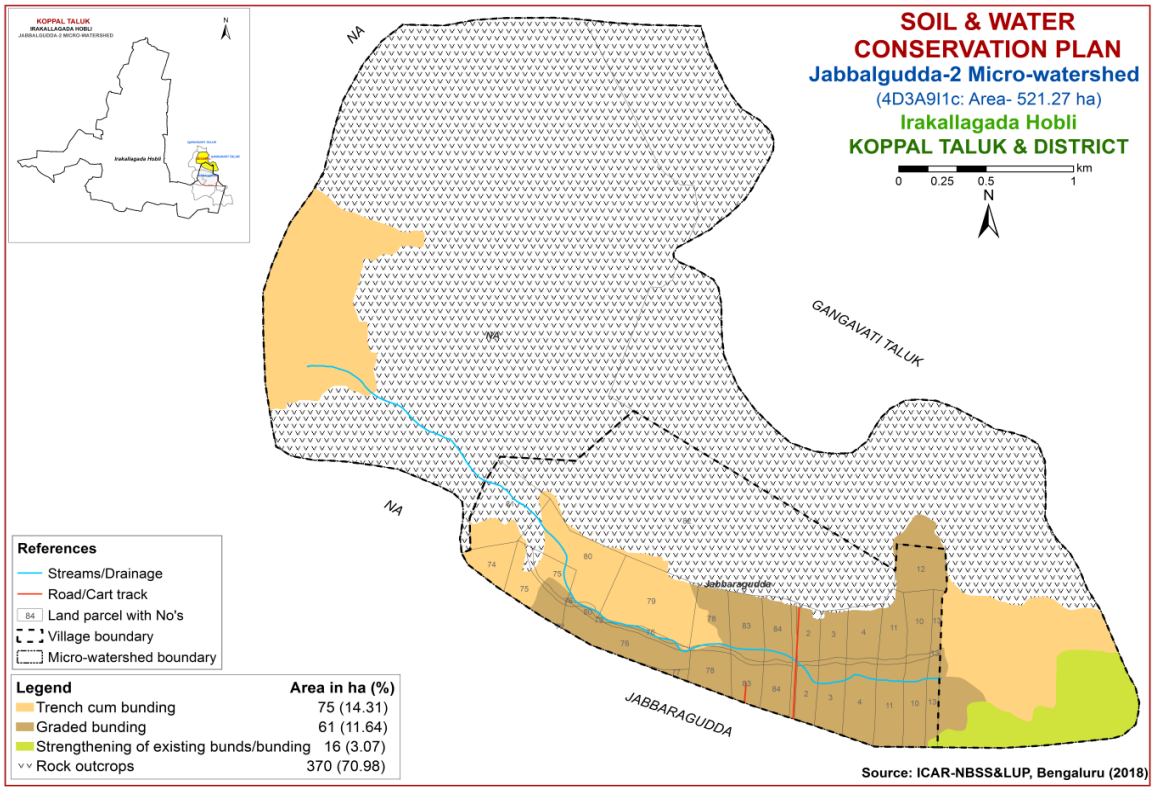


Fig. 9.2 Soil and Water Conservation Plan map of Jabbalgudda-2 Microwatershed

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

Jabalgudda -2 (9I1c) Microwatershed

Soil Phase Information

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Soil Gravelliness	Available Water Capacity	Surface Soil Texture	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Jabbaragudda	2	3.73	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Fallow land (Rg+Fl)	Not Available	IIew	Graded bunding
Jabbaragudda	3	4.75	KVRmB1	LMU-2	Deep (100-150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Clay	Very gently sloping (1-3%)	Slight	Redgram+Groundnut (Rg+Gn)	Not Available	IIs	Graded bunding
Jabbaragudda	4	6.24	KVRmB1	LMU-2	Deep (100-150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Clay	Very gently sloping (1-3%)	Slight	Redgram+Maize+Paddy (Rg+Mz+Pd)	Not Available	IIs	Graded bunding
Jabbaragudda	10	5.41	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Maize (Rg+Mz)	Not Available	IIew	Graded bunding
Jabbaragudda	11	6.02	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Paddy (Rg+Pd)	Not Available	IIew	Graded bunding
Jabbaragudda	12	3.38	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIew	Graded bunding
Jabbaragudda	13	2.61	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Vegetables (Rg+Veg)	Not Available	IIew	Graded bunding
Jabbaragudda	72	0.01	TSDiB1	LMU-1	Very deep (>150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Sandy clay	Very gently sloping (1-3%)	Slight	Redgram+Paddy (Rg+Pd)	Not Available	IIw	Graded bunding
Jabbaragudda	74	2.25	CSRhB2g1	LMU-5	Shallow (25-50 cm)	Gravelly (15-35%)	Very Low (<50 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Paddy (Rg+Pd)	Not Available	IIIes	Trench cum bunding
Jabbaragudda	75	4.96	CSRhB2g1	LMU-5	Shallow (25-50 cm)	Gravelly (15-35%)	Very Low (<50 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Fallow land (Rg+Fl)	Not Available	IIIes	Trench cum bunding
Jabbaragudda	76	5.28	TSDiB1	LMU-1	Very deep (>150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Sandy clay	Very gently sloping (1-3%)	Slight	Redgram+Groundnut (Rg+Gn)	Not Available	IIw	Graded bunding
Jabbaragudda	77	0.34	HLPiB2	LMU-1	Moderately deep (75-100 cm)	Non gravelly (<15%)	Medium (101-150 mm/m)	Sandy clay	Very gently sloping (1-3%)	Moderate	Redgram+Maize+Paddy (Rg+Mz+Pd)	Not Available	IIew	Graded bunding
Jabbaragudda	78	5.6	KVRmB1	LMU-2	Deep (100-150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Clay	Very gently sloping (1-3%)	Slight	Redgram+Bajra+Paddy+Groundnut (Rg+Bj+Pd+Gn)	Not Available	IIs	Graded bunding
Jabbaragudda	79	8.22	CSRiB2	LMU-5	Shallow (25-50 cm)	Non gravelly (<15%)	Very Low (<50 mm/m)	Sandy clay	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Jabbaragudda	80	7.25	CSRiB2	LMU-5	Shallow (25-50 cm)	Non gravelly (<15%)	Very Low (<50 mm/m)	Sandy clay	Very gently sloping (1-3%)	Moderate	Redgram+Maize+Bajra (Rg+Mz+Bj)	Not Available	IIIes	Trench cum bunding
Jabbaragudda	81	6.45	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Granite outcrop (Gc)	Not Available	Ro	Ro
Jabbaragudda	82	53.6	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Granite outcrop (Gc)	Not Available	Ro	Ro
Jabbaragudda	83	5.15	HNHhB2g1	LMU-4	Moderately shallow (50-75 cm)	Gravelly (15-35%)	Low (51-100 mm/m)	Sandy clay loam	Very gently sloping (1-3%)	Moderate	Redgram+Paddy (Rg+Pd)	Not Available	IIew	Graded bunding
Jabbaragudda	84	4.78	KVRmB1	LMU-2	Deep (100-150 cm)	Non gravelly (<15%)	Very high (>200 mm/m)	Clay	Very gently sloping (1-3%)	Slight	Redgram+Bajra (Rg+Bj)	Not Available	IIs	Graded bunding
NA	NA	226.51	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Not Available (NA)	Not Available	Ro	Ro

Appendix II

Jabalgudda -2 (9I1c) 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
Jabbaragudda	2	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	Medium (23 – 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)
Jabbaragudda	3	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 0.75 %)	Medium (23 – 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)
Jabbaragudda	4	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	10	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	11	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	12	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	13	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	72	Slightly acid (pH 6.0 – 6.5)	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)
Jabbaragudda	74	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 – 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)
Jabbaragudda	75	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 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)
Jabbaragudda	76	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)
Jabbaragudda	77	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (> 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)
Jabbaragudda	78	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	79	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)
Jabbaragudda	80	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 – 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)
Jabbaragudda	81	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro
Jabbaragudda	82	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro
Jabbaragudda	83	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
Jabbaragudda	84	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 – 0.75 %)	Medium (23 – 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)
NA	NA	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro	Ro

Appendix III

Jabalgudda -2 (9I1c) 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
Jabbaragudda	2	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	3	S2rz	S2tz	S3tz	S2z	S3tz	S2z	S2rz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz
Jabbaragudda	4	S2rz	S2tz	S3tz	S2z	S3tz	S2z	S2rz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz
Jabbaragudda	10	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	11	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	12	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	13	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	72	S3tw	S2t	S3tw	S2w	S3tw	S2w	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2t	S3tw	S2tw	S2tw	S3tw	S2tw	S2tw	S2tw
Jabbaragudda	74	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	N1r	N1r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	N1r	S3r
Jabbaragudda	75	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	N1r	N1r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	N1r	S3r
Jabbaragudda	76	S3tw	S2t	S3tw	S2w	S3tw	S2w	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S3tw	S3tw	S2tw	S2tw	S2tw	S2t	S3tw	S2tw	S2tw	S3tw	S2tw	S2tw	S2tw
Jabbaragudda	77	S3rw	S2w	S2rw	S2w	S2rw	S2w	S3rw	S2rw	S2w	S2rw	S2rw	S2w	S2rw	S2w	N1tw	S3rw	S2rw	S2tw	S2w	S2w	S2tw	S2tw	S2rw	S2w	S2tw	S2w	S2w	S2tw	S2rw	S2rw	S2w
Jabbaragudda	78	S2rz	S2tz	S3tz	S2z	S3tz	S2z	S2rz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz
Jabbaragudda	79	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	N1r	N1r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	N1r	S3r
Jabbaragudda	80	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	N1r	N1r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	S3r	S3r	S3r	S3r	S3r	N1r	N1r	S3r
Jabbaragudda	81	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
Jabbaragudda	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
Jabbaragudda	83	N1rw	S2rw	S3rw	S2rw	S3rw	S2rw	N1rw	S3rw	S2rw	S3rw	S3rw	S2rw	S3rw	S2rw	S3rw	S3rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S2rw	S2rw	S2rw	S2rw	S2rw	S3rw	S3rw	S2rw
Jabbaragudda	84	S2rz	S2tz	S3tz	S2z	S3tz	S2z	S2rz	S2z	S2z	S2z	S2tz	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz	S2tz	S2tz	S3tz
NA	NA	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

Ro-Rock outcrops

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

CONTENTS

LIST OF TABLES

SALIENT FINDINGS OF THE STUDY

- Results indicated that 35 farmers were sampled in Jabbalgudda-2 micro-watershed among them 8(22.86%) were marginal farmers, 7 (20%) were small farmers, 12 (34.29%) were semi medium farmers, 3 (8.57 %) were medium farmers and 5 (14.29 %) landless farmers were also interviewed for the survey.
- The data indicated that there were 164 population households were there in the studied micro watershed. Among them 95 (57.93%) men and 69 (42.07%) were women. The average family size of landless was 3, marginal farmers were 4, small and semi medium farmer was 5 and medium farmers were 9.
- The data indicated that 21(12.80%) people were in 0-15 years of age, 79 (48.17 %) were in 16-35 years of age, 54 (32.93 %) were in 36-60 years of age and 10 (6.10%) were above 61 years of age.
- The results indicated that the Jabbalgudda-2 had 31.10 per cent illiterates, 31.71 per cent of them had primary school education, 4.27 per cent of them had both middle schools, 14.63 per cent of them had high school education, 7.93 per cent of them had PUC education, 0.61 per cent them had ITI and diploma education and 4.88 per cent them had degree education.
- The results indicated that, 80 per cent of households practicing agriculture, 2.86 per cent of the household heads were agricultural labour and in private service respectively. 14.29 per cent of the household heads were general labour.
- The results indicated that agriculture was the major occupation for 61.59 per cent of the household members, 3.05 per cent were agricultural labourers, 10.37 per cent were general labours, 2.44 per cent of them were in private sector, 13.41 per cent of them were students and 4.27 per cent of them were children.
- In case of landless households 100 per cent were general labourers. In case of marginal farmers 70.97 per cent were agriculturist, 16.13 per cent were students and 3.23 per cent were general labour and in private service. In case of small farmers 81.82 per cent of them were agriculturist, 6.06 per cent were in agricultural labour and 12.12 per cent of them were students. In case of semi medium farmers 72.41 per cent of the family members were agriculturist, 3.45 per cent were agriculture labour, 5.71 per cent were in private service and 10.34 per cent of them were students. In case of medium farmers 38.46 per cent of the family members were agriculturist, 3.85 per cent of them were agricultural labour, 26.92 per cent of them were student, 11.54 per cent of them were housewives and 3.85 per cent of them were children.
- The results showed that 100 per cent of population have not participated in any local institutions.
- The results indicated that 91.43 per cent of the households possess Katcha house and 8.57 per cent of them possess Thatched house.
- The results showed that, 48.57 per cent of the households possess TV, 17.14 per cent of the households possess Mixer grinder, 28.57 per cent of the households possess

bicycle, 22.86 per cent of the households possess motor cycle, and 85.71 per cent of the households possess mobile phones.

- The results showed that the average value of television was Rs. 9000, mixer grinder was Rs.2000, bicycle was Rs.2100, motor cycle was Rs.27375 and mobile phone was Rs.2350.
- Data indicated that, 2.86 per cent of the households possess both tractor and sprayer respectively. 34.29 per cent of the households possess weeder.
- The results showed that, average value of tractor was Rs. 400000, the average value of sprayer was Rs. 1000 and the average value of weeder was Rs. 93.
- The results indicated that, 2.86 per cent of the households possess both bullocks and buffalo and 14.29 per cent of the households possess local cow. In case of semi medium farmers, 8.33 per cent of the households possess bullock, and buffalo correspondingly and 33.33 per cent of the households possess local cow. In medium farmers 33.33 per cent of the households possess local cow.
- The results indicated that, average own labour men available in the micro watershed was 1.77, average own labour (women) available was 1.40, average hired labour (men) available was 7.47and average hired labour (women) available was 6.13.
- In case of marginal farmers, average own labour men available was 1.38, average own labour (women) was also 1, average hired labour (men) was 6.13 and average hired labour (women) available was 4.88. In case of small farmers, average own labour men available was 1.71, average own labour (women) was 1.57, average hired labour (men) was 8.14 and average hired labour (women) available was 6.71. In case of semi medium farmers, average own labour men available was 2, average own labour (women) was 1.42, average hired labour (men) was 8.08 and average hired labour (women) available was 6.42. In medium farmers average own labour men available was 2, average own labour (women) was 2, average hired labour (men) was 7 and average hired labour (women) available was 7.
- The results indicated that, 85.71 per cent of the household opined that hired labour was adequate.
- The results indicated that, households of the Jabbalgudda-2 micro-watershed possess 19.62 ha (46.98 %) of dry land and 22.14 ha (53.02%) of irrigated land. Marginal farmers possess 5.46 ha (100 %) of dry land. Small farmers possess 8.90 ha (90.61 %) of dry land and 0.92 ha (9.39 %) of irrigated land. Semi medium farmers possess 5.26 ha (26.85 %) of dry land and 14.33 ha (73.15 %) of irrigated land. Medium farmers possess 6.88 ha (100%) of irrigated land.
- The results indicated that, the average value of dry land was Rs. 346,523.62 and average value of irrigated was Rs. 415,429.62. In case of marginal famers, the average land value was Rs. 568,026.71 for dry land. In case of small famers, the average land value was Rs. 269,577.08 for dry land Rs. 650,000.01 for irrigated land. In case of semi medium famers, the average land value was Rs. 247,000 for dry land

and Rs. 460,248.45 for irrigated land. In case of medium famers, the average land value was Rs. 290,588.24 for irrigated land.

- The results indicated that, there were 14 functioning bore wells in the micro watershed.
- The results indicated that, bore well was the major irrigation source for 40 per cent of the farmers.
- The results indicated that on an average the depth of the bore well was 38.32 meters.
- The results indicated that, in case of small farmers there was 0.92 ha of irrigated land, in semi medium farmers there was 14.34 ha irrigated land and in medium farmers there was 4.86 per cent of the irrigated land.
- The results indicated that, farmers have grown maize (21.29 ha), paddy (12.13 ha), groundnut (2.02 ha), bajra (1.70 ha) and navane (1.21 ha). Marginal farmers have grown maize, groundnut and bajra. Small farmers had grown maize, paddy, bajra and navane. Semi medium farmers had grown maize, paddy and groundnut. Medium farmers had grown maize and paddy.
- The results indicated that, the cropping intensity in Jabbalgudda-2 micro-watershed was found to be 99.92 per cent. In case of marginal farmers it was 99.41 per cent, in small, semi medium farmers and medium farmers it was 100 per cent.
- The results indicated that, 68.57 per cent of the households have bank account and 28.57 per cent of the households have savings.
- The results indicated that, 25 per cent of marginal, 63.16 per cent of small, 42.86 per cent of the small, 33.33 per cent of the semi medium and medium farmers have borrowed credit from different sources respectively.
- The results indicated that, 40 per cent of the households have availed loan from commercial bank, 10 per cent of the households have availed loan from friends/ relatives and 50 per cent have availed loan from Grameena bank.
- The results indicated that, marginal, small, semi medium and medium farmers have availed Rs.57500, Rs. 126666.67, Rs. 212500 and Rs. 10000 respectively. Overall average credit amount availed by households in the micro watershed is 135500.
- The results indicated that, 100 per cent of the institutional credit was borrowed for agriculture production.
- The results indicated that, 100 percent of private credit was taken for agriculture production.
- Results indicated that 100 per cent of the households have unpaid their institutional credit.
- Results indicated that 100 percent of the households have unpaid their private loan.
- Results indicated that 100 per cent of the farmers opined that the credit, which was taken from various institutes was helped them to perform timely agricultural operations.

- Results indicated that 100 per cent of the farmers opined that the credit, which was taken from private credit helped them to perform timely agricultural operations.
- The results indicated that, the total cost of cultivation for bajra was Rs. 31144.38. The gross income realized by the farmers was Rs. 26243.75. The net income from bajra cultivation was Rs. -4900.63, thus the benefit cost ratio was found to be 1:0.84.
- The results indicated that, the total cost of cultivation for maize was Rs. 35993.38. The gross income realized by the farmers was Rs. 42562.86. The net income from maize cultivation was Rs. 6569.47. Thus the benefit cost ratio was found to be 1:1.18.
- The results indicated that, the total cost of cultivation for paddy was Rs. 120050.47. The gross income realized by the farmers was Rs. 97734.16. The net income from paddy cultivation was Rs. -22316.31. Thus the benefit cost ratio was found to be 1:0.81.
- The results indicated that, the total cost of cultivation for groundnut was Rs. 43776.50. The gross income realized by the farmers was Rs. 47823.32. The net income from groundnut cultivation was Rs. 4046.81. Thus the benefit cost ratio was found to be 1:1.09.
- The results indicated that, the total cost of cultivation for Navane+redgram was Rs. 23835.19. The gross income realized by the farmers was Rs. 33641.40. The net income from Navane+redgram cultivation was Rs. 9806.21. Thus the benefit cost ratio was found to be 1:1.41.
- The results indicated that, 8.57 per cent of the households opined that dry fodder and green fodder were adequate respectively.
- The table indicated that, in landless farmers, the average income from wage was Rs. 94000. In marginal farmers the average income from service/salary was Rs. 8750, wage was Rs.45000 and agriculture was Rs.65318.75. In small farmers the average income from wage was Rs.30000 and agriculture was Rs.130714.29. In semi medium farmers, the average income from service/salary was Rs. 17,500, wage was Rs. 13,333.33 and agriculture was Rs. 192,916.67. In case of medium farmers the average income from wage was Rs.26666.67 and agriculture was Rs.333333.33.
- The results indicated that, in case of landless farmers, the annual average expenditure from wage was Rs. 64400. In marginal farmers the annual average expenditure from service/salary was Rs. 45000, wage was Rs. 33833.33 and agriculture was Rs.34250. In small farmers, the annual average expenditure from wage was Rs. 52000 and agriculture was Rs.64142.86. In semi medium farmers, the annual average expenditure from service/salary was Rs. 51666.67, wage was Rs. 18500 and agriculture was Rs.109583.33. In case of medium farmers, the annual average expenditure from wage was Rs. 65000 and agriculture was Rs.183333.33.
- The results indicated that, sampled households have grown 19 coconut trees and 3 mango trees in their field and also planted 6 coconut trees in their backyard.

- The results indicated that, households have planted 2 teak trees, 62 neem trees, 2 tamarind tress, 3 acacia trees and 2 banyan trees in their field and also grown 1 Neem tree in the backyard.
- The results indicated that, households have an average investment capacity of Rs.2285.71 for improved livestock management. Semi medium farmers have an average investment capacity of Rs.6666.67 for improved livestock management.
- The results indicated that for 2.86 per cent of the households were dependent on government subsidy for improved livestock management.
- The results indicated that, maize crops were sold to the extent of 100 per cent. Bajra, Groundnut, navane and paddy were sold to an extent of 55 per cent, 80 per cent, 25 per cent and 75 per cent respectively.
- The results indicated that, 45.71 percent of the households have sold their produce local/village merchant and 42.86 percent of the households sold their produce in regulated markets.
- The results indicated that 8.57 per cent of the households have used cart as a mode of transport and 80 per cent have used tractor.
- The results indicated that, 40 per cent of the households have experienced the soil and water erosion problems i.e. 37.50 percent of marginal farmers, 57.14 per cent of small farmers, 50 per cent of semi medium farmers and 33.33 per cent of medium farmers.
- The results indicated that, 80 per cent of the households have shown interest in soil testing.
- The results indicated that, 88.57 percent used fire wood as a source of fuel and 11.43 percent of the households used LPG as a source of fuel.
- The results indicated that, piped supply was the source of drinking water for 20 per cent, 71.43 per cent of them were using bore well and 8.57 per cent of the households were using lake/tank for drinking water.
- The results indicated that, electricity was the major source of light for 100 per cent of the households.
- The results indicated that, 20 per cent of the households possess sanitary toilet i.e. 20 per cent of landless, 12.50 per cent of marginal, 14.29 per cent of the small, 33.33 per cent of the semi medium farmers and 25 per cent of the medium farmers had sanitary toilet facility.
- The results indicated that, 100 per cent of the sampled households possessed BPL card.
- The results indicated that, 51.43 per cent of the households participated in NREGA programme which included 100 per cent of the landless, 50 per cent of the marginal and semi medium farmers, 14.29 per cent of the small farmers and 66.67 per cent of the medium farmers.

- The results indicated that cereals and pulses were adequate for 100 per cent of the households; milk and egg were adequate for 97.14 per cent of the households respectively. Oil seed, vegetables and meat were adequate for 2.86 per cent, 11.43 per cent and 17.14 per cent of the households respectively.
- The results indicated that, oilseed, vegetables, fruits and meat were inadequate for 97.14 per cent, 88.57 per cent, 100 per cent and 82.86 per cent of the households.
- The results indicated that, Lower fertility status of the soil was the constraint experienced by 85.71 per cent of the households, wild animal menace on farm field and frequent incidence of pest and diseases were experienced by (77.14%), inadequacy of irrigation water (65.71%), high cost of Fertilizers and plant protection chemicals and high rate of interest on credit problems were experienced by (62.86%), low price for the agricultural commodities (74.29%), lack of marketing facilities in the area (77.14%), inadequate extension services and lack of transport for safe transport of the agricultural produce to the market were experienced by (82.86%) and Source of Agri-technology information(Newspaper/TV/Mobile) (2.86 %) of the households.

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, labour 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.

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 Jains. 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. It consists of four taluks namely Koppal, Gangavathi, Kushtagi and Yelburga. The undulating topography with black cotton soil shrips, cut across by numerous nalas or streams is the major characteristic feature of the study region. The Koppal district is having partly red sandy and black soil suitable for agriculture and horticulture crops. Majority of Gangavathi taluk is having black soil. The taluk is also having very few hills with xerophilous vegetation. The partly red sandy soil and black soil of mixed geographical origin are found in the Yelburga taluk.

Three physiographic divisions have made considering the local conditions of landforms and crops grown in the district. On the basis of physiographic, 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 Ephemeral in nature, these come under Tungabhadra sub-basin. The drainage exhibit dendritic to subdendritic 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%.

Description of the micro-watershed

Jabbalgudda-2 micro-watershed (Hire Benakal-watershed, Koppal Taluk and District) is located at North latitude 15027’27.435’’ to 150 25’55.561” and East longitude 76^0 22’22.24’’ to $76^0$20’57.012’’ E covering an area of 426.17 ha and spread across Hamandurga, Agoli, Yammigudda, Indargi and Jabbaragudda villages.

Methodology followed in assessing socio-economic status of households

In order to assess the socio-economic condition of the farmers in the watershed a comprehensive questionnaire was prepared. Major components such as demographic conditions, migration details, food consumption and family expenditure pattern, material

possession, land holding, land use management, cropping pattern, cost of cultivation of crops, livestock management. The statistical components such as frequency and percentage were used to analyze the data. About 35 households located in the micro-watershed were interviewed for the survey.

SALIENT FEATURES OF THE SURVEY

Households sampled for socio-economic survey: The data on households sampled for socio economic survey in Jabbalgudda-2 micro-watershed is presented in Table 1 and it indicated that 35 farmers were sampled in Jabbalgudda-2 micro-watershed among them 8(22.86%) were marginal farmers, 7 (20%) were small farmers, 12 (34.29%) were semi medium farmers, 3 (8.57 %) were medium farmers and 5 (14.29 %) landless farmers were also interviewed for the survey.

Table 1: Households sampled for socio economic survey in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Farmers	5	14.29	8	22.86	7	20.00	12	34.29	3	8.57	35	100.00

Population characteristics: The population characteristics of households sampled for socio-economic survey in Jabbalgudda-2 micro-watershed is presented in Table 2. The data indicated that there were 164 population households were there in the studied micro watershed. Among them 95 (57.93%) men and 69 (42.07%) were women. The average family size of landless was 3, marginal farmers were 4, small and semi medium farmer was 5 and medium farmers were 9.

Table 2: Population characteristics of Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (16)		MF (31)		SF (33)		SMF (58)		MDF (26)		All (164)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Male	11	68.75	19	61.29	20	60.61	32	55.17	13	50.00	95	57.93
2	Female	5	31.25	12	38.71	13	39.39	26	44.83	13	50.00	69	42.07
Total		16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00
Average		3		4		5		5		9		5	

Age wise classification of population: The age wise classification of household members in Jabbalgudda-2 micro-watershed is presented in Table 3. The data indicated that 21(12.80%) people were in 0-15 years of age, 79 (48.17 %) were in 16-35 years of age, 54 (32.93 %) were in 36-60 years of age and 10 (6.10%) were above 61 years of age.

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

Sl.No.	Particulars	LL (16)		MF (31)		SF (33)		SMF (58)		MDF (26)		All (164)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	0-15 years of age	0	0.00	4	12.90	4	12.12	9	15.52	4	15.38	21	12.80
2	16-35 years of age	7	43.75	16	51.61	13	39.39	26	44.83	17	65.38	79	48.17
3	36-60 years of age	8	50.00	10	32.26	12	36.36	20	34.48	4	15.38	54	32.93
4	> 61 years	1	6.25	1	3.23	4	12.12	3	5.17	1	3.85	10	6.10
Total		16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00

Education level of household members: Education level of household members in Jabbalgudda-2 micro-watershed is presented in Table 4. The results indicated that the Jabbalgudda-2 had 31.10 per cent illiterates, 31.71 per cent of them had primary school

education, 4.27 per cent of them had both middle schools, 14.63 per cent of them had high school education, 7.93 per cent of them had PUC education, 0.61 per cent them had ITI and diploma education and 4.88 per cent them had degree education.

Table 4: Education level of household members in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (16)		MF (31)		SF (33)		SMF (58)		MDF (26)		All (164)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Illiterate	4	25.00	8	25.81	11	33.33	19	32.76	9	34.62	51	31.10
2	Primary School	8	50.00	10	32.26	8	24.24	14	24.14	12	46.15	52	31.71
3	Middle School	0	0.00	1	3.23	3	9.09	3	5.17	0	0.00	7	4.27
4	High School	2	12.50	4	12.90	5	15.15	11	18.97	2	7.69	24	14.63
5	PUC	1	6.25	3	9.68	3	9.09	4	6.90	2	7.69	13	7.93
6	Diploma	0	0.00	0	0.00	0	0.00	1	1.72	0	0.00	1	0.61
7	ITI	0	0.00	0	0.00	0	0.00	1	1.72	0	0.00	1	0.61
8	Degree	1	6.25	3	9.68	3	9.09	1	1.72	0	0.00	8	4.88
9	Others	0	0.00	2	6.45	0	0.00	4	6.90	1	3.85	7	4.27
Total		16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00

Occupation of household heads: The data regarding the occupation of the household heads in Jabbalgudda-2 micro-watershed is presented in Table 5. The results indicated that, 80 per cent of households practicing agriculture, 2.86 per cent of the household heads were agricultural labour and in private service respectively. 14.29 per cent of the household heads were general labour.

Table 5: Occupation of household heads in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	0	0.00	8	100.00	7	100.00	10	83.33	3	100.00	28	80.00
2	Agricultural Labour	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	1	2.86
3	General Labour	5	100.00	0	0.00	0	0.00	0	0.00	0	0.00	5	14.29
4	Private Service	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	1	2.86
Total		5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00

Occupation of the household members: The data regarding the occupation of the household members in Jabbalgudda-2 micro-watershed is presented in Table 6. The results indicated that agriculture was the major occupation for 61.59 per cent of the household members, 3.05 per cent were agricultural labourers, 10.37 per cent were general labours, 2.44 per cent of them were in private sector, 13.41 per cent of them were students and 4.27 per cent of them were children.

In case of landless households 100 per cent were general labourers. In case of marginal farmers 70.97 per cent were agriculturist, 16.13 per cent were students and 3.23 per cent were general labour and in private service. In case of small farmers 81.82 per cent of them were agriculturist, 6.06 per cent were in agricultural labour and 12.12 per cent of them were students. In case of semi medium farmers 72.41 per cent of the family members were agriculturist, 3.45 per cent were agriculture labour, 5.71 per cent were in private service and 10.34 per cent of them were students. In case of medium farmers

38.46 per cent of the family members were agriculturist, 3.85 per cent of them were agricultural labour, 26.92 per cent of them were student, 11.54 per cent of them were housewives and 3.85 per cent of them were children.

Table 6: Occupation of family members in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (16)		MF (31)		SF (33)		SMF (58)		MDF (26)		All (164)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Agriculture	0	0.00	22	70.97	27	81.82	42	72.41	10	38.46	101	61.59
2	Agricultural Labour	0	0.00	0	0.00	2	6.06	2	3.45	1	3.85	5	3.05
3	General Labour	16	100.00	1	3.23	0	0.00	0	0.00	0	0.00	17	10.37
4	Private Service	0	0.00	1	3.23	0	0.00	3	5.17	0	0.00	4	2.44
5	Student	0	0.00	5	16.13	4	12.12	6	10.34	7	26.92	22	13.41
6	Others	0	0.00	0	0.00	0	0.00	0	0.00	4	15.38	4	2.44
7	Housewife	0	0.00	0	0.00	0	0.00	1	1.72	3	11.54	4	2.44
8	Children	0	0.00	2	6.45	0	0.00	4	6.90	1	3.85	7	4.27
Total		16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00

Institutional participation of the household members: The data regarding the institutional participation of the household members in Jabbalgudda-2 micro-watershed is presented in Table 7. The results showed that 100 per cent of population have not participated in any local institutions.

Table 7: Institutional Participation of household members in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (16)		MF (31)		SF (33)		SMF (58)		MDF (26)		All (164)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	No Participation	16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00
Total		16	100.00	31	100.00	33	100.00	58	100.00	26	100.00	164	100.00

Type of house owned: The data regarding the type of house owned by the households in Jabbalgudda-2 micro-watershed is presented in Table 8. The results indicated that 91.43 per cent of the households possess Katcha house and 8.57 per cent of them possess Thatched house.

Table 8: Type of house owned by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Thatched	1	20.00	1	12.50	0	0.00	1	8.33	0	0.00	3	8.57
2	Katcha	4	80.00	7	87.50	7	100.00	11	91.67	3	100.00	32	91.43
Total		5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00

Durable Assets owned by the households: The data regarding the Durable Assets owned by the households in Jabbalgudda-2 micro-watershed is presented in Table 9. The results showed that, 48.57 per cent of the households possess TV, 17.14 per cent of the households possess Mixer grinder, 28.57 per cent of the households possess bicycle, 22.86 per cent of the households possess motor cycle, and 85.71 per cent of the households possess mobile phones.

Table 9: Durable Assets owned by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Television	2	40.00	4	50.00	3	42.86	5	41.67	3	100.00	17	48.57
2	Mixer/Grinder	1	20.00	1	12.50	1	14.29	3	25.00	0	0.00	6	17.14
3	Bicycle	2	40.00	2	25.00	1	14.29	5	41.67	0	0.00	10	28.57
4	Motor Cycle	1	20.00	3	37.50	1	14.29	2	16.67	1	33.33	8	22.86
5	Mobile Phone	4	80.00	6	75.00	6	85.71	12	100.00	2	66.67	30	85.71
6	Blank	1	20.00	2	25.00	1	14.29	0	0.00	0	0.00	4	11.43

Average value of durable assets: The data regarding the average value of durable assets owned by the households in Jabbalgudda-2 micro-watershed is presented in Table 10. The results showed that the average value of television was Rs. 9000, mixer grinder was Rs.2000, bicycle was Rs.2100, motor cycle was Rs.27375 and mobile phone was Rs.2350.

Table 10: Average value (Rs) of durable assets owned by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Television	9,000.00	9,000.00	9,000.00	9,000.00	9,000.00	9,000.00
2	Mixer/Grinder	2,000.00	2,000.00	2,000.00	2,000.00	0.00	2,000.00
3	Bicycle	2,000.00	1,500.00	2,000.00	2,400.00	0.00	2,100.00
4	Motor Cycle	35,000.00	25,666.00	35,000.00	21,000.00	30,000.00	27,375.00
5	Mobile Phone	2,000.00	2,885.00	2,262.00	2,346.00	2,166.00	2,350.00

Farm Implements owned: The data regarding the farm implements owned by the households in Jabbalgudda-2 micro-watershed is presented in Table 11. Data indicated that, 2.86 per cent of the households possess both tractor and sprayer respectively. 34.29 per cent of the households possess weeder.

Table 11: Farm Implements owned by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Tractor	0	0.00	1	12.50	0	0.00	0	0.00	0	0.00	1	2.86
2	Sprayer	0	0.00	1	12.50	0	0.00	0	0.00	0	0.00	1	2.86
3	Weeder	2	40.00	4	50.00	2	28.57	3	25.00	1	33.33	12	34.29

Average value of farm implements: The data regarding the average value of farm Implements owned by the households in Jabbalgudda-2 micro-watershed is presented in Table 12. The results showed that, average value of tractor was Rs. 400000, the average value of sprayer was Rs. 1000 and the average value of weeder was Rs. 93.

Table 12: Average value (Rs) of farm implements owned by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Tractor	0.00	400,000.00	0.00	0.00	0.00	400,000.00
2	Sprayer	0.00	1,000.00	0.00	0.00	0.00	1,000.00
3	Weeder	100.00	82.00	100.00	100.00	100.00	93.00

Livestock possession by the households: The data regarding the Livestock possession by the households in Jabbalgudda-2 micro-watershed is presented in Table 13. The results indicated that, 2.86 per cent of the households possess both bullocks and buffalo and 14.29 per cent of the households possess local cow. In case of semi medium farmers, 8.33 per cent of the households possess bullock, and buffalo correspondingly and 33.33 per cent of the households possess local cow. In medium farmers 33.33 per cent of the households possess local cow.

Table 13: Livestock possession by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%
1	Bullock	1	8.33	0	0.00	1	2.86
2	Local cow	4	33.33	1	33.33	5	14.29
3	Buffalo	1	8.33	0	0.00	1	2.86

Average Labour availability: The data regarding the average labour availability in Jabbalgudda-2 micro-watershed is presented in Table 14. The results indicated that, average own labour men available in the micro watershed was 1.77, average own labour (women) available was 1.40, average hired labour (men) available was 7.47and average hired labour (women) available was 6.13.

Table 14: Average Labour availability in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Own labour Male	0.00	1.38	1.71	2.00	2.00	1.77
2	Own Labour Female	0.00	1.00	1.57	1.42	2.00	1.40
3	Hired labour Male	0.00	6.13	8.14	8.08	7.00	7.47
4	Hired labour Female	0.00	4.88	6.71	6.42	7.00	6.13

Adequacy of Hired Labour: The data regarding the adequacy of hired labour in Jabbalgudda-2 micro-watershed is presented in Table 15. The results indicated that, 85.71 per cent of the household opined that hired labour was adequate.

Table 15: Adequacy of Hired Labour in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Adequate	0	0.00	8	100.00	7	100.00	12	100.00	3	100.00	30	85.71

Distribution of land (ha): The data regarding the distribution of land (ha) in Jabbalgudda-2 micro-watershed is presented in Table 16. The results indicated that, households of the Jabbalgudda-2 micro-watershed possess 19.62 ha (46.98 %) of dry land and 22.14 ha (53.02%) of irrigated land. Marginal farmers possess 5.46 ha (100 %) of dry land. Small farmers possess 8.90 ha (90.61 %) of dry land and 0.92 ha (9.39 %) of irrigated land. Semi medium farmers possess 5.26 ha (26.85 %) of dry land and 14.33 ha (73.15 %) of irrigated land. Medium farmers possess 6.88 ha (100%) of irrigated land.

Table 16: Distribution of land (Ha) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		ha	%	ha	%	ha	%	ha	%	ha	%
1	Dry	5.46	100.00	8.90	90.61	5.26	26.85	0.00	0.00	19.62	46.98
2	Irrigated	0.00	0.00	0.92	9.39	14.33	73.15	6.88	100.00	22.14	53.02
Total		5.46	100.00	9.82	100.00	19.60	100.00	6.88	100.00	41.75	100.00

Average land value (Rs./ha): The data regarding the average land value (Rs./ha) in Jabbalgudda-2 micro-watershed is presented in Table 17. The results indicated that, the average value of dry land was Rs. 346,523.62 and average value of irrigated was Rs. 415,429.62. In case of marginal famers, the average land value was Rs. 568,026.71 for dry land. In case of small famers, the average land value was Rs. 269,577.08 for dry land Rs. 650,000.01 for irrigated land. In case of semi medium famers, the average land value was Rs. 247,000 for dry land and Rs. 460,248.45 for irrigated land. In case of medium famers, the average land value was Rs. 290,588.24 for irrigated land.

Table 17: Average land value (Rs. /ha) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
		N	N	N	N	N
1	Dry	568,026.71	269,577.08	247,000.00	0.00	346,523.62
2	Irrigated	0.00	650,000.01	460,248.45	290,588.24	415,429.62

Status of bore wells: The data regarding the status of bore wells in Jabbalgudda-2 micro-watershed is presented in Table 18. The results indicated that, there were 14 functioning bore wells in the micro watershed.

Table 18: Status of bore wells in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Functioning	0	0	1	10	3	14

Source of irrigation: The data regarding the source of irrigation in Jabbalgudda-2 micro-watershed is presented in Table 19. The results indicated that, bore well was the major irrigation source for 40 per cent of the farmers.

Table 19: Source of irrigation in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Bore Well	0	0.00	0	0.00	1	14.29	10	83.33	3	100.00	14	40.00

Depth of water: The data regarding the depth of water in Jabbalgudda-2 micro-watershed is presented in Table 20.The results indicated that on an average the depth of the bore well was 38.32 meters.

Table 20: Depth of water in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
		N	N	N	N	N	N
1	Bore Well	0.00	0.00	13.06	78.74	101.60	38.32

Irrigated Area (ha): The data regarding the irrigated area (ha) in Jabbalgudda-2 micro-watershed is presented in Table 21. The results indicated that, in case of small farmers there was 0.92 ha of irrigated land, in semi medium farmers there was 14.34 ha irrigated land and in medium farmers there was 4.86 per cent of the irrigated land.

Table 21: Irrigated Area (ha) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Kharif	0.00	0.00	0.92	14.34	4.86	20.12
Total		0.00	0.00	0.92	14.34	4.86	20.12

Cropping pattern: The data regarding the cropping pattern in Jabbalgudda-2 micro-watershed is presented in Table 22. The results indicated that, farmers have grown maize (21.29 ha), paddy (12.13 ha), groundnut (2.02 ha), bajra (1.70 ha) and navane (1.21 ha). Marginal farmers have grown maize, groundnut and bajra. Small farmers had grown maize, paddy, bajra and navane. Semi medium farmers had grown maize, paddy and groundnut. Medium farmers had grown maize and paddy.

Table 22: Cropping pattern in Jabbalgudda-2 micro-watershed Area (ha)

Sl.No.	Particulars	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Kharif - Maize	4.13	5.52	7.59	4.05	21.29
2	Kharif - Paddy	0	0.92	10.39	0.81	12.13
3	Kharif - Groundnut	0.81	0	1.21	0	2.02
4	Kharif - Bajra	0.49	1.21	0	0	1.7
5	Kharif - Navane (Fox Millet)	0	1.21	0	0	1.21
Total		5.43	8.87	19.2	4.86	38.35

Cropping intensity: The data regarding the cropping intensity in Jabbalgudda-2 micro-watershed is presented in Table 23. The results indicated that, the cropping intensity in Jabbalgudda-2 micro-watershed was found to be 99.92 per cent. In case of marginal farmers it was 99.41 per cent, in small, semi medium farmers and medium farmers it was 100 per cent.

Table 23: Cropping intensity (%) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Cropping Intensity	0.00	99.41	100.00	100.00	100.00	99.92

Possession of Bank account: The data regarding the possession of Bank account and savings in Jabbalgudda-2 micro-watershed is presented in Table 24. The results indicated that, 68.57 per cent of the households have bank account and 28.57 per cent of the households have savings.

Table 24: Possession of Bank account and savings in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Account	0	0.00	6	75.00	4	57.14	12	100.00	2	66.67	24	68.57
2	Savings	0	0.00	2	25.00	3	42.86	4	33.33	1	33.33	10	28.57

Borrowing status: The data regarding the possession of borrowing status in Jabbalgudda-2 micro-watershed is presented in Table 25. The results indicated that, 25 per cent of marginal, 63.16 per cent of small, 42.86 per cent of the small, 33.33 per cent of the semi medium and medium farmers have borrowed credit from different sources respectively.

Table 25: Borrowing status in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Credit Availed	0	0.00	2	25.00	3	42.86	4	33.33	1	33.33	10	28.57

Source of credit: The data regarding the source of credit availed by households in Jabbalgudda-2 micro-watershed is presented in Table 26. The results indicated that, 40 per cent of the households have availed loan from commercial bank, 10 per cent of the households have availed loan from friends/ relatives and 50 per cent have availed loan from Grameena bank.

Table 26: Source of credit availed by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (0)		MF (2)		SF (3)		SMF (4)		MDF (1)		All (10)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Commercial Bank	0	0.00	0	0.00	2	66.67	2	50.00	0	0.00	4	40.00
2	Friends/Relatives	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	1	10.00
3	Grameena Bank	0	0.00	2	100.00	1	33.33	2	50.00	0	0.00	5	50.00

Average credit amount: The data regarding the average credit amount availed by households in Jabbalgudda-2 micro-watershed is presented in Table 27. The results indicated that, marginal, small, semi medium and medium farmers have availed Rs.57500, Rs. 126666.67, Rs. 212500 and Rs. 10000 respectively. Overall average credit amount availed by households in the micro watershed is 135500.

Table 27: Average Credit amount availed by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (2)	SF (3)	SMF (4)	MDF (1)	All (10)
		N	N	N	N	N
1	Average Credit	57,500.00	126,666.67	212,500.00	10,000.00	135,500.00

Purpose of credit borrowed (institutional Source): The data regarding the purpose of credit borrowed from institutional sources by households in Jabbalgudda-2 micro-watershed is presented in Table 28. The results indicated that, 100 per cent of the institutional credit was borrowed for agriculture production.

Table 28: Purpose of credit borrowed (institutional Source) by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (2)		SF (3)		SMF (4)		All (9)	
		N	%	N	%	N	%	N	%
1	Agriculture production	2	100.00	3	100.00	4	100.00	9	100.00

Purpose of credit borrowed (Private Credit): The data regarding the purpose of credit borrowed from private sources by households in Jabbalgudda-2 micro-watershed is

presented in Table 29. The results indicated that, 100 percent of private credit was taken for agriculture production.

Table 29: Purpose of credit borrowed (Private Credit) by households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MDF (1)		All (1)	
		N	%	N	%
1	Agriculture production	1	100.00	1	100.00

Repayment status of households (Institutional): The data regarding the repayment status of credit borrowed from institutional sources by households in Jabbalgudda-2 micro-watershed is presented in Table 30. Results indicated that 100 per cent of the households have unpaid their institutional credit.

Table 30: Repayment status of households (Institutional) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (2)		SF (3)		SMF (4)		All (9)	
		N	%	N	%	N	%	N	%
1	Un paid	2	100.00	3	100.00	4	100.00	9	100.00

Repayment status of households (Private): The data regarding the repayment status of credit borrowed from private sources by households in Jabbalgudda-2 micro-watershed is presented in Table 31. Results indicated that 100 percent of the households have unpaid their private loan.

Table 31: Repayment status of households (Private) in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MDF (1)		All (1)	
		N	%	N	%
1	Un paid	1	100.00	1	100.00

Opinion on institutional sources of credit: Results (Table 32) indicated that 100 per cent of the farmers opined that the credit, which was taken from various institutes was helped them to perform timely agricultural operations.

Table 32: Opinion on institutional sources of credit in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	MF (2)		SF (3)		SMF (4)		All (9)	
		N	%	N	%	N	%	N	%
1	Helped to perform timely agricultural operations	2	100.00	3	100.00	4	100.00	9	100.00

Opinion on private sources of credit: Results (Table 33) indicated that 100 per cent of the farmers opined that the credit, which was taken from private credit helped them to perform timely agricultural operations.

Table 33: Opinion on non institutional sources of credit in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MDF (1)		All (1)	
		N	%	N	%
1	Helped to perform timely agricultural operations	1	100.00	1	100.00

Cost of Cultivation of Bajra: The data regarding the cost of cultivation of bajra in Jabbalgudda-2 micro-watershed is presented in Table 34. The results indicated that, the total cost of cultivation for bajra was Rs. 31144.38. The gross income realized by the farmers was Rs. 26243.75. The net income from bajra cultivation was Rs. -4900.63, thus the benefit cost ratio was found to be 1:0.84.

Table 34: Cost of Cultivation of Bajra in Jabbalgudda-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	25.93	5125.25	16.46
2	Bullock		Pairs/day	0.00	0.00	0.00
3	Tractor		Hours	3.50	2449.42	7.86
4	Machinery		Hours	0.00	0.00	0.00
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	27.79	3334.50	10.71
6	Seed Inter Crop		Kgs.	0.00	0.00	0.00
7	FYM		Quintal	7.20	1440.83	4.63
8	Fertilizer + micronutrients		Quintal	5.56	4223.70	13.56
9	Pesticides (PPC)		Kgs / liters	0.82	823.33	2.64
10	Irrigation		Number	0.00	0.00	0.00
11	Repairs			0.00	0.00	0.00
12	Msc. Charges (Marketing costs etc)			0.00	0.00	0.00
13	Depreciation charges			0.00	3.31	0.01
14	Land revenue and Taxes			0.00	3.29	0.01
II	**Cost B1**					
16	Interest on working capital				1178.80	3.78
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				18582.44	59.67
III	**Cost B2**					
18	Rental Value of Land				333.33	1.07
19	**Cost B2 = (Cost B1 + Rental value)**				18915.78	60.74
IV	**Cost C1**					
20	Family Human Labour			45.08	9396.29	30.17
21	**Cost C1 = (Cost B2 + Family Labour)**				28312.07	90.91
V	**Cost C2**					
22	Risk Premium				1.00	0.00
23	**Cost C2 = (Cost C1 + Risk Premium)**				28313.07	90.91
VI	**Cost C3**					
24	Managerial Cost				2831.31	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				31144.38	100.00
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		24.70	25935.00	
		b) Main Crop Sales Price (Rs.)			1050.00	
	By Product	e) Main Product (q)		1.03	308.75	
		f) Main Crop Sales Price (Rs.)			300.00	
b.	Gross Income (Rs.)				26243.75	
c.	Net Income (Rs.)				-4900.63	
d.	Cost per Quintal (Rs./q.)				1260.91	
e.	Benefit Cost Ratio (BC Ratio)				1:0.84	

Cost of Cultivation of Maize: The data regarding the cost of cultivation of maize in Jabbalgudda-2 micro-watershed is presented in Table 35. The results indicated that, the total cost of cultivation for maize was Rs. 35993.38. The gross income realized by the farmers was Rs. 42562.86. The net income from maize cultivation was Rs. 6569.47. Thus the benefit cost ratio was found to be 1:1.18.

Table 35: Cost of Cultivation of Maize in Jabbalgudda-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	43.94	7854.92	21.82
2	Bullock		Pairs/day	1.09	651.02	1.81
3	Tractor		Hours	4.79	3364.07	9.35
4	Machinery		Hours	0.24	165.53	0.46
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	26.72	3206.99	8.91
6	Seed Inter Crop		Kgs.	0.00	0.00	0.00
7	FYM		Quintal	3.80	759.20	2.11
8	Fertilizer + micronutrients		Quintal	8.75	7187.34	19.97
9	Pesticides (PPC)		Kgs /liters	0.00	0.00	0.00
10	Irrigation		Number	2.79	0.00	0.00
11	Repairs			0.00	0.00	0.00
12	Msc. Charges (Marketing costs etc)			0.00	0.00	0.00
13	Depreciation charges			0.00	711.63	1.98
14	Land revenue and Taxes			0.00	3.29	0.01
II	**Cost B1**					
16	Interest on working capital				1338.54	3.72
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				25242.53	70.13
III	**Cost B2**					
18	Rental Value of Land				428.57	1.19
19	**Cost B2 = (Cost B1 + Rental value)**				25671.10	71.32
IV	**Cost C1**					
20	Family Human Labour			38.07	7049.16	19.58
21	**Cost C1 = (Cost B2 + Family Labour)**				32720.26	90.91
V	**Cost C2**					
22	Risk Premium				1.00	0.00
23	**Cost C2 = (Cost C1 + Risk Premium)**				32721.26	90.91
VI	**Cost C3**					
24	Managerial Cost				3272.13	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				35993.38	100.00
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		36.01	41148.97	
		b) Main Crop Sales Price (Rs.)			1142.86	
	By Product	e) Main Product (q)		2.71	1413.88	
		f) Main Crop Sales Price (Rs.)			521.43	
b.	Gross Income (Rs.)				42562.86	
c.	Net Income (Rs.)				6569.47	
d.	Cost per Quintal (Rs./q.)				999.67	
e.	Benefit Cost Ratio (BC Ratio)				1:1.18	

Cost of Cultivation of Paddy: The data regarding the cost of cultivation of paddy in Jabbalgudda-2 micro-watershed is presented in Table 36. The results indicated that, the total cost of cultivation for paddy was Rs. 120050.47. The gross income realized by the farmers was Rs. 97734.16. The net income from paddy cultivation was Rs. -22316.31. Thus the benefit cost ratio was found to be 1:0.81.

Table 36: Cost of Cultivation of Paddy in Jabbalgudda-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	39.25	6977.99	5.81
2	Bullock		Pairs/day	0.41	247.00	0.21
3	Tractor		Hours	2.57	1862.05	1.55
4	Machinery		Hours	0.65	452.83	0.38
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	106.53	68526.30	57.08
6	Seed Inter Crop		Kgs.	0.00	0.00	0.00
7	FYM		Quintal	4.76	951.97	0.79
8	Fertilizer + micronutrients		Quintal	14.74	12368.30	10.30
9	Pesticides (PPC)		Kgs / liters	0.79	789.99	0.66
10	Irrigation		Number	3.98	0.00	0.00
11	Repairs			0.00	0.00	0.00
12	Msc. Charges (Marketing costs etc)			0.00	0.00	0.00
13	Depreciation charges			0.00	0.75	0.00
14	Land revenue and Taxes			0.00	3.29	0.00
II	**Cost B1**					
16	Interest on working capital				9916.51	8.26
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				102096.97	85.05
III	**Cost B2**					
18	Rental Value of Land				407.41	0.34
19	**Cost B2 = (Cost B1 + Rental value)**				102504.38	85.38
IV	**Cost C1**					
20	Family Human Labour			35.68	6631.41	5.52
21	**Cost C1 = (Cost B2 + Family Labour)**				109135.79	90.91
V	**Cost C2**					
22	Risk Premium				1.00	0.00
23	**Cost C2 = (Cost C1 + Risk Premium)**				109136.79	90.91
VI	**Cost C3**					
24	Managerial Cost				10913.68	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				120050.47	100.00
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		68.86	97175.39	
		b) Main Crop Sales Price (Rs.)			1411.11	
	By Product	e) Main Product (q)		3.40	558.76	
		f) Main Crop Sales Price (Rs.)			164.44	
b.	Gross Income (Rs.)				97734.16	
c.	Net Income (Rs.)				-22316.31	
d.	Cost per Quintal (Rs./q.)				1743.29	
e.	Benefit Cost Ratio (BC Ratio)				1:0.81	

Cost of Cultivation of Ground nut: The data regarding the cost of cultivation of groundnut in Jabbalgudda-2 micro-watershed is presented in Table 37. The results indicated that, the total cost of cultivation for groundnut was Rs. 43776.50. The gross income realized by the farmers was Rs. 47823.32. The net income from groundnut cultivation was Rs. 4046.81. Thus the benefit cost ratio was found to be 1:1.09.

Table 37: Cost of Cultivation of Groundnut in Jabbalgudda-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	39.73	6504.33	14.86
2	Bullock		Pairs/day	1.24	741.00	1.69
3	Tractor		Hours	4.12	2881.67	6.58
4	Machinery		Hours	0.00	0.00	0.00
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	82.33	12350.00	28.21
6	Seed Inter Crop		Kgs.	0.00	0.00	0.00
7	FYM		Quintal	4.12	823.33	1.88
8	Fertilizer + micronutrients		Quintal	6.18	5413.42	12.37
9	Pesticides (PPC)		Kgs / liters	1.24	1235.00	2.82
10	Irrigation		Number	4.12	0.00	0.00
11	Repairs			0.00	0.00	0.00
12	Msc. Charges (Marketing costs etc)			0.00	0.00	0.00
13	Depreciation charges			0.00	9.88	0.02
14	Land revenue and Taxes			0.00	3.29	0.01
II	**Cost B1**					
16	Interest on working capital				2378.73	5.43
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				32340.65	73.88
III	**Cost B2**					
18	Rental Value of Land				333.33	0.76
19	**Cost B2 = (Cost B1 + Rental value)**				32673.99	74.64
IV	**Cost C1**					
20	Family Human Labour			35.82	7121.83	16.27
21	**Cost C1 = (Cost B2 + Family Labour)**				39795.82	90.91
V	**Cost C2**					
22	Risk Premium				1.00	0.00
23	**Cost C2 = (Cost C1 + Risk Premium)**				39796.82	90.91
VI	**Cost C3**					
24	Managerial Cost				3979.68	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				43776.50	100.00
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		11.12	46405.13	
		b) Main Crop Sales Price (Rs.)			4175.00	
	By Product	e) Main Product (q)		2.68	1418.19	
		f) Main Crop Sales Price (Rs.)			530.00	
b.	Gross Income (Rs.)				47823.32	
c.	Net Income (Rs.)				4046.81	
d.	Cost per Quintal (Rs./q.)				3938.51	
e.	Benefit Cost Ratio (BC Ratio)				1:1.09	

Cost of Cultivation of Navane+Redgram: The data regarding the cost of cultivation of Navane+redgram in Jabbalgudda-2 micro-watershed is presented in Table 38. The results indicated that, the total cost of cultivation for Navane+redgram was Rs. 23835.19. The gross income realized by the farmers was Rs. 33641.40. The net income from Navane+redgram cultivation was Rs. 9806.21. Thus the benefit cost ratio was found to be 1:1.41.

Table 38: Cost of Cultivation of Navane+Redgram in Jabbalgudda-2 micro-watershed

Sl.No	Particulars		Units	Phy Units	Value(Rs.)	% to C3
I	**Cost A1**					
1	Hired Human Labour		Man days	25.52	4528.33	19.00
2	Bullock		Pairs/day	0.82	494.00	2.07
3	Tractor		Hours	2.47	1976.00	8.29
4	Machinery		Hours	0.00	0.00	0.00
5	Seed Main Crop (Establishment and Maintenance)		Kgs (Rs.)	16.47	5763.33	24.18
6	Seed Inter Crop		Kgs.	8.23	0.00	0.00
7	FYM		Quintal	0.82	1646.67	6.91
8	Fertilizer + micronutrients		Quintal	3.29	3276.87	13.75
9	Pesticides (PPC)		Kgs / liters	0.00	0.00	0.00
10	Irrigation		Number	0.00	0.00	0.00
11	Repairs			0.00	0.00	0.00
12	Msc. Charges (Marketing costs etc)			0.00	0.00	0.00
13	Depreciation charges			0.00	0.02	0.00
14	Land revenue and Taxes			0.00	3.29	0.01
II	**Cost B1**					
16	Interest on working capital				1282.54	5.38
17	**Cost B1 = (Cost A1 + sum of 15 and 16)**				18971.05	79.59
III	**Cost B2**					
18	Rental Value of Land				333.33	1.40
19	**Cost B2 = (Cost B1 + Rental value)**				19304.39	80.99
IV	**Cost C1**					
20	Family Human Labour			11.53	2362.97	9.91
21	**Cost C1 = (Cost B2 + Family Labour)**				21667.35	90.90
V	**Cost C2**					
22	Risk Premium				1.00	0.00
23	**Cost C2 = (Cost C1 + Risk Premium)**				21668.35	90.91
VI	**Cost C3**					
24	Managerial Cost				2166.84	9.09
25	**Cost C3 = (Cost C2 + Managerial Cost)**				23835.19	100.00
VII	**Economics of the Crop**					
a.	Main Product	a) Main Product (q)		12.35	19760.00	
		b) Main Crop Sales Price (Rs.)			1600.00	
		c) Intercrop (q)		3.29	13832.00	
		d) Intercrop Sales Price (Rs.)			4200.00	
	By Product	e) Main Product (q)		0.82	49.40	
		f) Main Crop Sales Price (Rs.)			60.00	
b.	Gross Income (Rs.)				33641.40	
c.	Net Income (Rs.)				9806.21	
d.	Cost per Quintal (Rs./q.)				1523.66	
e.	Benefit Cost Ratio (BC Ratio)				1:1.41	

Adequacy of fodder: The data regarding the adequacy of fodder in Jabbalgudda-2 micro-watershed is presented in Table 39. The results indicated that, 8.57 per cent of the households opined that dry fodder and green fodder were adequate respectively.

Table 39: Adequacy of fodder in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%
1	Adequate-Dry Fodder	2	16.67	1	33.33	3	8.57
2	Adequate-Green Fodder	2	16.67	1	33.33	3	8.57

Average Annual gross income of households: The results of the overall average annual gross income of the household in Jabbalgudda-2 is presented in table 40. The table indicated that, in landless farmers, the average income from wage was Rs. 94000. In marginal farmers the average income from service/salary was Rs. 8750, wage was Rs.45000 and agriculture was Rs.65318.75. In small farmers the average income from wage was Rs.30000 and agriculture was Rs.130714.29. In semi medium farmers, the average income from service/salary was Rs. 17,500, wage was Rs. 13,333.33 and agriculture was Rs. 192,916.67. In case of medium farmers the average income from wage was Rs.26666.67 and agriculture was Rs.333333.33.

Table 40: Average Annual gross income (Rs.) of households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Service/salary	0.00	8,750.00	0.00	17,500.00	0.00	8,000.00
2	Wage	94,000.00	45,000.00	30,000.00	13,333.33	26,666.67	36,571.43
3	Agriculture	0.00	65,318.75	130,714.29	192,916.67	333,333.33	135,787.14
Income(Rs.)		94,000.00	119,068.75	160,714.29	223,750.00	360,000.00	180,358.57

Average Annual expenditure of households: The results of the overall average annual expenditure of the household in Jabbalgudda-2 were presented in Table 41. The results indicated that, in case of landless farmers, the annual average expenditure from wage was Rs. 64400. In marginal farmers the annual average expenditure from service/salary was Rs. 45000, wage was Rs. 33833.33 and agriculture was Rs.34250. In small farmers, the annual average expenditure from wage was Rs. 52000 and agriculture was Rs.64142.86. In semi medium farmers, the annual average expenditure from service/salary was Rs. 51666.67, wage was Rs. 18500 and agriculture was Rs.109583.33. In case of medium farmers, the annual average expenditure from wage was Rs. 65000 and agriculture was Rs.183333.33.

Table 41: Average Annual expenditure of households in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
1	Service/salary	0.00	45,000.00	0.00	51,666.67	0.00	5,714.29
2	Wage	64,400.00	33,833.33	52,000.00	18,500.00	65,000.00	24,485.71
3	Agriculture	0.00	34,250.00	64,142.86	109,583.33	183,333.33	73,942.86
Total		64,400.00	113,083.33	116,142.86	179,750.00	248,333.33	721,709.52
Average		12,880.00	14,135.42	16,591.84	14,979.17	82,777.78	20,620.27

Horticulture species grown: The data regarding horticulture species grown in Jabbalgudda-2 micro-watershed is presented in Table 42. The results indicated that, sampled households have grown 19 coconut trees and 3 mango trees in their field and also planted 6 coconut trees in their backyard.

Table 42: Horticulture species grown in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Coconut	0	0	2	1	5	3	8	2	4	0	19	6
2	Mango	0	0	1	0	1	0	1	0	0	0	3	0

F: Field; B: Backyard

Forest species grown: The data regarding forest species grown in Jabbalgudda-2 micro-watershed is presented in Table 43. The results indicated that, households have planted 2 teak trees, 62 neem trees, 2 tamarind tress, 3 acacia trees and 2 banyan trees in their field and also grown 1 Neem tree in the backyard.

Table 43: Forest species grown in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		F	B	F	B	F	B	F	B	F	B	F	B
1	Teak	0	0	2	0	0	0	0	0	0	0	2	0
2	Neem	0	0	16	0	21	0	24	1	1	0	62	1
3	Tamarind	0	0	2	0	0	0	0	0	0	0	2	0
4	Acacia	0	0	0	0	0	0	3	0	0	0	3	0
5	Banyan	0	0	0	0	1	0	1	0	0	0	2	0

F: Field; B: Backyard

Average Additional investment capacity: The data regarding average additional investment capacity in Jabbalgudda-2 micro-watershed is presented in Table 44. The results indicated that, households have an average investment capacity of Rs.2285.71 for improved livestock management. Semi medium farmers have an average investment capacity of Rs.6666.67 for improved livestock management.

Table 44: Average additional investment capacity of households in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	LL (5)	MF (8)	SF (7)	SMF (12)	MDF (3)	All (35)
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1	Improved livestock management	0.00	0.00	0.00	6,666.67	0.00	2,285.71

Table 45: Source of funds for additional investment capacity in Jabbalgudda-2 micro-watershed

Sl.No	Item	Improved livestock management	
		N	%
1	Government subsidy	1	2.86

Source of additional investment: The data regarding source of funds for additional investment in Jabbalgudda-2 micro-watershed is presented in Table 45. The results

indicated that for 2.86 per cent of the households were dependent on government subsidy for improved livestock management.

Marketing of the agricultural produce: The data regarding marketing of the agricultural produce in Jabbalgudda-2 micro-watershed is presented in Table 46. The results indicated that, maize crops were sold to the extent of 100 per cent. Bajra, Groundnut, navane and paddy were sold to an extent of 55 per cent, 80 per cent, 25 per cent and 75 per cent respectively.

Table 46: Marketing of the agricultural produce in Jabbalgudda-2 micro-watershed

Sl.No	Crops	Output obtained (q)	Output retained (q)	Output sold (q)	Output sold (%)	Avg. Price obtained (Rs/q)
1	Bajra	51	22.95	28.05	55.00	1050.0
2	Groundnut	22	4.40	17.60	80.00	4175.0
3	Maize	684	0.00	684.00	100.00	1105.88
4	Navane	15	11.25	3.75	25.00	1600.0
5	Paddy	797	199.25	597.75	75.00	1411.11

Marketing Channels used for sale of agricultural produce: The data regarding marketing channels used for sale of agricultural produce in Jabbalgudda-2 micro-watershed is presented in Table 47. The results indicated that, 45.71 percent of the households have sold their produce local/village merchant and 42.86 percent of the households sold their produce in regulated markets.

Table 47: Marketing Channels used for sale of agricultural produce in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%
1	Local/village Merchant	4	50.00	4	57.14	7	58.33	1	33.33	16	45.71
2	Regulated Market	4	50.00	3	42.86	6	50.00	2	66.67	15	42.86

Mode of transport of agricultural produce: The data regarding mode of transport of agricultural produce in Jabbalgudda-2 micro-watershed is presented in Table 48. The results indicated that 8.57 per cent of the households have used cart as a mode of transport and 80 per cent have used tractor.

Table 48: Mode of transport of agricultural produce in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cart	0	0.00	1	12.50	1	14.29	1	8.33	0	0.00	3	8.57
2	Tractor	0	0.00	7	87.50	6	85.71	12	100.00	3	100.00	28	80.00

Incidence of soil and water erosion problems: The data regarding incidence of soil and water erosion problems in Jabbalgudda-2 microwatershed is presented in Table 49. The results indicated that, 40 per cent of the households have experienced the soil and water erosion problems i.e. 37.50 percent of marginal farmers, 57.14 per cent of small farmers, 50 per cent of semi medium farmers and 33.33 per cent of medium farmers.

Table 49: Incidence of soil and water erosion problems in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%
1	Soil and water erosion problems in the farm	3	37.50	4	57.14	6	50.00	1	33.33	14	40.00

Interest towards soil testing: The data regarding interest shown towards soil testing in Jabbalgudda-2 micro-watershed is presented in Table 50. The results indicated that, 80 per cent of the households have shown interest in soil testing.

Table 50: Interest shown towards soil testing in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Interest in soil test	0	0.00	7	87.50	7	100.00	11	91.67	3	100.00	28	80.00

Usage pattern of fuel for domestic use: The data regarding usage pattern of fuel for domestic use in Jabbalgudda-2 micro-watershed is presented in Table 51. The results indicated that, 88.57 percent used fire wood as a source of fuel and 11.43 percent of the households used LPG as a source of fuel.

Table 51: Usage pattern of fuel for domestic use in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Fire Wood	5	100.00	7	87.50	6	85.71	10	83.33	3	100.00	31	88.57
2	LPG	0	0.00	1	12.50	1	14.29	2	16.67	0	0.00	4	11.43

Source of drinking water: The data regarding source of drinking water in Jabbalgudda-2 micro-watershed is presented in Table 52. The results indicated that, piped supply was the source of drinking water for 20 per cent, 71.43 per cent of them were using bore well and 8.57 per cent of the households were using lake/tank for drinking water.

Table 52: Source of drinking water in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Piped supply	2	40.00	3	37.50	1	14.29	1	8.33	0	0.00	7	20.00
2	Bore Well	2	40.00	5	62.50	5	71.43	10	83.33	3	100.00	25	71.43
3	Lake/ Tank	1	20.00	0	0.00	1	14.29	1	8.33	0	0.00	3	8.57

Source of light: The data regarding source of light in Jabbalgudda-2 micro-watershed is presented in Table 53. The results indicated that, electricity was the major source of light for 100 per cent of the households.

Table 53: Source of light in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Electricity	5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00

Existence of Sanitary toilet facility: The data regarding existence of sanitary toilet facility in Jabbalgudda-2 micro-watershed is presented in Table 54. The results indicated

that, 20 per cent of the households possess sanitary toilet i.e. 20 per cent of landless, 12.50 per cent of marginal, 14.29 per cent of the small, 33.33 per cent of the semi medium farmers and 25 per cent of the medium farmers had sanitary toilet facility.

Table 54: Existence of Sanitary toilet facility in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Sanitary toilet facility	1	20.00	1	12.50	1	14.29	3	25.00	1	33.33	7	20.00

Possession of PDS card: The data regarding possession of PDS card in Jabbalgudda-2 micro-watershed is presented in Table 55. The results indicated that, 100 per cent of the sampled households possessed BPL card.

Table 55: Possession of PDS card in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	BPL	5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00

Participation in NREGA programme: The data regarding participation in NREGA programme in Jabbalgudda-2 micro-watershed is presented in Table 56. The results indicated that, 51.43 per cent of the households participated in NREGA programme which included 100 per cent of the landless, 50 per cent of the marginal and semi medium farmers, 14.29 per cent of the small farmers and 66.67 per cent of the medium farmers.

Table 56: Participation in NREGA programme in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	LL (5)		MF (8)		SF (7)		SMF(12)		MDF(3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Participation in NREGA programme	5	100.00	4	50.00	1	14.29	6	50.00	2	66.67	18	51.43

Adequacy of food items: The data regarding adequacy of food items in Jabbalgudda-2 micro-watershed is presented in Table 57. The results indicated that cereals and pulses were adequate for 100 per cent of the households; milk and egg were adequate for 97.14 per cent of the households respectively. Oil seed, vegetables and meat were adequate for 2.86 per cent, 11.43 per cent and 17.14 per cent of the households respectively.

Table 57: Adequacy of food items in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Cereals	5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00
2	Pulses	5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00
3	Oilseed	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	1	2.86
4	Vegetables	1	20.00	0	0.00	0	0.00	3	25.00	0	0.00	4	11.43
5	Fruits	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6	Milk	5	100.00	8	100.00	7	100.00	11	91.67	3	100.00	34	97.14
7	Egg	5	100.00	8	100.00	7	100.00	11	91.67	3	100.00	34	97.14
8	Meat	1	20.00	1	12.50	1	14.29	3	25.00	0	0.00	6	17.14

Response on Inadequacy of food items: The data regarding inadequacy of food items in Jabbalgudda-2 micro-watershed is presented in Table 58. The results indicated that,

oilseed, vegetables, fruits and meat were inadequate for 97.14 per cent, 88.57 per cent, 100 per cent and 82.86 per cent of the households.

Table 58: Response on Inadequacy of food items in Jabbalgudda-2 micro-watershed

Sl.No.	Particulars	LL (5)		MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%	N	%
1	Oilseed	5	100.00	8	100.00	7	100.00	11	91.67	3	100.00	34	97.14
2	Vegetables	4	80.00	8	100.00	7	100.00	9	75.00	3	100.00	31	88.57
3	Fruits	5	100.00	8	100.00	7	100.00	12	100.00	3	100.00	35	100.00
4	Milk	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	1	2.86
5	Egg	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	1	2.86
6	Meat	4	80.00	7	87.50	6	85.71	9	75.00	3	100.00	29	82.86

Farming constraints: The data regarding farming constraints experienced by households in Jabbalgudda-2 micro-watershed is presented in Table 59. The results indicated that, Lower fertility status of the soil was the constraint experienced by 85.71 per cent of the households, wild animal menace on farm field and frequent incidence of pest and diseases were experienced by (77.14%), inadequacy of irrigation water (65.71%), high cost of Fertilizers and plant protection chemicals and high rate of interest on credit problems were experienced by (62.86%), low price for the agricultural commodities (74.29%), lack of marketing facilities in the area (77.14%), inadequate extension services and lack of transport for safe transport of the agricultural produce to the market were experienced by (82.86%) and Source of Agri-technology information(Newspaper/ TV/Mobile) (2.86 %) of the households.

Table 59: Farming constraints Experienced in Jabbalgudda-2 micro-watershed

Sl. No.	Particulars	MF (8)		SF (7)		SMF (12)		MDF (3)		All (35)	
		N	%	N	%	N	%	N	%	N	%
1	Lower fertility status of the soil	8	100	9	128.57	11	91.67	2	66.67	30	85.71
2	Wild animal menace on farm field	6	75	7	100.00	11	91.67	3	100	27	77.14
3	Frequent incidence of pest and diseases	6	75	6	85.71	12	100.00	3	100	27	77.14
4	Inadequacy of irrigation water	4	50	6	85.71	11	91.67	2	66.67	23	65.71
5	High cost of Fertilizers and plant protection chemicals	4	50	6	85.71	10	83.33	2	66.67	22	62.86
6	High rate of interest on credit	4	50	6	85.71	10	83.33	2	66.67	22	62.86
7	Low price for the agricultural commodities	4	50	7	100.00	12	100.00	3	100	26	74.29
8	Lack of marketing facilities in the area	7	87.50	6	85.71	11	91.67	3	100	27	77.14
9	Inadequate extension services	8	100	6	85.71	11	91.67	3	100	29	82.86
10	Lack of transport for safe transport of the Agril produce to the market.	8	100	6	85.71	11	91.67	3	100	29	82.86
11	Source of Agri-technology information(Newspaper/TV/Mobile)	1	12.50	0	0.00	0	0.00	0	0.00	1	2.86

Chapter 5

SUMMARY

In order to assess the socio-economic condition of the farmers in the watershed a comprehensive questionnaire was prepared. Major components such as demographic conditions, migration details, food consumption and family expenditure pattern, material possession, land holding, land use management, cropping pattern, cost of cultivation of crops, livestock management. The statistical components such as frequency and percentage were used to analyze the data. About 35 households located in the micro watershed were interviewed for the survey.

Results indicated that 35 farmers were sampled in Jabbalgudda-2 micro-watershed among them 8(22.86%) were marginal farmers, 7 (20%) were small farmers, 12 (34.29%) were semi medium farmers, 3 (8.57 %) were medium farmers and 5 (14.29 %) landless farmers were also interviewed for the survey. The data indicated that there were 164 population households were there in the studied micro watershed. Among them 95 (57.93%) men and 69 (42.07%) were women. The average family size of landless was 3, marginal farmers were 4, small and semi medium farmer was 5 and medium farmers were 9. The data indicated that 21(12.80%) people were in 0-15 years of age, 79 (48.17 %) were in 16-35 years of age, 54 (32.93 %) were in 36-60 years of age and 10 (6.10%) were above 61 years of age.

The results indicated that the Jabbalgudda-2 had 31.10 per cent illiterates, 31.71 per cent of them had primary school education, 4.27 per cent of them had both middle schools, 14.63 per cent of them had high school education, 7.93 per cent of them had PUC education, 0.61 per cent them had ITI and diploma education and 4.88 per cent them had degree education. The results indicated that, 80 per cent of households practicing agriculture, 2.86 per cent of the household heads were agricultural labour and in private service respectively. 14.29 per cent of the household heads were general labour.

The results indicated that agriculture was the major occupation for 61.59 per cent of the household members, 3.05 per cent were agricultural labourers, 10.37 per cent were general labours, 2.44 per cent of them were in private sector, 13.41 per cent of them were students and 4.27 per cent of them were children.

In case of landless households 100 per cent were general labourers. In case of marginal farmers 70.97 per cent were agriculturist, 16.13 per cent were students and 3.23 per cent were general labour and in private service. In case of small farmers 81.82 per cent of them were agriculturist, 6.06 per cent were in agricultural labour and 12.12 per cent of them were students. In case of semi medium farmers 72.41 per cent of the family members were agriculturist, 3.45 per cent were agriculture labour, 5.71 per cent were in private service and 10.34 per cent of them were students. In case of medium farmers 38.46 per cent of the family members were agriculturist, 3.85 per cent of them were

agricultural labour, 26.92 per cent of them were student, 11.54 per cent of them were housewives and 3.85 per cent of them were children.

The results showed that 100 per cent of population have not participated in any local institutions. The results indicated that 91.43 per cent of the households possess Katcha house and 8.57 per cent of them possess Thatched house. The results showed that, 48.57 per cent of the households possess TV, 17.14 per cent of the households possess Mixer grinder, 28.57 per cent of the households possess bicycle, 22.86 per cent of the households possess motor cycle, and 85.71 per cent of the households possess mobile phones. The results showed that the average value of television was Rs. 9000, mixer grinder was Rs.2000, bicycle was Rs.2100, motor cycle was Rs.27375 and mobile phone was Rs.2350. Data indicated that, 2.86 per cent of the households possess both tractor and sprayer respectively. 34.29 per cent of the households possess weeder. The results showed that, average value of tractor was Rs. 400000, the average value of sprayer was Rs. 1000 and the average value of weeder was Rs. 93.

The results indicated that, 2.86 per cent of the households possess both bullocks and buffalo and 14.29 per cent of the households possess local cow. In case of semi medium farmers, 8.33 per cent of the households possess bullock, and buffalo correspondingly and 33.33 per cent of the households possess local cow. In medium farmers 33.33 per cent of the households possess local cow. The results indicated that, average own labour men available in the micro watershed was 1.77, average own labour (women) available was 1.40, average hired labour (men) available was 7.47and average hired labour (women) available was 6.13.

In case of marginal farmers, average own labour men available was 1.38, average own labour (women) was also 1, average hired labour (men) was 6.13 and average hired labour (women) available was 4.88. In case of small farmers, average own labour men available was 1.71, average own labour (women) was 1.57, average hired labour (men) was 8.14 and average hired labour (women) available was 6.71. In case of semi medium farmers, average own labour men available was 2, average own labour (women) was 1.42, average hired labour (men) was 8.08 and average hired labour (women) available was 6.42. In medium farmers average own labour men available was 2, average own labour (women) was 2, average hired labour (men) was 7 and average hired labour (women) available was 7.

The results indicated that, 85.71 per cent of the household opined that hired labour was adequate. The results indicated that, households of the Jabbalgudda-2 micro-watershed possess 19.62 ha (46.98 %) of dry land and 22.14 ha (53.02%) of irrigated land. Marginal farmers possess 5.46 ha (100 %) of dry land. Small farmers possess 8.90 ha (90.61 %) of dry land and 0.92 ha (9.39 %) of irrigated land. Semi medium farmers possess 5.26 ha (26.85 %) of dry land and 14.33 ha (73.15 %) of irrigated land. Medium farmers possess 6.88 ha (100%) of irrigated land. The results indicated that, the average

value of dry land was Rs. 346,523.62 and average value of irrigated was Rs. 415,429.62. In case of marginal famers, the average land value was Rs. 568,026.71 for dry land. In case of small famers, the average land value was Rs. 269,577.08 for dry land Rs. 650,000.01 for irrigated land. In case of semi medium famers, the average land value was Rs. 247,000 for dry land and Rs. 460,248.45 for irrigated land. In case of medium famers, the average land value was Rs. 290,588.24 for irrigated land.

The results indicated that, there were 14 functioning bore wells in the micro watershed. The results indicated that, bore well was the major irrigation source for 40 per cent of the farmers. The results indicated that on an average the depth of the bore well was 38.32 meters. The results indicated that, in case of small farmers there was 0.92 ha of irrigated land, in semi medium farmers there was 14.34 ha irrigated land and in medium farmers there was 4.86 per cent of the irrigated land.

The results indicated that, farmers have grown maize (21.29 ha), paddy (12.13 ha), groundnut (2.02 ha), bajra (1.70 ha) and navane (1.21 ha). Marginal farmers have grown maize, groundnut and bajra. Small farmers had grown maize, paddy, bajra and navane. Semi medium farmers had grown maize, paddy and groundnut. Medium farmers had grown maize and paddy. The results indicated that, the cropping intensity in Jabbalgudda-2 micro-watershed was found to be 99.92 per cent. In case of marginal farmers it was 99.41 per cent, in small, semi medium farmers and medium farmers it was 100 per cent.

The results indicated that, 68.57 per cent of the households have bank account and 28.57 per cent of the households have savings. The results indicated that, 25 per cent of marginal, 63.16 per cent of small, 42.86 per cent of the small, 33.33 per cent of the semi medium and medium farmers have borrowed credit from different sources respectively. The results indicated that, 40 per cent of the households have availed loan from commercial bank, 10 per cent of the households have availed loan from friends/ relatives and 50 per cent have availed loan from Grameena bank. The results indicated that, marginal, small, semi medium and medium farmers have availed Rs.57500, Rs. 126666.67, Rs. 212500 and Rs. 10000 respectively. Overall average credit amount availed by households in the micro watershed is 135500.

The results indicated that, 100 per cent of the institutional credit was borrowed for agriculture production. The results indicated that, 100 percent of private credit was taken for agriculture production. Results indicated that 100 per cent of the households have unpaid their institutional credit. Results indicated that 100 percent of the households have unpaid their private loan. Results indicated that 100 per cent of the farmers opined that the credit, which was taken from various institutes was helped them to perform timely agricultural operations. Results indicated that 100 per cent of the farmers opined that the credit, which was taken from private credit helped them to perform timely agricultural operations.

The results indicated that, the total cost of cultivation for bajra was Rs. 31144.38. The gross income realized by the farmers was Rs. 26243.75. The net income from bajra cultivation was Rs. -4900.63, thus the benefit cost ratio was found to be 1:0.84. The results indicated that, the total cost of cultivation for maize was Rs. 35993.38. The gross income realized by the farmers was Rs. 42562.86. The net income from maize cultivation was Rs. 6569.47. Thus the benefit cost ratio was found to be 1:1.18. The results indicated that, the total cost of cultivation for paddy was Rs. 120050.47. The gross income realized by the farmers was Rs. 97734.16. The net income from paddy cultivation was Rs. -22316.31. Thus the benefit cost ratio was found to be 1:0.81. The results indicated that, the total cost of cultivation for groundnut was Rs. 43776.50. The gross income realized by the farmers was Rs. 47823.32. The net income from groundnut cultivation was Rs. 4046.81. Thus the benefit cost ratio was found to be 1:1.09. The results indicated that, the total cost of cultivation for Navane+redgram was Rs. 23835.19. The gross income realized by the farmers was Rs. 33641.40. The net income from Navane+redgram cultivation was Rs. 9806.21. Thus the benefit cost ratio was found to be 1:1.41.

The results indicated that, 8.57 per cent of the households opined that dry fodder and green fodder were adequate respectively. The table indicated that, in landless farmers, the average income from wage was Rs. 94000. In marginal farmers the average income from service/salary was Rs. 8750, wage was Rs.45000 and agriculture was Rs.65318.75. In small farmers the average income from wage was Rs.30000 and agriculture was Rs.130714.29. In semi medium farmers, the average income from service/salary was Rs. 17,500, wage was Rs. 13,333.33 and agriculture was Rs. 192,916.67. In case of medium farmers the average income from wage was Rs.26666.67 and agriculture was Rs.333333.33.

The results indicated that, in case of landless farmers, the annual average expenditure from wage was Rs. 64400. In marginal farmers the annual average expenditure from service/salary was Rs. 45000, wage was Rs. 33833.33 and agriculture was Rs.34250. In small farmers, the annual average expenditure from wage was Rs. 52000 and agriculture was Rs.64142.86. In semi medium farmers, the annual average expenditure from service/salary was Rs. 51666.67, wage was Rs. 18500 and agriculture was Rs.109583.33. In case of medium farmers, the annual average expenditure from wage was Rs. 65000 and agriculture was Rs.183333.33.

The results indicated that, sampled households have grown 19 coconut trees and 3 mango trees in their field and also planted 6 coconut trees in their backyard. The results indicated that, households have planted 2 teak trees, 62 neem trees, 2 tamarind tress, 3 acacia trees and 2 banyan trees in their field and also grown 1 Neem tree in the backyard.

The results indicated that, households have an average investment capacity of Rs.2285.71 for improved livestock management. Semi medium farmers have an average investment capacity of Rs.6666.67 for improved livestock management. The results indicated that for 2.86 per cent of the households were dependent on government subsidy

for improved livestock management. The results indicated that, maize crops were sold to the extent of 100 per cent. Bajra, Groundnut, navane and paddy were sold to an extent of 55 per cent, 80 per cent, 25 per cent and 75 per cent respectively.

The results indicated that, 45.71 percent of the households have sold their produce local/village merchant and 42.86 percent of the households sold their produce in regulated markets. The results indicated that 8.57 per cent of the households have used cart as a mode of transport and 80 per cent have used tractor. The results indicated that, 40 per cent of the households have experienced the soil and water erosion problems i.e. 37.50 percent of marginal farmers, 57.14 per cent of small farmers, 50 per cent of semi medium farmers and 33.33 per cent of medium farmers. The results indicated that, 80 per cent of the households have shown interest in soil testing.

The results indicated that, 88.57 percent used fire wood as a source of fuel and 11.43 percent of the households used LPG as a source of fuel. The results indicated that, piped supply was the source of drinking water for 20 per cent, 71.43 per cent of them were using bore well and 8.57 per cent of the households were using lake/tank for drinking water. The results indicated that, electricity was the major source of light for 100 per cent of the households.

The results indicated that, 20 per cent of the households possess sanitary toilet i.e. 20 per cent of landless, 12.50 per cent of marginal, 14.29 per cent of the small, 33.33 per cent of the semi medium farmers and 25 per cent of the medium farmers had sanitary toilet facility. The results indicated that, 100 per cent of the sampled households possessed BPL card. The results indicated that, 51.43 per cent of the households participated in NREGA programme which included 100 per cent of the landless, 50 per cent of the marginal and semi medium farmers, 14.29 per cent of the small farmers and 66.67 per cent of the medium farmers.

The results indicated that cereals and pulses were adequate for 100 per cent of the households; milk and egg were adequate for 97.14 per cent of the households respectively. Oil seed, vegetables and meat were adequate for 2.86 per cent, 11.43 per cent and 17.14 per cent of the households respectively. The results indicated that, oilseed, vegetables, fruits and meat were inadequate for 97.14 per cent, 88.57 per cent, 100 per cent and 82.86 per cent of the households. The results indicated that, Lower fertility status of the soil was the constraint experienced by 85.71 per cent of the households, wild animal menace on farm field and frequent incidence of pest and diseases were experienced by (77.14%), inadequacy of irrigation water (65.71%), high cost of Fertilizers and plant protection chemicals and high rate of interest on credit problems were experienced by (62.86%), low price for the agricultural commodities (74.29%), lack of marketing facilities in the area (77.14%), inadequate extension services and lack of transport for safe transport of the agricultural produce to the market were experienced by (82.86%) and Source of Agri-technology information(Newspaper/TV/Mobile) (2.86 %) of the households.