ICAR-NBSS&LUP Sujala MWS Publ.131

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

GUDIGERI-2 (4D4A2N2a) MICRO WATERSHED

Alavandi 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. Thechallenges 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 Gudigeri-2 microwatershed in Koppal Taluk and District, Karnataka" for integrated development was taken up in collaboration with the State Agricutural Universities, IISC, KSRSAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots and socio-economic status of farm households covering thirty per cent farmers randomely selected representing landed and landless class of farmers in the micro-watershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur **S.K. SINGH**
Date: 13.02.2018 Director, ICAR - NBSS&LUP Nagpur

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PART-A

LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

The land resource inventory of Gudigeri-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 494 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, one per cent by waterbodies, settlements and others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 6 soil series and 8 soil phases (management units) and 4 land use classes.*
- *The length of crop growing period is <90 days and starts from 2^{nd} week of August to 2^{nd} 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 250 m grid interval.*
- *Land suitability for growing 24 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- *Entire area is suitable for agriculture.*
- *About <1 per cent of the soils are shallow (25-50cm),47 per cent moderately shallow (50-75 cm) , 3 per cent moderately deep (75-100 cm) and about 49 per cent are deep to very deep soils (100->150 cm).*
- *Entire area is having clayey soils at the surface.*
- *About 61 per cent of the area has non-gravelly soils, 35per cent has gravelly soils (15-35 % gravel) and 3 per cent has very gravelly (35- 60% gravel) soils.*
- *With respect to available water capacity 48 per cent of the area has low (51-100 mm/m), 3 per cent medium (101-150 mm/m) and 49 per cent area has very high (>200mm/m) .*

- *An area of about 2 per cent has nearly level (0-1%) and 97 per cent has very gently sloping (1-3%) lands.*
- *Entire area has moderately eroded (e2) lands.*
- *An area of about 7 per cent is strongly alkaline (pH 8.4 to 9.0) and 92 per cent has very strongly alkaline (pH>9.0).*
- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1}indicating that the soils are non-saline.*
- *Organic carbon is low (<0.5%) in about 81 per cent and medium (0.5-0.75%) in 18 per cent of the soils.*
- *Available phosphorus is low (<23 kg/ha) in the entire area of the microwatershed.*
- *Available potassium is high (>337 kg/ha) in the entire area of the microwatershed.*
- *Available sulphur is low (<10 ppm) in 38 per cent area, medium (10-20 ppm) in about 27 per cent area and about 35 per cent area is high (>20 ppm).*
- *Available boron is low (0.5 ppm) in about 42 per cent, medium (0.5-1.0 ppm) in 9 per cent and high (>1.0ppm) in 49 per cent area.*
- *Available iron is sufficient (>4.5 ppm) in the entire area.*
- *Available zinc is deficient (<0.6 ppm) in the entire area.*
- *Available manganese and copper are sufficient in the entire area.*
- *The land suitability for 24 major crops grown in the microwatershed was assessed and the areas that are highly suitable class (S1) and moderately suitable class (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	-	*489(99)*		*Guava*	-	-
Maize	-	-		*Jackfruit*	-	-
Bajra	-	-		*Jamun*	-	*241(49)*
Groundnut	-	*233(47)*		*Musambi*	-	*256(52)*
Sunflower	-	*256(52)*		*Lime*	-	*256(52)*
Chilli	-	-		*Cashew*	-	-
Tomato	-	-		*Custard apple*		*489(99)*
Drumstick	-	*256(52)*		*Amla*		*489(99)*
Mulbery		*489(99)*		*Tamarind*	-	*241(49)*
Mango	-	-		*Marigold*	-	*489(99)*
Sapota	-			*Chrysanthemum*	-	*489(99)*
Pomegranate	-	*256 (52)*		*Jasmine*	-	*233(47)*

Apart from the individual crop suitability, a proposed crop plan has been prepared for the 4 identified LUCs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and other horticulture crops.

- ❖ *Maintaining soil-health is vital to 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 to 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 sub marginal 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 Gudigeri-2 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.

Chapter 2

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Gudigeri-2 micro-watershed is located in the central part of Karnataka in Koppal taluk and district (Fig. 2.1). It lies between $15^0$19' and $15^0$21' North latitudes and $75^0$53' and $75^0$55' East longitudes, covering an area of about 494 ha. It comprises parts of Kavalura village. It is about 34 km from Koppal town and is bounded by Gudigeri on the south, Yelburga on the northeast and Kavalura on the western and eastern side of the microwatershed.

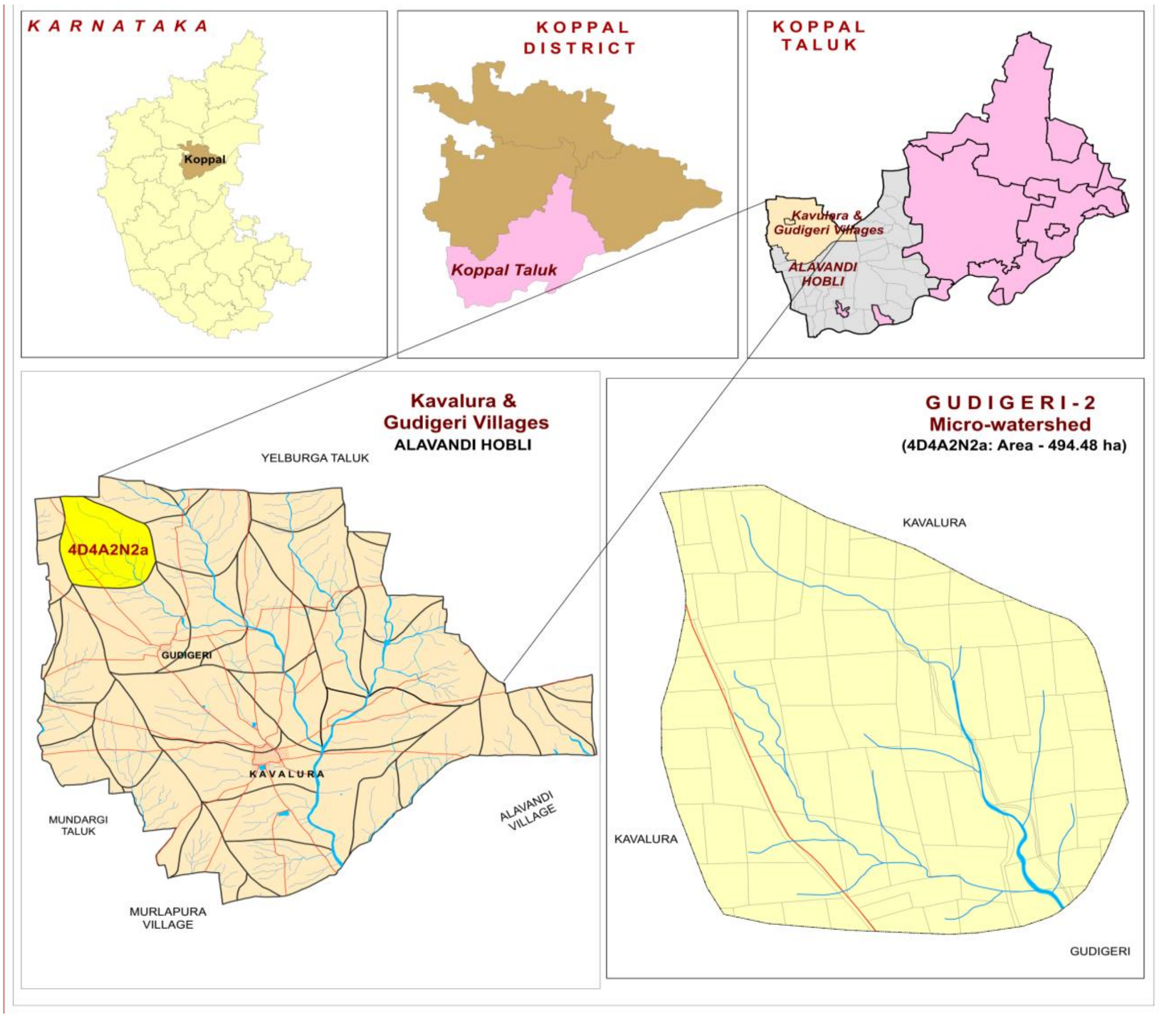


Fig.2.1 Location map of Gudiger-2 Microwatershed

2.2 Geology

Major formation observed in the micro watershed is alluvium (Fig. 2.2). 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.2.0 Alluvium

2.3 Physiography

Physiographically, the area has been identified as alluvial landscape based on geology. The microwatershed has been further divided into very gently sloping uplands and nearly level plains based on slope and its relief features. The elevation ranges from 540 to 575 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 total annual rainfall of 662 mm (Table 2.1). Of this, a maximum of 424 mm precipitation is received during 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 is received 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 to193 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**	

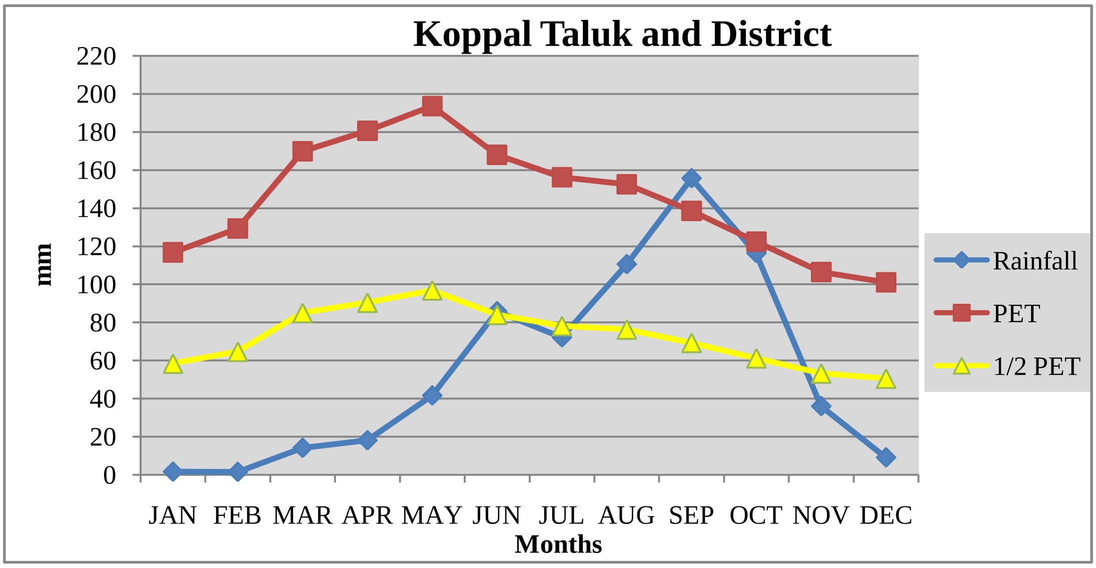


Fig. 2.3 Rainfall distribution in Koppal Taluk and District

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 Gudigeri-2 Microwatershed

2.7 Land Utilization

About 91 per cent area (Table 2.2) in Koppal district is cultivated at present and about 17 per cent of the area is sown more than once. 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 boulder 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 Gudigeri-2 microwatershed is presented in Fig.2.6. Simultaneously, enumeration of existing wells (bore wells and open wells) and other soil and water conservation structures in the microwatershed is made and their location in different survey numbers is marked on the cadastral map. Map showing the location of wells, soil conservation structures and other water bodies in Gudigeri-2 microwatershed is given Fig.2.7

Table 2.2 Land Utilization in Koppal District

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

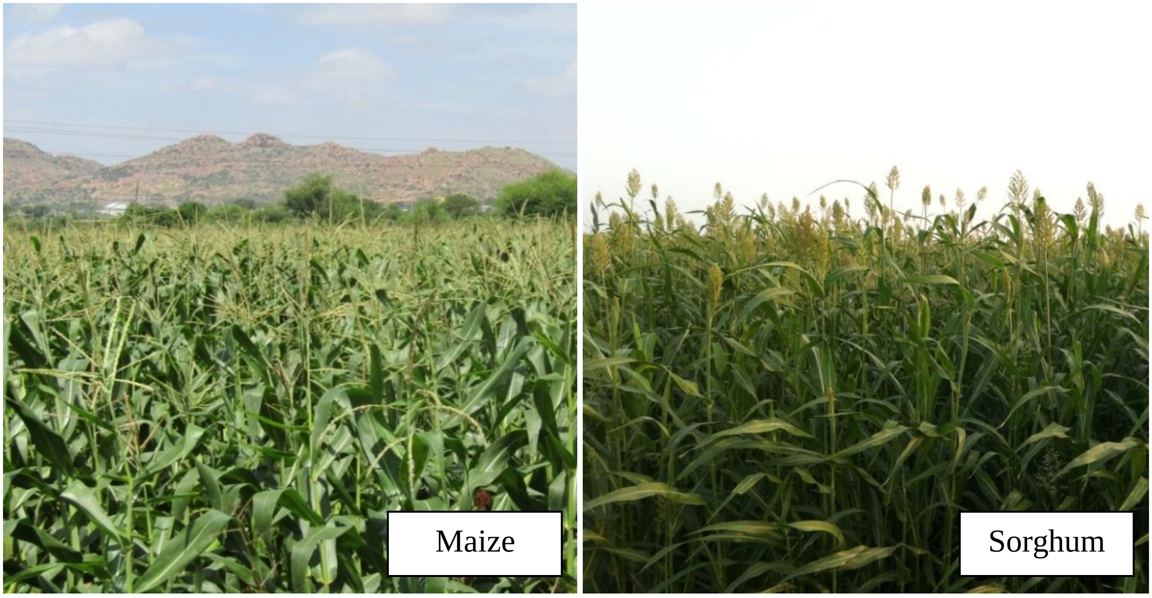


Fig.2.5 (a) Different crops and cropping system in Gudigeri-2 Microwatershed

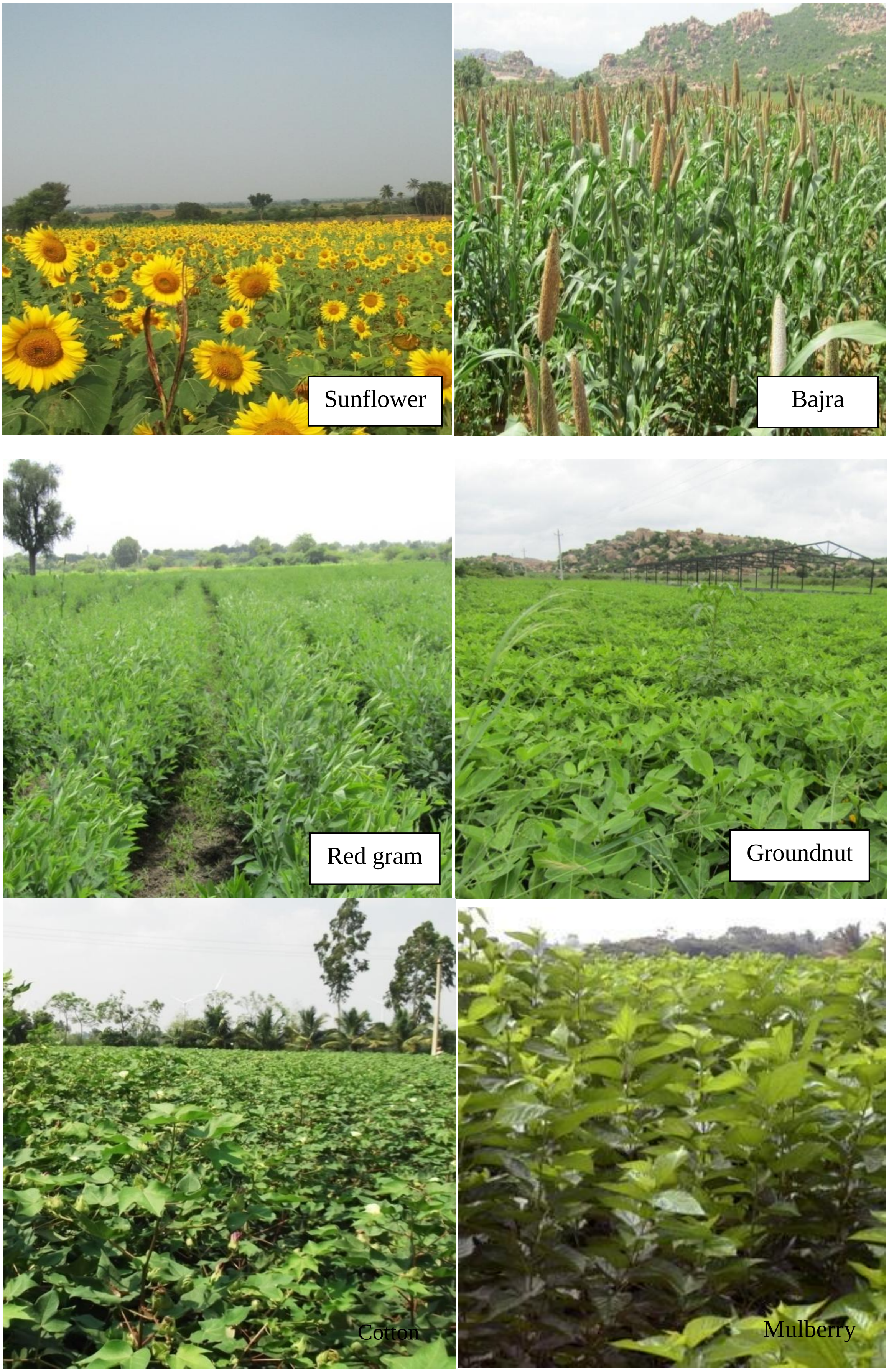


Fig.2.5 (b) Different crops and cropping systems in Gudigeri-2 Microwatershed

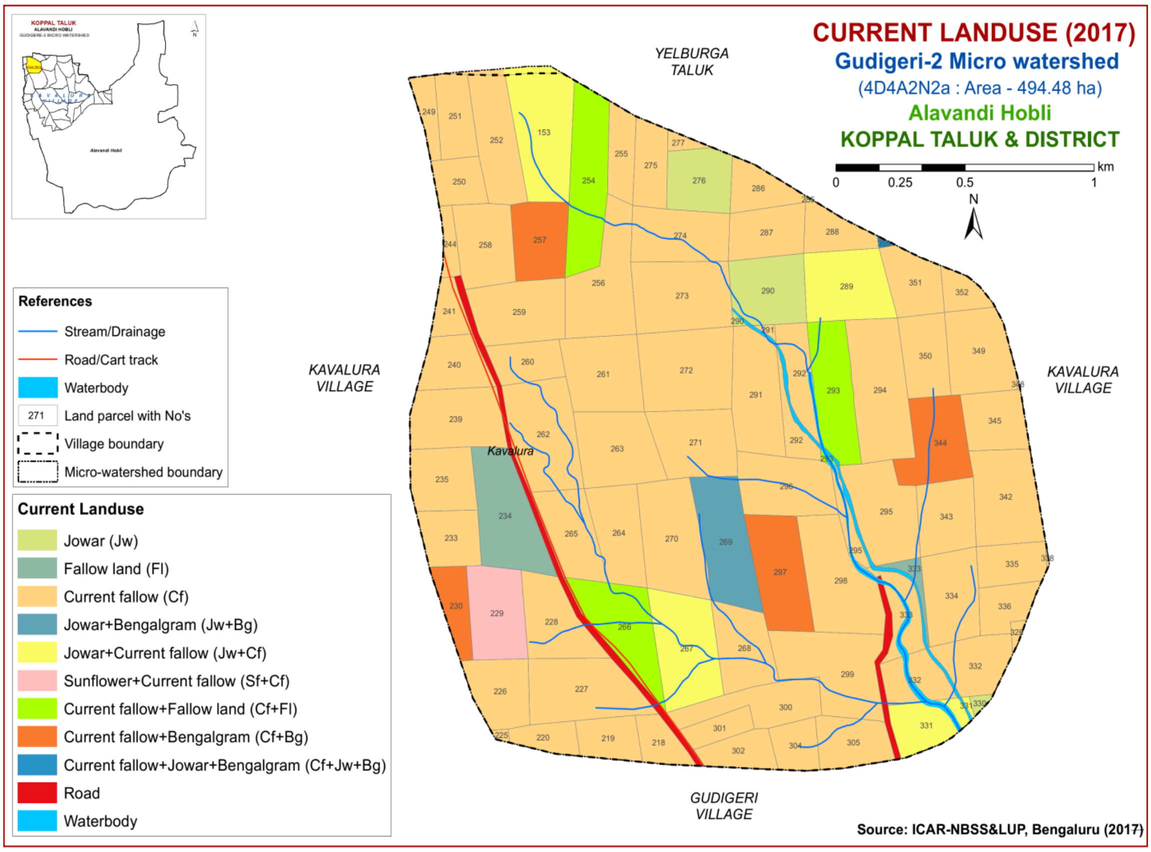


Fig.2.6 Current Land Use –Gudigeri-2 Microwatershed

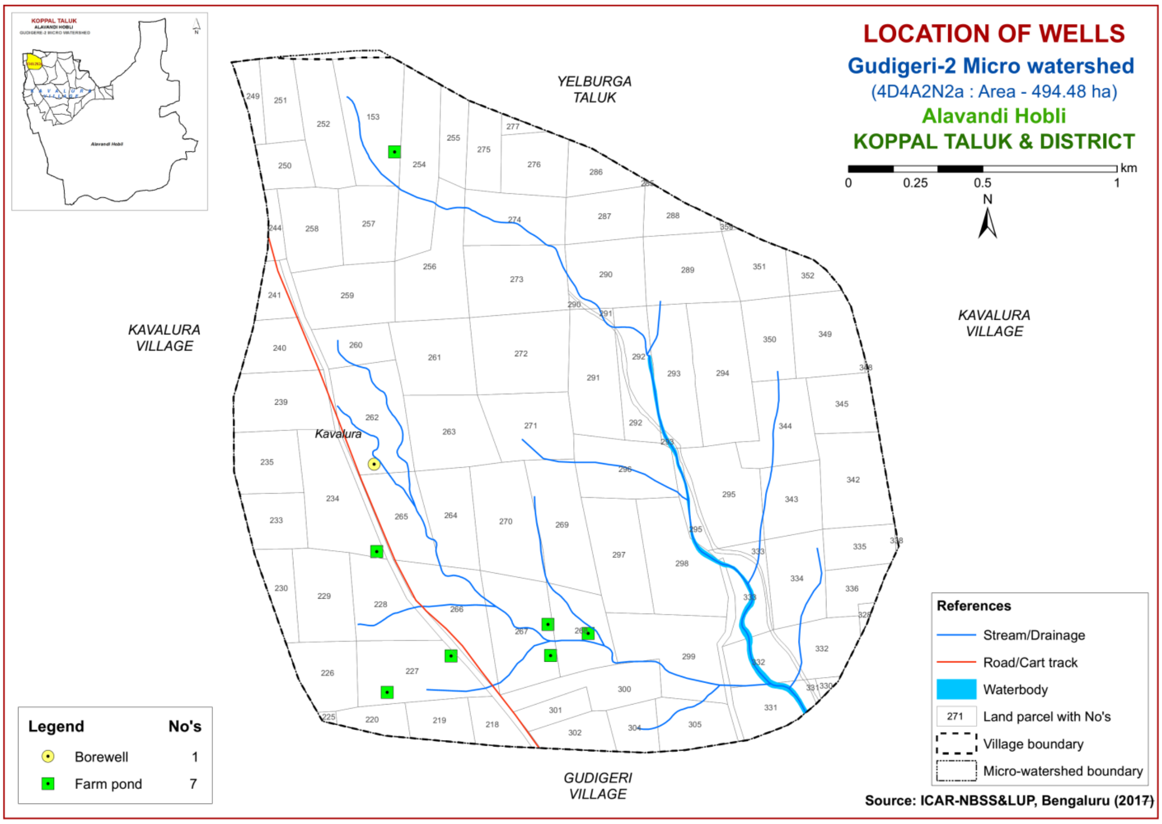


Fig.2.6 Location of wells and conservation structures- Gudigeri-2 Microwatershed

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 Gudigeri-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 (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 494 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 a 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 a alluvial landscape and is divided into landforms uplands, very gently sloping and plains 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.

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

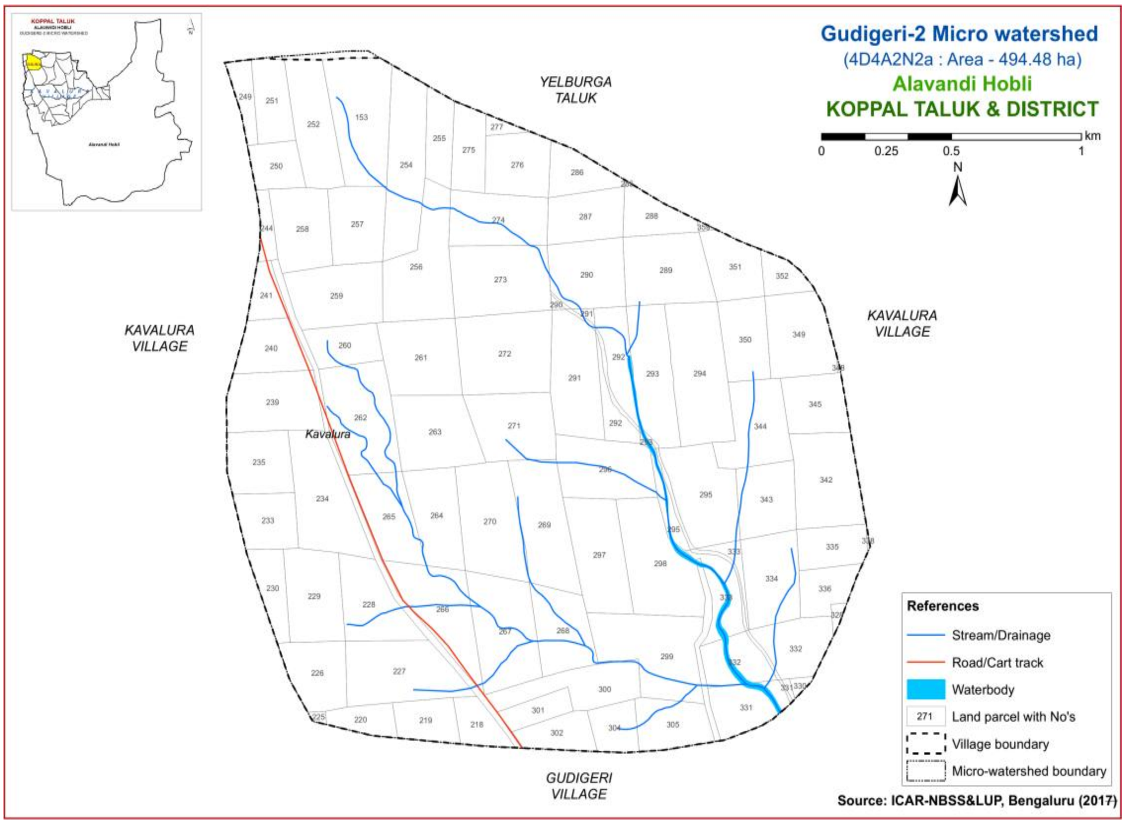


Fig 3.1 Scanned and Digitized Cadastral map of Gudigeri-2 Microwatershed

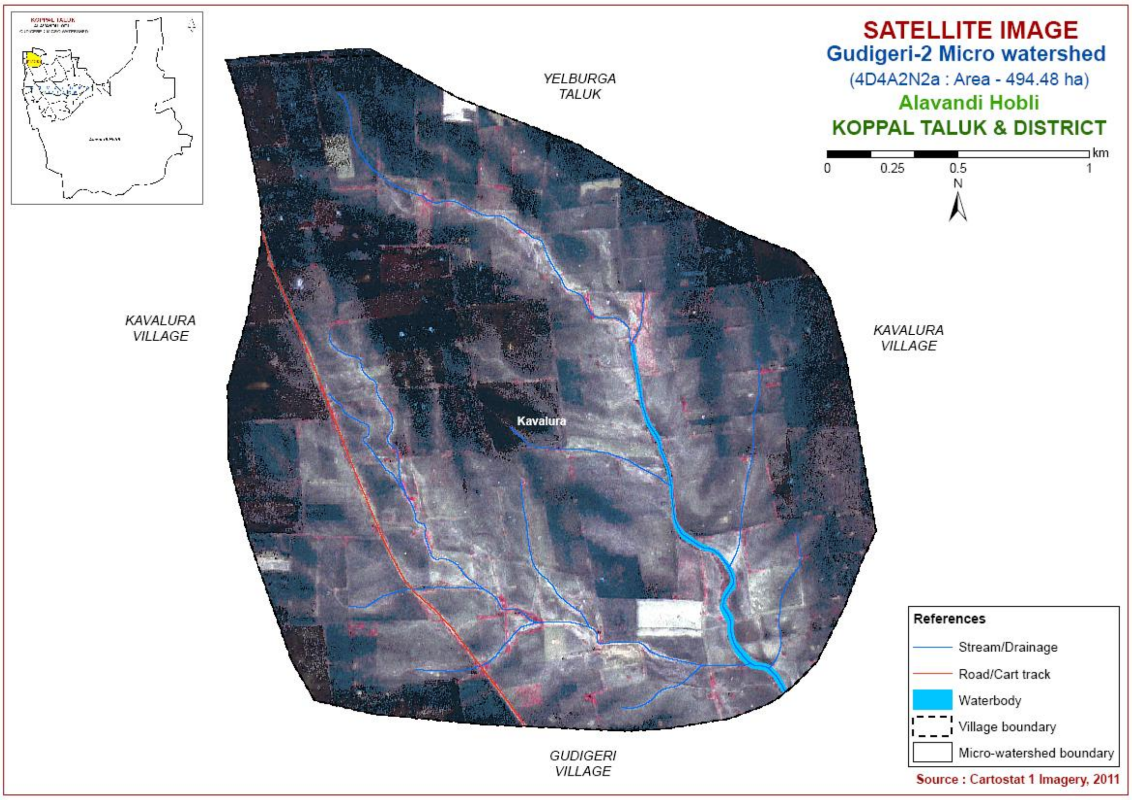


Fig.3.2 Satellite Image of Gudigeri-2Microwatershed

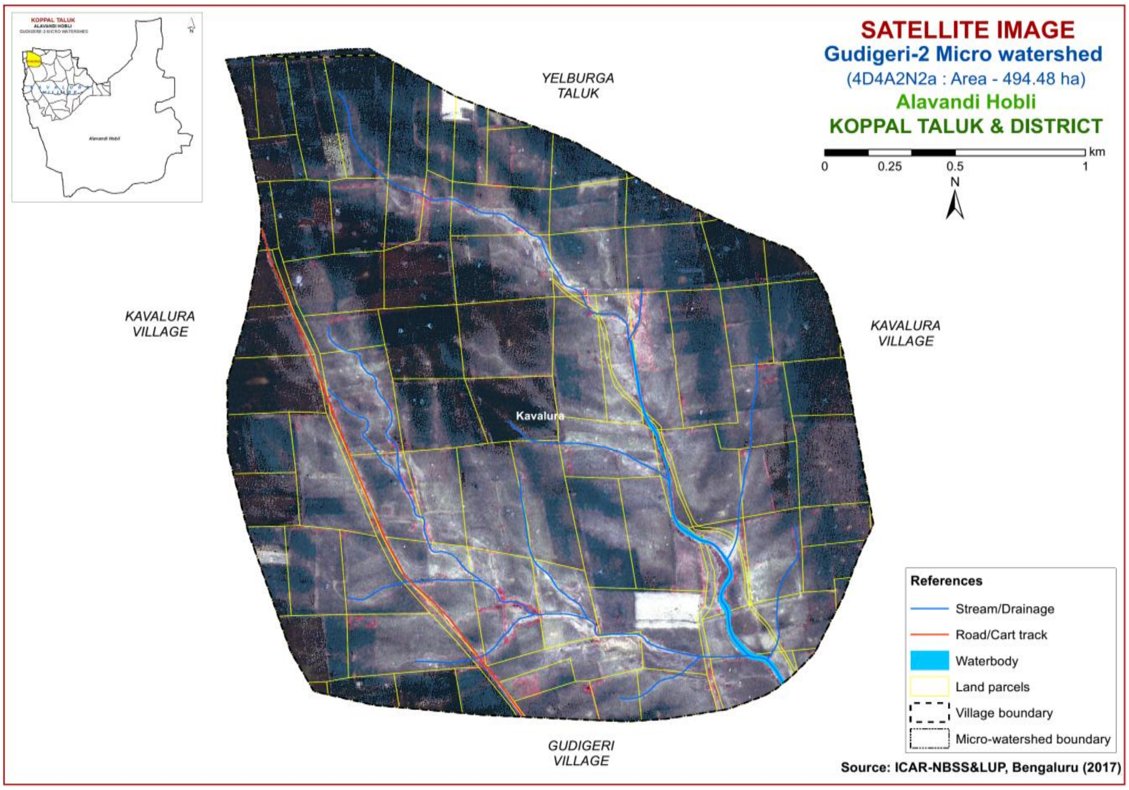


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of GUDIGERI-2 Microwatershed

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 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).

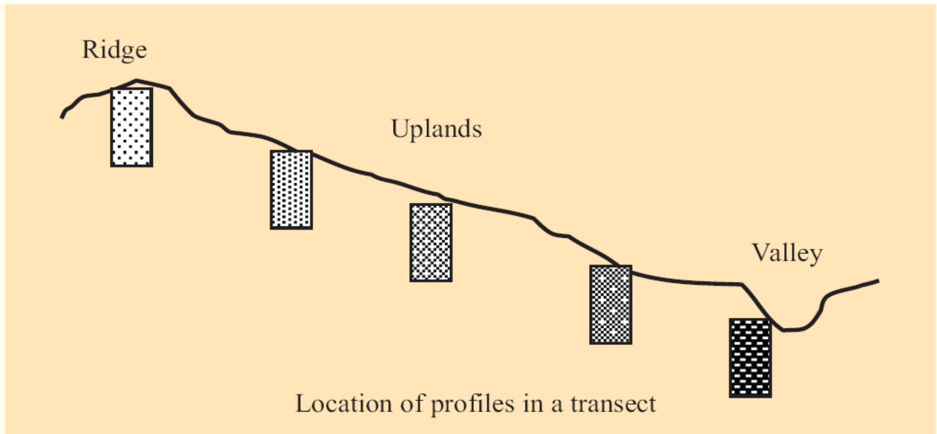


Fig: 3.4. Location of profiles in a transect

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, 6 soil series were identified in Gudigeri-2 microwatershed.

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

Soils of Alluvial Landscape							
Sl. No	**Soil Series**	**Depth(cm)**	**Colour(moist)**	**Texture**	**Gravel (%)**	**Horizon sequence**	**Calcareo-usness**
1	Muttal (MTL)	25-50	10YR3/2,3/3,4/2, 7.5YR3/2, 3/3,6/4	gc	15-35	Ap-Bw-Ck	e-ev
2	Ravanaki (RNK)	50-75	7.5YR3/2,3/3,5/2,5/3 10YR3/1,3/2,4/1, 4/2, 5/1,6/1	c	<15	Ap-Bw-Cr	e-ev
3	Dambarahalli (DRL)	75-100	10YR 2/1, 3/1, 4/3	c	<15	Ap-Bw-Ck	e-es
4	Gatareddihal (GRH)	100-150	10YR 2/1,3/1, 2.5Y 4/3,5/4	c	<15	Ap-Bw-BC-C	es
5	Murlapur (MLR)	>150	10YR 2/1,2/2, 3/1,3/2,4/1	c	10-20	Ap-Bss	e-es
6	Alawandi (AWD)	>150	10YR 2/1,3/2	c	<15	Ap-Bss	e-es

3.4 Soil Mapping

The area under each soil series was further separated into 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 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 mapping units representing 6 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 8 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 soil phase will have similar management needs and have to be treated accordingly.

3.5 Land Use Classes

The 8 soil phases identified and mapped in the microwatershed were regrouped into 4 Land Use Classes (LUC'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 Use Classes (LUC's) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LUCs. For Gudigeri-2 microwatershed, five soil and site characteristics, namely soil depth, soil texture, slope, erosion and gravel content have been considered for defining LUCs. The land use classes are expected to behave similarly for a given level of management.

3.6 Laboratory Characterization

Soil samples 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 farmer's fields in Gudigeri-2 microwatershed (49 samples) for fertility status (major and micronutrients) at 250 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 Gudigeri-2 Microwatershed

Soil map unit no*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Alluvial landscape				
	MTL	Muttal soils are shallow (25-50 cm), well drained, have very dark grayish brown to dark brown, calcareous black gravelly clay soils occurring on gently to very gently sloping uplands under cultivation		**4 (0.71)**
304		MTLiB2	Sandy clay surface, slope 1-3%, moderate erosion	4(0.71)
	RNK	Ravanaki soils are moderately shallow (50-75 cm), moderately well drained, have dark brown to very dark grayish brown and dark gray, calcareous clay black soils occurring on very gently sloping uplands under cultivation		**233 (47.02)**
336		RNKmB2	Clay surface, slope 1-3%, moderate erosion	58(11.71)
337		RNKmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	175 (35.31)
	DRL	Dambarahalli soils are moderately deep (75-100 cm), moderately well drained, have dark brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation		**15 (2.98)**
352		DRLmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	15 (2.98)
	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 very gently sloping uplands under cultivation		**88 (17.86)**
373		GRHmB2	Clay surface, slope 1-3%, moderate erosion	88(17.86)
	MLR	Murlapur soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to very dark gray, calcareous black cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation		**123 (24.96)**
413		MLRmA2	Clay surface, slope 0-1%, moderate erosion	11 (2.28)
418		MLRmB2	Clay surface, slope 1-3%, moderate erosion	112(22.68)
	AWD	Alawandi soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to black calcareous cracking clay soils occurring on very gently sloping uplands under cultivation		**29 (5.95)**
424		AWDmB2	Clay surface, slope 1-3%, moderate erosion	29 (5.95)
1000		Others	Waterbody	3 (0.51)

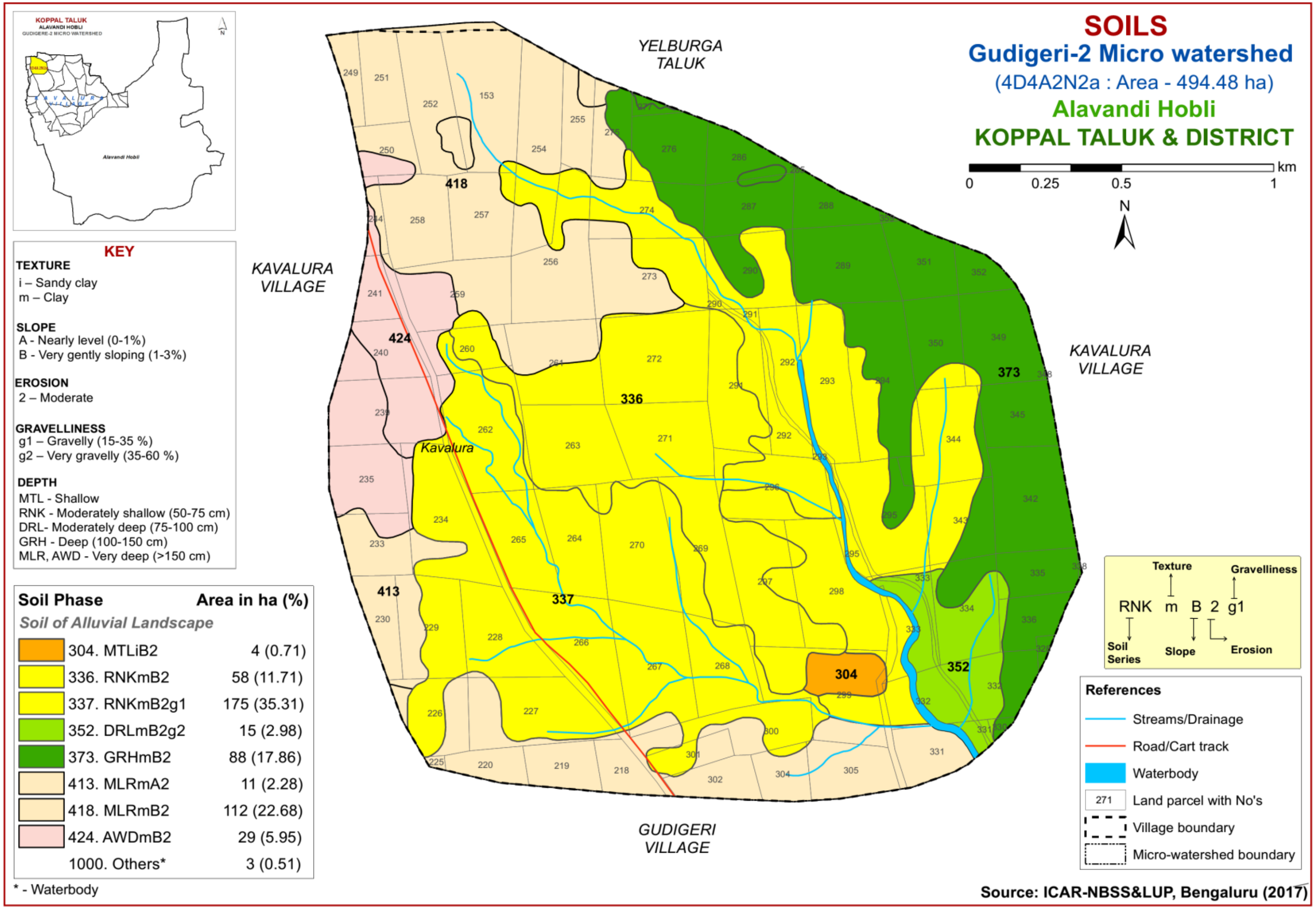


Fig 3.5 Soil phase or mapping units of Gudigeri-2 microwatershed

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Gudigeri-2 microwatershed is provided in this chapter. The microwatershed area has been identified as alluviual landscape based on geology. In all, 6 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 6 soil series identified followed by 8 soil phases (management units) mapped under each series (Fig. 3.5) are furnished below. The physical and chemical characteristics of soil series identified in Gudigeri-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 Alluvial Landscape

In this landscape, 6 soil series are identified and mapped. Of these series, Ravanaki (RNK) occupies maximum area of 233 ha (47%) followed by Murlapur (MLR) 123 ha (25%). The brief description of soil series along with the soil phases identified and mapped is given below.

4.1.1 Muttal (MTL) Series: Muttal soils are shallow (25-50 cm), well drained, have dark brown to very dark grayish brown, calcareous gravelly clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains. The Muttal series has been classified as a member of the clayey, mixed, isohyperthermic (calc) family of (Paralithic) Haplustepts.

The thickness of the solum ranges from 30 to 50 cm. The thickness of A horizon ranges from 15 to 18 cm. Its colour is in 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2.5 to 4. The texture varies from sandy clay to clay with 10 to 15 per cent gravel. The thickness of B horizon ranges from 18 to 32 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 6 and chroma 2 to 4. Its texture is clay. The available water capacity is low (50-100 mm/m). One soil phase was identified and mapped.

Landscape and soil profile characteristics of Muttal (MTL) Series

4.1.2 Ravanaki (RNK) Series: Ravanaki soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark grayish brown calcareous clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains. The Ravanaki series has been classified as a member of very fine, smectitic, isohyperthermic (calc) family of Fluventic Haplustepts.

The thickness of the solum ranges from 50 to 75 cm. The thickness of A horizon ranges from 15 to 20 cm. Its colour is in 7.5 YR and 10 YR hue with value 2 to 3 and chroma 2.5 to 4. The texture varies from sandy clay to clay with 10 to 15 per cent gravel. The thickness of B horizon ranges from 35 to 60 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 6 and chroma 2 to 4. Its texture is dominantly clay with gravel content of <15 per cent. The available water capacity is low (51-100 mm/m). Two soil phases were identified and mapped.

Landscape and Soil Profile Characteristics of Ravanaki (RNK) Series

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

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 and is calcareous. The available water capacity is very high (>200 mm/m). One soil phase was identified and mapped.

Landscape and soil profile characteristics of Gatareddihal (GRH) Series

4.1.4 Murlapur (MLR) series: Murlapur soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to very dark gray, calcareous black cracking clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains. The Murlapur series has been classified as a member of the very fine, smectitic, isohyperthermic (calc) family of Typic Haplusterts.

The thickness of the solum is >150 cm. The thickness of A horizon ranges from 20 to 25 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 150 to 190 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 2. Its texture is clay and is calcareous. The available water capacity is very high (>200 mm/m). Two soil phases were identified and mapped.

Landscape and soil profile characteristics of Murlapur (MLR) Series

4.1.5 Dambarahalli (DRL) Series: Dambarahalli soils are moderately deep (75-100 cm), moderately well drained, have black and very dark gray to dark brown calcareous cracking clay soils. They have developed from alluvium and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 75 to 99 cm. The thickness of A horizon ranges from 13 to 24 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 2. The texture is clay. The thickness of B horizon ranges from 54 to 85 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1 to 3. Its texture is clay and is calcareous. The available water capacity is high (150-200 mm/m). One soil phase was identified and mapped.

Landscape and soil profile characteristics of Dambarahalli (DRL) Series

4.1.6 Alawandi (AWD) Series: Alawandi soils are very deep (>150 cm), moderately well drained, have black to very dark grayish brown, calcareous cracking clay soils. They have developed from alluvium and occur on nearly level to very gently sloping plains under cultivation.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 16 to 26 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 2. The texture varies from sandy clay to clay. The thickness of B horizon is more than 150 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 3. Its texture is clay and is calcareous. The available water capacity is very high (>200 mm/m). One soil phase was identified and mapped.

Landscape and soil profile characteristics of Alawandi (AWD) Series

Table: 4.1 Physical and Chemical Characteristics of Soil Series identified in Gudigeri-2 microwatershed

Series Name: Muttal (MTL), Pedon: RM-13
Location: $15^0$14'30.8"N, $75^0$56'50.6"E, Gatareddihalla village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Clayey, mixed, isohyperthermic (calc) (Paralithic) 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	39.05	13.74	47.21	3.05	5.05	8.21	14.63	8.11	15-30	c	29.95	17.94
20-34	Bwk	28.77	19.57	51.66	4.81	4.71	4.92	9.09	5.24	10	c	33.44	21.56

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	8.27	-	-	0.202	0.79	6.10	-	-	0.62	0.25	-	36.64	0.78	-	0.69
20-34	8.36	-	-	0.177	0.99	23.04	-	-	0.29	0.38	-	39.60	0.77	-	0.96

Contd…

Series Name: Gatareddihalla (GRH), Pedon: RM-2
Location: 15⁰24'01"N, 76⁰09'29"E, Chilavadagi village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Fine, smectitic, isohyperthermic (calc) Vertic 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
0-11	Ap	45.30	15.84	38.86	4.01	9.19	10.45	13.31	8.34	-	sc	25.72	17.55
11-35	Bw1	39.72	13.13	47.15	3.41	10.65	11.50	9.05	5.11	-	c	29.58	20.25
35-66	Bw2	34.69	17.29	48.02	3.32	4.93	12.63	8.14	5.67	-	c	35.93	18.05
66-86	Bw3	34.09	18.15	47.76	4.96	10.14	7.98	7.01	3.99	-	c	35.19	16.79
86-112	Bw4	42.55	16.46	40.98	5.53	11.91	9.68	10.21	5.21	-	c	44.70	16.06
112-125	Bc	56.02	14.48	29.50	11.41	17.07	12.36	10.26	4.92	-	scl	37.55	11.51

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}							%	%
0-11	8.27	-	-	1.11	0.91	5.40	-	-	0.44	3.70	-	31.60	0.81	-	11.72
11-35	8.82	-	-	0.476	0.67	5.28	-	-	0.46	7.29	-	35.10	0.74	-	20.77
35-66	9.14	-	-	0.637	0.87	3.60	-	-	0.45	10.70	-	37.70	0.79	-	28.39
66-86	9.11	-	-	0.633	0.23	5.60	-	-	0.42	10.55	-	38.10	0.80	-	27.70
86-112	9.6	-	-	0.847	0.35	4.92	-	-	0.40	14.55	-	33.90	0.83	-	42.93
112-125	9.73	-	-	0.783	0.19	4.44	-	-	0.25	12.99	-	25.30	0.86	-	51.33

Contd…

Series Name: Ravanaki (RNK), **Pedon:** RM-20
Location: $15^0$14'22.7"N, $75^0$57'45.8"E, Gatareddihalla village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Very fine, smectitic, 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
0-28	Ap	24.43	17.76	57.81	5.30	3.89	3.78	7.14	4.32	20	c	41.40	29.60
28-55	Bw	18.77	15.59	65.64	2.74	3.73	2.85	4.83	4.61	10	c	46.71	35.18
55-80	Bc	12.53	15.43	72.04	2.60	1.92	1.47	3.16	3.39	10	c	56.82	43.73

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}							%	%
0-28	8.86	-	-	0.483	0.63	15.48	-	-	0.86	6.27	-	37.00	0.64	-	16.94
28-55	8.61	-	-	1.4	0.23	13.68	-	-	0.68	12.27	-	53.20	0.81	-	23.06
55-80	8.35	-	-	4.53	0.91	11.40	-	-	0.75	28.97	-	54.80	0.76	-	52.86

Contd…

Series Name: Murlapur (MLR), Pedon: R-A1/16

Location: 15^{0}19'42.9"N, 75^{0}55'84.7"E, Kavalura village, Koppal taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bangalore **Classification:** Very 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
0-30	Ap	27.97	13.96	58.07	4.22	4.77	6.66	8.10	4.22	10	c	36.24	25.90
30-53	BA	26.34	17.48	56.17	4.17	5.05	6.04	7.24	3.84	05	c	38.55	28.98
53-83	Bss1	19.35	19.55	61.10	3.13	3.91	4.03	5.48	2.80	05	c	44.48	33.69
83-105	Bss2	16.63	17.47	65.90	2.70	3.93	2.92	3.93	3.15	<5	c	50.55	38.11
105-160	Bss3	14.69	20.34	64.97	0.79	2.26	4.07	4.18	3.39	<5	c	51.54	40.19

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}							%	%
0-30	9.19	-	-	0.313	0.57	10.08	-	-	0.64	5.67	-	42.08	0.72	-	13.48
30-53	9.22	-	-	0.449	0.24	13.08	-	-	0.35	8.23	-	41.02	0.73	-	20.06
53-83	9.17	-	-	0.377	0.82	16.92	-	-	0.39	14.28	-	51.20	0.84	-	27.90
83-105	9.18	-	-	0.477	0.61	15.48	-	-	0.35	13.19	-	53.11	0.81	-	24.84
105-160	9.01	-	-	1.17	0.24	16.92	-	-	0.43	19.61	-	53.95	0.83	-	36.35

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 recognized 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 8 soil map units identified in the Gudigeri-2 microwatershed are grouped under one land capability classes and two land capability subclasses (Fig. 5.1).

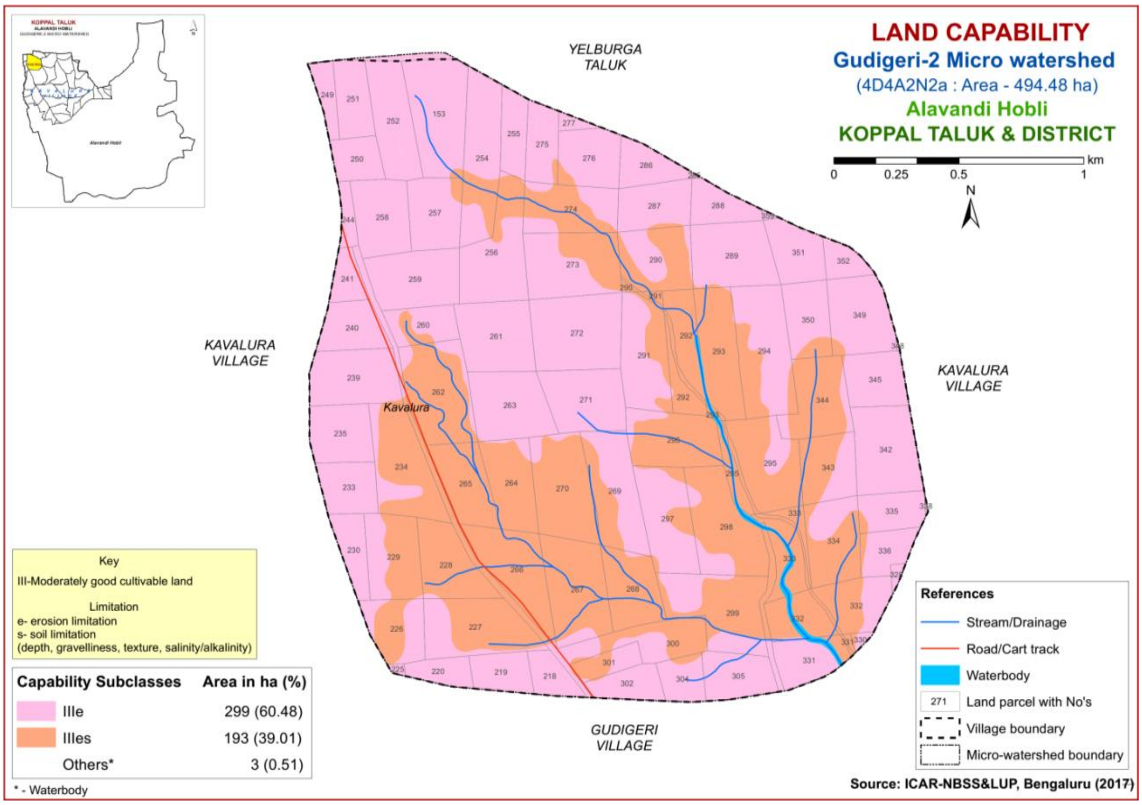


Fig. 5.1 Land Capability map of Microwatershed

Entire area in the microwatershed is suitable for agriculture. Moderately good lands (Class III) cover an entire area of the microwatershed with severe problems of erosion and soil.

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). The area extent and their geographical distribution in the microwatershed is given in Fig 5.2.

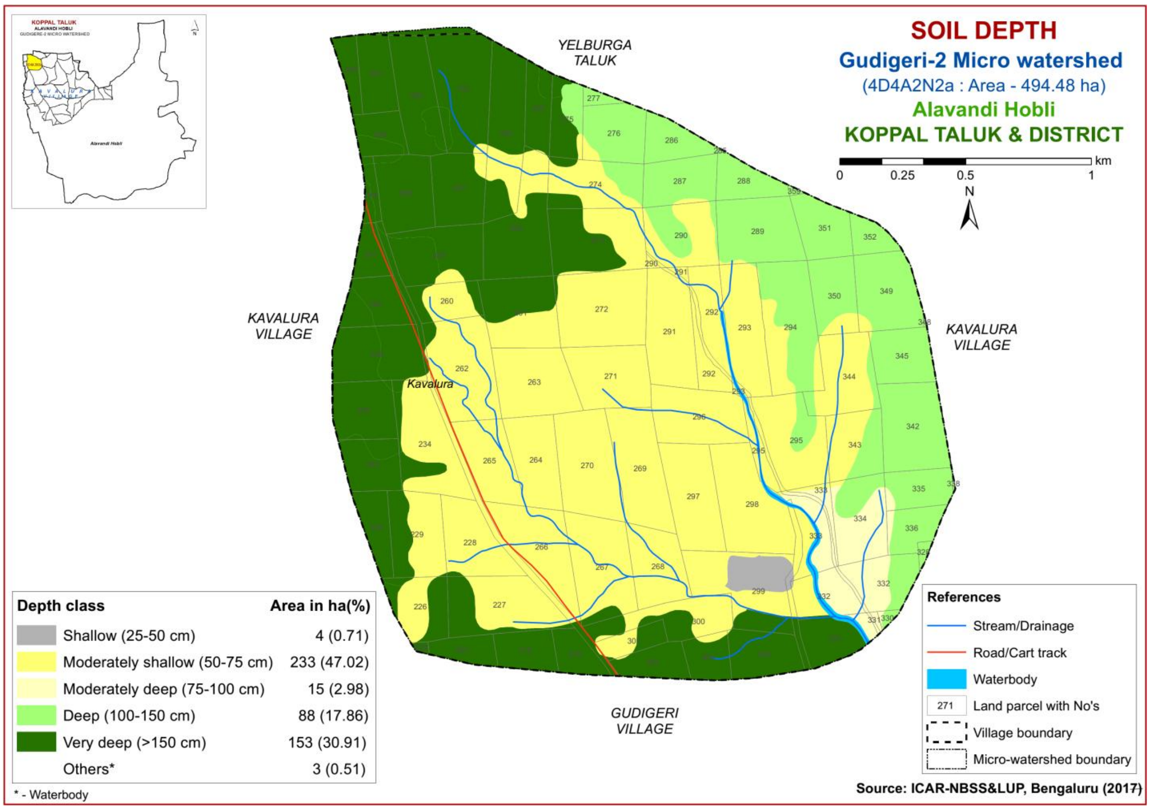


Fig. 5.2 Soil Depth map of Gudigeri-2 Microwatershed

Shallow (<25 cm) soils occupy an area of about 4 ha (<1%) and are distributed in the southern part of the microwatershed. Moderately shallow soils (50-75 cm) occupy a maximum area of about 233 ha (47 %) and occur in the major part of the microwatershed. An area of about 15 ha (3%) is moderately deep (75-100 cm) soils and are distributed in the southeastern part of the microwatershed. Deep (100-150 cm) soils occupy an area of about 88 ha (18%) and occur in the eastern part of the microwatershed. Very deep (>150 cm) soils occupy an area of about 153 (31 %) and are distributed in the western, northern and southern parts of the microwatershed.

The most productive lands cover about 241 ha (49%) where all climatically adopted long duration crops can be grown. The problem lands cover about 4 ha (<1%) where only short duration crops can be grown. The probability of crop failure is very high.

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 behavior, microbial activity and crop suitability. The textural classes used for LRI were used to classify and a surface soil textural map was generated. The area extent and their geographical distribution in the microwatershed is given in Fig 5.3.

The soils in the entire microwatershed are clayey at the surface (Fig. 5.3). They are most productive lands that have high potential for soil-water retention and availability, and nutrient retention and availability, but have problems of drainage, infiltration, workability and other physical problems.

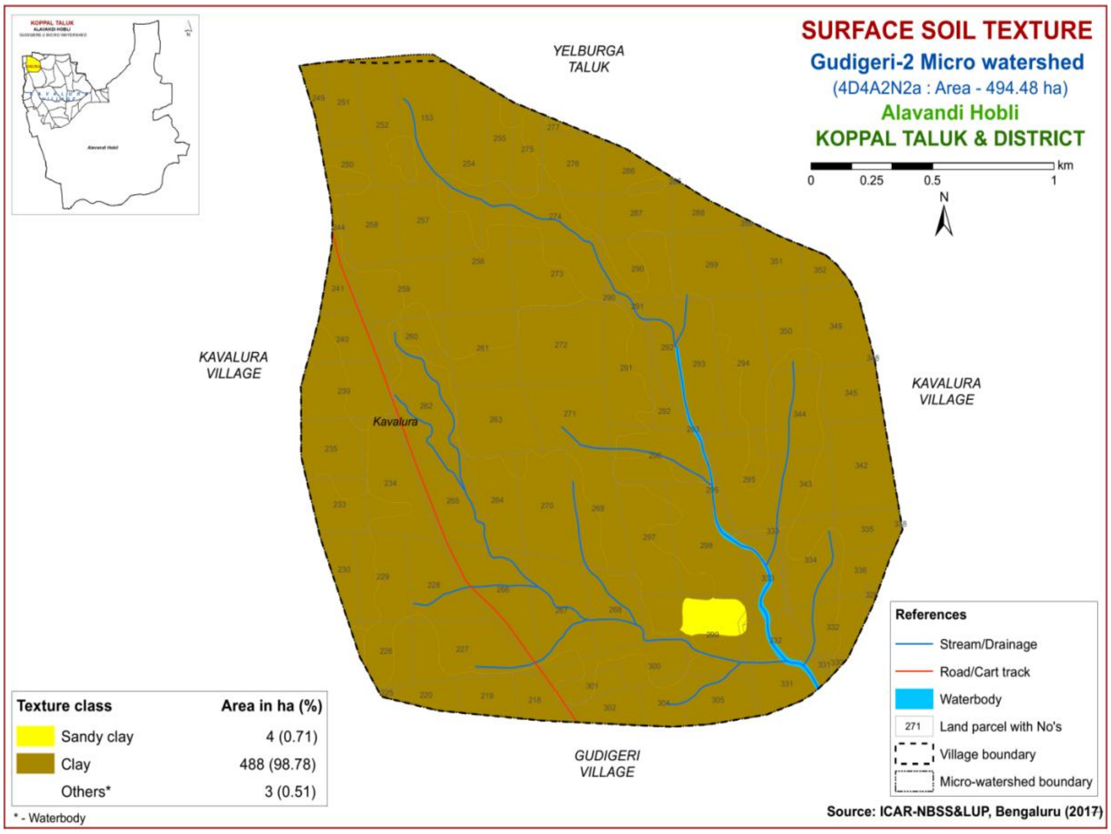


Fig. 5.3 Surface Soil Texture map of Gudigeri-2 Microwatershed

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 geographic distribution in the microwatershed is shown in Fig. 5.4.

The soils that are non-gravelly (<15% gravel) cover maximum area of about 303 ha (61%) and are distributed in the major part of the microwatershed. An area of 175 ha (35%) is covered by gravelly (15-35% gravel) soils and are distributed in the northeastern, southern and central part of the microwatershed. A small area of about 15 (3%) has soils that are very gravelly (35-60% gravel) and are distributed in the southeastern part of the Gudigeri-2 microwatershed (Fig. 5.4).

The most productive lands with respect to gravelliness are found to cover an area of about 303 ha (61 %). 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 very gravelly (35-60%) where only short duration crops can be grown cover about 3 per cent.

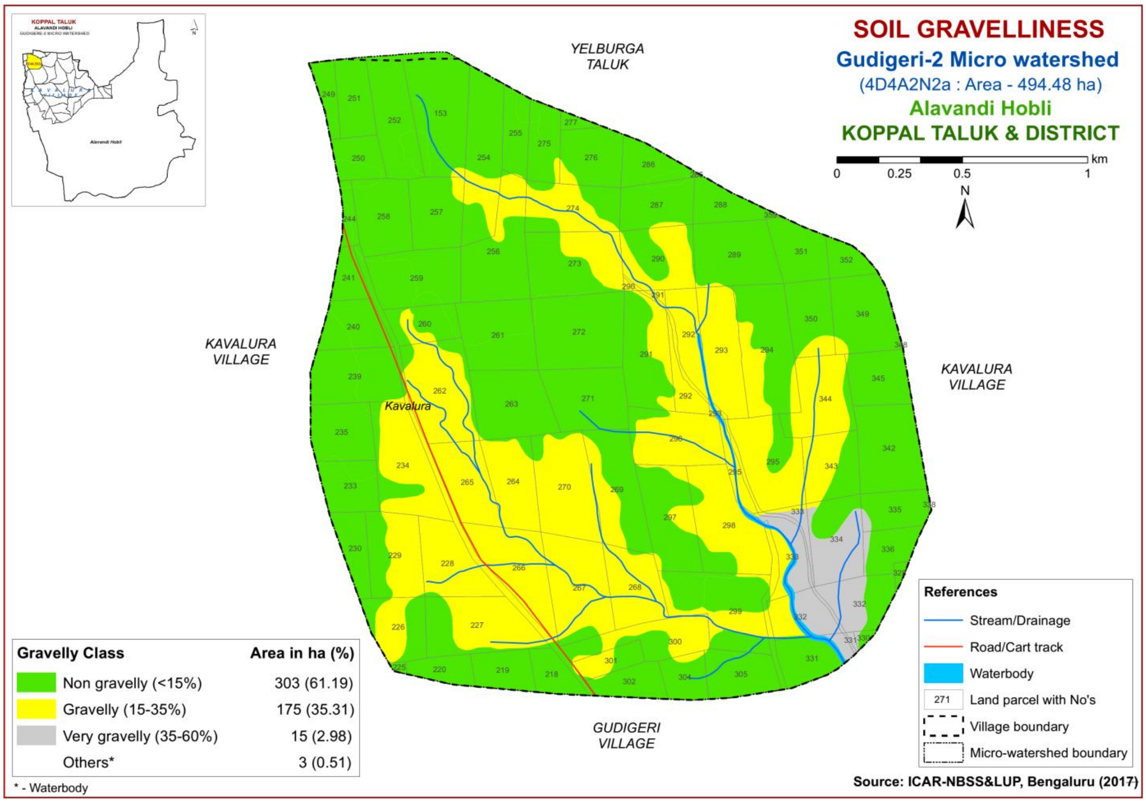


Fig. 5.4 Soil Gravelliness map of Gudigeri-2 Microwatershed

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).

An area of about 236 ha (48%) is low (51-100 mm/m) in available water capacity and distributed in the southern and central part of the Gudigeri-2 microwateshed. An area of about 15 ha (3%) is medium (101-150 mm/m) in available water capacity and distributed in the southeastern part. Maximum area of about 241 ha (49%) area is very high in available water capacity and distributed in the major part of the microwatershed.

An area of about 236 ha 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. An area of about 241 ha (49%) has soils that have very high potential (>200 mm/m) with regard to available water capacity where all climatically adapted long duration crops can be grown successfully.

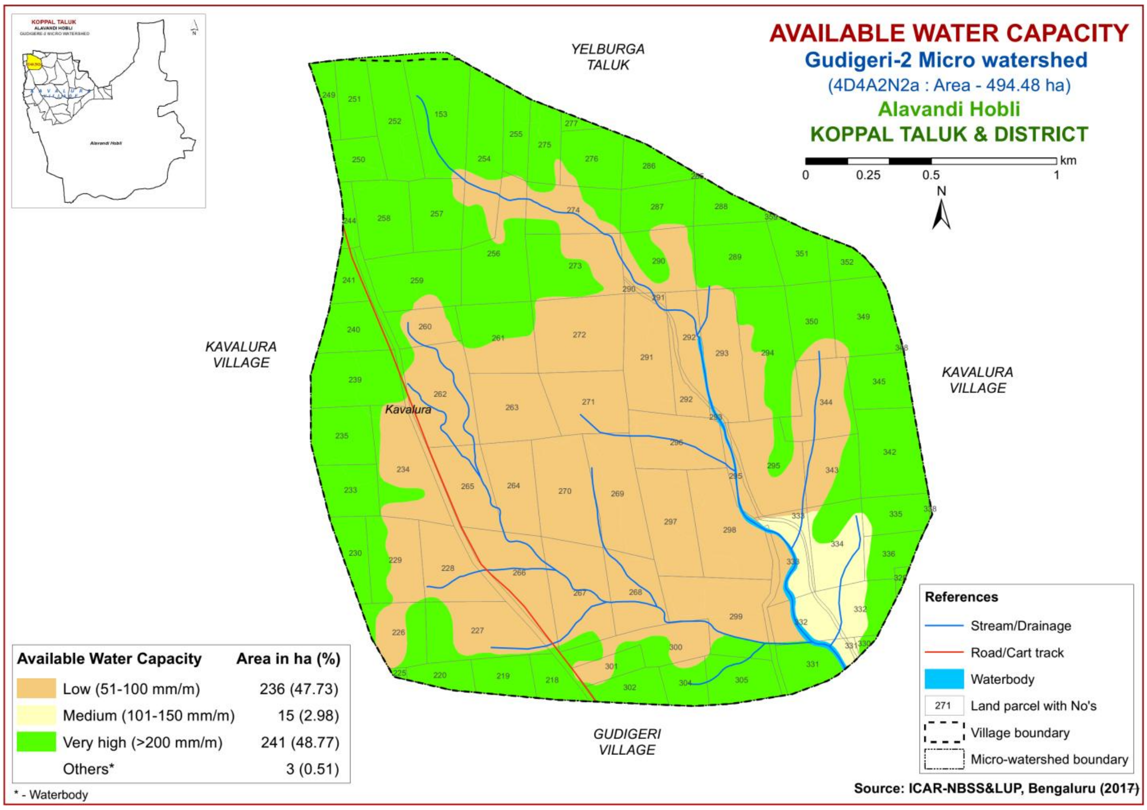


Fig. 5.5 Soil Available Water Capacity map of Gudigeri-2 Microwatershed

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 two 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 about 11 ha (2%) is nearly level (0-1%) and distributed in the western part of the microwatershed. Maximum area of about 481 ha (97 %) is very gently sloping (1-3% slope) lands and distributed in the major part of the microwatershed. In all these areas, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.

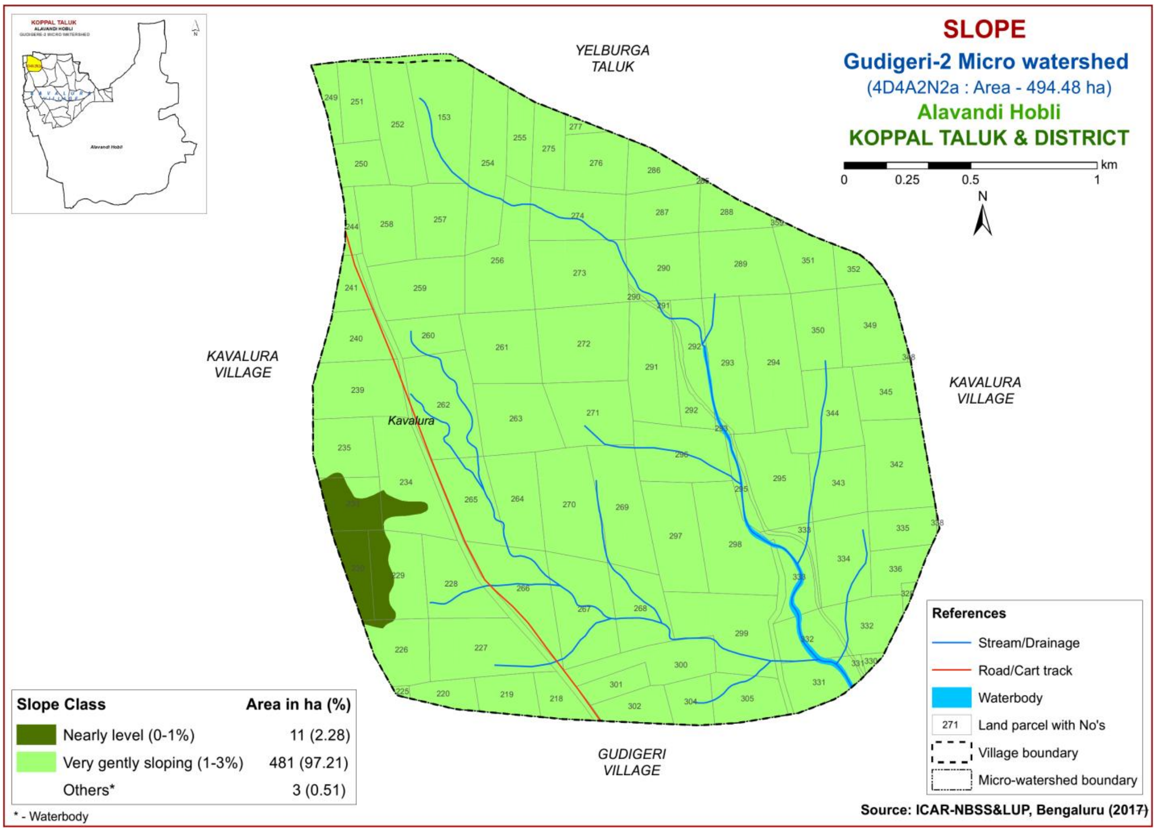


Fig. 5.6 Soil Slope map of Gudigeri-2 Microwatershed

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 Gudigeri-2 is given in Figure 5.7.

Entire area in the microwatershed has moderately eroded (e2 class) soils. These are problematic and need appropriate soil and water conservation and other land development measures.

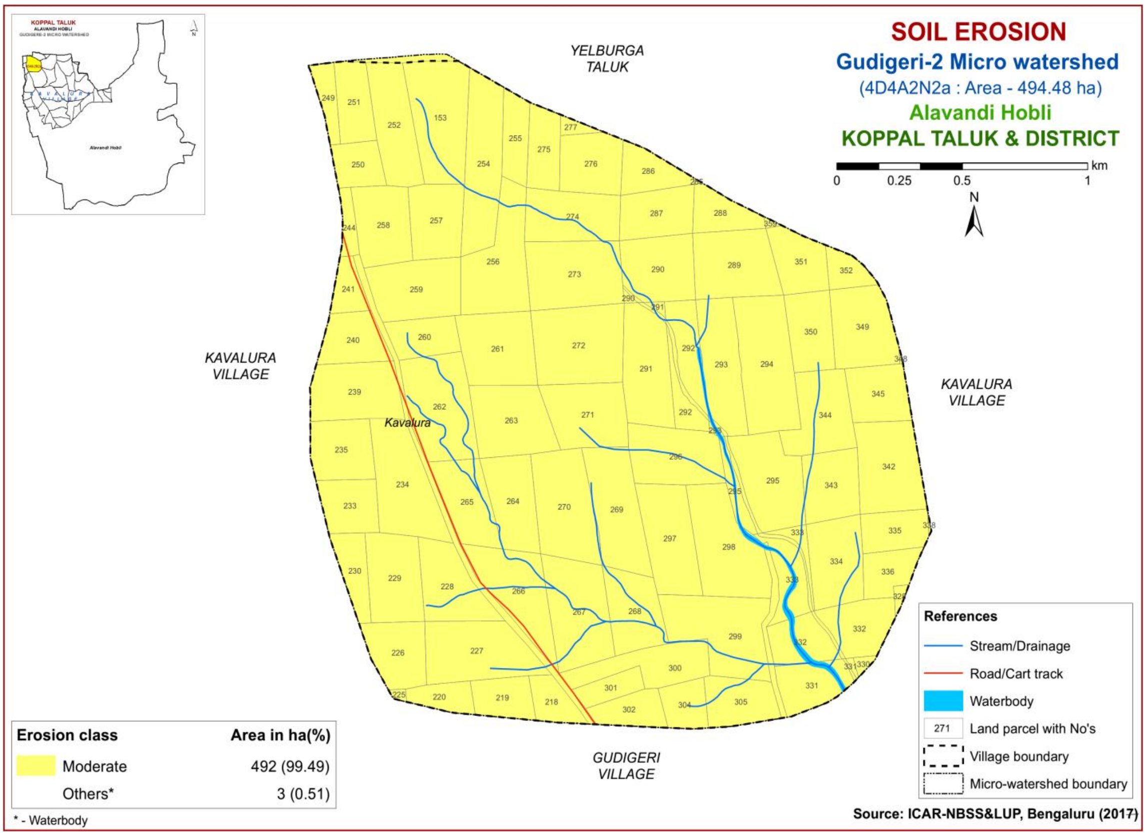


Fig. 5.7 Soil Erosion map of Gudigeri-2 Microwatershed

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 250 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 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 Gudigeri-2 microwatershed for soil reaction (pH) showed that an area of about 37 ha (7 %) is strongly alkaline (pH 8.4-9.0) and are distributed in the southern and eastern part of the part of the microwatershed. Maximum area of about 455 ha (92 %) is under very strongly alkaline (pH > 9.0) and is distributed in the major part of the microwatershed. (Fig.6.1). Thus, entire soils in the microwatershed are alkaline in reaction.

6.2 Electrical Conductivity (EC)

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

6.3 Organic Carbon

The soil organic carbon content (an index of available nitrogen) of the microwatershed is low (<0.5%) in a maximum area of about 402 ha (81%) and is distributed in the major part of the microwatershed. An area of 90 ha (18 %) is medium (0.5-0.75 %) in organic carbon content and is distributed in the southeastern and western part of the microwatershed (Fig 6.3).

6.4 Available Phosphorus

Entire area is low (<23 kg/ha) in available phosphorus. The areas that are low in available phosphorus, apply extra 25 per cent over the recommended dose to realize better crop performance (Fig 6.4).

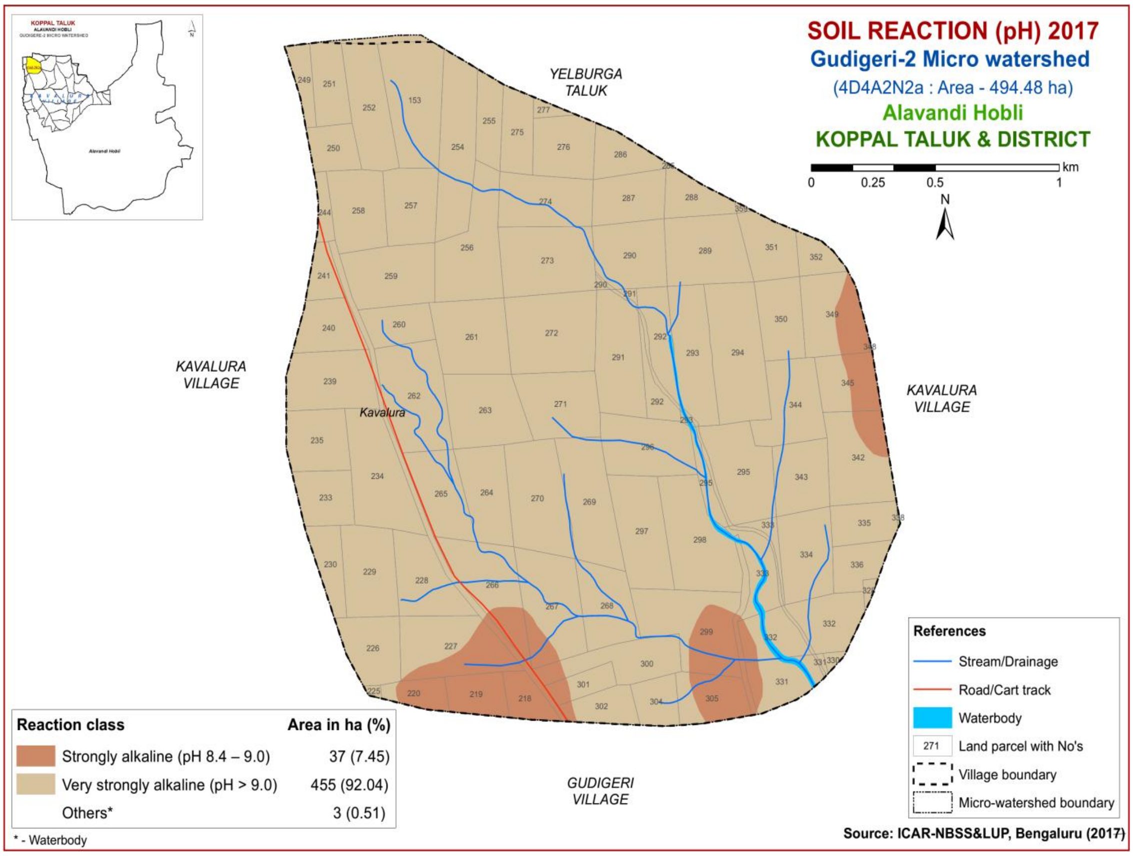


Fig.6.1 Soil Reaction (pH) map of Gudigeri-2 Microwatershed

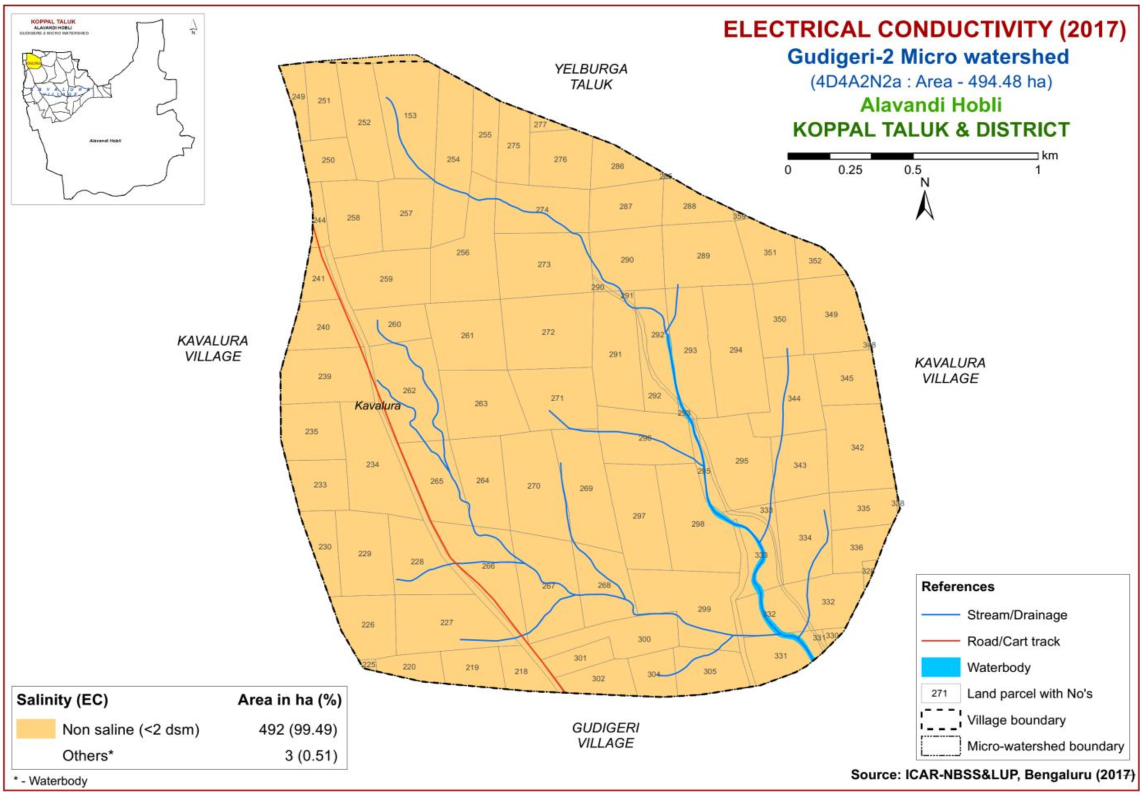


Fig.6.2 Electrical Conductivity (EC) map of Gudigeri-2 Microwatershed

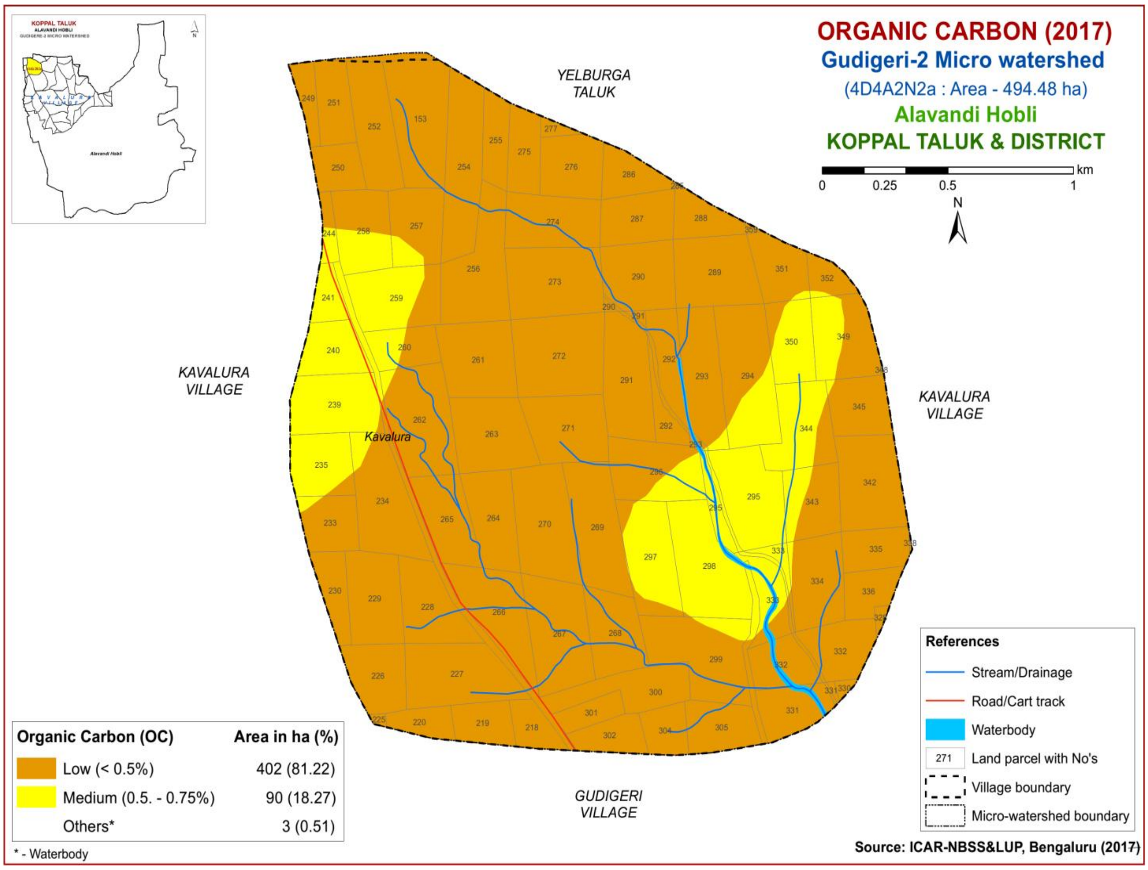


Fig.6.3 Soil Organic Carbon map of Gudigeri-2 Microwatershed

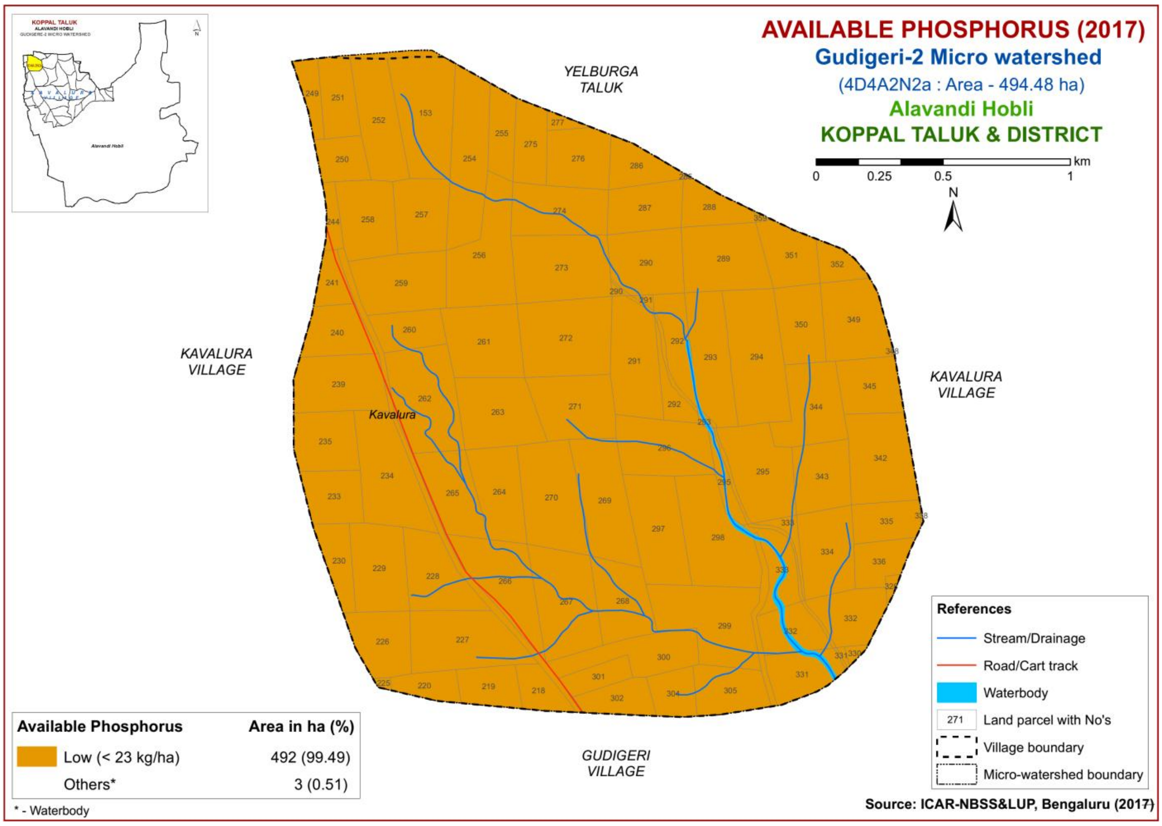


Fig.6.4 Soil Available Phosphorus map of Gudigeri-2 Microwatershed

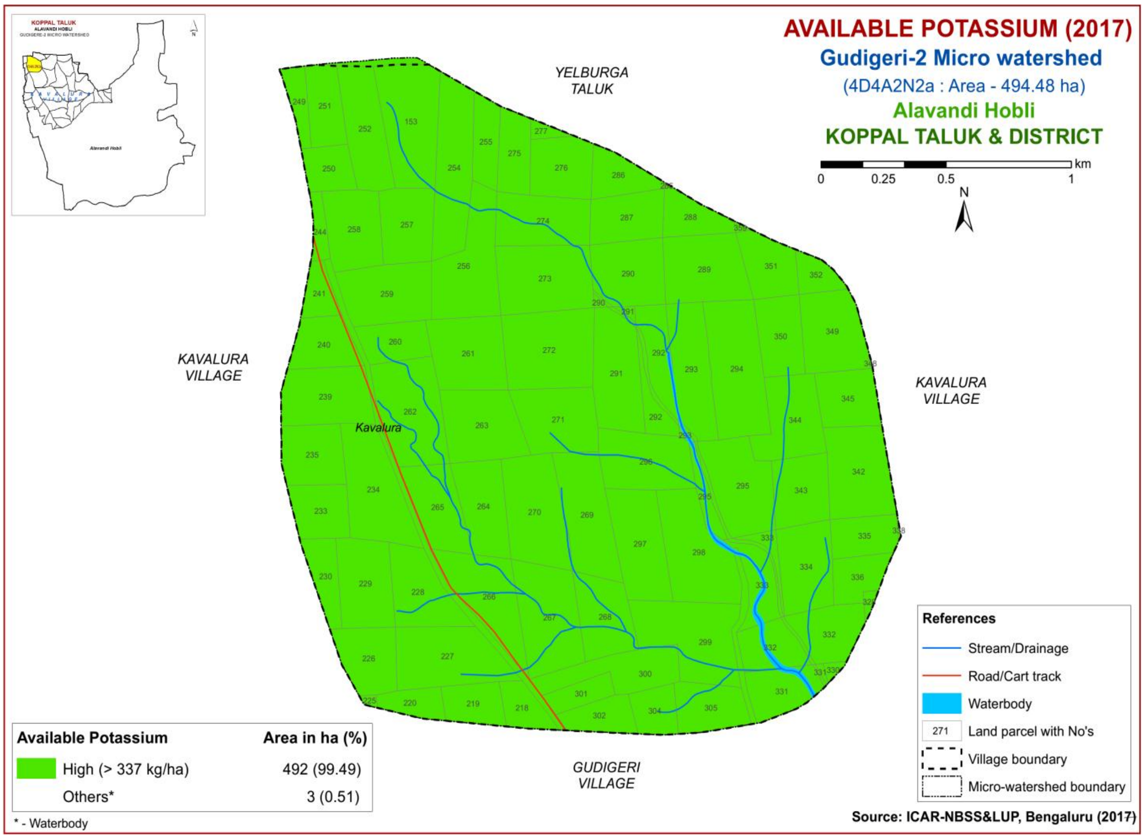


Fig.6.5 Soil Available Potassium map of Gudigeri-2 Microwatershed

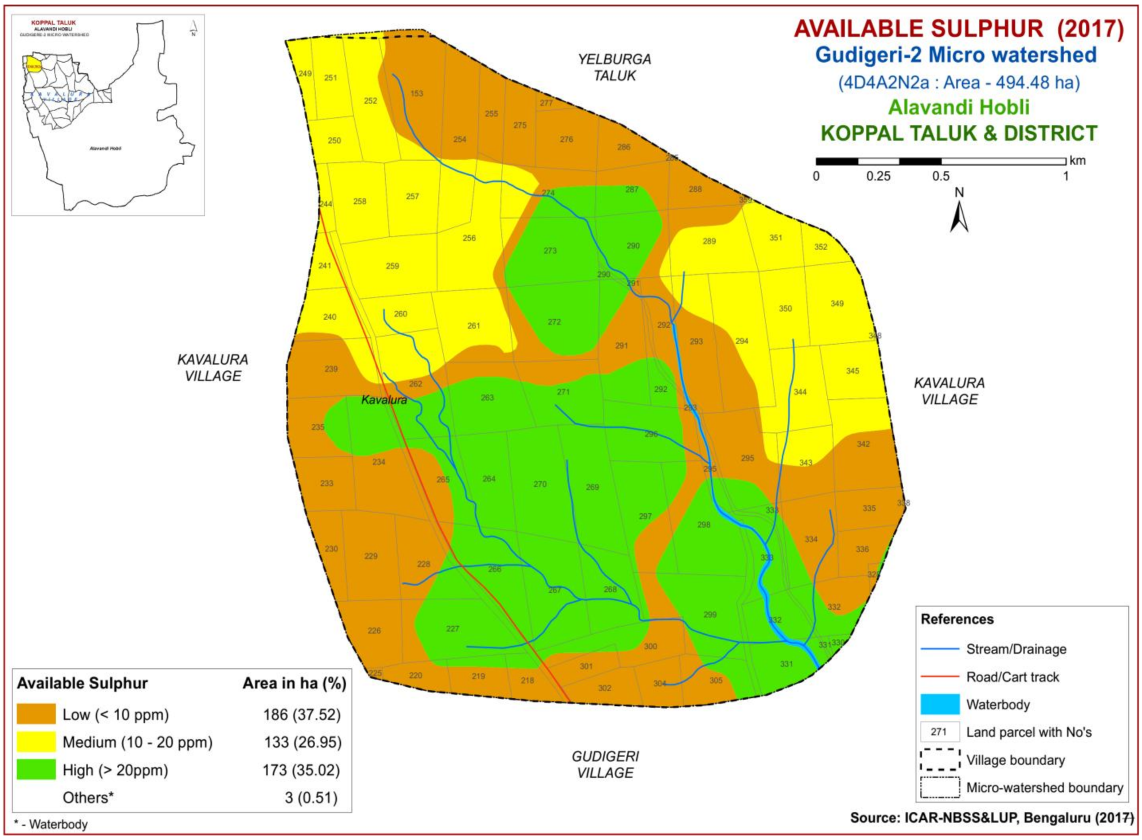


Fig.6.6 Soil Available Sulphur map of Gudigeri-2 Microwatershed

6.5 Available Potassium

Entire area in the microwatershed is high (>337 kg/ha) in available potassium content. The areas with high potassium content, reduce 25 per cent from the recommended dose to avoid the excess application of fertilizer (Fig 6.4).

6.6 Available Sulphur

An area of about 186 ha (38 %) is low (<10 ppm) in available sulphur and distributed in the major part of the microwatershed. An area of about 133 ha (27 %) is medium (10-20 ppm) and distributed in the northwestern and eastern part of the microwatershed. Areas with high (>20 ppm) available sulphur content cover about 173 ha (35%) and distributed in the southern and central 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

An area of about 208 ha (42 %) is low (<0.5 ppm) in available boron and distributed in the western, central and eastern part of the microwatershed. An area of about 43 ha (9 %) is medium (0.5-1.0 ppm) and distributed in the northern and northeastern part of the microwatershed. Maximum area of about 241 ha (49 %) is high (>1.0 ppm) in available boron content and distributed in the major part of the microwatershed (Fig.6.7).

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in the entire microwatershed area (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).

6.11 Available Zinc

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

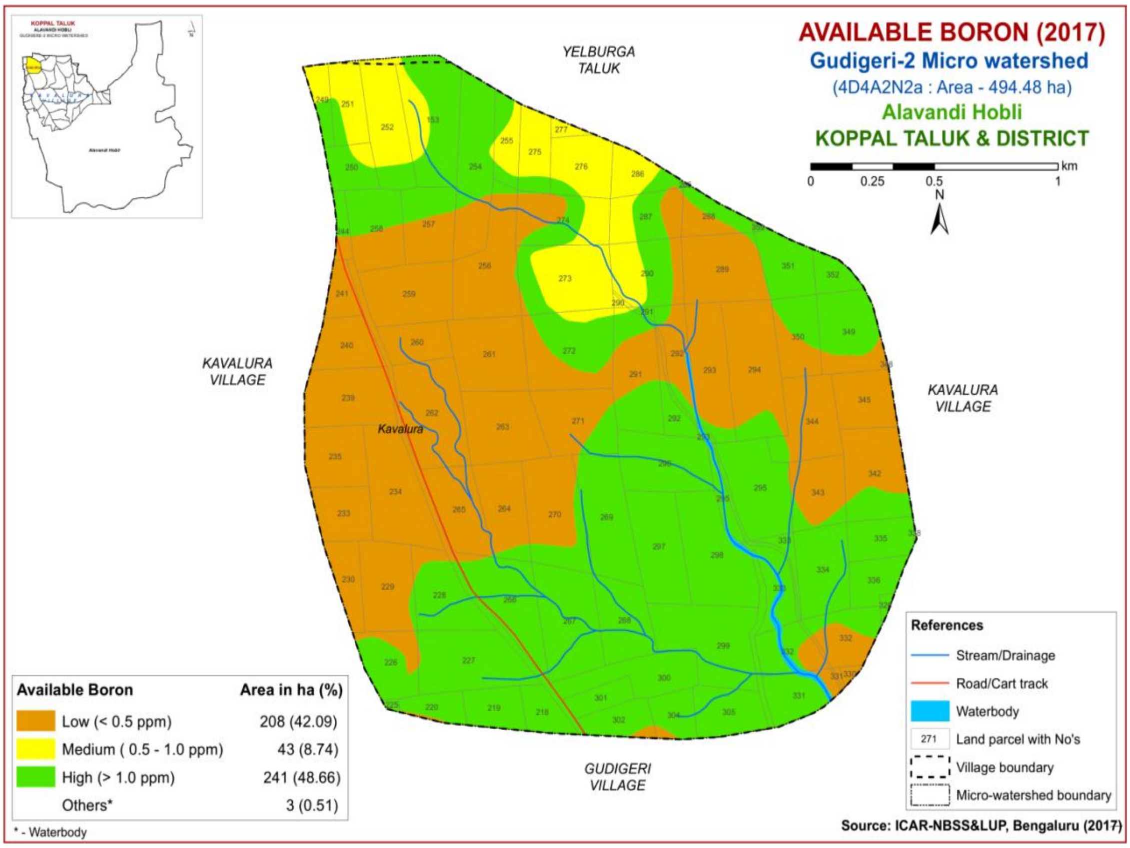


Fig.6.7 Soil Available Boron map of Gudigeri-2 Microwatershed

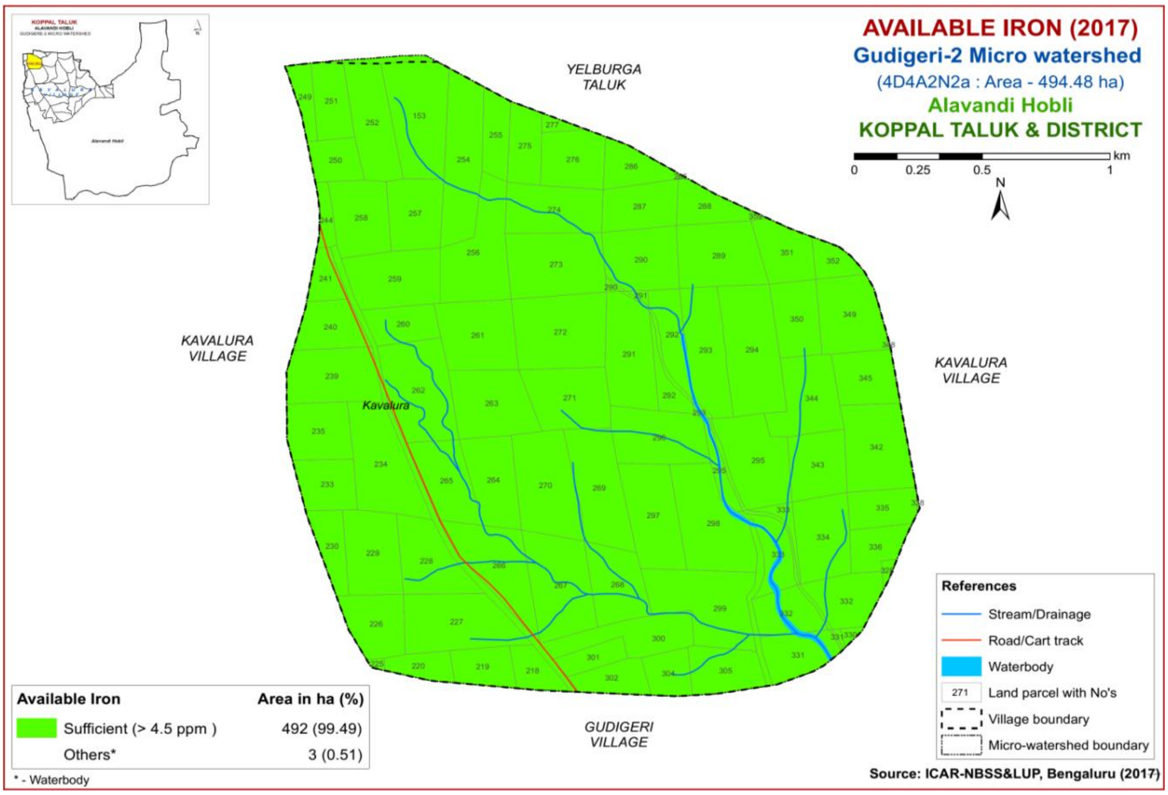


Fig.6.8 Soil Available Iron map of Gudigeri-2 Microwatershed

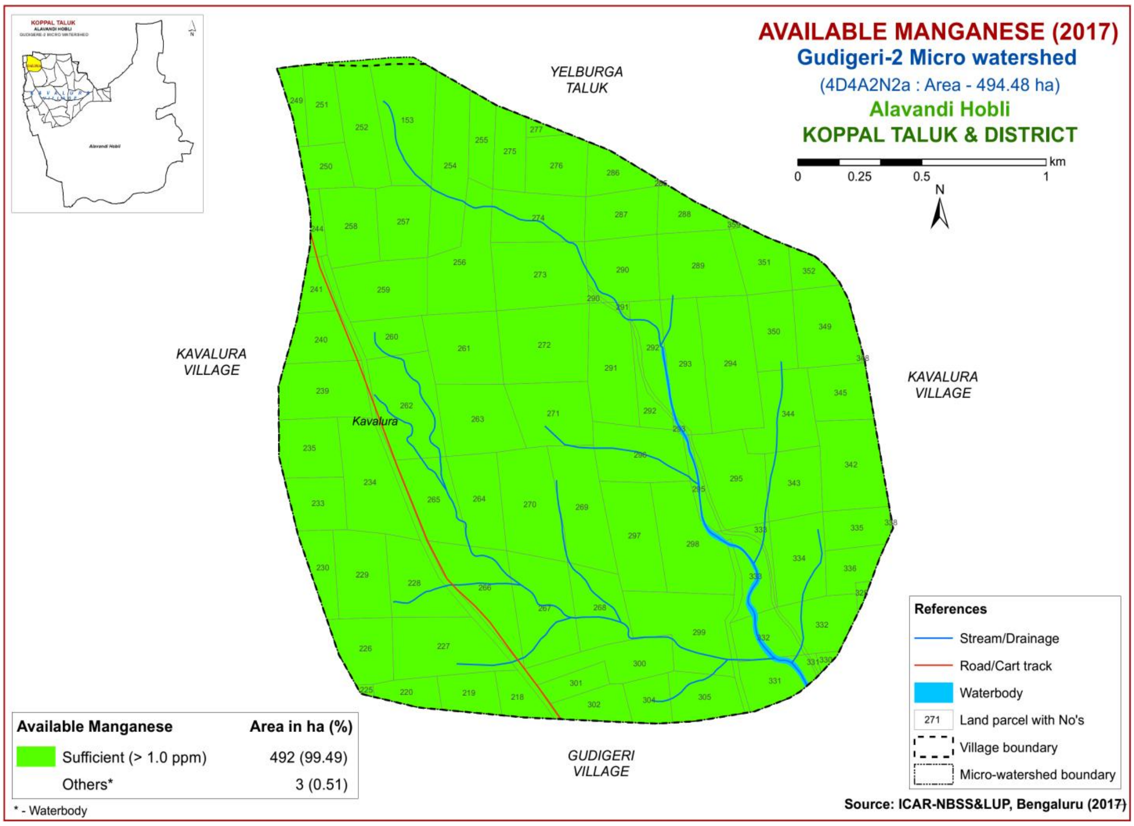


Fig.6.9 Soil Available Manganese map of Gudigeri-2 Microwatershed

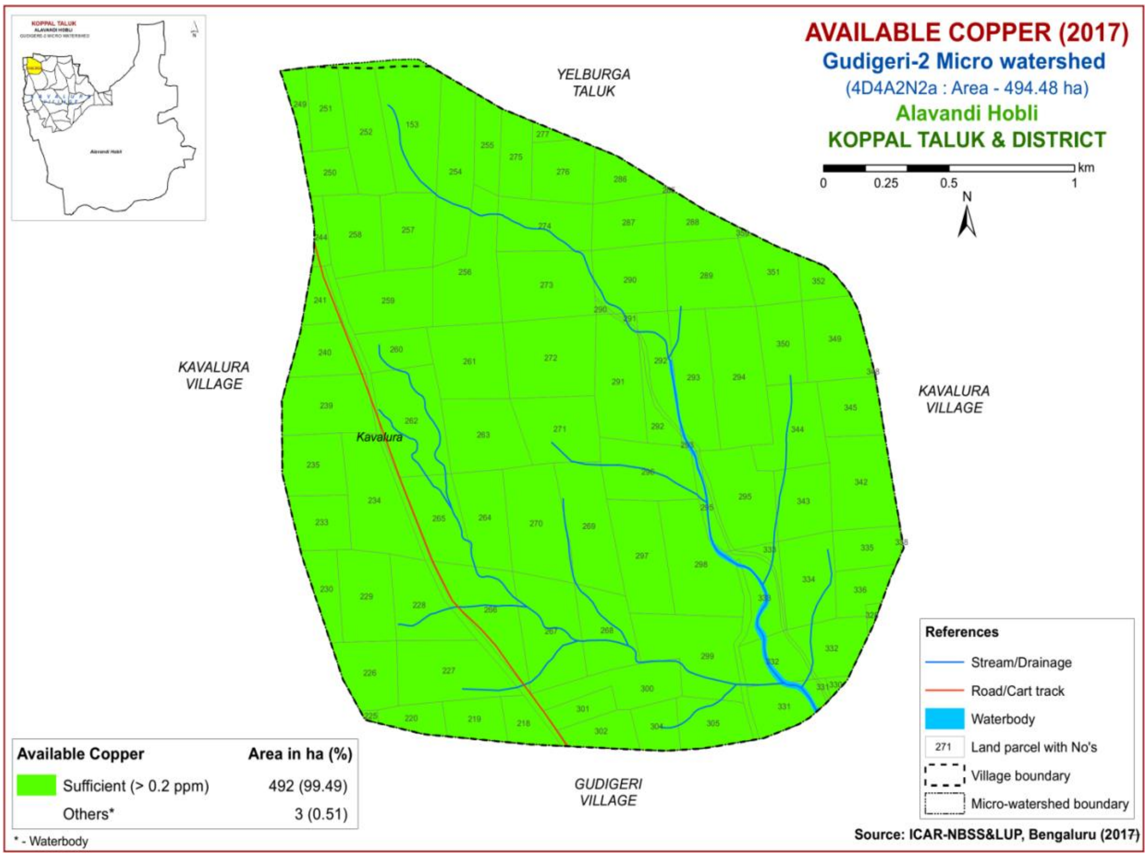


Fig.6.10 Soil Available Copper map of Gudigeri-2 Microwatershed

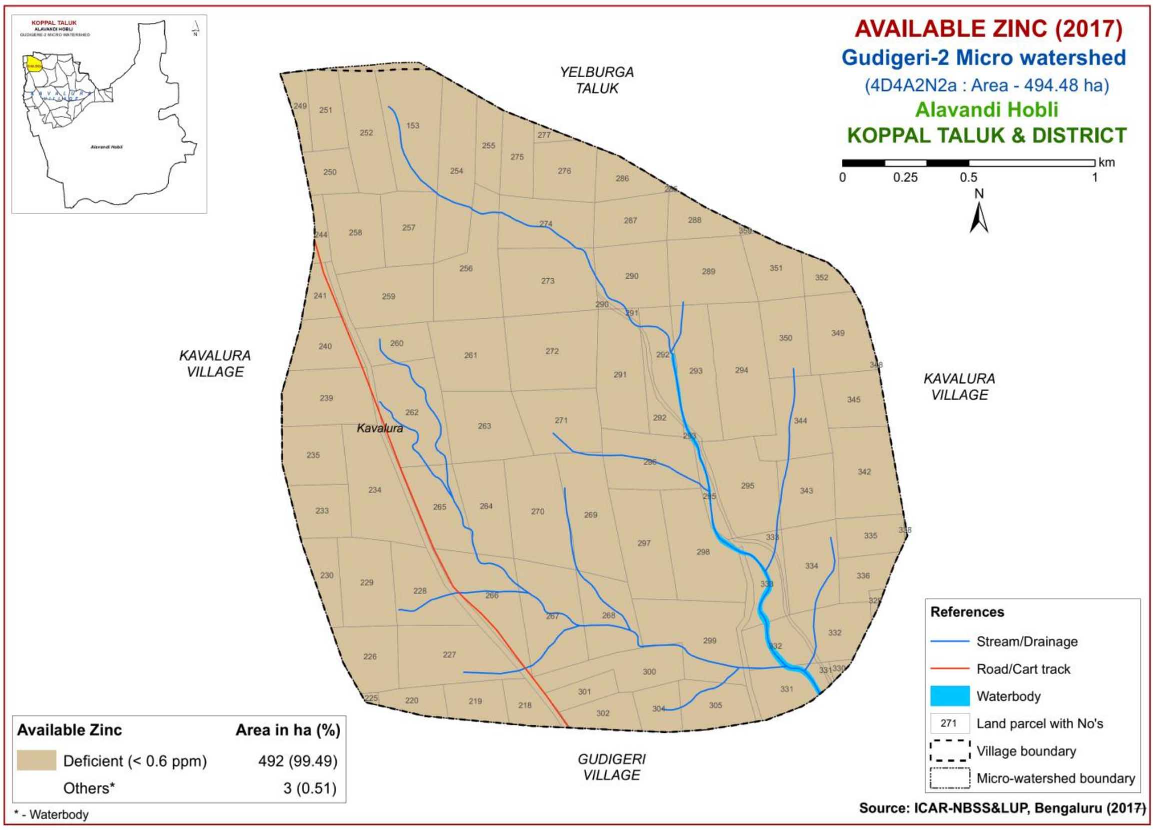


Fig.6.11 Soil Available Zinc map of Gudigeri-2 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Gudigeri-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 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 and N1 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, 's' for sodium,'z' for calcareousness 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 24 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 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 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.

Maximum area of about 489 ha (99%) is moderately suitable (Class S2) for growing sorghum and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness and gravelliness. Marginally suitable (Class

Table 7.1 Soil-Site Characteristics of Adavalli-1 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	Surface	Sub-surface								
MTLiB2	662	<90	WD	25-50	sc	c	-	15-35%	51-100	1-3%	Moderate	8.27	0.20	0.69	36.64	-
RNKmB2	662	<90	MWD	50-75	c	c	-	<15	51-100	1-3%	Moderate	8.86	0.483	16.94	37.00	-
RNKmB2g1	662	<90	MWD	50-75	c	c	15-35%	<15	51-100	1-3%	Moderate	8.86	0.483	16.94	37.00	-
DRLmB2g2	662	<90	MWD	75-100	c	c	35-60%	<15	151-200	1-3%	Moderate	-	-	-	-	-
GRHmB2	662	<90	MWD	100-150	c	c	-	<15	>200	1-3%	Moderate	8.27	1.11	11.72	31.60	-
MLRmA2	662	<90	MWD	>150	c	c	-	10-20	>200	0-1%	Moderate	9.19	0.31	13.48	42.08	-
MLRmB2	662	<90	MWD	>150	c	c	-	10-20	>200	1-3%	Moderate	9.19	0.31	13.48	42.08	-
AWDmB2	662	<90	-	>150	c	c	-	<15	-	1-3%	Moderate	-	-	-	-	-

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

S3) land cover an area of about 4 ha (<1%) and distributed in the southern part of the microwatershed with moderate limitations of rooting depth and calcareousness.

Table 7.2 Crop suitability criteria for Sorghum

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable(S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	2-3	3-8	8-15	>15
LGP	Days	120-150	120-90	<90	
Soil drainage	Class	Well to mod. Well drained	imperfect	Poorly/excessively	V. poorly
Soil reaction	pH	6.0-8.0	5.5-5.9,8.1-8.5	<5.5,8.6-9.0	>9.0
Surface soil texture	Class	c, cl, sicl, sc	l, sil, sic	sl, ls	S, fragmental skeletal
Soil depth	cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

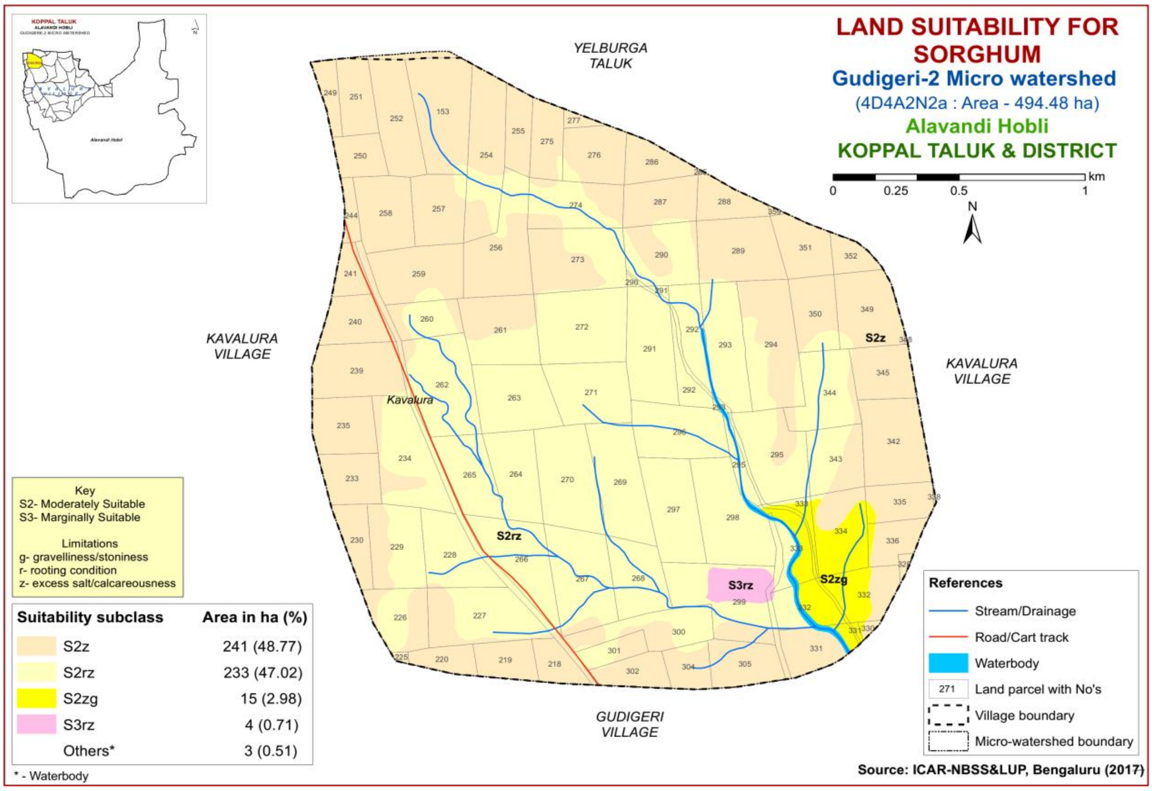


Fig. 7.1 Land Suitability map of sorghum

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 (S1) and moderately suitable (S2) lands for growing maize. Marginally suitable (Class S3) lands cover an entire area of the microwatershed. They have moderate limitations of texture and calcareousness.

Table 7.3 Crop suitability criteria for Maize

Crop requirement		Rating			
Soil–site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable(S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	<3	3.5	5-8	
LGP	Days	>100	100-80	60-80	
Soil drainage	Class	Well drained	Mod. to imperfectly	Poorly/excessively	V.poorly
Soil reaction	pH	5.5-7.5	7.6-8.5	8.6-9.0	
Surface soil texture	Class	l, cl, scl, sil	sl, sicl, sic	C(s-s), ls	S,fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-50	>50
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	2.0-4.0	
Sodicity (ESP)	%	<10	10-15	>15	

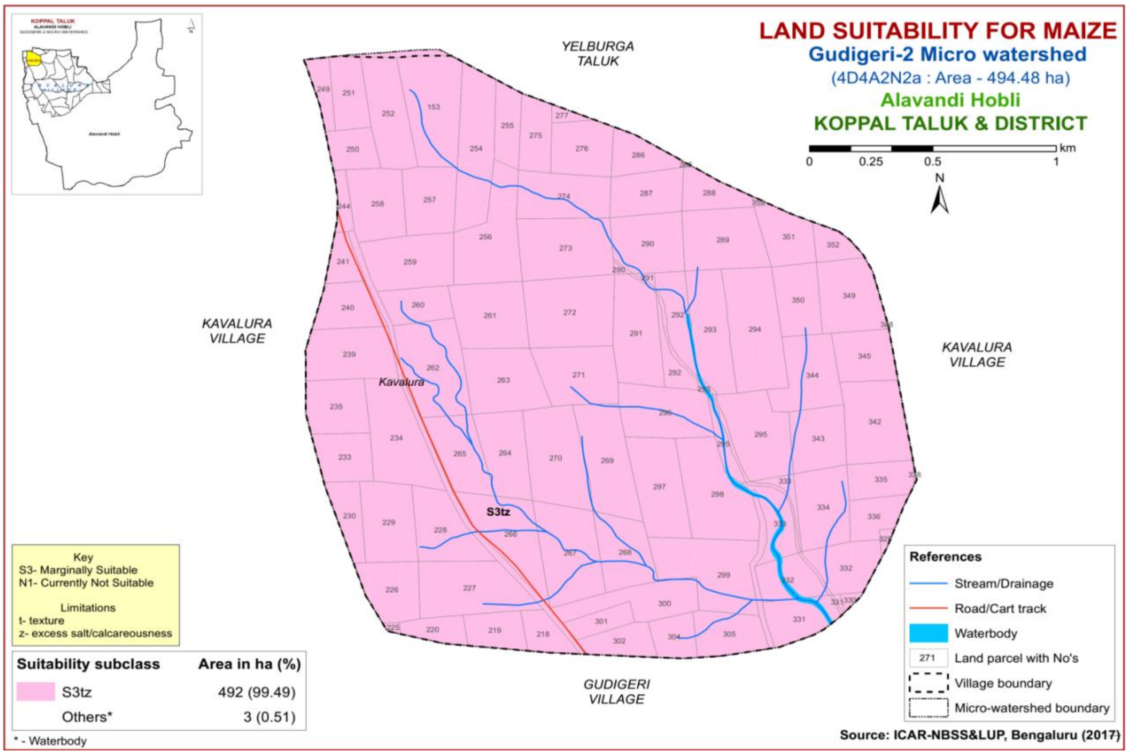


Fig. 7.2 Land Suitability map of Maize

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 Karnataka in the northern districts. 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 (S1) and moderately suitable (S2) lands for growing Bajra. Marginally suitable (Class S3) lands cover an entire area of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

Table 7.4 Crop suitability criteria for Bajra

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable(S2)**	**Marginally suitable (S3)**	**Not suitable (N)**
Slope	%	2-3	3-8	8-15	>15
LGP	Days	120-150	120-90	<90	
Soil drainage	Class	Well to mod. Well drained	imperfect	Poorly/excessively	V.poorly
Soil reaction	pH	5.5-8.0	5.0-5.5,7.8-8.4	8.4-9.0	>9.0
Surface soil texture	Class	c(red), sicl, sc,sl, cl	l, c (black) scl, sil, sic	sl, ls	s, fragmental skeletal
Soil depth	cm	100-75	50-75	25-50	<25
Gravel content	% vol.	15-35	35-60	60-80	-
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

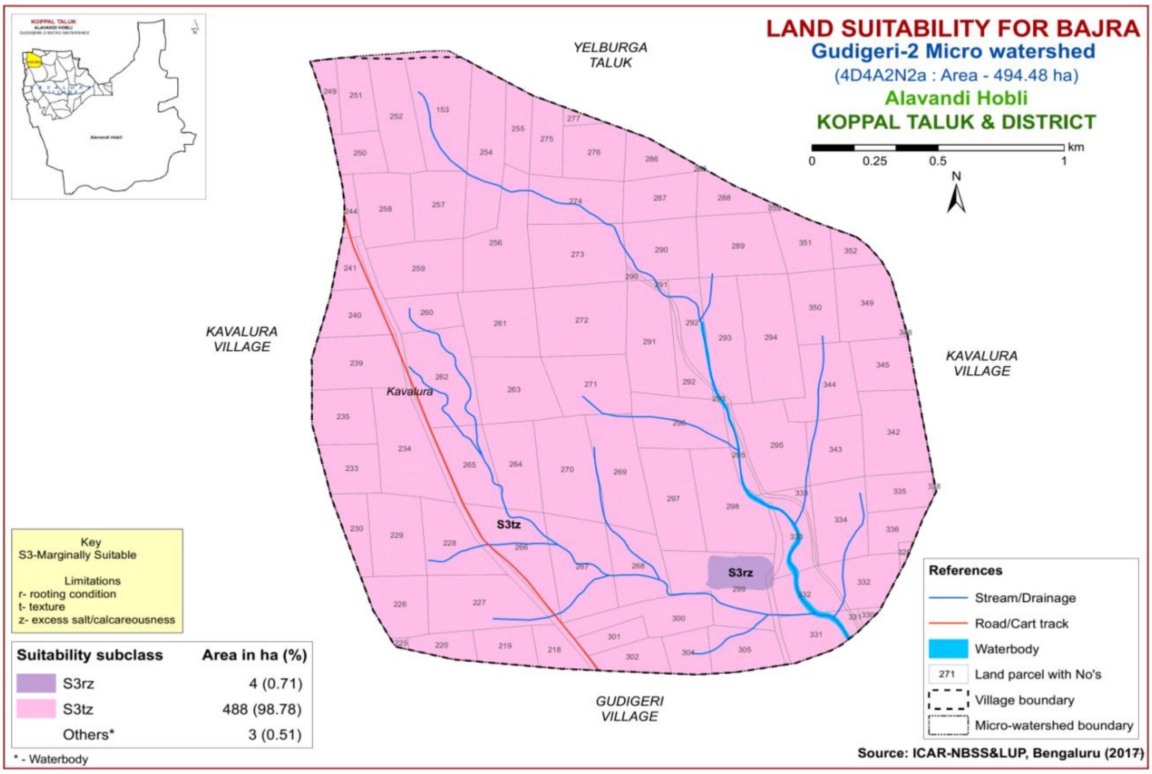


Fig. 7.3 Land Suitability map of Bajra

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.

Table 7.5 Crop suitability criteria for Groundnut

Crop requirement		**Rating**			
Soil–site characteristics	**Unit**	**Highly suitable (S1)**	**Moderately suitable (S2)**	**Marginally suitable (S3)**	**Not suitable(N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	100-125	90-105	75-90	
Soil drainage	Class	Well drained	Mod. Well drained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.0-8.0	8.1-8.5,5.5-5.9	>8.5,<5.5	
Surface soil texture	Class	l, cl, sil, sc, sic	sc, sic, c,	s, ls, sl,c (>60%)	s, fragmental
Soil depth	cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-50	>50	
$CaCO_3$ in root zone	%	high	Medium	low	
Salinity (EC)	dSm^{-1}	<2.0	2.0-4.0	4.0-8.0	
Sodicity (ESP)	%	<5	5-10	>10	

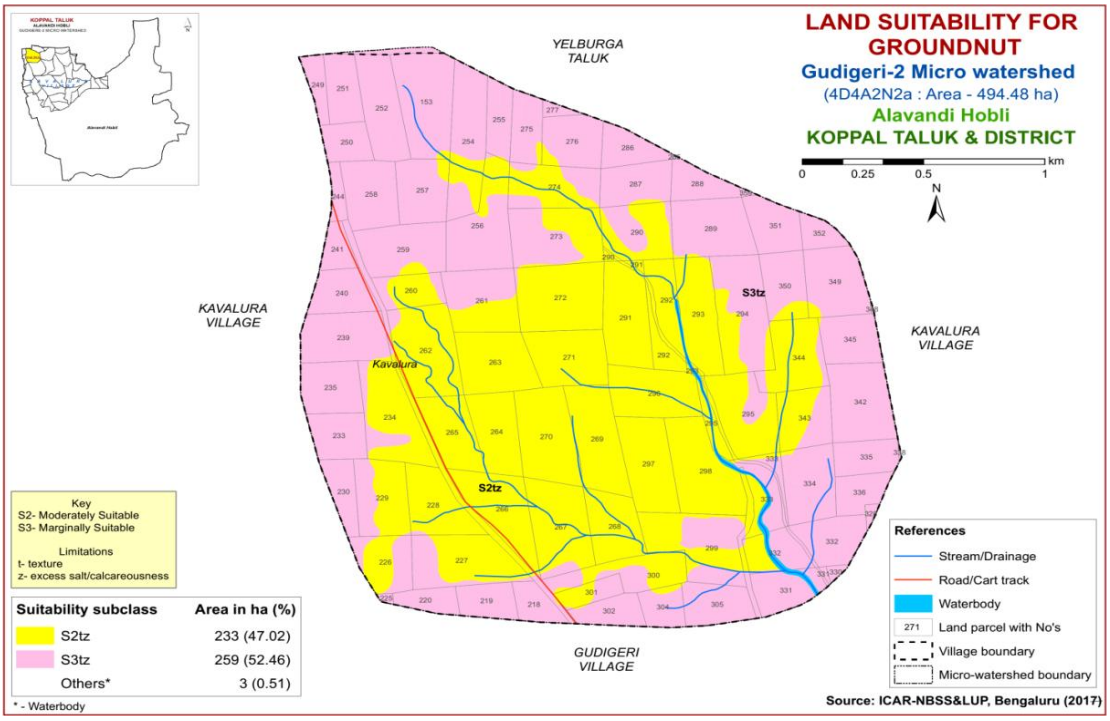


Fig. 7.4 Land Suitability map for groundnut

An area of about 233 ha (47%) is moderately suitable (Class S2) for groundnut and are distributed in the central and southern part of the microwatershed. They have minor limitations of texture and calcareousness. Marginally suitable (Class S3) lands occupy an area of about 259 ha (52%) and are distributed in the major part of the microwatershed with moderate limitations of texture and calcareousness.

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.

Table 7.6 Crop suitability criteria for Sunflower

Crop requirement		Rating			
Soil–site characteristics	**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Slope	%	<3	3-5	5-10	>10
LGP	Days	>90	80-90	70-80	<70
Soil drainage	class	Well drained	mod. Well drained	imperfectly drained	Poorly drained
Soil reaction	pH	6.5-8.0	8.1-8.5:5.5-6.4	8.6-9.0;4.5-5.4	>9.0:<4.5
Surface soil texture	Class	l, cl, sil, sc	Scl, sic, c,	c (>60%), sl	ls, s
Soil depth	Cm	>100	75-100	50-75	<50
Gravel content	%vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

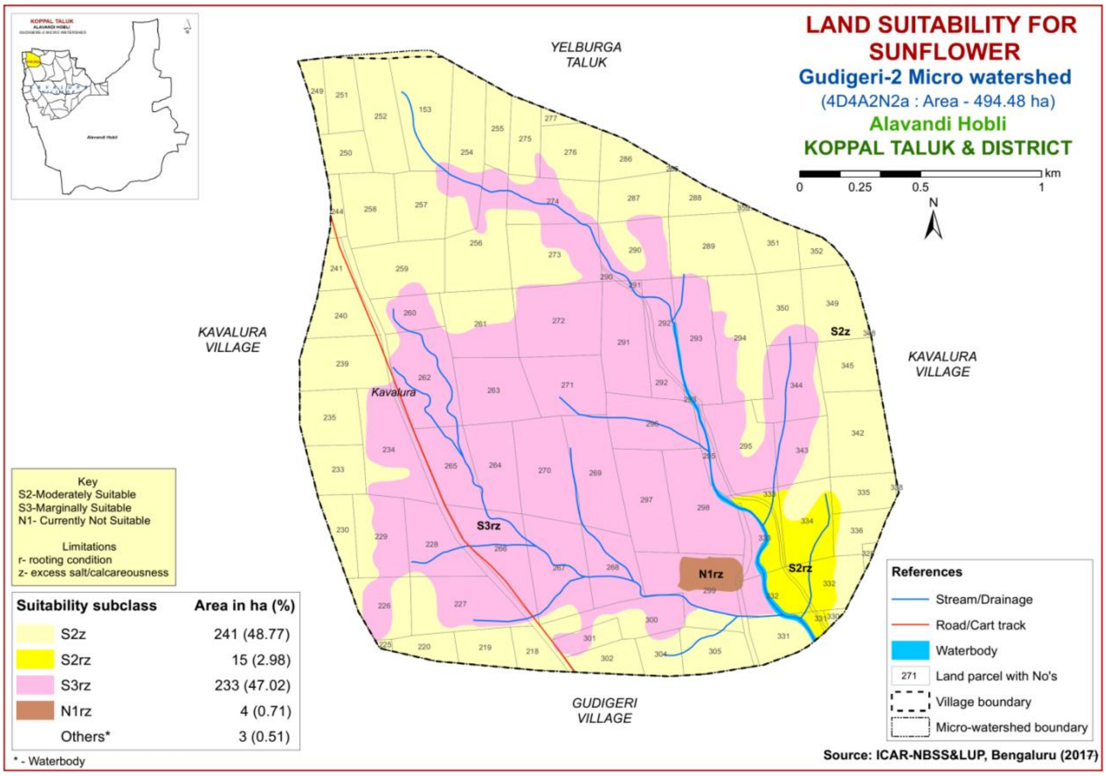


Fig. 7.5 Land Suitability map of sunflower

An area of about 256 ha (52%) is moderately suitable (Class S2) for growing sunflower and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth and calcareousness. An area of about 233 ha (47%) is marginally suitable (Class S3) for sunflower and are distributed in the central and southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness. A small area of about 4 ha (<1%) is not suitable (Class N1) for growing sunflower and occur in the southern part of the microwatershed with severe limitations of rooting depth and calcareousness.

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

Chilli is one of the major fruit and spice crop grown in an area of 0.42 lakh ha in Karnataka State. The crop requirements for growing chilli (Table 7.7) 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 7.6.

There are no highly (S1) and moderately suitable (S2) lands for growing Chilli. Marginally suitable (Class S3) lands cover an entire area of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

Table 7.7 Crop suitability criteria for Chilli

Crop requirement		Rating			
Soil –site characteristics	**Unit**	**Highly suitable(S1)**	**Moderately suitable (S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Mean temp. in growingseason	^0c	20-30	30-35 13-15	35-40 10-12	>40 <10
Slope	%	<3	3-5	5-10	>10
LGP	Days	>150	120-150	90-120	<90
Soil drainage	Class	Well drained	Moderately drained	Imp./ poor drained/excessively	Very poorly drained
Soil reaction	pH	6.5-7.8,6.0-7.0	7.8-8.4	8.4-9.0,5.0-5.9	>9.0
Surface soil texture	Class	scl, cl, sil	sl, sc,sic,c(m/k)	C(ss), ls, s	
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	<4
Sodicity (ESP)	%	<5	5-10	10-15	

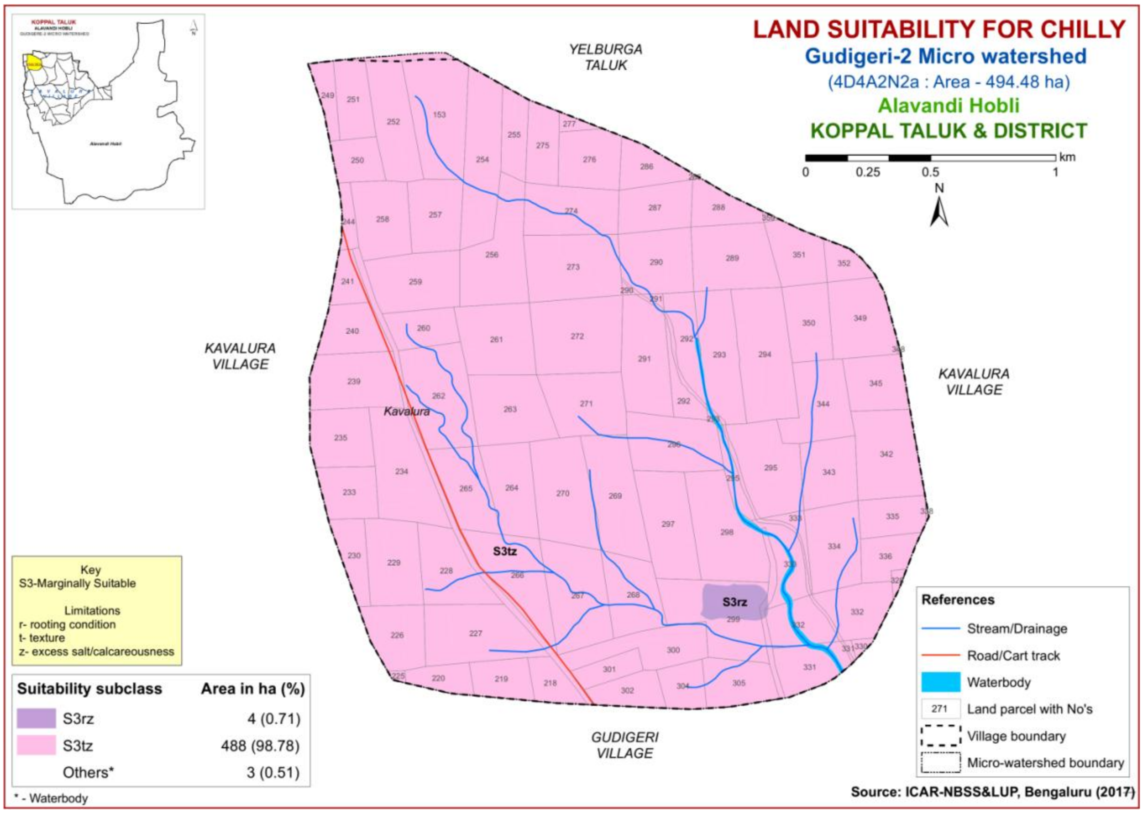


Fig. 7.6 Land Suitability map of Chilli

7.7 Land Suitability for Tomato (*Solanum lycopersicum*)

Tomato is one of the most important vegetable and fruit crop grown in an area of 0.65 lakh ha in almost all the districts of the State. The crop requirements (Table 7.8) for growing tomato were matched with the soil-site characteristics (Table 7.1) 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 7.7.

There are no highly (S1) and moderately suitable (S2) lands for growing tomato. Marginally suitable (Class S3) lands cover an entire area of the microwatershed. They have moderate limitations of texture, rooting depth and calcareousness.

Table 7.8 Crop suitability criteria for Tomato

Crop requirement			Rating			
Soil-site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}c	25-28	29-32 20-24	15-19 33-36	<15 >36
Soil moisture	Growing period	Days	>150	120-150	90-120	
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	l, sl, cl, scl	sic,sicl,sc,c(m/k)	c (ss)	ls, s
	pH	1:2.5	6.0-7.0	5.0-5.9:7.1-8.5	<5;>8.5	
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	
Rooting conditions	Soil depth	Cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	ds/m	Non saline	slight	strongly	
	Sodicity (ESP)	%	<10	10-15	>15	-
Erosion	Slope	%	1-3	3-5	5-10	>10

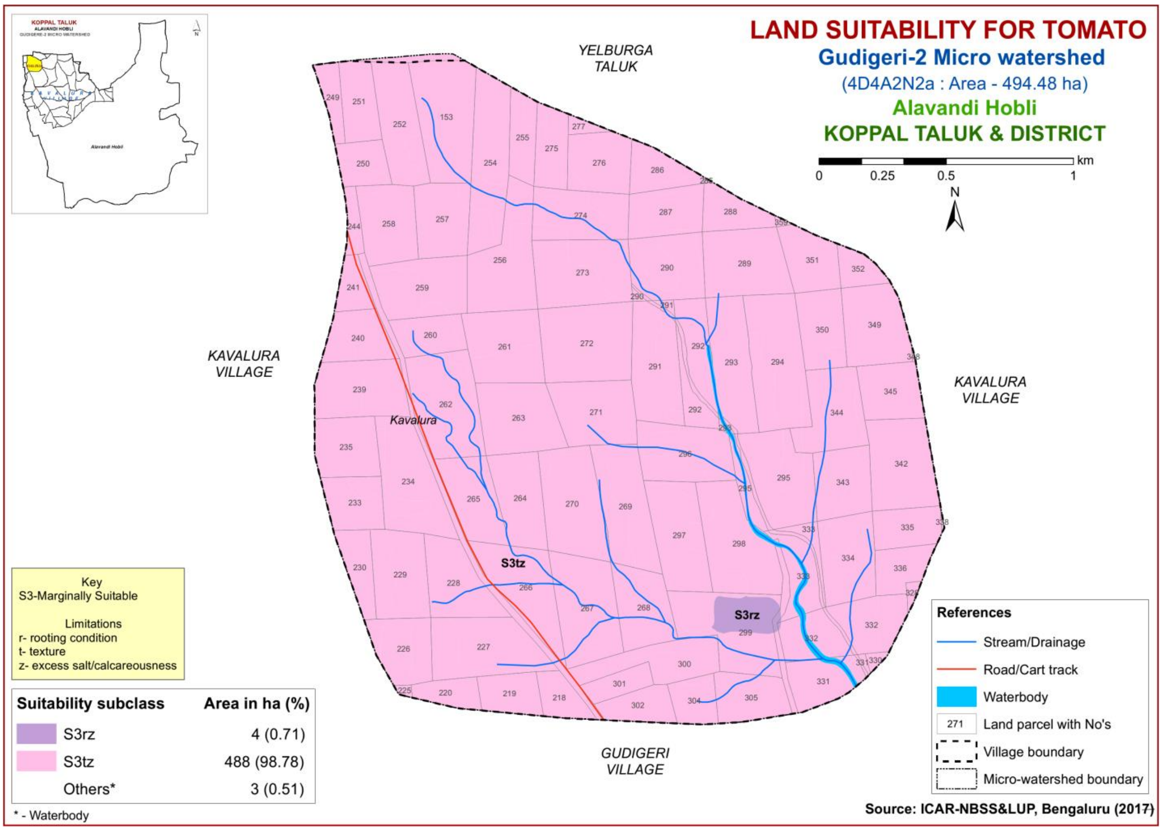


Fig. 7.7 Land Suitability map of tomato

7.8 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 7.9) were matched with the soil-site characteristics (Table 7.6) and a land suitability map for growing drumstick was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed are given in Figure 7.8.

Table 7.9 Land suitability criteria for Drumstick

Crop requirement			Rating			
Soil-site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Sc, scl, cl, c (red)	Sl, c (black)	ls	S
	pH	1:2.5	5.5-6.5	5-5.5:6.5-7.3	7.8-8.4	>8.4
Rooting conditions	Soil depth	Cm	>100	75-100	50-75	<50
	Gravelcontent	% vol.	0-35	35-60	60-80	>80
Erosion	Slope	%	0-3	3-10	-	>10

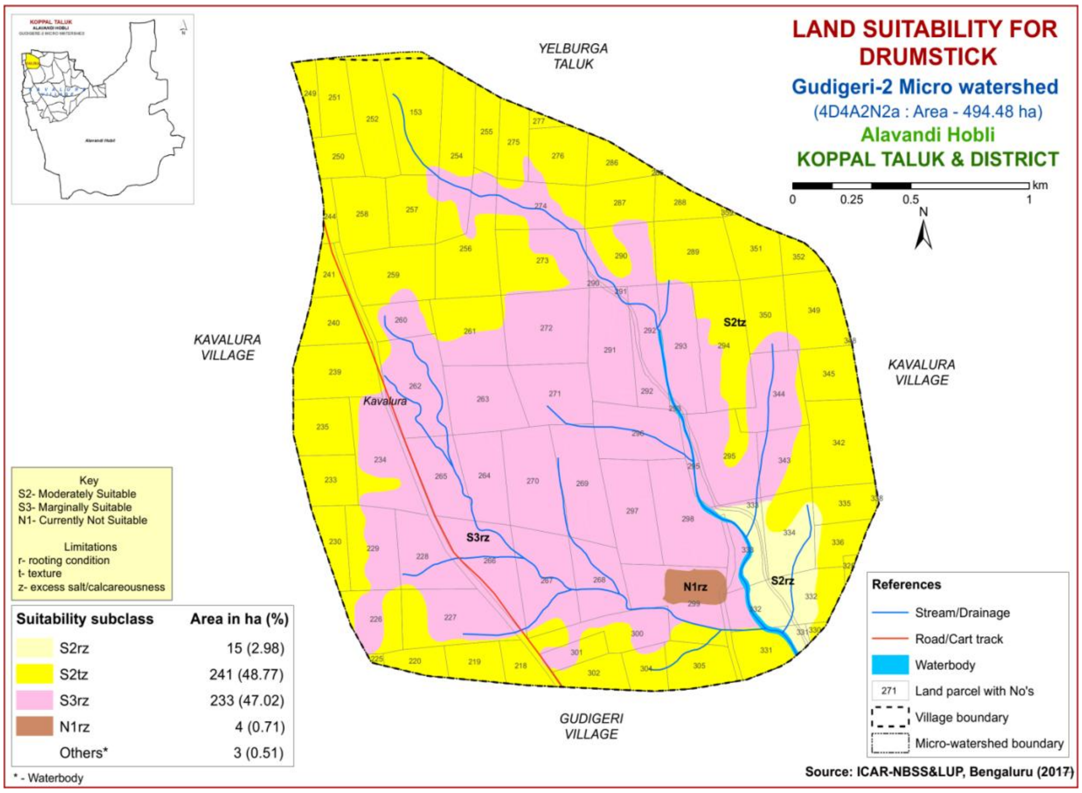


Fig. 7.8 Land Suitability map of Drumstick

Moderately suitable (Class S2) lands occupy an area of about 256 ha (52%) and distributed in the major part of the microwatershed. They have minor limitations of texture, rooting depth and calcareousness. Marginally suitable lands cover an area of about 233 ha (47%) and occur in the central and southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness. A small area of about 4 ha (< 1%) is not suitable (Class N1) and occur in the southern part of the microwatershed with severe limitations of rooting depth and calcareousness.

7.9 Land Suitability for Mulbery (*Morus nigra*)

Mulbery 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 mulbery (Table 7.10) 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 are given in Figure 7.9.

Table 7.10 Land suitability criteria for Mulberry

Crop requirement			Rating			
Soil-site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Sc, cl, scl	C (red)	C(black),sl, ls	-
	pH	1:2.5				
Rooting conditions	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	% vol.	0-35	35-60	60-80	>80
Erosion	Slope	%	0-3	3-5	5-10	>10

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

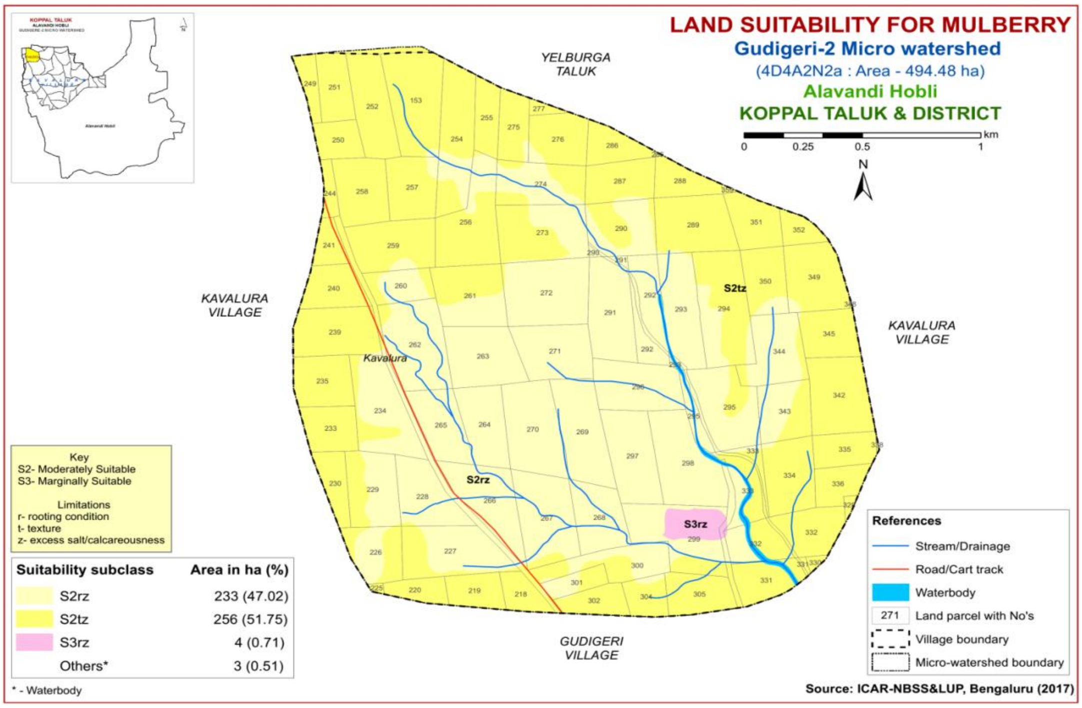


Fig. 7.9 Land Suitability map of Mulberry

Moderately suitable (Class S2) lands occupy maximum area of about 489 ha (99%) and occur in the major part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Marginally suitable lands cover an area of about 4 ha (<1%) and occur in the southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness.

7.10 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 7.11) 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 7.10.

There are no highly (S1) and moderately suitable (S2) lands for growing mango. Marginally suitable (Class S3) lands cover an area of about 256 ha (51%) and distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Area not suitable (Class N1) for growing mango cover about 237 ha (48%) and occur in the central and southern part of the microwatershed with severe limitations of rooting depth, texture and calcareousness.

Table 7.11 Crop suitability criteria for Mango

Crop requirement			Rating			
Soil-site characteristics		Unit	Highly suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Climate	Temp. in growingseason	^{0}C	28-32	24-27 33-35	36-40	20-24
	Min. temp. beforeflowering	^{0}C	10-15	15-22	>22	
Soil moisture	Growing period	Days	>180	150-180	120-150	<120
Soil aeration	Soil drainage	Class	Well drained	Mod. To imp. drained	Poor drained	V.poorly drained
	Water table	M	>3	2.50-3.0	2.5-1.5	<1.5
Nutrient availability	Texture	Class	Sc,l, sil, cl	Sl, sc, sic,l,c	C (<60%)	C(>60%),
	pH	1:2.5	5.5-7.5	7.6-8.5:5.0-5.4	8.6-9.0:4.0-4.9	>9.0<4.0
	OC	%	High	medium	low	
	$CaCO_3$ in root zone	%	Non calcareous	<5	5-10	>10
Rooting conditions	Soil depth	cm	>200	125-200	75-125	<75
	Gravel content	%vol	Non-gravelly	<15	15-35	>35
Soil toxicity	Salinity	dS/m	Nonsaline	<2.0	2.0-3.0	>3.0
	Sodicity	%	Non sodic	<10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

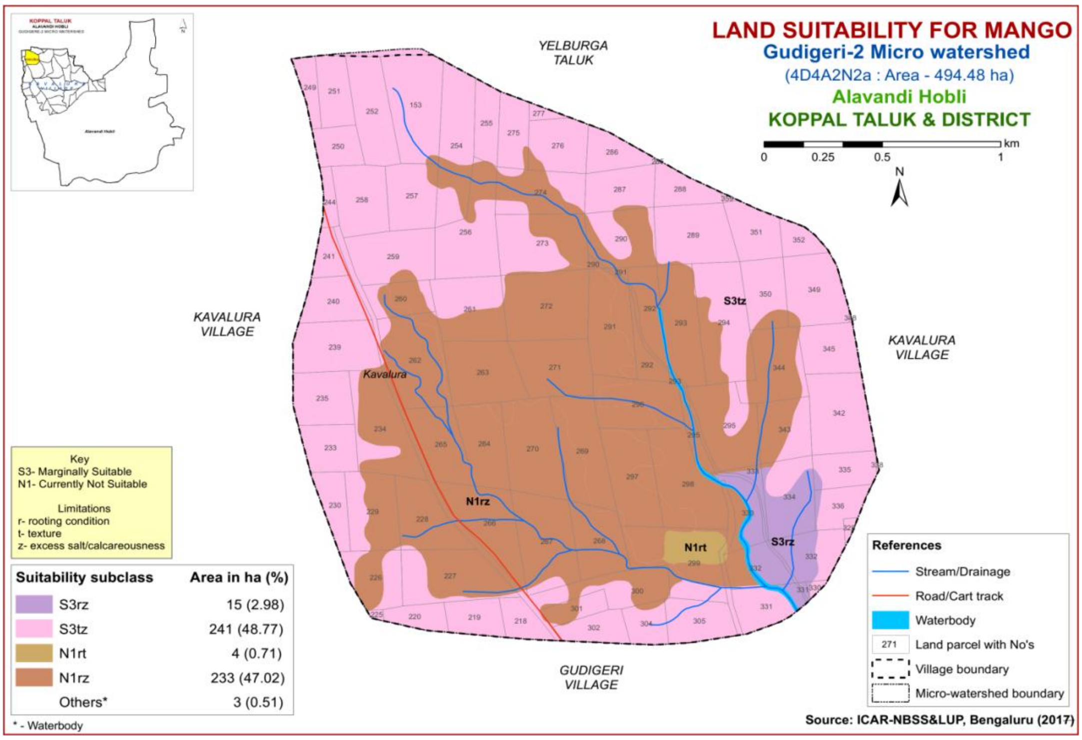


Fig. 7.10 Land Suitability map of Mango

7.11 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 7.12) 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 7.11.

Table 7.12 Crop suitability criteria for Sapota

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Climate	Temperature in growing season	^{0} C	28-32	33-36 24-27	37-42 20-23	>42 <18
Soil moisture	Growing period	Days	>150	120-150	90-120	<120
Soil aeration	Soil drainage	Class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	Scl, l, cl, sil	Sl, sicl, sc	C (<60%)	ls,s,C(>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0:5.0-5.9	8.1-9.0:4.5-4.9	>9.0:<4.5
	$CaCO_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	Cm	>150	75-150	50-75	<50
	Gravel content	%vol.	Non gravelly	<15	15-35	<35
Soil toxicity	Salinity	dS/m	Non saline	Up to 1.0	1.0-2.0	2.0-4.0
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10

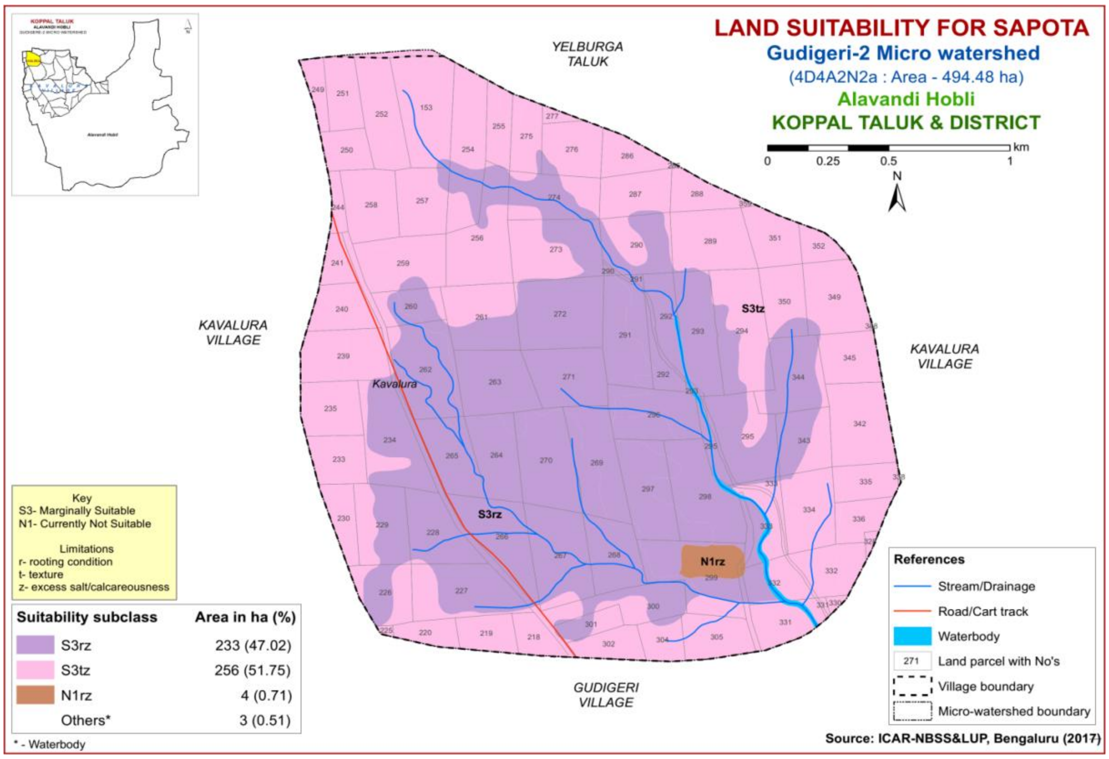


Fig. 7.11 Land Suitability map of Sapota

There are no highly (S1) and moderately suitable (S2) lands for growing sapota. Marginally suitable (Class S3) lands cover a maximum area of about 489 ha (99%) and occur in the major part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. An area of about 4 ha (<1%) is not suitable (Class N1) for growing sapota and occur in the southern part of the microwatershed with severe limitations of rooting depth and calcareousness.

7.12 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 7.13) 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 7.12.

Moderately suitable (Class S2) lands occupy an area of about 256 ha (52%) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Marginally suitable (Class S3) lands for growing pomegranate occupy an area of about 233 ha (47 %) and are distributed in the central and southern part of the microwatershed with moderate limitations of rooting depth and calcareousness. A small area of about 4 ha (<1 %) is not suitable (Class N1) for growing pomegranate and occur in the southern part of the microwatershed with severe limitations of rooting depth and calcareousness.

Table 7.13 Crop suitability criteria for Pomegranate

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	30-34	35-38 25-29	39-40 15-24	
Soil moisture	Growing period	Days	>150	120-150	90-120	<90
Soil aeration	Soil drainage	Class	Well drained	imperfectly drained		
Nutrient availability	Texture	Class	Sl, scl, l, cl	C, sic, sicl	Cl, s, ls	S,fragmental
Rooting conditions	pH	1:2.5	5.5-7.5	7.6-8.5	8.6-9.0	
	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	%vol.	nil	15-35	35-60	>60
Soil toxicity	Salinity	dS/m	Nil	<9	>9	<50
	Sodicity	%	nil			
Erosion	Slope	%	<3	3-5	5-10	

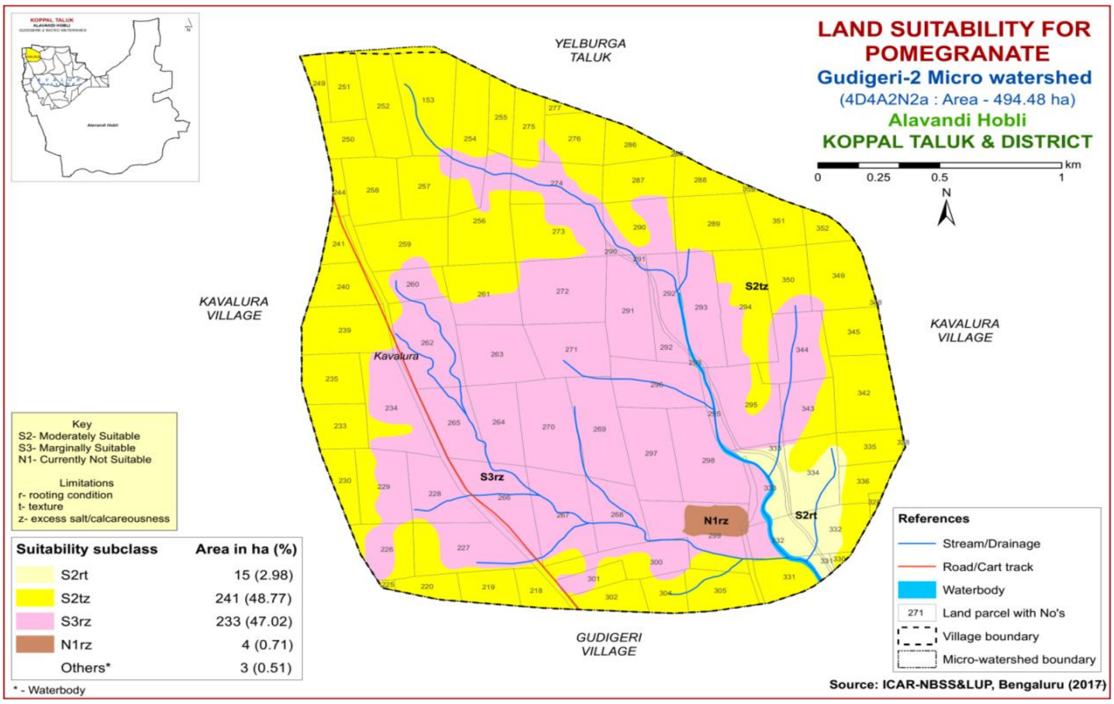


Fig. 7.12 Land Suitability map of Pomegranate

7.13 Land suitability for Guava (*Psidium guajava*)

Guava is one of the most important fruit crop grown in an area of about 6558 ha in almost all the districts of the state. The crop requirements (Table 7.14) 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 7.13.

There are no highly (Class S1) and moderately suitable (Class S2) lands for growing guava. Marginally suitable (Class S3) lands cover a maximum area of about 488 ha (99%) and occur in the major part of the microwatershed. They have moderate limitations of texture and calcareousness. An area of about 4 ha (<1%) is not suitable (Class N1) for growing guava and distributed in the southern part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.14 Crop suitability criteria for Guava

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Climate	Temperature in growing season	^{0}C	28-32	33-36 24-27	37-42 20-23	
Soil moisture	Growing period	Days	>150	120-150	90-120	<90
Soil aeration	Soil drainage	Class	Well drained	Mod. to imperfectly	poor	Very poor
Nutrient availability	Texture	Class	Scl, l, cl, sil	Sl,sicl,sic.sc,c	C (<60%)	C(>60%)
	pH	1:2.5	6.0-7.5	7.6-8.0:5.0-5.9	8.1-8.5:4.5-4.9	>8.5:<4.5
	$CaCO_3$ in root zone	%	Non calcareous	<10	10-15	>15
Rooting conditions	Soil depth	Cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	dS/m	<2.0	2.0-4.0	4.0-6.0	
	Sodicity	%	Non sodic	10-15	15-25	>25
Erosion	Slope	%	<3	3-5	5-10	>10

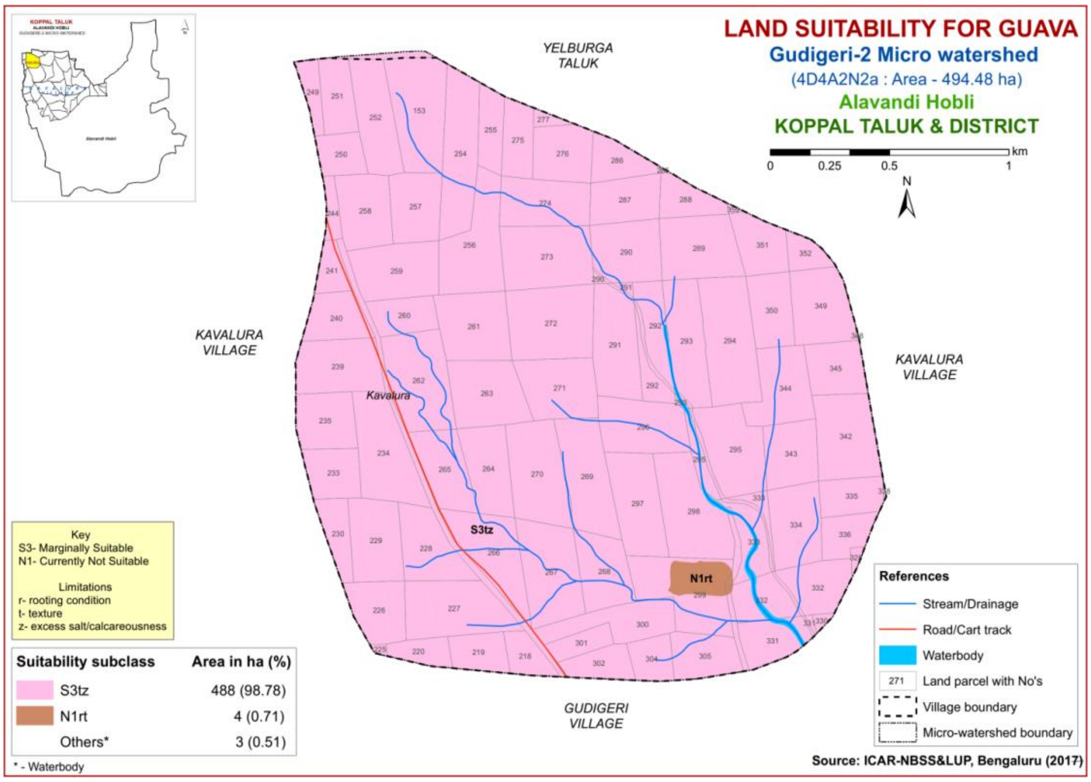


Fig. 7.13 Land Suitability map of Guava

7.14 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 7.15) 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 7.14.

There are no highly (S1) and moderately suitable (Class S2) lands for growing jackfruit. Marginally suitable (Class S3) lands cover a maximum area of about 488 ha (99%) and occur in the major part of the microwatershed. They have moderate limitations of texture and calcareousness. An area of about 4 ha (<1%) is not suitable (Class N1) for growing jackfruit and occur in the southern part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.15 Land suitability criteria for Jackfruit

Crop requirement			Rating			
Soil site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Soil aeration	Soil drainage	class	well	Mod. well	Poorly	V. Poorly
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
Rooting conditions	Soil depth	cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-5	>5	-

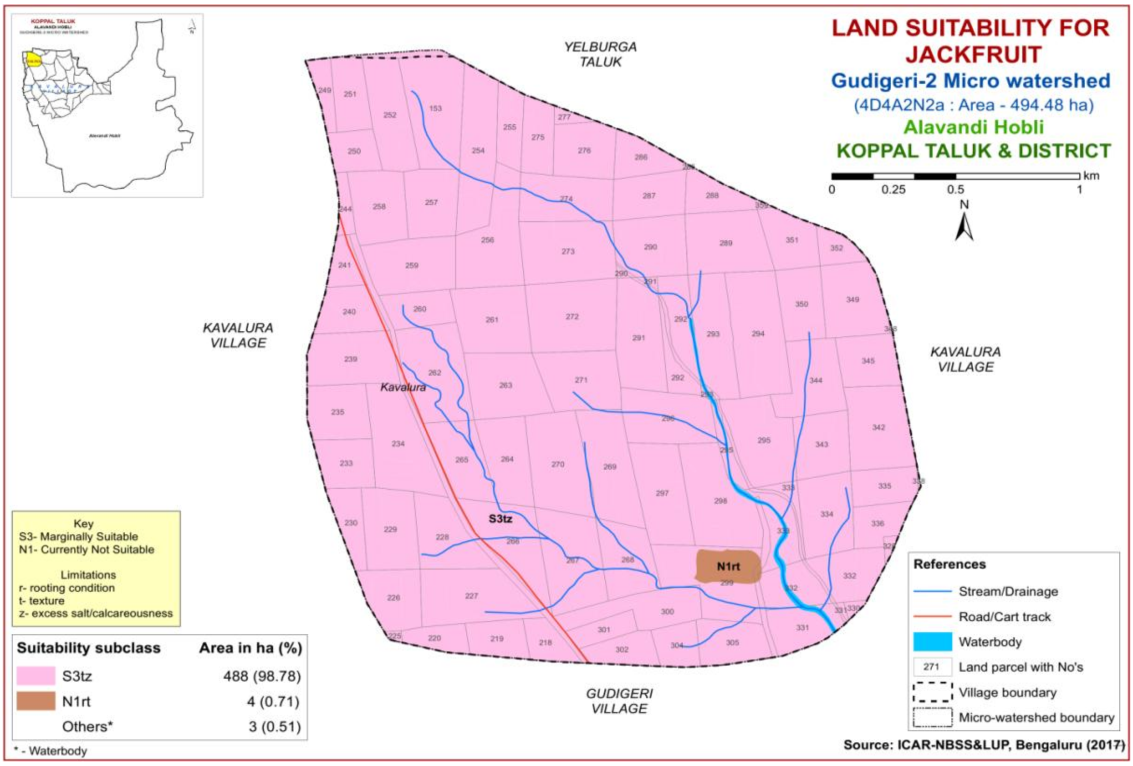


Fig. 7.14 Land Suitability map of jackfruit

7.15 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 7.16) 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 7.15.

There are no highly suitable (Class S1) lands for growing jamun. An area of about 241 ha (49%) is moderately suitable (Class S2) and occur in the outer corners of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. The marginally suitable (Class S3) lands cover an area of about 248 ha (50%) and are distributed in the major part of the microwatershed with moderate limitations of rooting depth, texture and calcareousness An area of about 4 ha (<1 %) is not suitable for growing jamun and are distributed in the southern part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.16 Land suitability criteria for Jamun

Crop requirement			Rating			
Soil- site characteristics		Unit	Highly suitable(S1)	Moderately Suitable(S2)	Marginally suitable(S3)	Not suitable (N)
Soil aeration	Soil drainage	Class	Well	Mod. well	Poorly	V. Poorly
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
Rooting conditions	Soil depth	cm	>150	100-150	50-100	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-5	5-10	>10

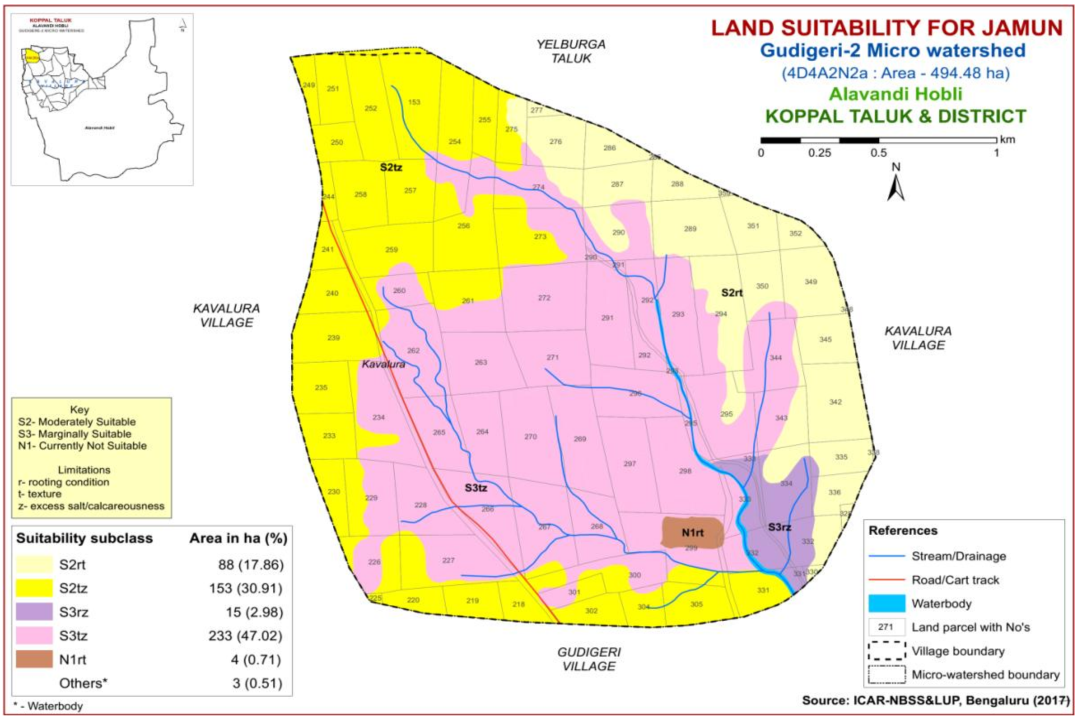


Fig. 7.15 Land Suitability map of jamun

7.16 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in an area of 5446 ha in almost all the districts of the state. The crop requirements for growing musambi (Table 7.17) 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 7.16.

An area of about 256 ha (52%) is moderately suitable (Class S2) for growing musambi and are distributed in the major part of the microwatershed with minor limitations of rooting depth and calcareousness. An area of about 233 ha (47%) is marginally suitable (Class S3) and distributed in the central part of the microwatershed. They have moderate limitations of rooting depth and calcareousness. An area of about 4 ha (<1 %) is not suitable suitable (Class N1) for growing musambi and distributed in the southern part of the microwatershed with severe limitations of calcareousness and rooting depth.

Table 7.17 Crop suitability criteria for Musambi

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Climate	Temperature in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	Class	Well drained	Mod. to imp.drained	Poorly	Very poorly
Nutrient availability	Texture	Class	scl,l,sicl,cl,s	sc, sc, c	c (>70%)	s, ls
	pH	1:2.5	6.0-7.5	5.5-6.47.6-8.0	4.0-5.4,8.1-8.5	<4.0,>8.5
	$CaCO_3$ in root zone	%	Non calcareous	Upto 5	5-10	>10
Rooting conditions	Soil depth	cm	>150	100-150	50-100	<50
	Gravel content	% vol.	Non gravelly	15-35	35-55	>55
Soil toxicity	Salinity	dS/m	Non saline	Upto 1.0	1.0-2.5	>2.5
	Sodicity	%	Non sodic	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

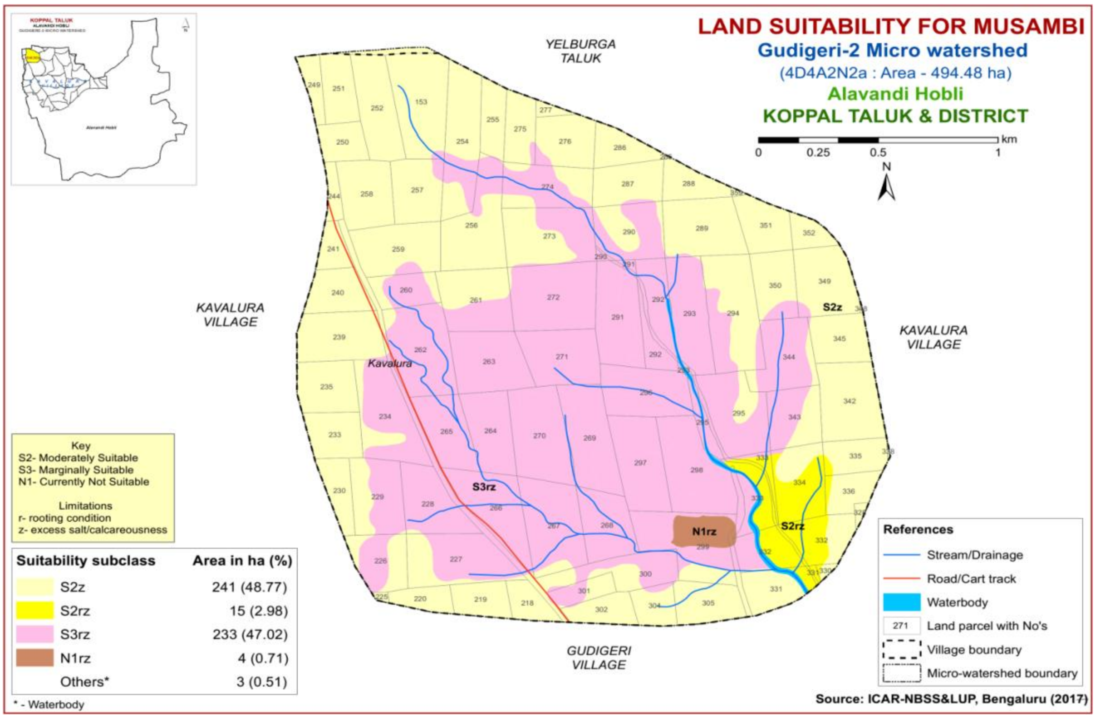


Fig. 7.16 Land Suitability map of Musambi

7.17 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in an area of 11752 ha in almost all the districts of the State. The crop requirements for growing lime (Table 7.18) 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 7.17.

Table 7.18 Crop suitability criteria for Lime

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Climate	Temperature in growing season	^{0}C	28-30	31-35 24-27	36-40 20-23	>40 <20
Soil moisture	Growing period	Days	240-265	180-240	150-180	<150
Soil aeration	Soil drainage	Class	Well drained	Mod. to imp. drained	Poorly	Very poorly
Nutrient availability	Texture	Class	scl,l,sicl,cl,s	sc, sc, c	c (>70%)	s, ls
	pH	1:2.5	6.0-7.5	5.5-6.4:7.6-8.0	4.0-5.4,8.1-8.5	<4.0,>8.5
	$CaCO_3$ in root zone	%	Non calcareous	Upto 5	5-10	>10
Rooting conditions	Soil depth	Cm	>150	100-150	50-100	<50
	Gravel content	% vol.	Non gravelly	15-35	35-55	>55
Soil toxicity	Salinity	dS/m	Non saline	Upto 1.0	1.0-2.5	>2.5
	Sodicity	%	Non sodic	5-10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

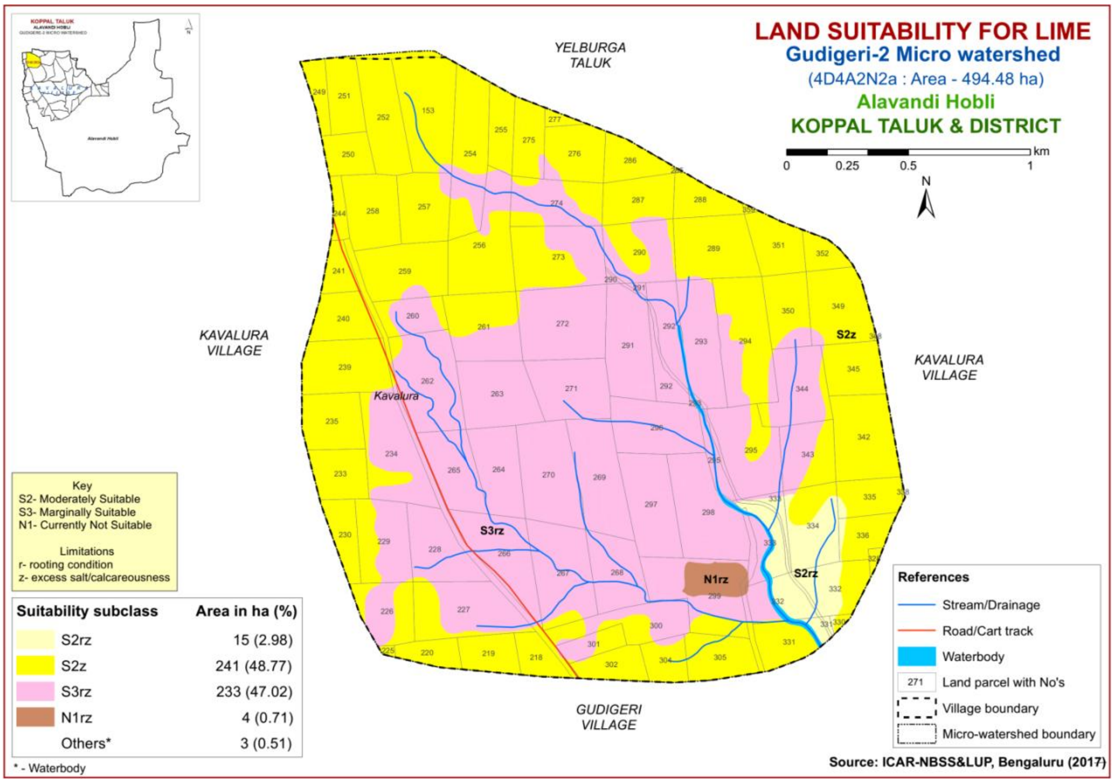


Fig. 7.17 Land Suitability map of Lime

An area of about 256 ha (52 %) is moderately suitable (Class S2) for growing lime and are distributed in the major part of the microwatershed with minor limitations of rooting depth and calcareousness. An area of about 233 ha (47%) is marginally suitable (Class S3) and occur in the central and southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness. Small area of about 4 ha (<1 %) is not suitable (Class N1) for growing lime and distributed in the southern part of the microwatershed with severe limitations of calcareousness and rooting depth.

7.18 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important nut crop grown in an area of 7052 ha in almost all the districts of the State. The crop requirements for growing cashew (Table 7.19) 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 7.18.

Entire area in the microwatershed is not suitable (Class N1) for growing cashew. They have severe limitations of texture, rooting depth and calcareousness.

Table 7.19 Land suitability criteria for Cashew

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Soil aeration	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V.Poorly drainage
Nutrient availability	Texture	Class				
	pH	1:2.5	5.5-6.5	5.0-5.5,6.5-7.3	7.3-7.8	>7.8
Rooting conditions	Soil depth	cm	>100	75-100	50-75	<50
	Gravel content	% vol.	<15	15-35	35-60	>60
Erosion	Slope	%	0-3	3-10	>10	

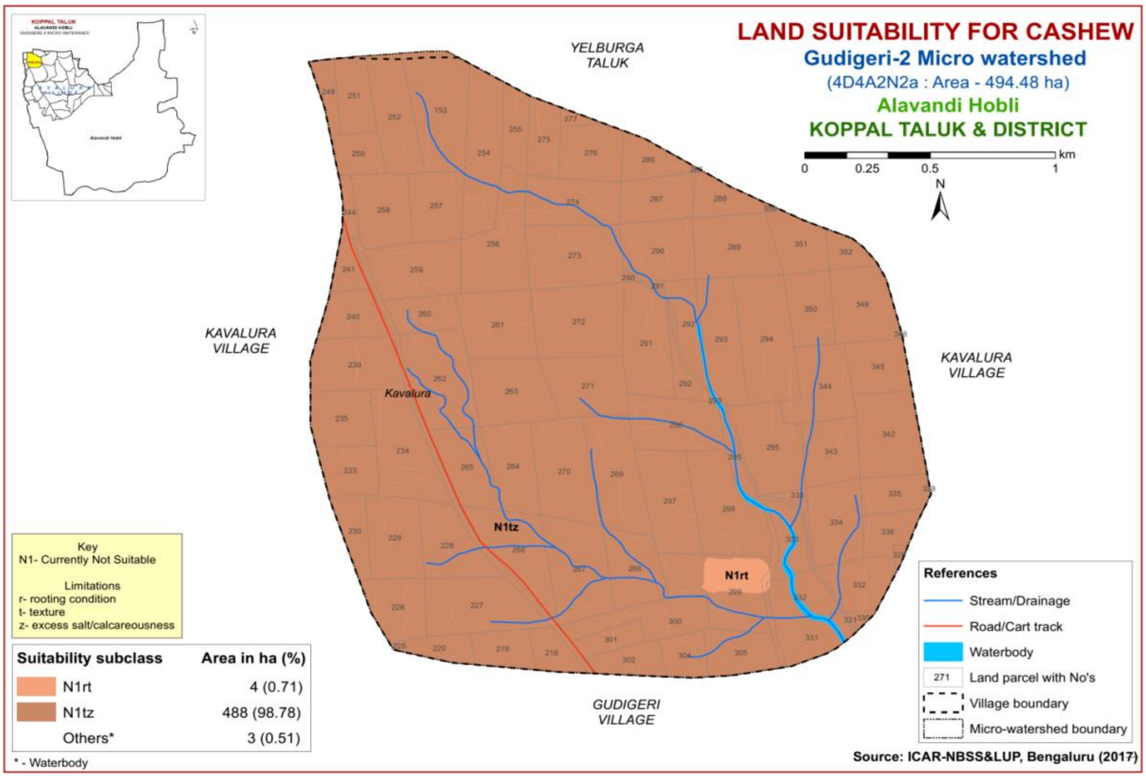


Fig. 7.18 Land Suitability map of Cashew

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

Custard apple is one of the most important fruit crop grown in 1426 ha in almost all the districts of the State. The crop requirements for growing custard apple (Table 7.20) 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 7.19.

Maximum area of about 489 ha (99%) is moderately suitable (Class S2) for growing custard apple and are distributed in the major part of the microwatershed. They have minor limitations of gravelliness, rooting depth and calcareousness. A small area of about 4 ha (<1 %) is marginally suitable (Class S3) and occur in the southern part of the microwatershed. They have moderate limitation of calcareousness.

Table 7.20 Land suitability criteria for Custard apple

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately Suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Soil aeration	Soil drainage	Class	Well drained	Mod. well drained	Poorly drained	V. Poorly drained
Nutrient availability	Texture	Class	Scl, cl, sc, c (red), c(black)	-	Sl, ls	-
	pH	1:2.5	6.0-7.3	7.3-8.4	5.0-5.5,8.4-9.0	>9.0
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15-35	35-60	60-80	-
Erosion	Slope	%	0-3	3-5	>5	-

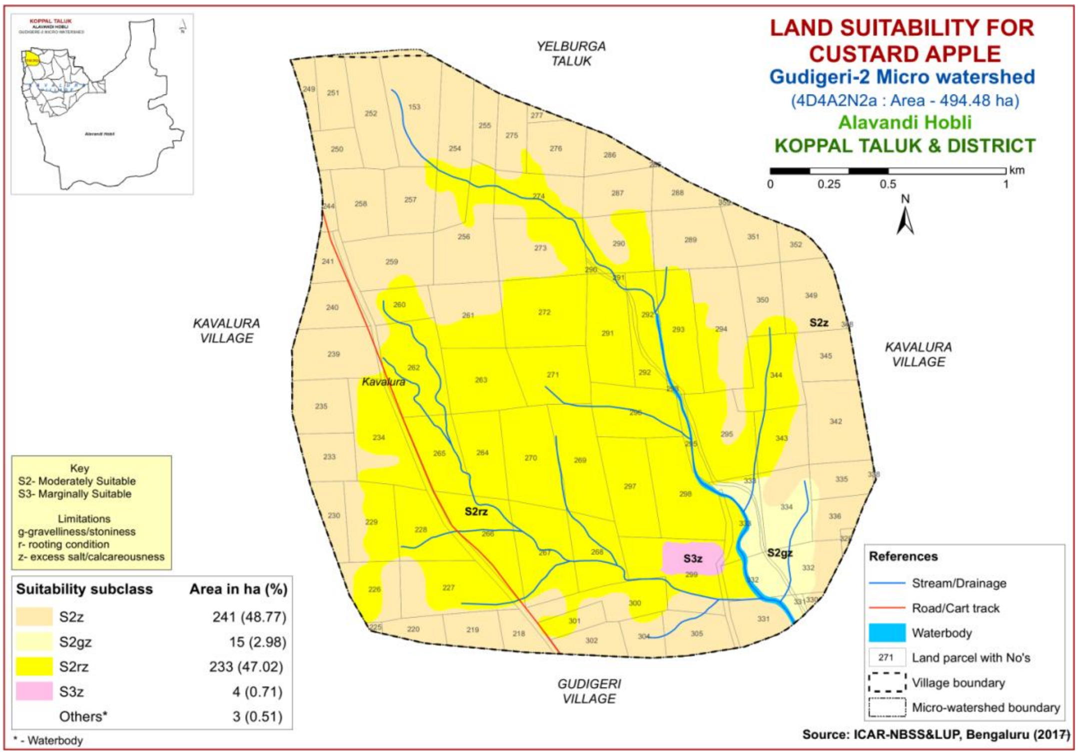


Fig. 7.19 Land Suitability map of Custard apple

7.20 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is the most important fruit and medicinal crop grown in an area of 151 ha and distributed in almost all the districts of the state. The crop requirements for growing amla (Table 7.21) 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 7.20.

Maximum area of about 489 ha (99%) has soils that are moderately suitable (Class S2) and are distributed in the major part of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. The marginally suitable (Class

S3) lands cover an area of about 4 ha (<1 %) and occur in the southern part of the microwatershed with moderate limitations of texture and calcareousness.

Table 7.21 Land suitability criteria for Amla

Crop requirement			Rating			
Soil –site characteristics		**Unit**	**Highly suitable(S1)**	**Moderately Suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Soil aeration	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V. Poorly drained
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	7.8-8.4	>8.4
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15-35	35-60	60-80	
Erosion	Slope	%	0-3	3-5	5-10	>10

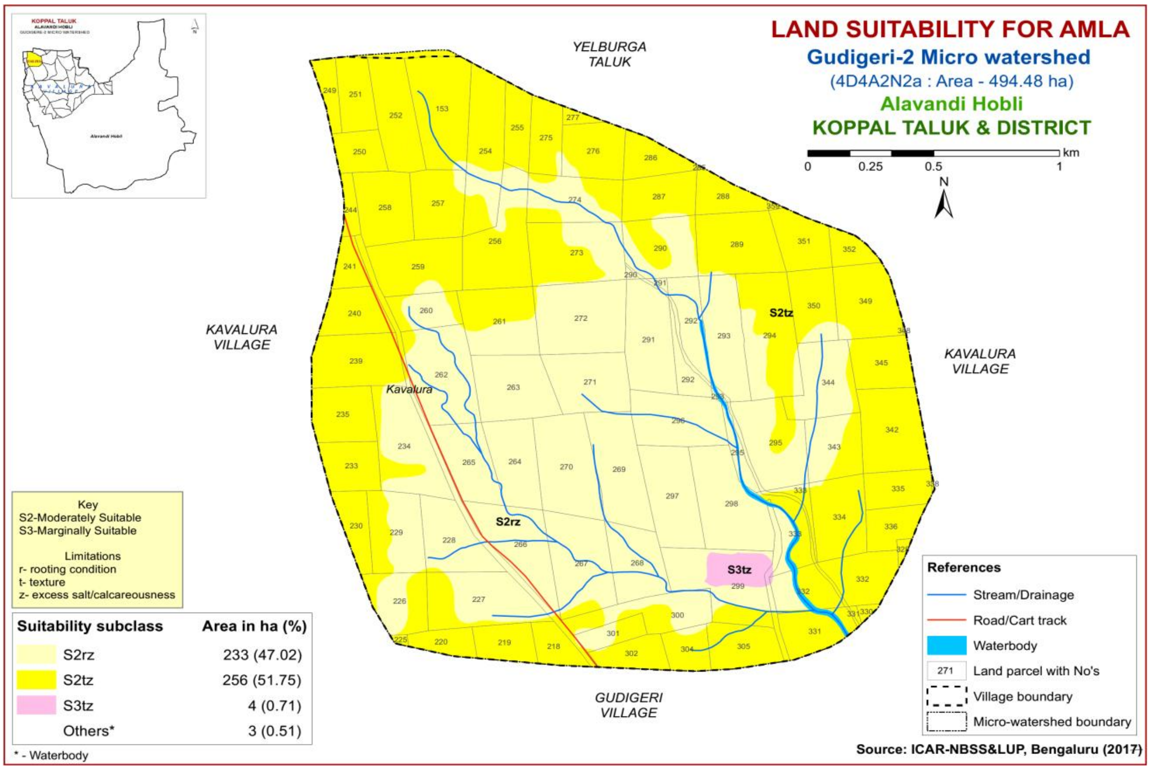


Fig. 7.20 Land Suitability map of Amla

7.21 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 7.22) 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 7.21.

There are no highly suitable lands (Class S1) for growing tamarind. An area of about 241 ha (49 %) is moderately suitable (Class S2) and distributed in the major part of the microwatershed. They have minor limitations of texture, rooting depth and calcareousness. An area of about 15 ha (3 %) is marginally suitable (Class S3) and occur in the southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness. An area of about 236 ha (48 %) is not suitable (Class N1) for growing tamarind and are distributed in the central and southern part of the microwatershed. They have severe limitations of rooting depth and calcareousness

Table 7.22 Land suitability criteria for Tamarind

Crop requirement			Rating			
Soil –site characteristics		Unit	Highly suitable(S1)	Moderately Suitable(S2)	Marginally suitable(S3)	Not suitable(N)
Soil aeration	Soil drainage	Class	Well drained	Mod.well drained	Poorly drained	V.Poorly drained
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
Rooting conditions	Soil depth	cm	>150	100-150	75-100	<75
	Gravel content	% vol.	<15	15-35	35-60	60-80
Erosion	Slope	%	0-3	3-5	5-10	>10

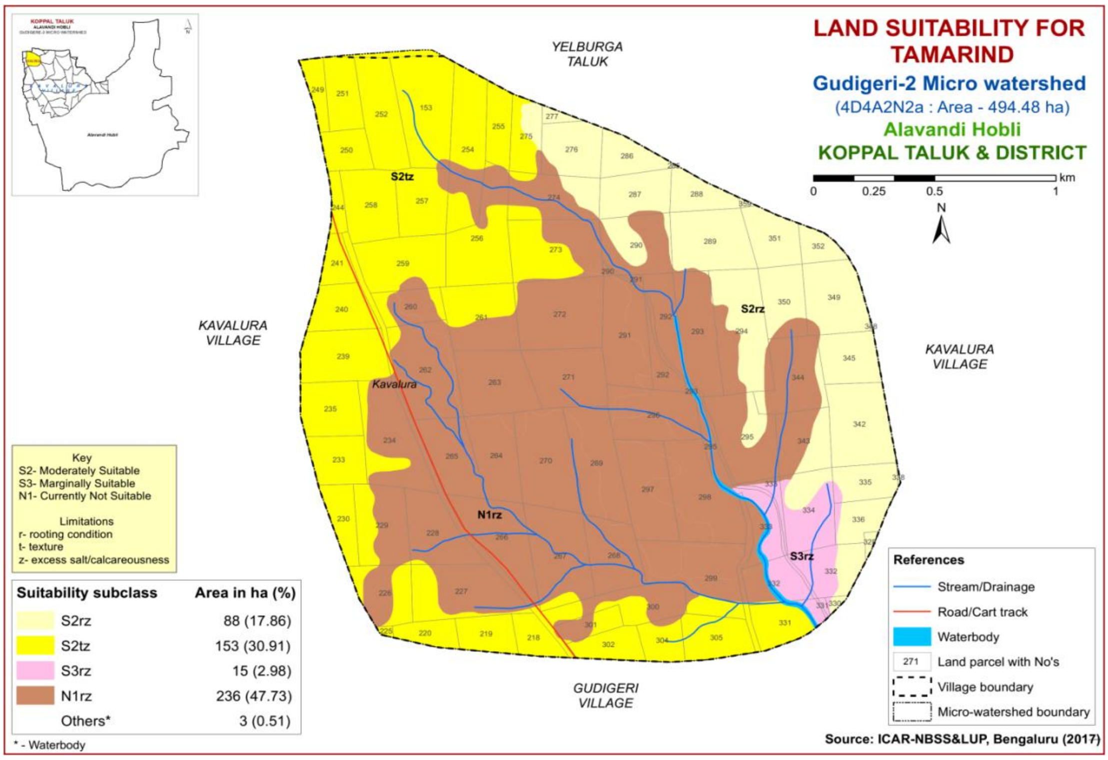


Fig. 7.21 Land Suitability map of Tamarind

7.22 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is the most important flower crop grown in an area of 9108 ha in almost all the districts of the state. The crop requirements for growing marigold (Table 7.23) 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 7.22.

Maximum area of about 489 ha (99%) is moderately suitable (Class S2) for growing marigold and occur in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness and texture. An area of about 4 ha (<1 %) is marginally suitable (Class S3) for growing marigold and occur in the southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness.

Table 7.23 Land suitability criteria for Marigold

Crop requirement			Rating			
Soil–site characteristics		Unit	Highly Suitable(S1)	Moderately Suitable(S2)	Marginally suitable(S3)	Not suitable(N)
climate	Temperature in growing season		18-23	17-15 24-35	35-40 10-14	>40 <10
Soil aeration	Soil drainage	class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	l ,sl, scl, cl, sil	sicl, sc, sic,c	c	ls, s
	pH	1:2.5	7.0-7.5	5.5-5.9,7.6-8.5	<5,>8.5	-
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	-
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
	Gravel content	% vol	<15	15-35	>35	-
Soil toxicity	Salinity	ds/m	Non saline	Slightly	Strongly	-
	Sodicity (ESP)	%	<10	10-15	>15	-
Erosion	Slope	%	1-3	3-5	5-10	-

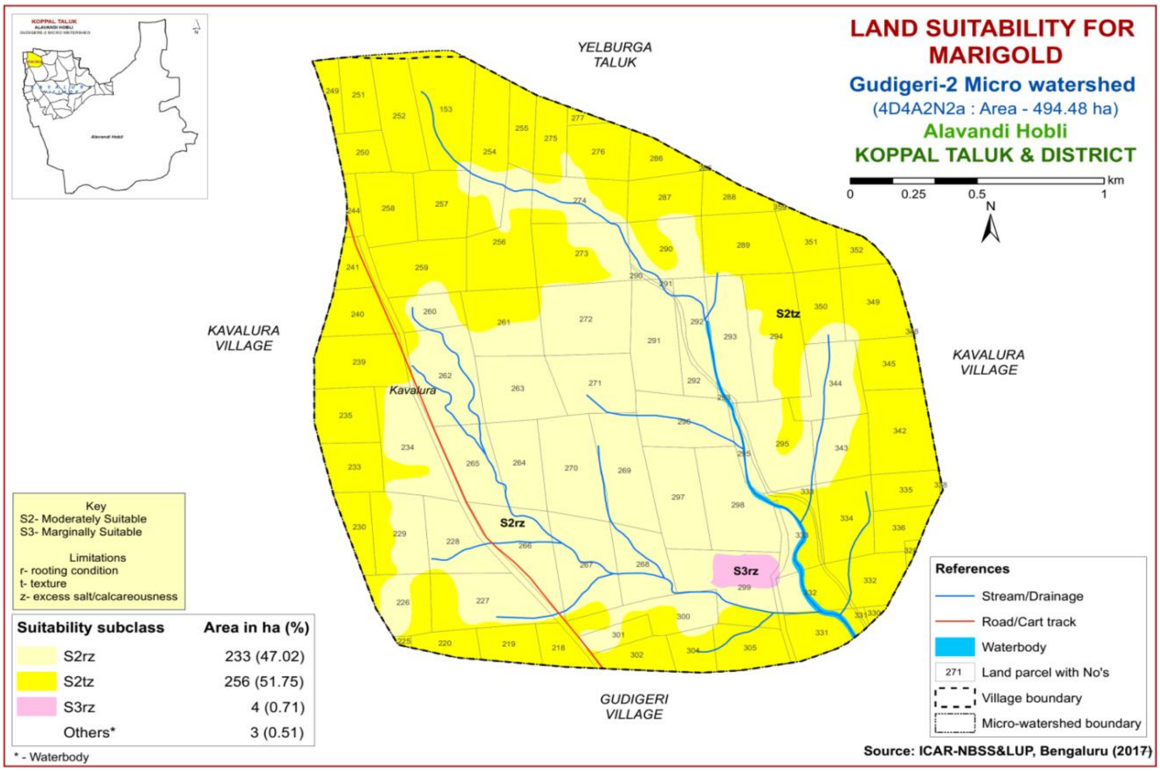


Fig. 7.22 Land Suitability map of Marigold

7.23 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 7.24) were matched with the soil-site characteristics 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 7.23.

Maximum area of about 489 ha (99%) is moderately suitable (Class S2) for growing chrysanthemum and occur in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness and texture. An area of about 4 ha (<1 %) is marginally suitable (Class S3) for growing chrysanthemum and occur in the southern part of the microwatershed. They have moderate limitations of rooting depth and calcareousness.

Table 7.24 Land suitability criteria for Chrysanthemum

Crop requirement			Rating			
Soil–site characteristics		Unit	Highly suitable(S1)	Moderately Suitable(S2)	Marginally suitable(S3)	Not suitable(N)
climate	Temperature in growing season	^{0}C	18-23	17-15 24-35	35-40 10-14	>40 <10
Soil aeration	Soil drainage	class	Well drained	Moderately well drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	l ,sl, scl, cl, sil	sicl, sc, sic, c	C	ls, s
	pH	1:2.5	7.0-7.5	5.5-5.9,7.6-8.5	<5,>8.5	
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	

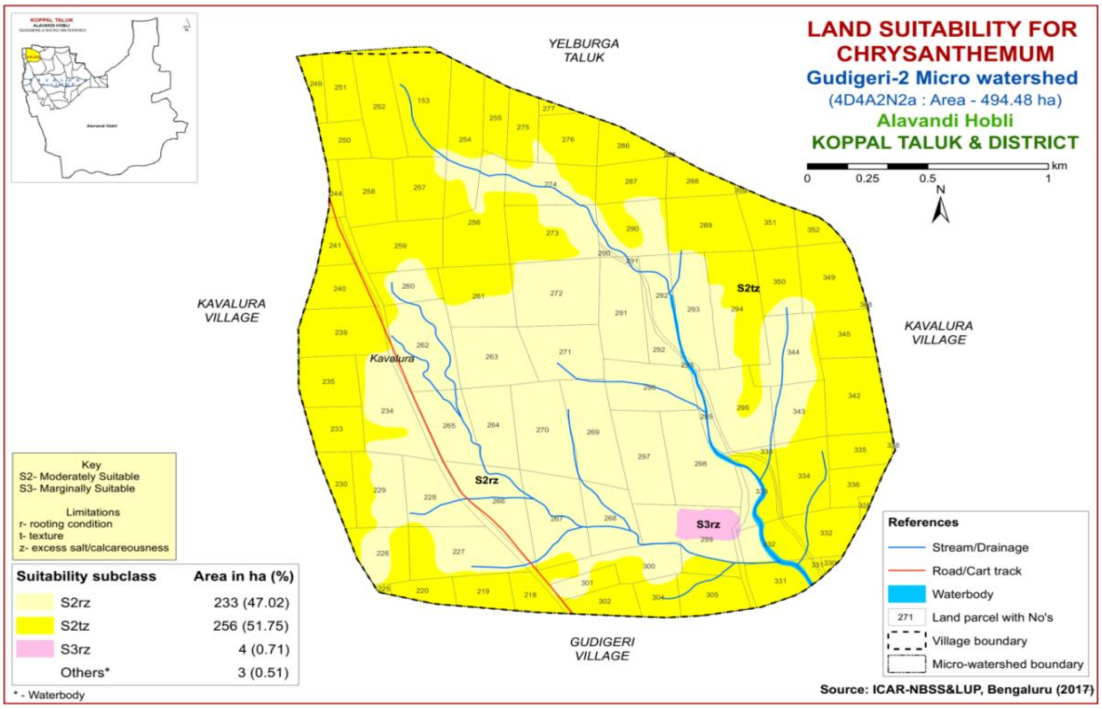


Fig. 7.23 Land Suitability map of Chrysanthemum

7. 24 Land Suitability for Jasmine *(Jasminum sp.)*

Jasmine is one of the most important flower crop grown in an area of 803 ha in almost all the districts of the State. The crop requirements (Table 7.25) 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 7.24.

Table 7.25 Land suitability criteria for jasmine (irrigated)

Crop requirement			Rating			
Soil-site characteristics		Unit	Highly suitable(S1)	Moderately suitable(S2)	Marginally suitable(S3)	Not suitable (N)
Climate	Temperature in growing season		18-23	17-15 24-35	35-40 10-14	
Soil aeration	Soil drainage	Class	Well drained	Moderately drained	Imperfectly drained	Poorly drained
Nutrient availability	Texture	Class	scl,l,scl,cl,sil	sicl,sc,sic,c (m/k)	c(ss),	ls, s
	pH	1:2.5	6.0-7.5	5.5-5.9:7.6-8.5	<5: >8.5	
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strong calcareous	
Rooting conditions	Soil depth	cm	>75	50-75	25-50	<25
	Gravel content	% vol.	<15	15-35	>35	
Soil toxicity	Salinity	ds/m	Non saline	Slight	Strongly	
	Sodicity	%	Non sodic	Slight	Strongly	
Erosion	Slope	%	1-3	3-5	5-10	

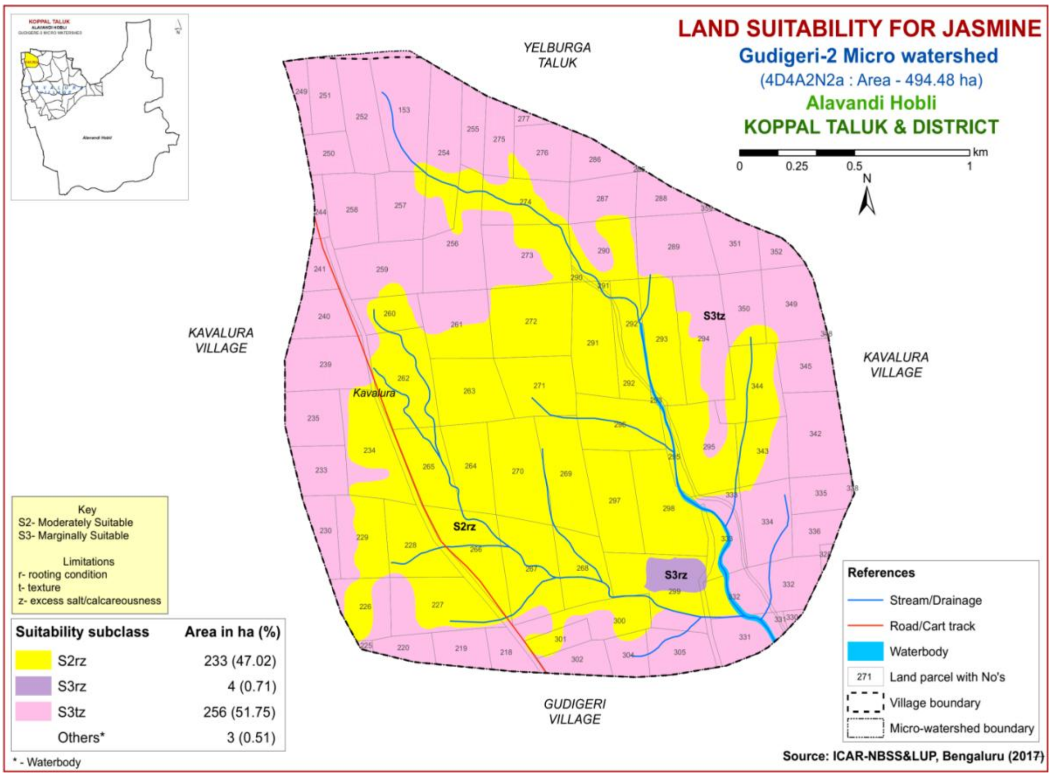


Fig. 7.24 Land Suitability map of Jasmine

An area of about 233 ha (47 %) is moderately suitable (Class S2) for growing jasmine and occur in the central and southern part of the microwatershed. They have minor limitations of rooting depth and calcareousness. An area of about 260 ha (52%) is marginally suitable (Class S3) for growing jasmine and occur in the major part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness.

7.25 Land Management Units (LMU)

The 8 soil map units identified in Gudigeri-2 microwatershed have been grouped into 4 Land Management Units (LMU) 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 (Fig.7.24) 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 four Land Management Units along with brief description of soil and site characteristics are given below.

LUC	Mapping unit	Soil and site characteristics
1	MLRmA2,MLRmB2 AWDmB2,GRHmB2	Very deep to deep, calcareous black soils with slopes of 0-3%,moderate erosion
2	DRLmB2g2	Moderately deep, calcareous black soils with slopes of 1-3%, moderate erosion, very gravelly (35-60%)
3	RNKmB2,RNKmB2g1	Moderately shallow, calcareous black gravelly sandy clay to clay soils with slopes of 1-3%, moderate erosion, gravelly (15-35%)
4	MTLiB2	Shallow, calcareous black clay soils with slopes of 1-3%, moderate erosion

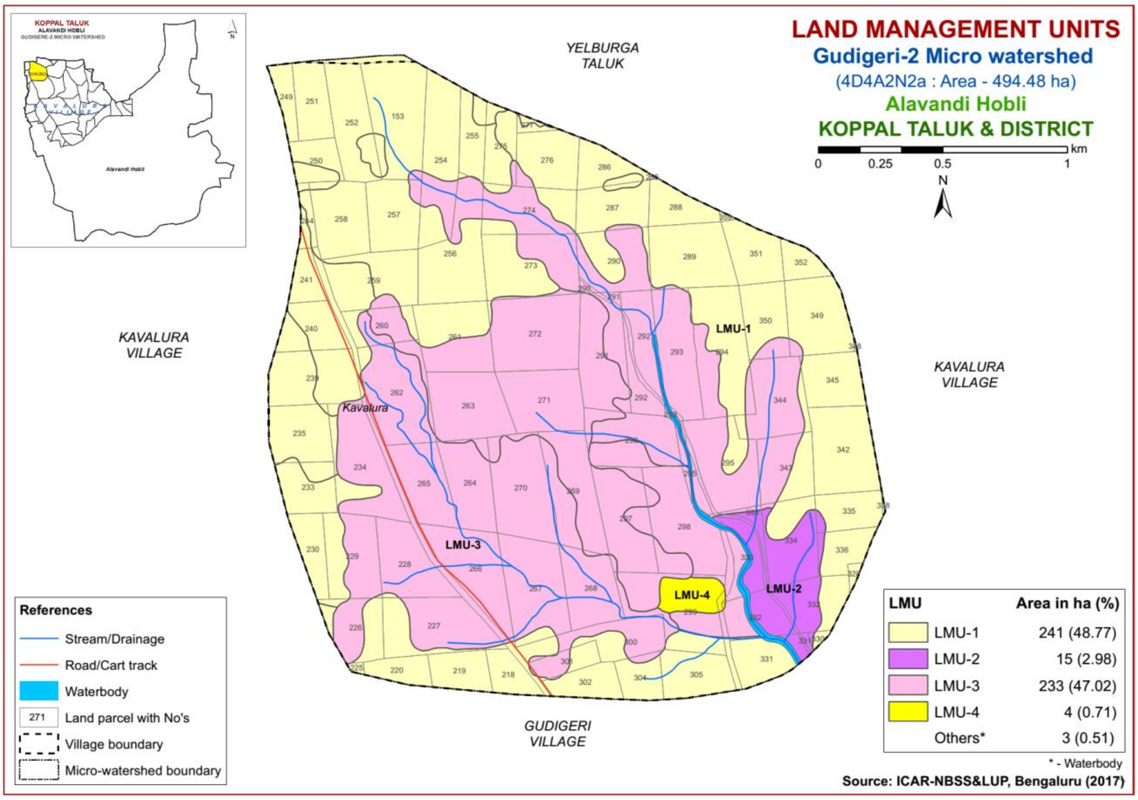


Fig. 7.25 Land Management Units map of Gudigeri-2 Microwatershed

Table 7.26 Proposed Crop Plan for Gudigeri-2 Microwatershed

Proposed Land use Class	Soil Map Units	Survey Number	Field Crops	Horticulture Crops	Suitable Interventions
1	413. MLRmA2 418. MLRmB2 424. AWDmB2 373. GRHmB2 (Deep to very deep, calcareous black clay soils)	**Kavalura:** 153,218,219,220,225,230,233,235, 239,240,241,244,249,250,251,252, 254,255,256,257,258,259,261,273, 275,276,277,285,286,287,288,289, 294,302,304,305,328,330,331,335, 336,338,342,345,348,349,350,351, 352,359	Sunflower, Sorghum, Cotton, Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Musambi, Lime, Pomegranate, Amla, Custard apple, Tamarind, Jamun, **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Chrysanthemum, Marigold	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, Suitable soil and water conservation practices
2	352. DRLmB2g2 (Moderately deep, calcareous black clay soils)	**Kavalura:** 332,333,334	Sorghum , Sunflower , Bajra, Safflower, Linseed, Bengal gram	**Fruit crops:** Pomegranate, Amla, Musambi Custard apple, Lime, **Vegetables:**Drumstick, Coriander **Flowers:** Chrysanthemum, Marigold	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
3	337. RNKmB2g1 336. RNKmB2 (Moderately shallow, calcareous black gravelly sandy clay to clay soils)	**Kavalura:** 226,227,228,229,234,260,262,263, 264,265,266,267,268,269,270,271, 272,274,290,291,292,293,295,296, 297,298,300,301,343,344	Bengal gram, Sorghum, Bajra	**Fruit crops:** Amla, Custard apple **Flowers:** Marigold, Jasmine, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
4	304. MTLiB2 (Shallow, calcareous black gravelly clay soils)	**Kavalura:** 299	Bengal gram, Horsegram	**Agri-Silvi-Pasture:** Hybrid Napier, *Styloxanthes hamata, Styloxanthes scabra*	Sowing across the slope, drip irrigation and mulching is recommended

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 unfavorable conditions occur

Characteristics of Gudigeri-2 Microwatershed

- ❖ The soil phases with sizeable area identified in the microwatershed belonged to the soil series of RNK (233 ha), MLR (123 ha), GRH (88 ha), AWD (29 ha), DRL (15 ha) and MTL (4 ha).
- ❖ As per land capability classification, entire area in the microwatershed falls under arable land category (Class III). The major limitations identified in the arable lands were texture, rooting depth and calcareousness.
- ❖ On the basis of soil reaction, an area of about 37 ha (7%) is strongly alkaline (pH 7.8-8.4) and 455 ha (92%) under very strongly alkaline (pH >9.0). Thus, all the soils in the microwatershed are 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.

Alkaline soils

(Slightly alkaline to strongly alkaline soils)

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

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. The entire area is suffering from moderate erosion. These areas 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 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, radish, 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 Gudigeri-2 Microwatershed.
- **Organic Carbon:** Maximum area of about 402 ha (81 %) is low in OC content and about 90 ha (18%) is medium (0.5-0.75%) 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 per cent in addition to the recommended level in the entire area where OC is less than 0.75 per cent. 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.

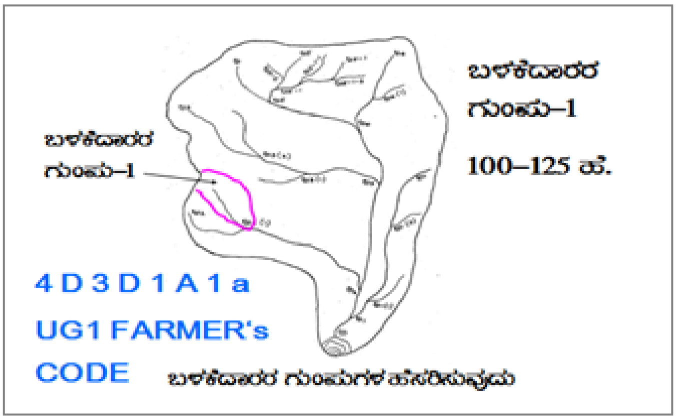
- **Available Phosphorus**: Entire area is low (<23 kg/ha) in available phosphorus. Additional 25 per cent phosphorus needs to be applied for better crop performance.
- **Available Potassium:** Available potassium is high (>337 kg/ha) in the entire area of the microwatershed. To avoid the excess application of fertilizer, reduce 25 per cent from the RDF.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. Available sulphur is low (<10 ppm) in 186 ha (38 %) area, medium in 133 ha (27 %) and high (>20 ppm) in 173 ha (35%) area of the microwatershed. The areas that are low and medium 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 iron:** It is sufficient in the entire area of the microwatershed.
- **Available Zinc:** It is deficient (<0.6 ppm) in the entire area of the microwatershed. Application of zinc sulphate @ 25kg/ha is to be followed in areas that are deficient in available zinc.
- **Available Boron:** An area of about 208 ha (42%) is low (<0.5 ppm) in available boron, medium (05-1.0 ppm) in 43 ha (9%) and high (>1.0 ppm) in 241 ha (49 %). The areas with low and medium in boron content 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 Manganese and Copper:** It is sufficient in the entire area of the microwatershed.
- **Soil alkalinity:** The entire area in the microwatershed has soils that are strongly to very strongly alkaline. These areas need application of gypsum and wherever calcium is in excess, iron pyrites and element sulphur can be recommended. Management practices like treating repeatedly with good quality water to drain out the excess salts and provision of subsurface drainage and growing of salt tolerant crops like Casuarina, Acasia, Neem, Ber etc, are recommended.

Land Suitability for various crops: Areas that are highly, moderately and marginally suitable and not suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth and salinity/alkalinity are the major constraints in various plots. With suitable management interventions, the productivity can be enhanced. In order to increase water holding capacity of light textured soils, growing of green manure crops and application of organic manure is recommended.

SOIL AND WATER CONSERVATION TREATMENT PLAN

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

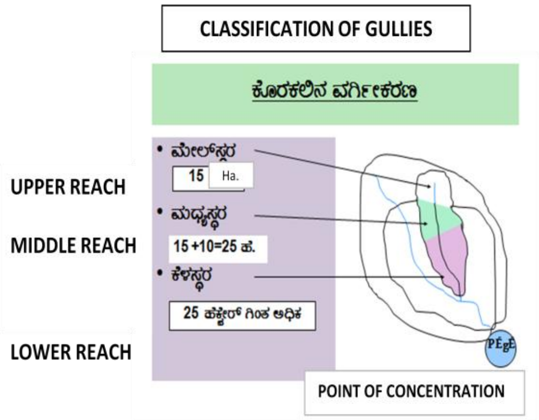
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

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

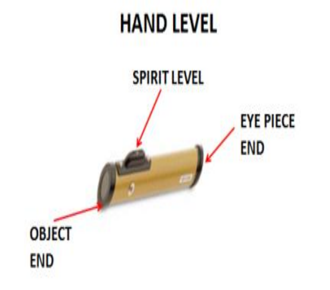
9.1.1 Arable Land Treatment

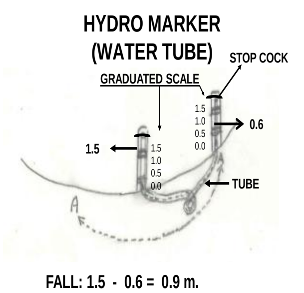
A. BUNDING

<table>
<tr><td colspan="2">Steps for Survey and Preparation of Treatment Plan</td><td rowspan="6">USER GROUP-1

</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td>Small gullies</td><td>(up to 5 ha catchment)</td></tr>
<tr><td>Medium gullies</td><td>(5-15 ha catchment)</td></tr>
<tr><td>Ravines</td><td>(15-25 ha catchment) and</td></tr>
<tr><td>Halla/Nala</td><td>(more than 25ha catchment)</td></tr>
</table>

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 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.

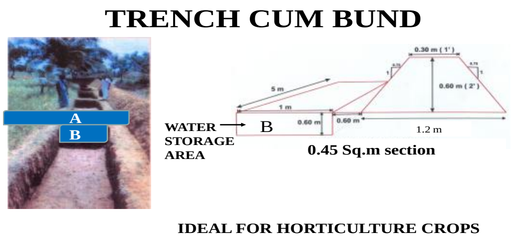
Recommended Bund Section

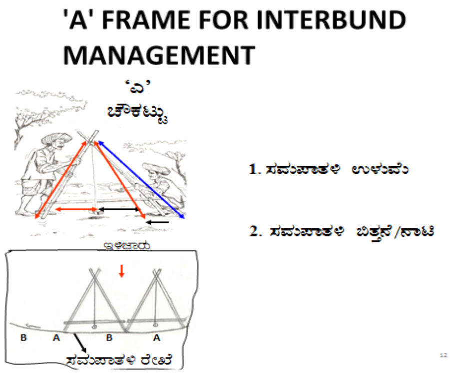
Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3	2.1	0.6	1.5:1	0.72	Very shallow clayey black soils	
0.45	2	0.75	01:01	0.92	Clayey	
0.45	2.4	0.75	1.3:1	1.07	Shallow black soils	
0.6	3.1	0.7	1.78:1	1.29	Medium clayey black 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 drainge 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 Levelling 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 earthern checks in the natural water course. Location and design details are given in the Manual.

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with different kinds of structures recommended has been prepared which shows the spatial distribution and extent of area. Maximum area of about 481 ha (97%) needs graded bunding. A small area of about 11 ha (2%) needs strengthening of the existing bunds/ bunding. The conservation plan prepared may be presented to all the stakeholders including farmers and after considering their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.

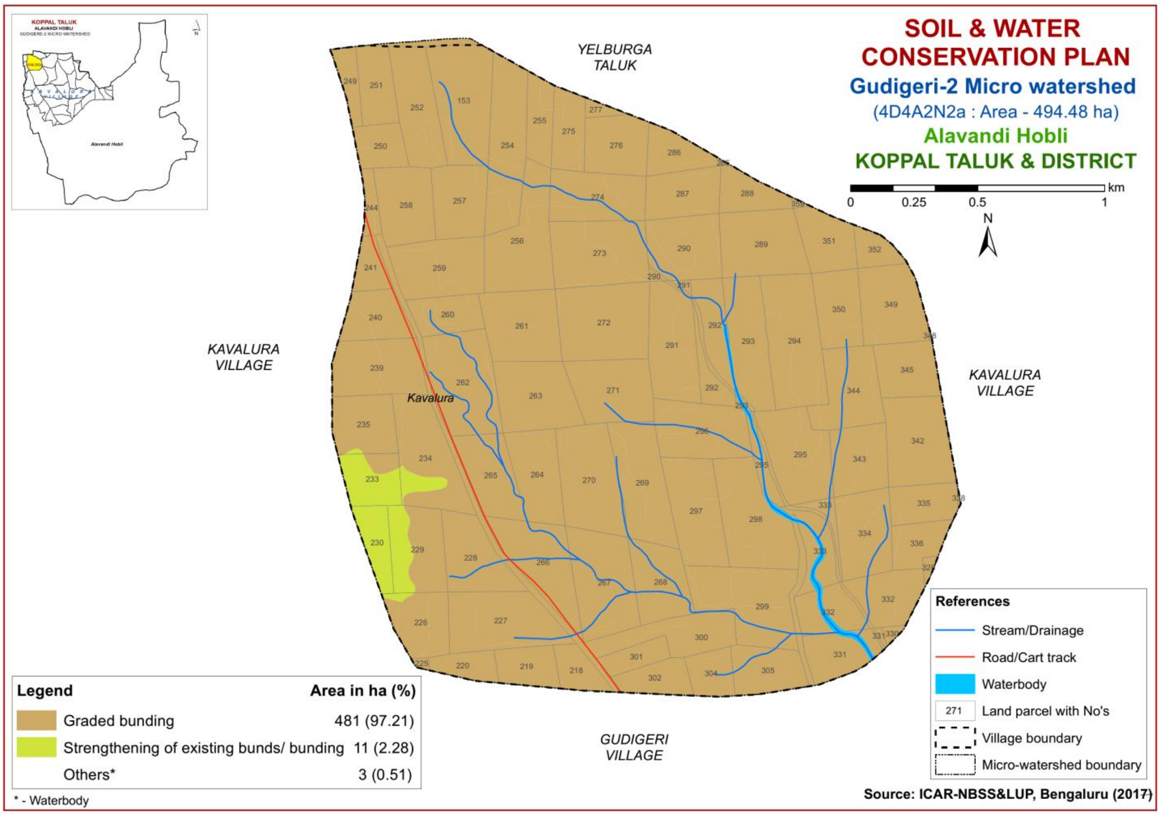


Fig. 9.1 Soil and Water Conservation Plan map of Gudigeri-2 Microwatershed

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 dugout 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

Gudigeri-2 Microwatershed

Soil Phase Information

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kavalur	153	10.61	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	1 Farm pond	IIIe	Graded bunding
Kavalur	218	2.77	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	219	3.59	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	220	2.57	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	225	0.25	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	226	5.49	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	227	9.4	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	2 Farm pond	IIIes	Graded bunding
Kavalur	228	6.68	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	229	7.2	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Sunflower+Current fallow (Sf+Cf)	Not Available	IIIes	Graded bunding
Kavalur	230	3.39	MLRmA2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Moderate	Current fallow+Bengalgram (Cf+Bg)	Not Available	IIIe	Field bunds/ bunding
Kavalur	233	4.55	MLRmA2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Nearly level (0-1%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Field bunds/ bunding
Kavalur	234	9.55	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Fallow land (Fl)	1 Farm pond	IIIes	Graded bunding
Kavalur	235	5.63	AWDmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	239	7.67	AWDmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	240	4.63	AWDmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	241	2.31	AWDmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	244	1.47	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	249	2.1	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	250	3.27	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	251	4.28	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kavalur	252	7.52	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	254	9.42	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Fallow land (Cf+Fl)	Not Available	IIIe	Graded bunding
Kavalur	255	3.44	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	256	9.34	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	257	5.93	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Bengalgram (Cf+Bg)	Not Available	IIIe	Graded bunding
Kavalur	258	6.5	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	259	7.9	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	260	3.94	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	261	8.06	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	262	10.03	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	1 Borewell	IIIes	Graded bunding
Kavalur	263	8.14	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	264	6.45	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	265	6.3	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	266	8.19	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Fallow land (Cf+Fl)	Not Available	IIIes	Graded bunding
Kavalur	267	9.59	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	2 Farm pond	IIIes	Graded bunding
Kavalur	268	6.29	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	1 Farm pond	IIIes	Graded bunding
Kavalur	269	8.85	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Bengalgram (Jw+Bg)	Not Available	IIIe	Graded bunding
Kavalur	270	9.56	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	271	7.62	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	272	10.53	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	273	9.54	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	274	7.18	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	275	3.97	MLRmB2	LMU-1	Very deep (>150	Clay	Non gravelly	Very high	Very gently	Moderat	Current fallow	Not	IIIe	Graded

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
					cm)		(<15%)	(>200 mm/m)	sloping (1-3%)	e	(Cf)	Available		bunding
Kavalur	276	5.62	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIe	Graded bunding
Kavalur	277	0.7	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	285	0.04	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	Not Available	IIIe	Graded bunding
Kavalur	286	3.62	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	287	5.28	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	288	3.51	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	289	8.29	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	Not Available	IIIe	Graded bunding
Kavalur	290	7.09	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalur	291	8.47	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	292	5.94	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	293	7.83	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Fallow land (Cf+Fl)	Not Available	IIIes	Graded bunding
Kavalur	294	10.89	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	295	9.99	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	296	7.89	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	297	8.22	RNKmB2	LMU-3	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Bengalgram (Cf+Bg)	Not Available	IIIe	Graded bunding
Kavalur	298	10.08	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	299	10.44	MTLiB2	LMU-4	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	300	6.3	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	301	2.39	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	302	3.37	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	304	3.07	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	305	4.92	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	328	0.39	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly	Very high	Very gently	Moderat	Current fallow	Not	IIIe	Graded

Village	Survey No	Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
							(<15%)	(>200 mm/m)	sloping (1-3%)	e	(Cf)	Available		bunding
Kavalur	330	0.4	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIe	Graded bunding
Kavalur	331	4.88	MLRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	Not Available	IIIe	Graded bunding
Kavalur	332	9.21	DRLmB2g2	LMU-2	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	333	4.76	DRLmB2g2	LMU-2	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	334	6.95	DRLmB2g2	LMU-2	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	335	3.94	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	336	3.4	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	338	0.06	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	342	8.62	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	343	5.75	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalur	344	7.32	RNKmB2g1	LMU-3	Moderately shallow (50-75 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Bengalgram (Cf+Bg)	Not Available	IIIes	Graded bunding
Kavalur	345	5.06	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	348	0.04	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	349	7.37	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	350	5.3	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	351	4.73	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	352	2.16	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalur	359	0.15	GRHmB2	LMU-1	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Currentfallow+Jowar+Ben+Jowar+Bengalgram (Cf+Jw+Bg)	Not Available	IIIe	Graded bunding

Appendix II

Gudigeri-2 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
Kavalura	153	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	218	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	219	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	220	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	225	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	226	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	227	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	228	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	229	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	230	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	233	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	234	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	235	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	239	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	240	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	241	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	244	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	249	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	250	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	251	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	252	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	254	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	255	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	256	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	257	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	258	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	259	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	260	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	261	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	262	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	263	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	264	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	265	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	266	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	267	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	268	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	269	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	270	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	271	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	272	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	273	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	274	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	275	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	276	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	277	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	285	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	286	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	287	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	288	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	289	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	290	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	291	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	292	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	293	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	294	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	295	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	296	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	297	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	298	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	299	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	300	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	301	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	302	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	304	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	305	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	328	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	330	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	331	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	332	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	333	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	High (> 20ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Village	Survey Number	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	334	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	335	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	336	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	338	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	342	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	343	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	344	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	345	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	348	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	349	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	350	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	351	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	352	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Low (< 10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	359	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	High (> 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)

Appendix III

Gudigeri-2 Microwatershed

Soil Suitability Information

Village	Survey No.	Mango	Maize	Sapota	Sorghum	Guava	Tamarind	Lime	Sunflower	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Drumstick	Mulberry
Kavalura	153	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	218	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	219	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	220	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	225	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	226	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	227	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	228	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	229	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	230	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	233	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	234	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	235	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	239	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	240	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	241	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	244	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	249	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	250	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	251	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	252	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	254	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	255	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	256	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	257	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	258	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	259	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	260	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	261	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	262	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	263	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	264	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	265	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	266	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	267	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	268	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	269	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	270	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	271	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	272	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	273	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz

Kavalura	274	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	275	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	276	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	277	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	285	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	286	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	287	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	288	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	289	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	290	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	291	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	292	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	293	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	294	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	295	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	296	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	297	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	298	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	299	N1rt	S3tz	N1rz	S3rz	N1rt	N1rz	N1rz	N1rz	S3tz	N1rt	S3z	N1rt	N1rt	N1rz	S3tz	S3rz	S3rz	S3rz	S3rz	N1rz	S3rz	S3rz	N1rz	S3rz
Kavalura	300	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	301	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	302	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	304	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	305	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	328	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	330	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	331	S3tz	S3tz	S3tz	S2z	S3tz	S2tz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2tz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	332	S3rz	S3tz	S3tz	S2zg	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2gz	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	333	S3rz	S3tz	S3tz	S2zg	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2gz	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	334	S3rz	S3tz	S3tz	S2zg	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2gz	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	335	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	336	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	338	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	342	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	343	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	344	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz
Kavalura	345	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	348	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	349	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	350	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	351	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	352	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	359	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz

PART-B

SOCIO-ECONOMIC STATUS OF FARM HOUSEHOLDS

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Chapter 1

EXECUTIVE SUMMARY

Baseline socioeconomic characterisation is prerequisite to prepare action plan for program implementation and to assess the project performance before making any changes in the watershed development program. The baseline provides appropriate policy direction for enhancing productivity and sustainability in agriculture.

Methodology: *The Gudigeri-2 micro-watershed is located between $15^0 19'$ – $15^0 21'$ North latitudes and $75^0 53'$ – $75^0 55'$ East longitudes, covering an area of about 494.48 and bounded by Kavalura, Gudigeri villages and Yelburga Taluk in Koppal taluk and district. It falls under Agro Ecological Region (AER)–3: (Deccan plateau, hot arid ecosubregion) Karnataka Plateau (Rayalseema as inclusion), hot arid ESR with deep loamy and clayey mixed red and black soils, low to medium AWC and LGP 60-90 days We used soil resource map as basis for sampling farm households to test the hypothesis that soil quality influence crop selection, and conservation investment of farm households. The level of technology adoption and productivity gaps and livelihood patterns were analyses. The cost of soil degradation and ecosystem services were quantified for each watershed.*

Results: *We found that*

Social Indicators;

- *Male and female ratio is 58 to 42 per cent to the total sample population.*
- *Younger age groups of population is around 54 per cent to the total population.*
- *Literacy population is around 81 per cent.*
- *Wood is the source of energy for a cooking among 50 per cent.*
- *Majority of farm households (75 %) are having MGNREGA card for rural employments.*
- *Dependence on ration cards through public distribution system is around 75 per cent.*
- *Swach bharath program providing closed toilet facilities around 50 per cent of sample households.*
- *Institutional participation is only 3.9 per cent of sample households.*
- *Rural migration to unban centre for employment is prevent among 33 per cent of farm households.*
- *Women participation is decision making is not found.*

Economic Indicators;

- *The average land holding is 4.02 ha indicates that majority of farm households are belong to marginal and small farmers.*

- *Agriculture is the main occupation only among 7 per cent and agricultural labours is predominant subsidiary occupation for 80 per cent of sample households.*
- *The average value of domestic assets is around Rs 17125 per household. Mobile and television are mass popular mass communication media.*
- *The average farm assets values is around 1.2 lakhs, about 75 per cent of sample farmers are owing tractors.*
- *The average per capita food consumption is around 643 grams (1443 kilo calories) against national institute of nutrition recommendation at 827 gram. Around 75 per cent of sample farmers are consuming less than the NIN recommendation.*
- *The annual average income is around Rs 11683 per household. About 100 per cent of farm households are below poverty line.*
- *The per capita monthly expenditure is around Rs 775 per household.*

Environmental Indicators-Ecosystem Services;

- *The value of ecosystem service helps to support investment to decision on soil and water conservation and in promoting sustainable land use.*
- *The onsite cost of different soil nutrients lost due to soil erosion is around Rs 5756 per ha/year. The total cost of annual soil nutrients is around Rs 2806682 per year for the total area of 494.8 ha.*
- *The average value of ecosystem service for food production is around Rs 2163/ ha/year. Per ha food production services is maximum in sunflower (Rs 3055 /ha) followed by green gram (Rs 2522/ha), groundnut (Rs 1574) and sorghum (1554).*
- *The average value of ecosystem service for fodder production is around Rs 5867/ ha/year. Per ha fodder production services is maximum in maize (Rs 3000 /ha) followed by sorghum (Rs 1600 /ha) and groundnut (Rs 1000/ha).*
- *The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum in green gram (Rs 34116) followed by sorghum (Rs 22586), sunflower (Rs 16628), groundnut (Rs 11453) and Maize (Rs 6037).*

Economic Land Evaluation;

- *The major cropping pattern is green gram (32 %) followed by Groundnut (19.4 %), maize (19.4 %), sunflower (16.1%) and sorghum (12.9 %).*
- *In Gudigeri-2 micro watershed, major soils are Muttal (MTL) series are having shallow soil deep. On this soil farmers are presently growing green gran (50 %) and groundnut (50 %). Ravanki (RNK) soil series are having moderately shallow soil depth cover around 47 per cent of area, major crops grown are maize. Gatareddaha (GRH) soil series are having deep soil depth covers around 17 % of*

area, the major crop grown is sunflower and Murlapur (MLR) soil series are Very deep soil deep cover around 25 % of area, the crops grown are green gram (50%) and sorghum (50 %).

- *The total cost of cultivation in study area for green gram ranges between Rs.14140/ha in MLR soil (with BCR of 1.33) and Rs.12466/ha in MTL soil (with BCR of 1.19).*
- *In groundnut the cost of cultivation in MTL soil is Rs.14355/ha (with BCR of 1.23).*
- *In maize the cost of cultivation in RNK soil is Rs.12633/ha (with BCR of 1.08).*
- *In sunflower the cost of cultivation in soil GHR is Rs.13056/ha (with BCR of 1.32) and Sorghum cost of cultivation in MLR soil is Rs.14007/ha (with BCR of 1.18).*

Suggestions;

- *Involving farmers is watershed planning helps in strengthing institutional participation.*
- *The per capita food consumption and monthly income is very low. Diversifying income generation activities from crop and livestock production in order to reduce risk related to drought and market prices.*
- *Majority of farmers reported that they are not getting timely support/extension services from the concerned development departments.*
- *By strengthing agricultural extension for providing timely advice improved technology there is scope to increase in net income of farm households.*
- *By adopting recommended package of practices by following the soil test fertiliser recommendation, there is scope to increase yield in green gram (20 %), groundnut (53.7%), maize (91.3%), sorghum (60%) and sunflower (55.6%).*

Chapter 2

INTRODUCTION

Sujala is a Watershed Development Project conceptualised by the Government of Karnataka and implemented by the Watershed Development Department of Government of Karnataka with tripartite cost-sharing arrangements. The World Bank through International Development Association provided major portion of plan outlay as a loan to Government of India and in turn loan to Government of Karnataka.

The Project Development Objective of Sujala-III is to demonstrate more effective watershed management through greater integration of programs related to rainfed agriculture, innovative and science based approaches and strengthened institutions and capacities. The project is implemented in 11 districts of Bidar, Vijayapura, Gulbarga, Yadgiri, Koppal, Gadag, Raichur, Davanagere, Tumkur, Chikkamangalur and Chamarajanagar which have been identified by the Watershed Development Department based on rainfall water and socio-economic conditions. The project will be implemented over six years and linked with the centrally financed IWMP.

The present study aims to characterize socio-economic status of farm households, assess the land and water use status, evaluate the economic viability of land use and prioritize farming constraints and suggest the measures for soil and water conservation for sustainable agriculture.

Objectives of the study

1. To characterize socio-economic status of farm households
2. To evaluate the economic viability of land use and land related constraints
3. To estimate the ecosystem service provided by the watershed and
4. To suggest alternatives for sustainable agriculture production.

Chapter 3

METHODOLOGY

Study area

Agro-climatic Zone 3: Northern Dry Zone: This zone is the largest in the state with a geographical area of 5.04 M ha, of which about 3.55 M ha is under cultivation. Irrigation is available to about 0.49 M ha. The zone encompasses the entire districts of Bijapur and Bellary, 6 taluks of Koppal, 5 taluks of Dharwad and 5 taluks of Belgaum. Of the 35 taluks in the zone, 9 taluks have a mean elevation of 800-900 m MSL while the rest have an elevation of 450-800 m. The rainfall is similar to that of the northeastern dry zone, ranging between 465 and 785 mm. Black soils are predominant in the zone with depth ranging from shallow to deep. General cropping season is *kharif* in shallow black soils and *rabi* in medium and deep black soils. Important crops grown are jowar, maize, bajra, groundnut, pulses, sunflower, cotton and sugarcane.

The Gudigeri-2 micro-watershed (Koppal taluk and district) is located between 15^{0}19’ – 15^{0}21’ North latitudes and 75^{0}53’ – 75^{0}55’ East longitudes, covering an area of about 494.48 and bounded by Kavalura, Gudigeri villages and Yelburga Taluk. It falls under **Agro Ecological Region (AER)–3: (Deccan plateau, hot arid ecosubregion)** Karnataka Plateau (Rayalseema as inclusion), hot arid ESR with deep loamy and clayey mixed red and black soils, low to medium AWC and LGP 60-90 days (Figure 1).

Sampling Procedure

In this study we have followed soil variability as criterion for sampling the farm households. In each micro-watershed the survey numbers and associated soil series are listed. Minimum three farm households for each soil series were taken and summed up to arrive at total sample for analysis.

Sources of data and analysis

For evaluating the specific objectives of the study, primary data was collected from the sample respondents by personal interview method with the help of pre-tested questionnaire. The data on socio-economic characteristics of respondents such as family size and composition, land holdings, asset position, occupational pattern and education level was collected. The present cropping pattern and the level of input use and yields collected during survry. The data collected from the representative farm households were analysed using Automated Land Potential Evalution System (Figure 2).

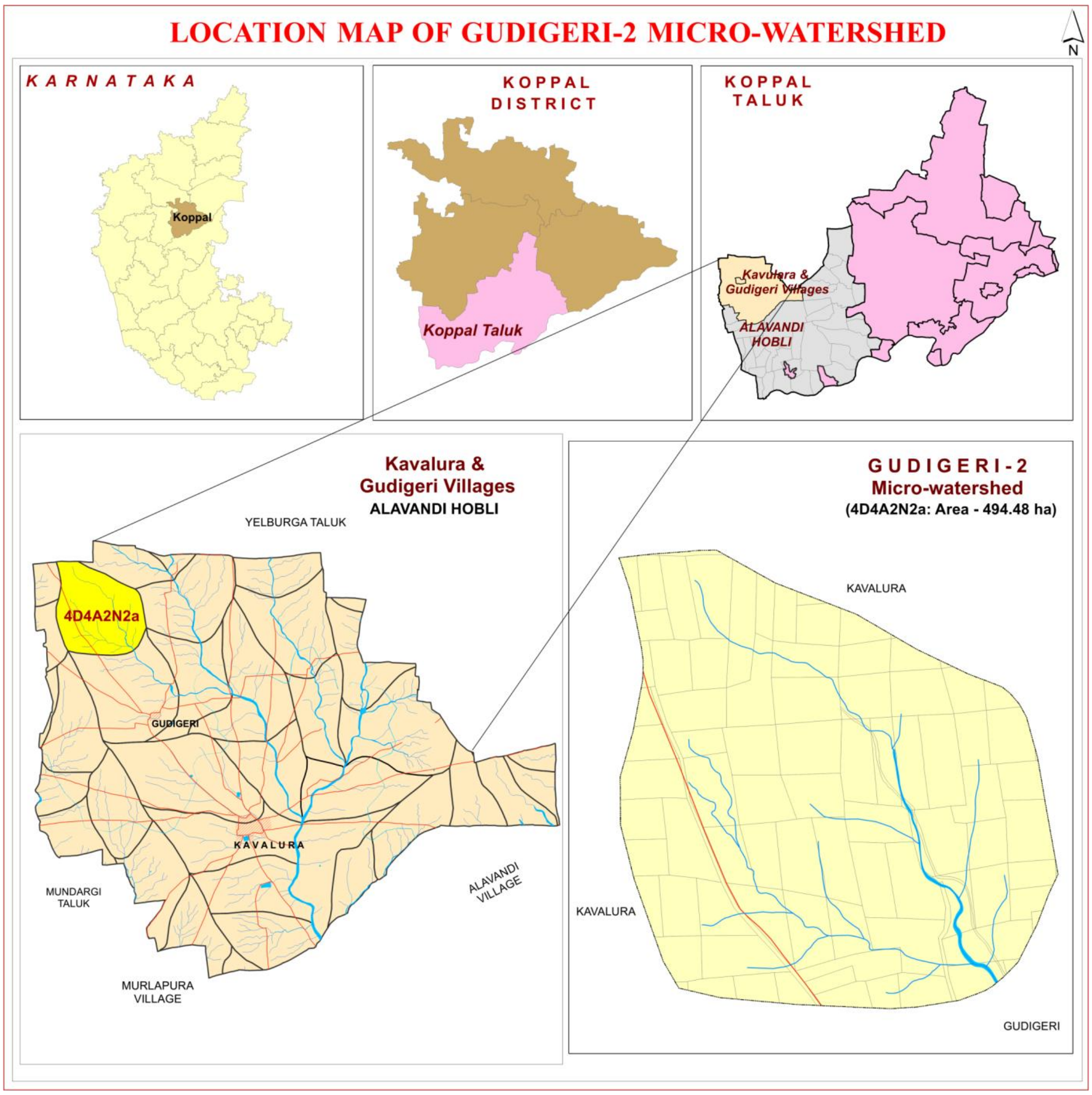
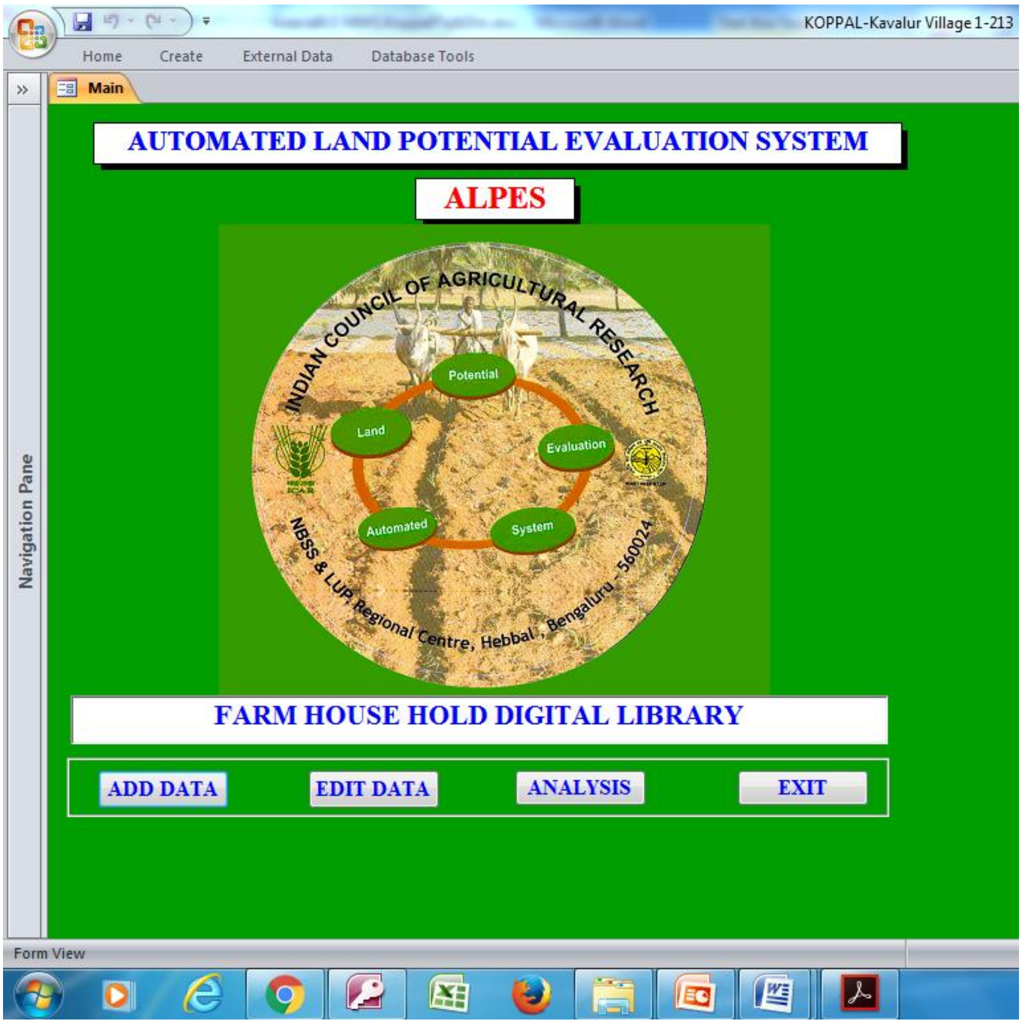


Figure 1: Location of study area

Steps followed in socio-economic assessment

1. After the completion of soil profile study link the cadastral number to the soil profile in the micro watershed.
2. Download the names of the farmers who are owning the land for each cadastral number in the Karnataka BHOOMI Website.
3. Compiling the names of the farmers representing for all the soil profiles studied in the micro watershed for socio-economic Survey.
4. Conducting the socioeconomic survey selected farm households in the micro watershed .
5. Farm households database created using the Automated Land Potential Evaluation System (ALPES) for analysis of socio economic status for each micro watershed .
6. Synthesis of tables and preparation of report for each micro watershed .



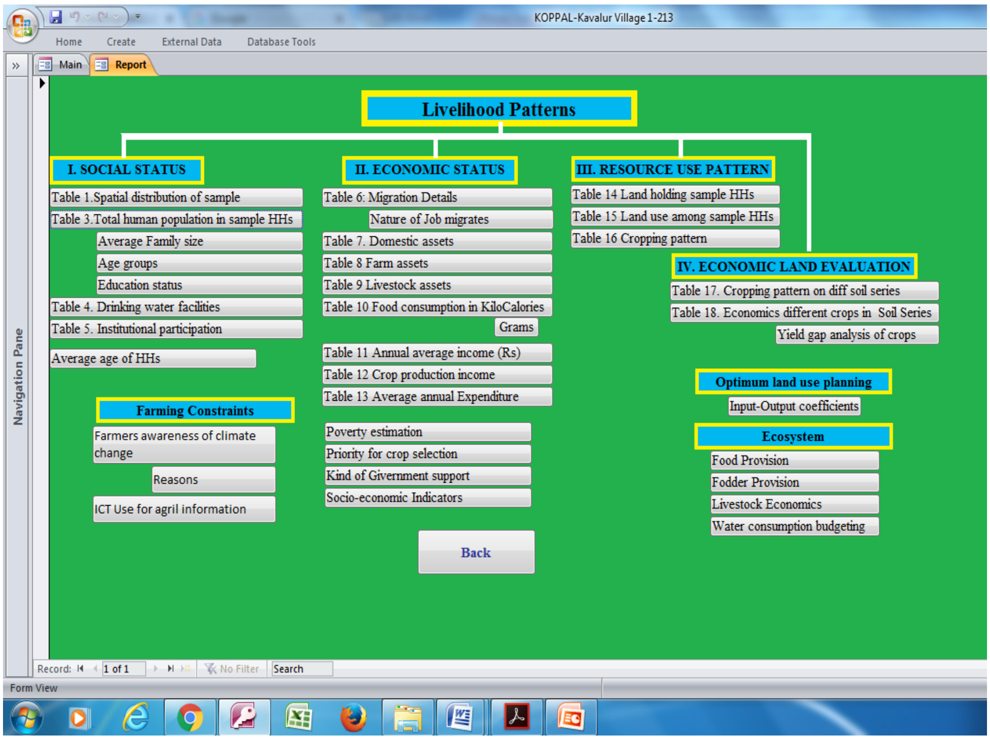


Figure 2: ALPES FRAMEWORK

The sample farmers were post classified in to marginal and small (0.00 to <=4.94 acres), medium and semi medium (>4.94 to <=24.7 acres) and large (>24.7 acres). The steps involved in estimation of soil potential involve estimation of total cost of cultivation, the yield/gross returns and net income per hectare. The cost of inputs such seed, manure and fertilizer, plant protection chemicals, payment towards human and bullock labour and interest on working capita are included under operational costs. In the case of perennial crops, the cost of establishment was estimated by using actual physical requirements and prevailing market prices. Estimation cost included maintenance cost up to bearing period. The value of main product and by product from the crop enterprise at the market rates were the gross returns of the crop. Net returns were worked out by deducting establishment and maintained cost from gross returns.

Operational Cost = cost of seeds, fertilizers, pesticides. Cost of human and bullock labour, cost of machinery, cost of irrigation water + interest on working capital.

Gross returns = Yield (Quintals/hectare)*Price (Rs/Quintal)

Net returns = Gross returns-Operational cost.

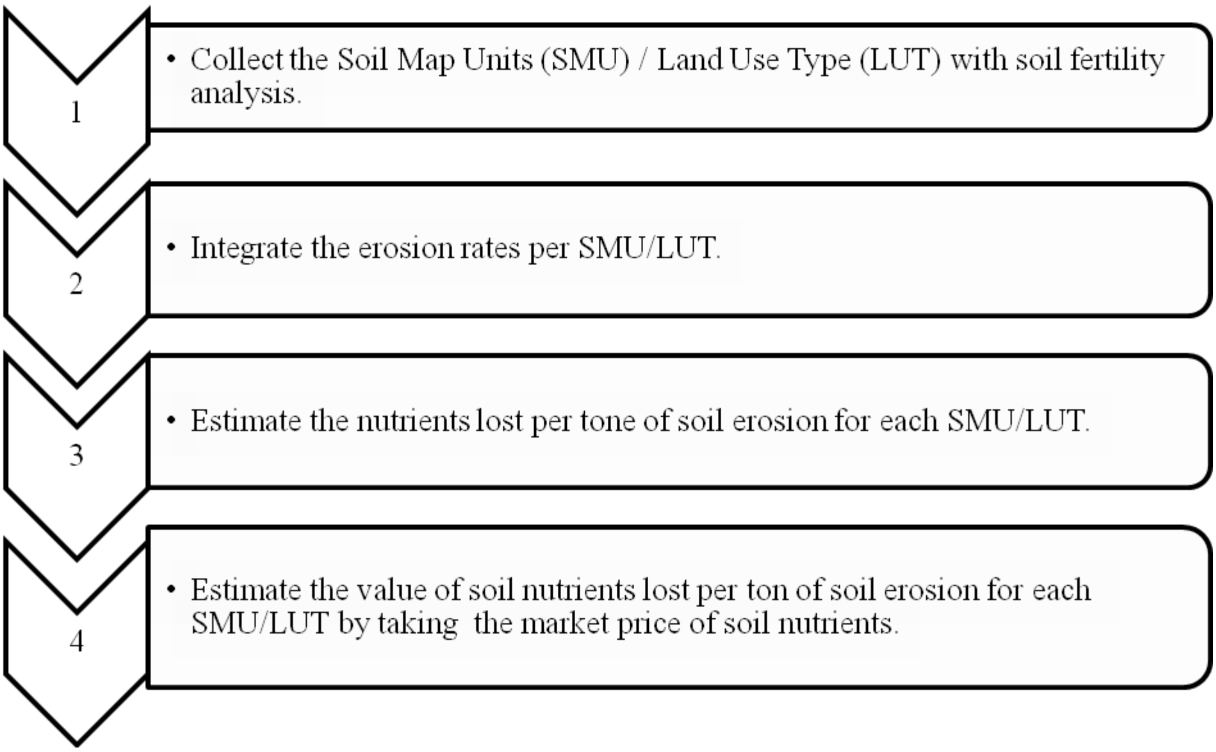
Benefit Cost Ratio = Net returns/Total cost.

Economic suitability classes: once each land use –land area combination has been assigned an economic value by the land evaluation, the question arises as to its ‘suitability’, that is, the degree to which it satisfies the land user. The FAO framework defines two suitability orders: ’S’(suitable if benefit cost ratio (BCR)>1) and ‘N’(not suitable if (BCR<1), which are dived into five economic suitability classes:’S1’(highly suitable if BCR>3), ’S2’(suitable if BCR>2 and <3),’S3’(Marginally suitable if BCR >1 and <2), ‘N1’(Not suitable for economic reasons but physically suitable) and ‘N2’(not suitable for physical reasons). The limit between ‘S3’ and ‘N1’must be at least at the point of financial feasibility (i.e. net returns, NPV, or IRR>0 and BCR>1). The other limits depend on social factors such as farm size, family size, alternative employment or investment possibilities and wealth expectations; these need to be specified for the Soil series.

Economic Valuation of Soil ecosystem services:

The replacement cost approach was followed for estimating the onsite cost of soil erosion, Market price method was followed for estimating the value of food and fodder production. Value transfer menthods was followed for estimating the value of water demand by different crops in the micro watershed.

Steps followed in Replacement cost methods for estimation of onsite cost of soil erosion



Chapter 4

RESULTS AND DISCUSSIONS

The main purpose to characterise the socio-economic systems in the watershed is to identify the existing production constraints and propose the potential/alternate options for agro-technology transfer and for bridging the adoption and yield gap. The demographic information shows that the household population dynamics encompasses the socioeconomic status of the farmer. For a rural family, the household size should be optimal to earn a comfortable livelihood through farm and non-farm wage earning. The total number of population in watershed area was 26, out of which 58 per cent were males and 42 per cent female. Average family size of the households is 6.3. Age is an important factor, which affects the potential employment and mobility status of respondents. The data on age wise distribution of farmers in the sample households indicated that majority of the farmers are coming under the age group of 0 to18 years (38.5 %) followed by 30 to 50 years (30.8 %), 18 to 30 years (23.1 %) and more than 50 years (7.7 %). Hence, in the study area in general, the respondents were of young and middle age, indicating thereby that the households had almost settled with whatever livelihood options they were practicing and sample respondents were young by age who could venture into various options of livelihood sources. Data on literacy indicated that 19 per cent of respondents were illiterate and 81 per cent literate (Table 1).

Table 1: Human population among sample households in Gudigeri-2 Microwatershed

Particulars	Units	Value
Total human population in sample HHs	Number	26.0
Male	% to total Population	57.7
Female	% to total Population	42.3
Average family size	Number	6.5
Age group		
0 to 18 year	% to total Population	38.5
18 to 30 year	% to total Population	23.1
30 to 50 years	% to total Population	30.8
>50 years	% to total Population	7.7
Average age of Households	Age in years	25.7
Education Status		
Illiterates	% to total Population	19.2
Literates	% to total Population	80.8
Primary School (<5 class)	% to total Population	34.6
Middle School (6- 8 Class)	% to total Population	15.4
High School (9- 10 Class	% to total Population	11.5
Others	% to total Population	19.2

The ethnic groups among the sample farm households found to be 100 per cent are belong to other Backward Castes (OBC) (Table 2 and Figure 3). About 50 per cent of sample households are using fire wood as source of fuel for cooking. All the sample farmers (100 %) are having electricity connection. Majority (75 %) are having MNREGA job cards. About 75 per cent of farm households are having ration cards for taking food grains from public distribution system. About 50 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Gudigeri-2 Microwatershed

Particulars	Unit	Value
Social groups		
OBC	% of Households	100
Types of fuel use for cooking		
Fire wood	% of Households	50.0
Fire wood & Gas	% of Households	25.0
Gas	% of Households	25.0
Energy supply for home		
Electricity	% of Households	100.0
Number of households having Health card		
Yes	% of Households	0.0
No	% of Households	100.0
MGNREGA Card		
Yes	% of Households	75.0
No	% of Households	25.0
Ration Card		
Yes	% of Households	75.0
No	% of Households	25.0
Households with toilet		
Yes	% of Households	50.0
No	% of Households	50.0
Drinking water facilities		
Tank	% to Households	25.0
Tube Well	% to Households	75.0

The data collected on the source of drinking water in the study area is presented in Table 2. Majority of the sample respondents are having tube well source for water supply for domestic purpose (75 %).

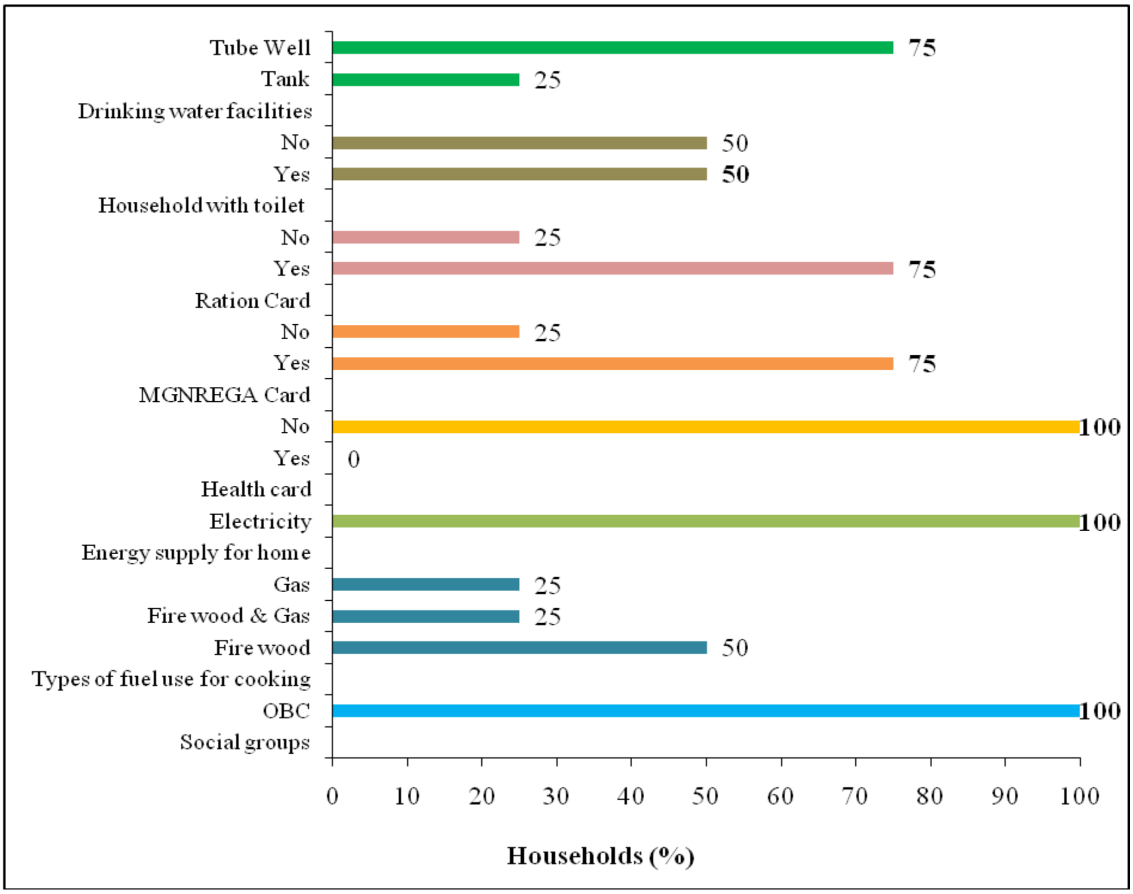


Figure 3: Basic needs of sample households in Gudigeri-2 Microwatershed

Only 3.9 per cent of the farmers are participating in community based organizations (Table 3). Among them majority were participating in Self help Group organization (3.9 %) like Sri Dharmasthala Swasahaya Sangha, Stri Shakhti Sangha.

Table 3: Institutional participation among the sample population in Gudigeri-2 Microwatershed

Particulars	Unit	Value
No. Of people participating	**% of Households**	3.9
Self help groups	% of Participating Households	3.9
No. Of people not participating	**% of Households**	96.2

The data on migration in Gudigeri-2 MWS is given in Table 4. It indicated that 33 per cent of samples households are migrated and about 50 per cent population were migrated. The average distance travelled for seeking employment is 591 km.

Table 4: Migration details among the sample households in Gudigeri-2 Microwatershed

Particulars	Value
% of households showing migration	33.3
% of persons migrating	50.0
No. of months migrated in a year	8.5
Average Distance of migration (km)	591.0
Nature of job	
Job/wage/work	100.0

The occupational patterns (Table 5) among sample households shows that agriculture is the main occupation of 6.7 per cent of farmers followed by subsidiary occupations like agricultural labour (80 %), private service (6.4 %) and Government Services (6.7 %) as main occupation.

Table 5: Occupational pattern in sample households in Gudigeri-2 Microwatershed

Occupation		% to total population
Main	**Subsidiary**	
Agriculture	Agriculture	6.7
	Agriculture Labour	80.0
	Private service	6.7
Govt. service		6.7
Grand Total		100.0
Family labour availability		**(Man days/ month)**
Male		62
Female		62
Total		124

The important assets especially with reference to domestic assets were analyzed and are given in Table 6 and Figure 4. The important domestic assets possessed by all categories of farmers are Mobile phones (100 %) followed by Television (100 %), Motor bike (50 %) and Bicycle (25 %). The average value of domestic assets is around Rs 17125 per households.

Table 6: Domestic assets among the sample households in Gudigeri-2 Microwatershed

Particulars	% of households	Average value in Rs
Bicycle	25.0	2500
Mobile Phone	100.0	4000
Motorcycle	50.0	55000
Television	100.0	7000
Average value	17125	

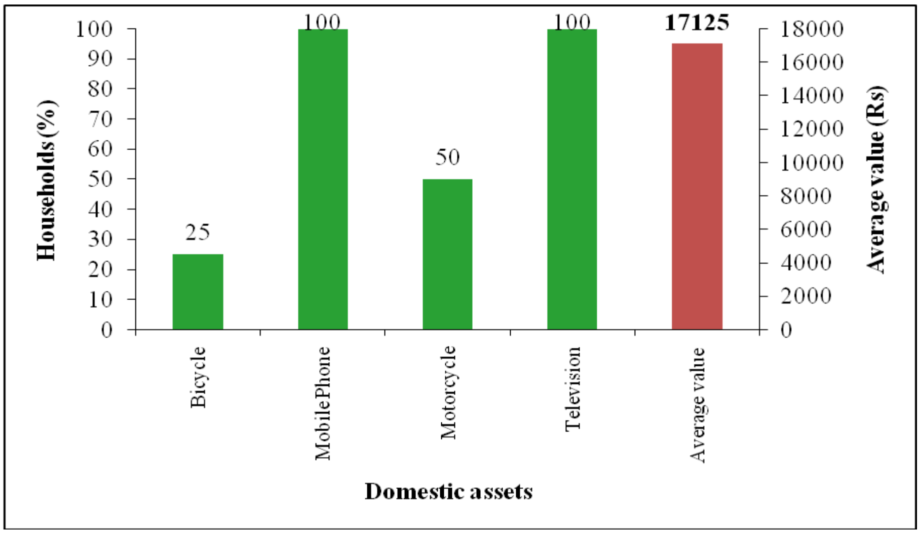


Figure 4: Domestic assets among the sample households in Gudigeri-2 Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer, thresher, drip/Sprinkler and power tiller. Plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned tractor (75 %) was found highest among the sample farmers followed by power tiller (50 %). The average value of farm assets is around Rs 112305 per households (Table 7 and Figure 5).

Table 7: Farm assets among samples households in Gudigeri-2 Microwatershed

Particulars	% of households	Average value in Rs
Bullock cart	25.0	600
Drip/Sprinkler	25.0	600
Plough	25.0	600
Power Tiller	50.0	37500
Sprayer	25.0	1200
Tractor	75.0	633333
Average value	112305	

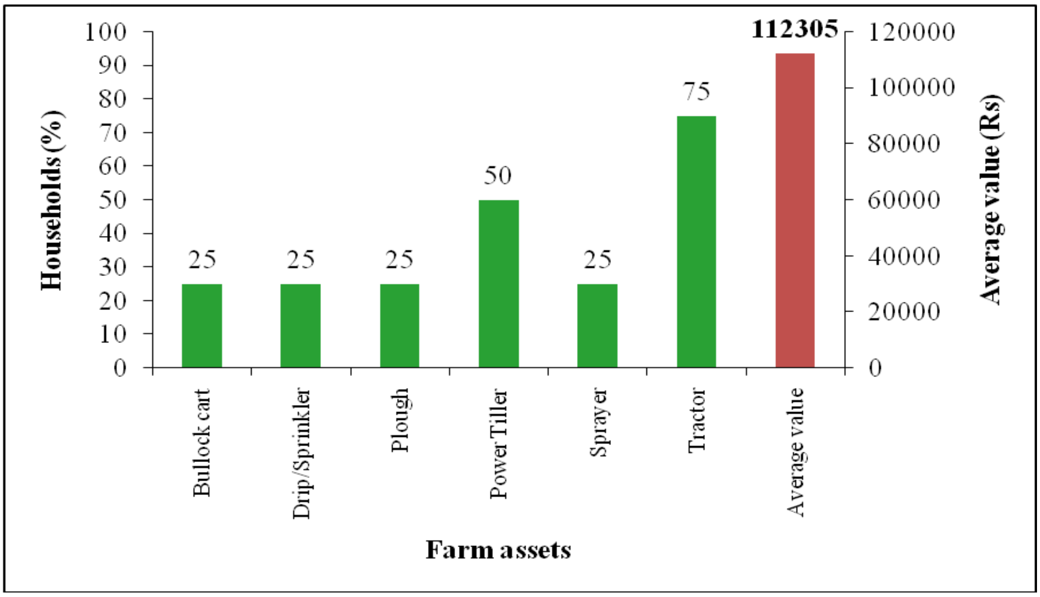


Figure 5: Farm assets among samples households in Gudigeri-2 Microwatershed

Among the farm households, maize and sorghum are the main crops grown for domestic food and fodder for animals. About 1229 kg of fodder is available per season for the livestock feeding (Table 8).

Table 8: Fodder availability of sample households in Gudigeri-2 Microwatershed

Particulars	Fodder yield (Kg/ha.)
Maize	1208
Sorghum	1250
Average Fodder availability	1229
Livestock having households	0
Livestock population	0

Women participation in decision making is nil this micro-watershed (Table 9) which means all the decision are made by men folk only.

Table 9: Women empowerment of sample households in Gudigeri-2 Microwatershed

% to Grand Total

Particulars	Yes	No
Women participation in local organization activities	0	100
Women elected as panchayat member	0	100
Women earning for her family requirement	0	100
Women taking decision in her family and agriculture related activities	0	100

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 10 and Figure 6. More quantity of cereals are consumed by sample farmers which accounted for 960 kcal per person. The other important food items consumed was pulses 114 kcal followed by cooking oil 173 kcal, milk 70 kcal, Egg 63 kcal and meat 32 kcal. In the sampled households, farmers were consuming less (1443 kcal) than NIN- recommended food requirement (2250 kcal).

Table 10: Per capita daily consumption of food among the sample farmers in Gudigeri-2 Microwatershed

Particulars	NIN recommendation (gram/ per day/ person)	Present level of consumption (gram/ per day/ person)	Kilo Calories /day/person
Cereals	396	282.41	960.2
Pulses	43	33.20	113.9
Milk	200	107.80	70.1
Vegetables	143	126.32	30.3
Cooking Oil	31	30.42	173.4
Egg	0.48	42.33	63.5
Meat	14.2	21.16	31.7
Total	827.68	643.65	1443.1
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		75	100
% Above NIN		25	0

Note: * day/person

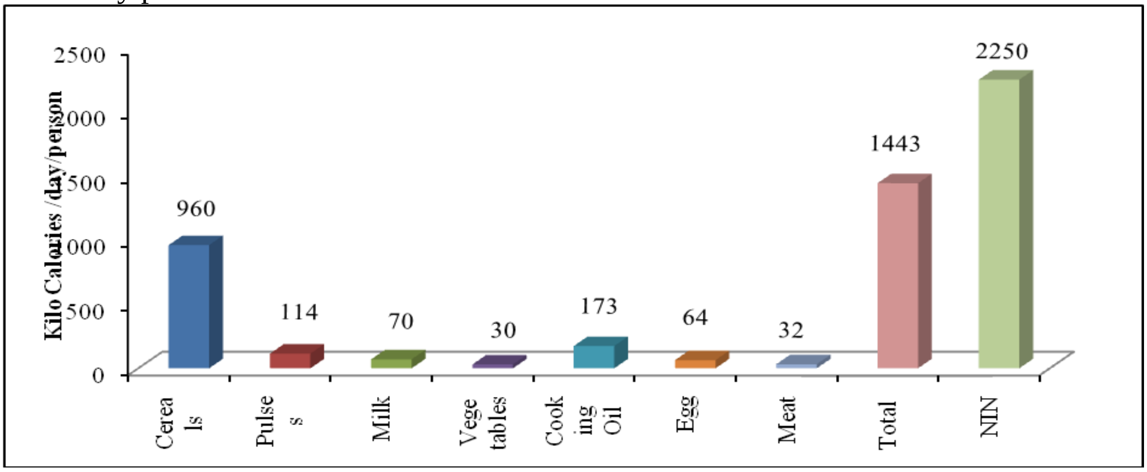


Figure 6: Per capita daily consumption of food among the sample farmers in Gudigeri-2 Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 11683. Major source of income to the farmers in the study area is from crop production (Rs 9087). The income from non farm income was very low at Rs 2596. The monthly per capita income is Rs.150, which is less than the threshold monthly income of Rs 975 for considering above poverty line. Due to the fact that erratic rainfall and shortage of water, farmers are diverting from crop production activities to enable the household for a comfortable livelihood. The incomes from the other aforesaid sources very meagre (Table 11).

Table 11: Annual average income of HHs from various sources in Gudigeri-2 Microwatershed

Particulars	Income*
Nonfarm income (Rs)	2596 (50)
Livestock income (Rs)	0
Crop Production (Rs)	9087 (100)
Total Annual Income (Rs)	***11683***
Average monthly per capita income (Rs)	150
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	100
% of households above poverty line	0

* Figure in the parenthesis indicates % of Households

The average annual expenditure of farm households indicated that farmers in the study area spend highest on food (Rs. 52230) followed by education, clothing, social functions and health. Now a days education is most important among all of us. In today's competitive world, education is a necessity for man after food, clothing, and shelter. It is the only fundamental way by which a desired change in the society can happen. The average per capita monthly expenditure is around Rs 775 and about 100 per cent of farm households are below poverty line (Table 12 and Figure 7).

Table 12: Average annual expenditure of sample HHs in Gudigeri-2 Microwatershed

Particulars	Value in Rupees	Per cent
Food	52230	86.4
Education	2250	3.7
Clothing	3000	5.0
Social functions	2000	3.3
Health	1000	1.7
Total Expenditure (Rs/year)	60480	100.0
Monthly per capita expenditure (Rs)	775	

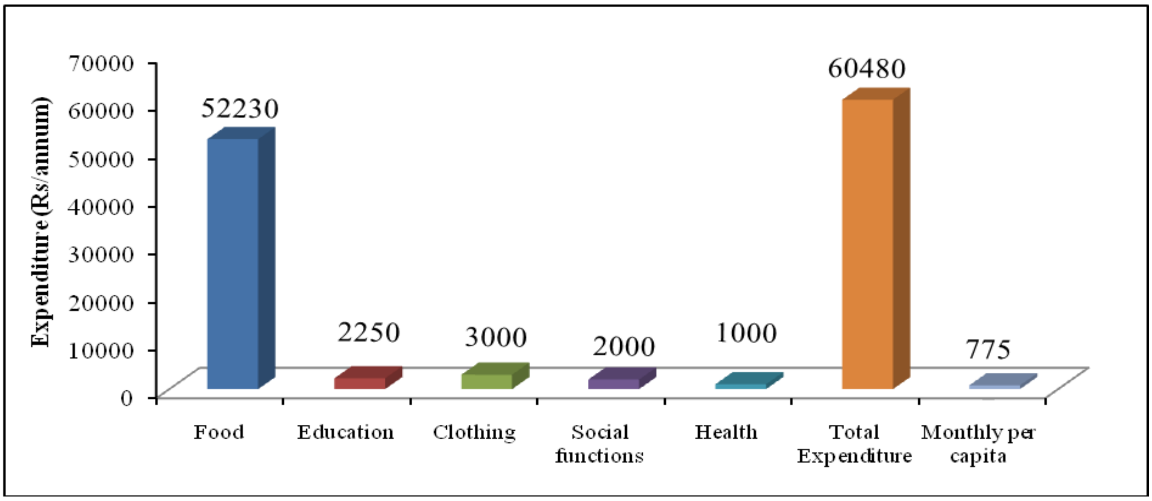


Figure 7: Average annual expenditure of sample HHs in Gudigeri-2 Microwatershed

The total land owned by the sample households are 16.38 ha which is under dry land is 11.05 ha and fallow land is 5.31ha. The average land holding is per households worked out to be 4.02 ha (Table 13).

Table 13: Land holding among samples households in Gudigeri-2 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	0.0	0.00
Rainfed Land	67.6	11.07
Fallow Land	32.4	5.31
Total land holding	100.0	16.38
Average land holding	4.02	

In watershed, the prevalent present land uses under perennial plants are banyan tree (50 %) followed by rosewood (33.3 %) and neem trees (16.7 %) (Table 14).

Table 14: Number of tree/plants covered in sample farm households in Gudigeri-2 Microwatershed

Particulars	Number of Plants/trees	Per cent
Banyan tree(Alada)	3	50.0
Neem trees	1	16.7
Rosewood	2	33.3
Grand Total	6	100.0

The land use decisions are usually based on experience of farmers, tradition, expected profit, personal preferences, resources and social requirements.

The present dominant crops grown in dry lands in the study area were green gram (32.3 %) followed by Groundnut (19.4 %), maize (19.4 %) and sunflower (16.1%) which are taken during *Kharif* and sorghum (12.9 %) during *Rabi* season respectively. The cropping intensity was 114.81 per cent (Table 15 and Figure 8).

Table 15: Present cropping pattern and cropping intensity in Gudigeri-2 Microwatershed

% to Grand Total

Particulars	Kharif	Rabi	Grand Total
Green gram	32.3	0.0	32.3
Sorghum	0.0	12.9	12.9
Sunflower	16.1	0.0	16.1
Groundnut	19.4	0.0	19.4
Maize	19.4	0.0	19.4
Grand Total	87.1	12.9	100.0
Cropping intensity (%)	114.81		

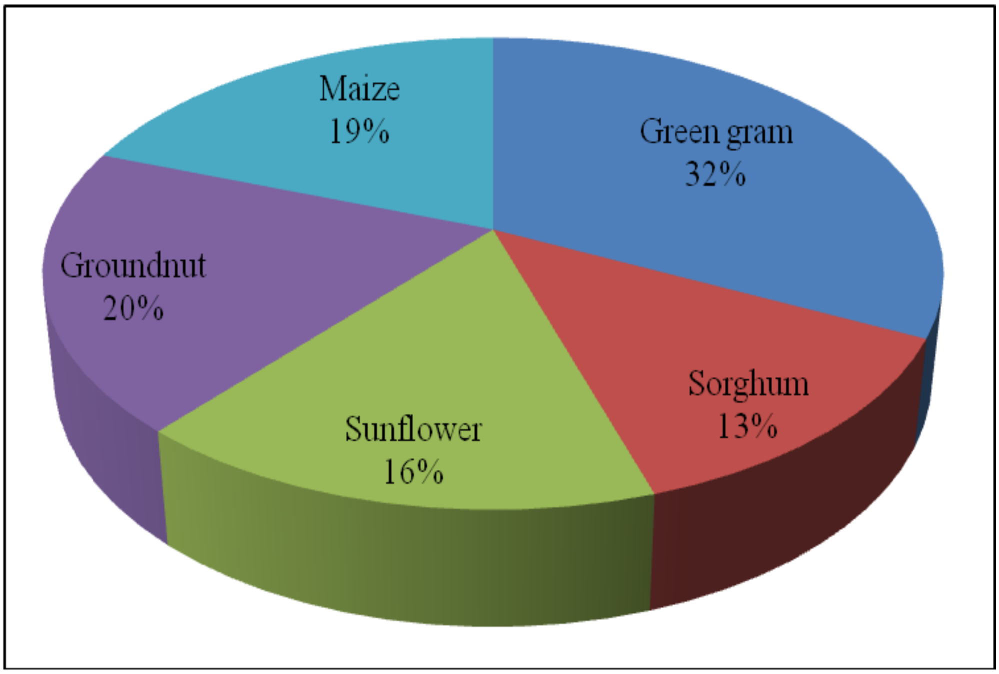


Figure 8: Present cropping pattern and cropping intensity in Gudigeri-2 Microwatershed

Economic land evaluation

In Gudigeri-2 micro-watershed, 6 soil series are identified and mapped (Table 16). The distribution of major soil series are Ravanaki covering an area of 233 ha (47 %) followed by Murlapur 123 ha (24.96 %), Gatareddihal 88 ha (17.86 %), Alawandi 29 ha (5.95 %), Dambarahalli 15 ha (2.98 %) and Muttal 4 ha (0.71 %).

Table 16: Distribution of soil series in Gudigeri-2 Microwatershed

Sl. No	Soil Series	Area in ha (%)
1	Muttal (MTL)	4 (0.71)
2	Ravanaki (RNK)	233 (47.02)
3	Dambarahalli (DRL)	15 (2.98)
4	Gatareddihal (GRH)	88 (17.86)
5	Murlapur (MLR)	123 (24.96)
6	Alawandi (AWD)	29 (5.95)
	Others	3 (0.51)
	Total	494.48

Present cropping pattern on different soil series are given in Table 17. Crops grown on Muttal soils are green gram and groundnut. Maize on Ravanaki, sunflower on Gatareddihal soils is grown and green gram and sorghum on Murlapur soils.

Table 17: Cropping pattern on major soil series in Gudigeri-2 micro-watershed

Soil Series	Soil Depth	Crops	Dry		Grand Total
			Kharif	Rabi	
Muttal	Shallow (25-50 cm)	Green gram	50.0	0.0	50.0
		Groundnut	50.0	0.0	50.0
Ravanaki	Moderately shallow (50-75 cm)	Maize	100.0	0.0	100.0
Gatareddihal	Deep (100-150 cm)	Sunflower	100.0	0.0	100.0
Murlapur	Very deep (>150 cm)	Green gram	50.0	0.0	50.0
		Sorghum	0.0	50.0	50.0

Land is used for agricultural use for growing cereals, pulse, oilseeds and commercial crops. The soil/ land potential are measures in terms of physical yield and net income. The alternative land use options for each micro-watershed are given below (Table 18)

Table 18: Alternative land use options for different size group of farmers (Benefit Cast Ratio) in Gudigeri-2 Microwatershed

Soil Series	Small Farmers	Medium Farmers	Large Farmers
MTL			Green gram (1.19), Groundnut (1.23)
RNK		Maize (1.08)	
GRH		Sunflower (1.32)	
MLR	Green gram (1.33) Sorghum (1.18)		

The productivity of different crops grown in Gudigeri-2 micro-watershed under different soil series and potential yield of the crops is given in Table 19.

The data on cost of cultivation and BCR of different crops across soil series is given in Table 19. The total cost of cultivation in study area for green gram ranges between Rs.14140/ha in MLR soil (with BCR of 1.33) and Rs.12466/ha in MTL soil (with BCR of 1.19), Groundnut cultivation in MTL soil is Rs.14355/ha (with BCR of 1.23), Maize cultivation in RNK soil is Rs.12633/ha (with BCR of 1.08), Sunflower cultivation in soil GHR is Rs.13056/ha (with BCR of 1.32) and Sorghum cost of cultivation in MLR soil is Rs.14007/ha (with BCR of 1.18).

Table 19: Economic land evaluation and bridging yield gap for different crops in Gudigeri-2 micro-watershed

Particulars	MTL (25-50 cm)		RNK (50-75 cm)	GRH (100-150 cm)	MLR (>150 cm)	
	Green gram	Ground nut	Maize	Sun flower	Green gram	Sorghum
Total cost (Rs/ha)	12466	14355	12633	13056	14140	14007
Gross Return (Rs/ha)	14820	17702	13585	17290	18772	16549
Net returns (Rs/ha)	2354	3346	952	4234	4632	2542
B:C	1.19	1.23	1.08	1.32	1.33	1.18
Farmers Practices (FP)						
FYM (t/ha)	0.8	0.4	0.4	0.0	0.0	0.0
Nitrogen (kg/ha)	38.9	38.9	30.2	36.5	40.0	40.0
Phosphorus (kg/ha)	35.3	35.3	22.7	34.5	28.8	28.8
Potash (kg/ha)	8.0	8.0	3.5	0.0	0.0	0.0
Grain (Qtl/ha)	5.0	4.2	5.0	5.0	5.0	7.5
Price of Yield (Rs/Qtl)	3000	4200	2500	3500	3800	2100
Soil test based fertilizer Recommendation (STBR)						
FYM (t/ha)	7.5	7.5	7.5	6.9	7.5	7.5
Nitrogen (kg/ha)	16.3	31.3	125.0	46.9	16.3	81.3
Phosphorus (kg/ha)	31.3	62.5	62.5	62.5	31.3	50.0
Potash (kg/ha)	18.8	18.8	18.8	28.1	18.8	30.0
Grain (Qtl/ha)	6.3	9.0	57.5	11.3	6.3	18.8
% of Adoption/yield gap (STBR-FP) / (STBR)						
FYM (%)	88.9	94.4	94.4	100.0	100.0	100.0
Nitrogen (%)	-139.1	-24.3	75.8	22.1	-146.2	50.8
Phosphorus (%)	-13.0	43.5	63.7	44.8	8.0	42.5
Potash (%)	57.2	57.2	81.1	100.0	100.0	100.0
Grain (%)	20.0	53.7	91.3	55.6	20.0	60.0
Impact of Land Resources Information						
Additional fertilizers cost(Rs/ha)	6431	8403	10276	8789	7700	9530
Additional yield benefits(Rs/ha)	3750	20300	131250	21875	4750	23625
Net change Income (Rs/ha)	-2681	11897	120974	13086	-2950	14095

The data on FYM, Nitrogen, Phosphorus and Potash application by the farmers to different crops and recommended FYM for different crops is given in table 19. There is a huge gap between FYM application by farmers and recommended FYM in all the crops across the soils. There is a larger yield gap in crops grown across different soil series. Adequate knowledge about recommended package of practices is the pre-requisite for their use in cultivation of crops. It is a fact that, recommended practices are major contributing factors to yield. Inadequate knowledge about recommended practices leads to their improper adoption. Strengthening of extension services by concerned agency is required to increase adoption of recommended cultivation practices and ultimately reducing the gap. By adopting soil-test fertiliser recommendation, there is scope to increase yield and income to a maximum of Rs 120974 in maize and a minimum of Rs 118947 in groundnut cultivation.

Economic valuation of Ecosystem Services (ES) was aimed at combining use and non-use values to determine Total Economic Value (TEV) of ES. Ecosystem Services (ES) were valued based on their annual flow or utilization in common monetary units, Rs/year. The valuation of ES was based on market price in 2017 or market cost approaches whichever is applicable and in other cases on value or benefit transfer from previous valuation studies.

The onsite cost of different soil nutrients lost due to soil erosion is given in Table 20 and Figure 9. The average value of soil nutrient loss is around Rs 5756 per ha/year. The total cost of annual soil nutrients is around Rs 2806682 per year for the total area of 494.48 ha.

Table 20: Estimation of onsite cost of soil erosion in Gudigeri-2 micro-watershed

Particulars	Quantity(kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	767.32	374131	4834.13	2357026
Phosphorus	0.41	199	18	8777
Potash	26.54	12943	530.9	258855
Iron	0.91	445	43.83	21369
Manganese	0.63	309	174.45	85057
Cupper	0.1	48	55.2	26915
Zinc	0.02	9	0.76	368
Sulphur	2.43	1187	97.37	47476
Boron	0.04	21	1.72	839
Total	798	389293	5756	2806682

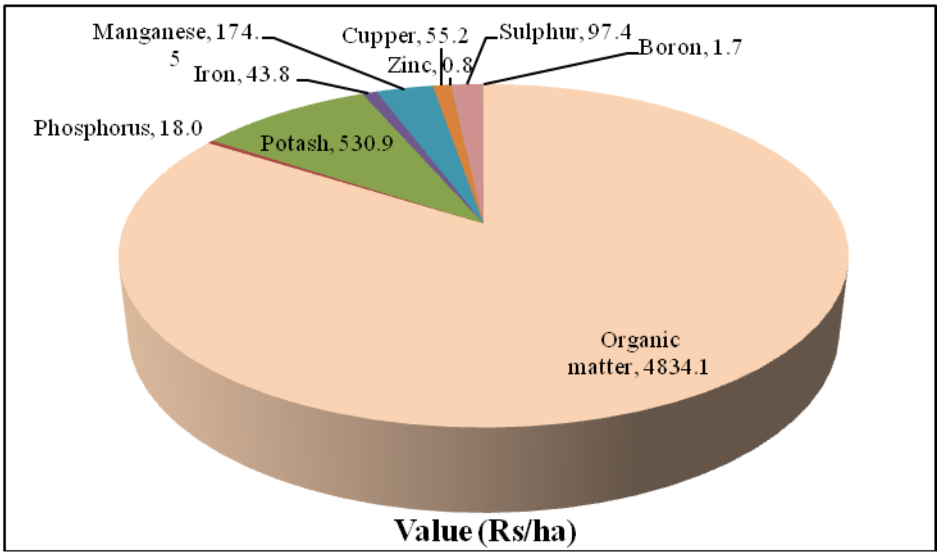


Figure 9: Estimation of onsite cost of soil erosion in Gudigeri-2 micro-watershed

The average value of ecosystem service for food production is around Rs 2163/ ha/year (Table 21 and Figure 10). Per ha food production services is maximum in sunflower (Rs 3055 /ha) followed by green gram (Rs 2522/ha), groundnut (Rs 1574), sorghum (1554) and maize is negative (Rs 1763).

Table 21: Ecosystem services of food production in Gudigeri-2 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Gross Returns (Rs/ha)	Cost of Cultivation (Rs/ha)	Total Value (Rs)	Net returns (Rs/ha)
Cereals	Maize	2.43	4.94	2500	12350	14113	30000	-1763
	Sorghum	1.62	7.41	2100	15561	14007	25200	1554
Pulses	Green gram	4.05	4.94	3400	16796	14274	68000	2522
Oil seeds	Groundnut	2.43	4.12	4200	17290	15716	42000	1574
	Sunflower	2.02	4.94	3500	17290	14235	35000	3055
Grand Total		12.55	5.21	3183	16599	14437	208331	2163

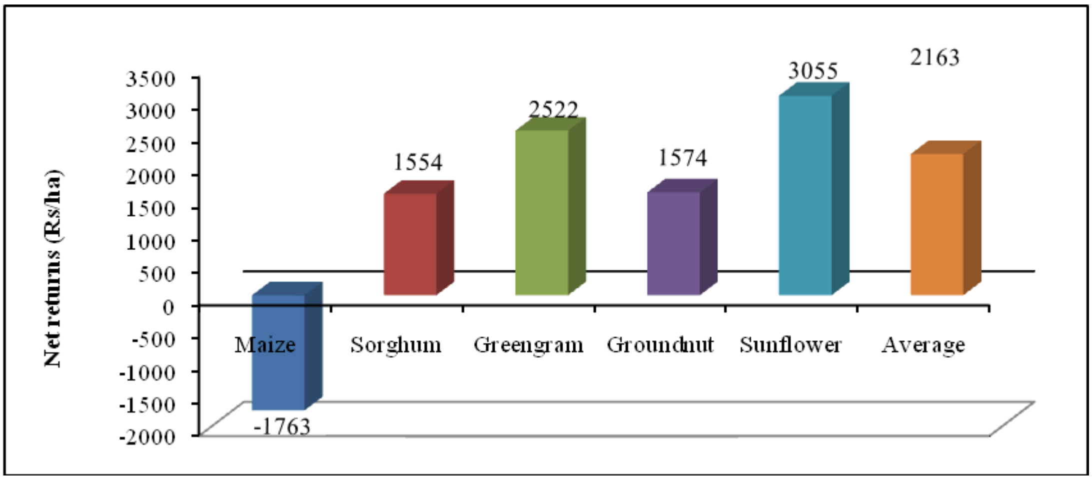


Figure 10: Ecosystem services of food production in Gudigeri-2 Microwatershed

The average value of ecosystem service for fodder production is around Rs 5867/ ha/year (Table 22 and Figure 11). Per ha fodder production services is maximum in maize (Rs 3000 /ha) followed by sorghum (Rs 1600 /ha) and Groundnut (Rs 1000/ha).

Table 22: Ecosystem services of fodder production in Gudigeri-2 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Returns (Rs/ha)	Total returns (Rs)
Cereals	Maize	2.43	0.82	1500	1235	3000
	Sorghum	1.62	1.24	800	988	1600
Oil seeds	Groundnut	2.43	0.41	1000	412	1000
Grand Total		6.48	0.82	1100	906	5867

The water demand for production of different crops was worked out in arriving at the ecosystem services of water support to crop growth.

Table 23: Ecosystem services of water supply in Gudigeri-2 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Green gram	4.94	3412	34116	691
Groundnut	4.12	1145	11453	278
Maize	4.94	604	6037	122
Sorghum	7.41	2259	22586	305
Sunflower	4.94	1663	16628	337
Average	5.21	2082	20822	399

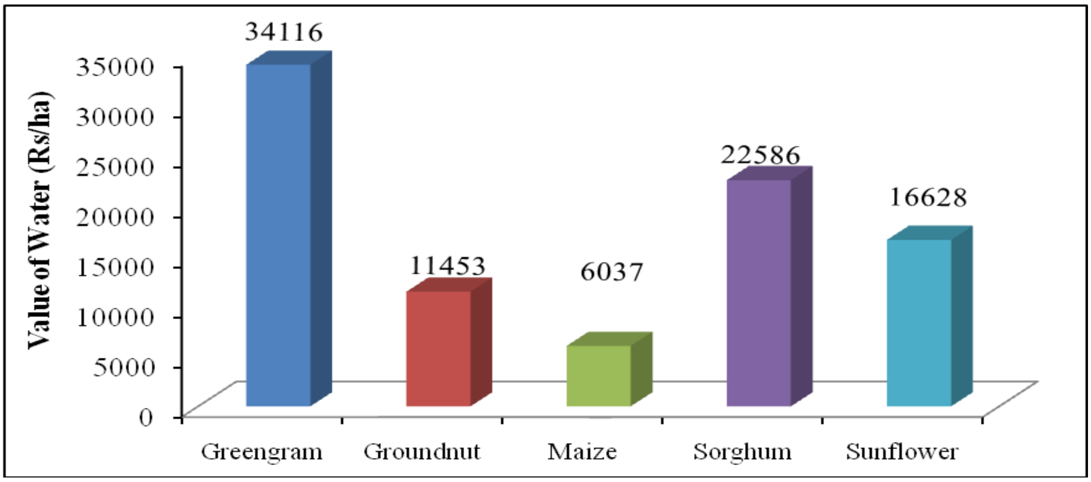


Figure 11: Ecosystem services of water supply in Gudigeri-2 Microwatershed

The data on water requirement for producing one quintal of grain is considered for estimating the total value of water required for crop production. The per hectare value of water used and value of water was maximum (Table 23 and Figure 9) in green gram (Rs 34116) followed by sorghum (Rs 22586), sunflower (Rs 16628), groundnut (Rs 11453) and Maize (Rs 6037).

The main constraints in farming is climate change particularly decline in rainfall and increasing temperature. Farmers reported that they are not getting timely support/extension services from the concerned development department (Table 24).

Table 24: Farming constraints related land resources of sample households in Gudigeri-2 Microwatershed

Particulars	Per cent
Farmers awareness of climate change	
Yes	75
No	25
Perception on climate change	
Increase in temperature	75
Availability agricultural technology information	
Yes	0
No	100

The findings of the study would be very much useful to the planners and policy makers of the study area to identify the irrationality in the existing production pattern and to suggest appropriate production plans for efficient utilization of their scarce resources resulting in increased net farm incomes and employment. The study also throws light on future potentialities of increasing net farm income and employment under different situations viz., with existing and recommended technology.