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

GUDIGERI-3 (4D4A2N2c) 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-3 microwatershed in Koppal Taluk, Koppal District, Karnataka" for integrated development was taken up in collaboration with the State Agricutural Universities, IISC, KSRSAC, KSNDMC as Consortia partners. The project provides detailed land resource information at cadastral level (1:7920 scale) for all the plots and socio-economic status of farm households covering thirty per cent farmers randomely selected representing landed and landless class of farmers in the micro-watershed. The project report with the accompanying maps for the microwatershed will provide required detailed database for evolving effective land use plan, alternative land use options and conservation plans for the planners, administrators, agricutural extention personnel, KVK officials, developmental departments and other land users to manage the land resources in a sustainable manner.

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

Nagpur
Date:25.12.2018

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PART-A

LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

The land resource inventory of Gudigeri-3 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 boundries. The soil map shows the geographic distribution and extent, characterstics, classification, behaviour and use potentials of the soils in the microwartershed.

The present study covers an area of 378 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 97 per cent is covered by soils, three per cent by waterbodies. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 9 soil series and 18 soil phases (management units) and 7 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 25 per cent of the soils are shallow to moderately shallow (25-75 cm) and 72 per cent area are moderately deep to very deep soils (75->150 cm).*
- *Entire area has clayey soils at the surface.*
- *About 33 per cent of the area has non-gravelly soils, 47 per cent gravelly soils (15-35 % gravel) and 17 per cent very gravelly (35- 60% gravel) soils.*
- *About 25 per cent area has low (51-100 mm/m), 16 per cent medium (101-150 mm/m) and 56 per cent area very high (>200mm/m) available water capacity.*
- *Entire area has very gently sloping (1-3%) lands.*
- *About 9 per cent area is slightly eroded and about 88 per cent area is moderately eroded (e2) lands.*

- *Entire area is strongly alkaline (pH 8.4 to 9.0) to very strongly alkaline (pH>9.0) in soil reaction.*
- *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 79 per cent, 15 per cent of the soils are medium (0.5-0.75%) and 3 per cent of the soils are high (>0.75%) in organic carbon.*
- *Available phosphorus is low (<23 kg/ha) in major area of about 93 per cent, medium (23-57 kg/ha) in 3 per cent area and high (>57 kg/ha) in <1 per cent area of the microwatershed.*
- *Major area of about 94 per cent has high (>337 kg/ha) in available potassium and a small area of about 2 per cent has medium (145-337 kg/ha) in available potassium.*
- *Available sulphur is low (<10 ppm) in 28 per cent area, medium (10-20 ppm) in about 1 per cent area and about 68 per cent area is high (>20 ppm).*
- *Available boron is low (0.5 ppm) in about 65 per cent area and medium (0.5-1.0 ppm) in 32 per cent area.*
- *Available iron is sufficient (>4.5 ppm) in about 90 per cent area and deficient (<4.5 ppm) in about 7 per cent area.*
- *Available zinc is deficient (<0.6 ppm) in major area of about 96 per cent and sufficient in very minor area of <1 per cent.*
- *Available manganese and copper are sufficient in all the soils.*
- *The land suitability for 24 major crops grown in the microwatershed were assessed and the areas that are highly suitable (S1) and moderately suitable (S2) are given below. It is however to be noted that a given soil may be suitable for various crops but what specific crop to be grown may be decided by the farmer looking to his capacity to invest on various inputs, marketing infrastructure, market price and finally the demand and supply position.*

Land suitability for various crops in the microwatershed

Crop	**Suitability Area in ha (%)**			**Crop**	**Suitability Area in ha (%)**	
	Highly suitable (S1)	**Moderately suitable (S2)**			**Highly suitable (S1)**	**Moderately suitable (S2)**
Sorghum	*45 (12)*	*267 (71)*		*Guava*	-	-
Maize	-	-		*Jackfruit*	-	-
Bajra	-	-		*Jamun*	-	210 (56)
Groundnut	-	*36 (9)*		*Musambi*	35 (9)	237 (63)
Sunflower	*35 (9)*	*237 (62)*		*Lime*	35 (9)	237 (63)
Chilli	-	-		*Cashew*	-	-
Tomato	-	-		*Custard apple*	*45(12)*	*267 (71)*
Drumstick	-	*272 (72)*		*Amla*	-	*312 (82)*
Mulberry	-	312 (82)		*Tamarind*	-	210 (56)
Mango	-	*81 (21)*		*Marigold*	-	*312 (82)*
Sapota	-	-		*Chrysanthemum*	-	*312 (82)*
Pomegranate	-	*272 (72)*		*Jasmine*	-	*40 (11)*

Apart from the individual crop suitability, a proposed crop plan has been prepared for the 7 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 submarginal lands, field bunds and also in the hillocks, mounds and ridges. That would help in supplementing the farm income, provide fodder and fuel, and generate lot of biomass which inturn would help in maintaining the ecological balance and contributes to mitigating the climate change.*

Chapter 1

INTRODUCTION

Soil is a finite natural resource that is central to sustainable agriculture and food security. Over the years, this precious resource is faced with the problems of erosion, salinity, alkalinity, degradation, depletion of nutrients and even decline in availability of land for agriculture. It is a known fact, that it takes thousands of years to form a few centimetres of soil, thus, soil is a precious gift of nature. The area available for agriculture is about 51 per cent of the total geographical area and more than 60 per cent of the people are still dependant on agriculture for their livelihood. However, the capacity of a soil to produce is limited and the limits to the production are set by its intrinsic characteristics, agroclimatic setting, and use and management. There is, therefore, tremendous pressure on land and water resources, which is causing decline in soil-health and stagnation in productivity. As much as 121 m ha of land is reportedly degraded which leads to impaired soil quality. It is imperative that steps are urgently taken to check and reverse land degradation without any further loss of time. The improvements in productivity will have to come from sustainable intensification measures that make the most effective use of land and water resources. 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.

Added to this, every year there is a significant diversion of farm lands and water resources for non-agricultural purposes. Thus, developing strategies to slow down the degradation process or reclaim the soils to normal condition and ensure sustainability of production system are the major issues today. This demands a systematic appraisal of our soil and land resources with respect to their extent, geographic distribution, characteristics, behaviour and use potential, which is very important for developing an effective land use and cropping systems for augmenting agricultural production on a sustainable basis. The soil and land resource inventories made so far in Karnataka had limited utility because the surveys were of different types, scales and intensities carried out at different times with specific objectives. Hence, there is an urgent need to generate 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 all the parameters which are critical for productivity *viz.*, soils, site characteristics like slope, erosion, gravelliness and stoniness, climate, water, 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-3 microwatershed in Koppal Taluk and District, Karnataka state for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological Units (LEUs) map.

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

Chapter 2

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Gudigeri-3 Microwatershed is located in the central part of northern Karnataka in Koppal Taluk, Koppal District, Karnataka State (Fig.2.1). It comprises parts of Kavalura and Gudigeri villages. It lies between $15^{0}18'$ and $15^{0}20'$North latitudes and $75^{0}54'$ and $75^{0}56'$ East longitudes and covers an area of 378 ha. It is about 112 km from Koppal town and is surrounded by Kavalura village on northern, eastern, southern and southeastern part and Gudigeri village on the western part of the microwatershed.

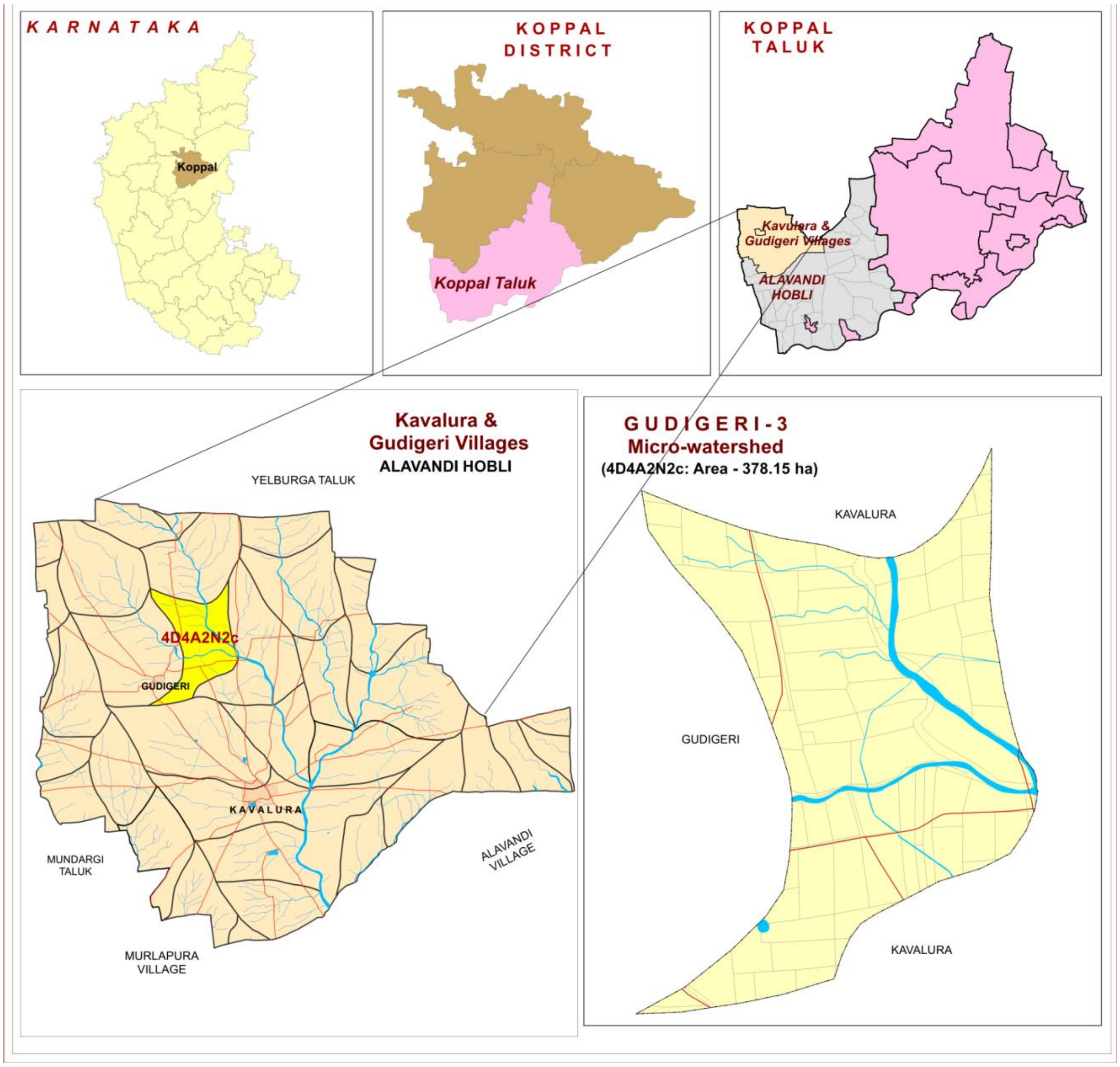


Fig.2.1 Location map of Gudigeri-3 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss and alluvium (Figs.2.2a and b). Granite gneisses are essentially pink to gray and are coarse to medium grained. They consist primarily of quartz, feldspar, biotite and hornblende. The gray granite gneisses are highly weathered, fractured and fissured upto a depth of about 10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in Gudigeri-3 village. The soil thickness of the alluvium generally is limited to less than a meter, except in river valleys where it is very deep extending to tens of meters. Such soils are transported and represent palaeo black soils originally formed at higher elevation, but now occupying river valleys.

Fig.2.2 Granite and granite gneiss rocks

Fig.2.2 b Alluvium

2.3 Physiography

Physiographically, the area has been identified as Granite gneiss and Alluvial landscapes based on geology. The microwatershed area has been further divided into mounds/ridges, summits, side slopes and very gently sloping uplands and nearly level plains based on slope and its relief features. The elevation ranges from 534 to 552 m in the gently sloping uplands. The mounds and ridges are mostly covered by rock outcrops.

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). Maximum of 424 mm precipitation takes place 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 takes place during the rest of the year. The winter season is from December to February. During April and May, the temperatures reach up to 45°C and in December and January, the temperatures will go down to 16°C. Rainfall distribution is shown in Figure 2.3. The average Potential Evapo Transpiration (PET) is 145 mm and varies from a low of 101 mm in December and 193 mm in the months 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**	

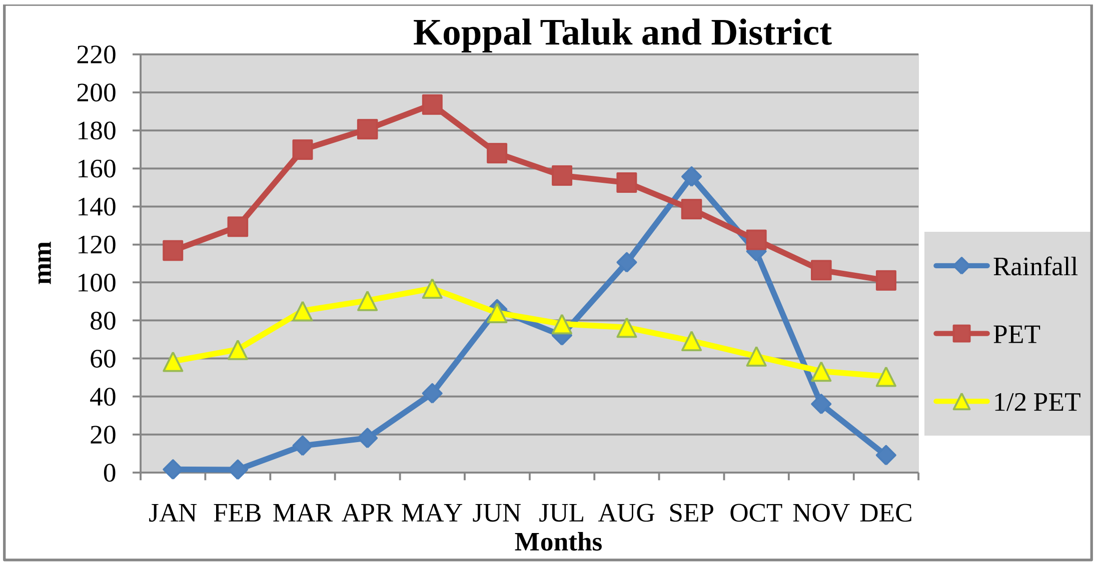


Fig. 2.3 Rainfall distribution in Koppal Taluk and District

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-3 microwatershed

2.7 Land Utilization

About 91 per cent area (Table 2.2) in Koppal district is cultivated at present and about 16 per cent of the area is sown more than once. An area of about 3 per cent is currently barren. Forests occupy a small area of about 5 per cent and the tree cover is in a very poor state. Most of the mounds, ridges and bouldery areas have very poor vegetative cover. Major crops grown in the area are sorghum, maize, bajra, cotton, safflower, sunflower, red gram, horse gram, onion, mulberry, pomegranate, sugarcane, bengalgram and groundnut (Fig 2.7). 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-3 Microwatershed is presented in Fig.2.5. 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-3 Microwatershed is given Fig.2.6

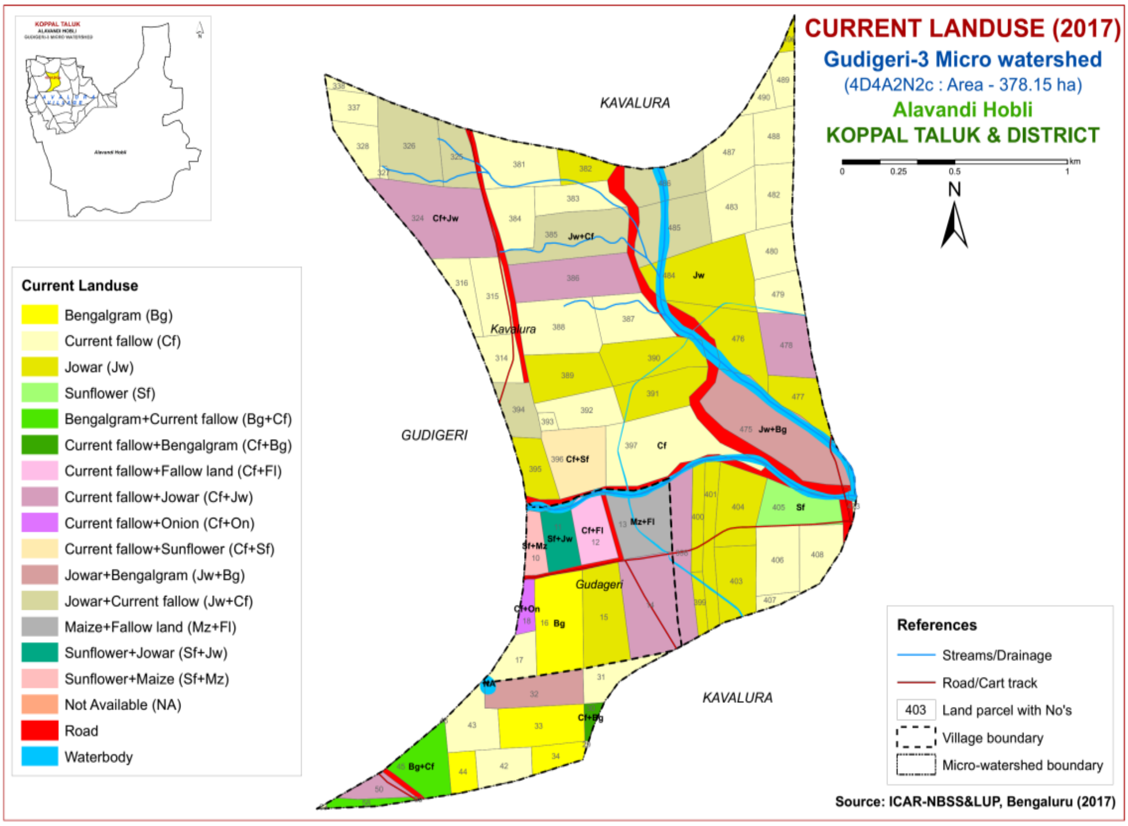


Fig.2.5 Current Land Use – Gudigeri-3 Microwatershed

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

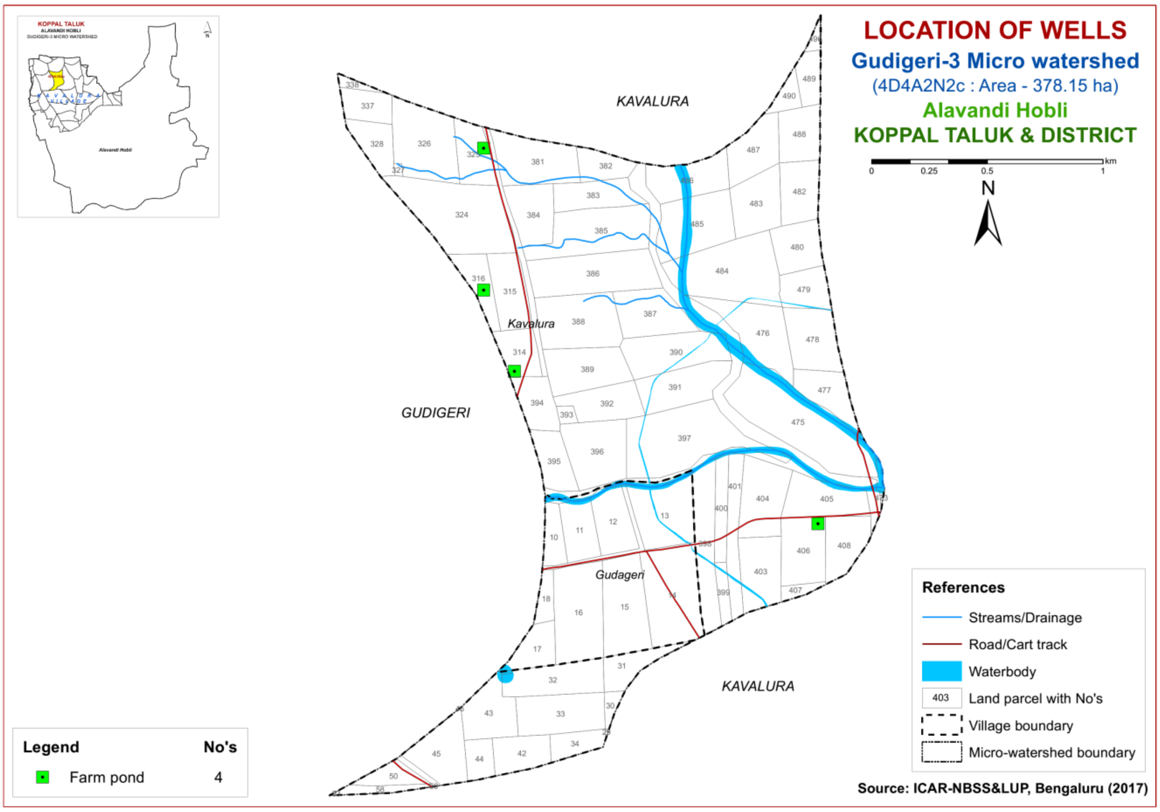


Fig.2.6 Location of conservation structures- Gudigeri-3 Microwatershed

Fig.2.7 (a) Different crops and cropping systems in Gudigeri-3 Microwatershed

Fig.2.7 (b) Different crops and cropping systems in Gudigeri-3 Microwatershed

Chapter 3

SURVEY METHODOLOGY

The purpose of land resource inventory is to delineate similar areas (soil series and phases), which respond or expected to respond similarly to a given level of management. This was achieved in Gudigeri-3 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 378 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 as a base. 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 (FCCs) of Cartosat-I and LISS-IV merged satellite data covering the microwatershed area was visually interpreted using image interpretation elements and all the available collateral data with local knowledge. The delineated physiographic boundaries were transferred on to a cadastral map overlaid on satellite imagery. Physiographically, the area has been identified as granite gneiss and alluvial landscapes and is divided into landforms such as ridges, mounds and uplands based on slope. They were further subdivided into physiographic/ image interpretation units based on image characteristics. The image interpretation legend for physiography is given below.

Image Interpretation Legend for Physiography

G- Granite gneiss landscape

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

DSe- Alluvial landscape

DSe 1 Summit

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

DSe 2 Very gently 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

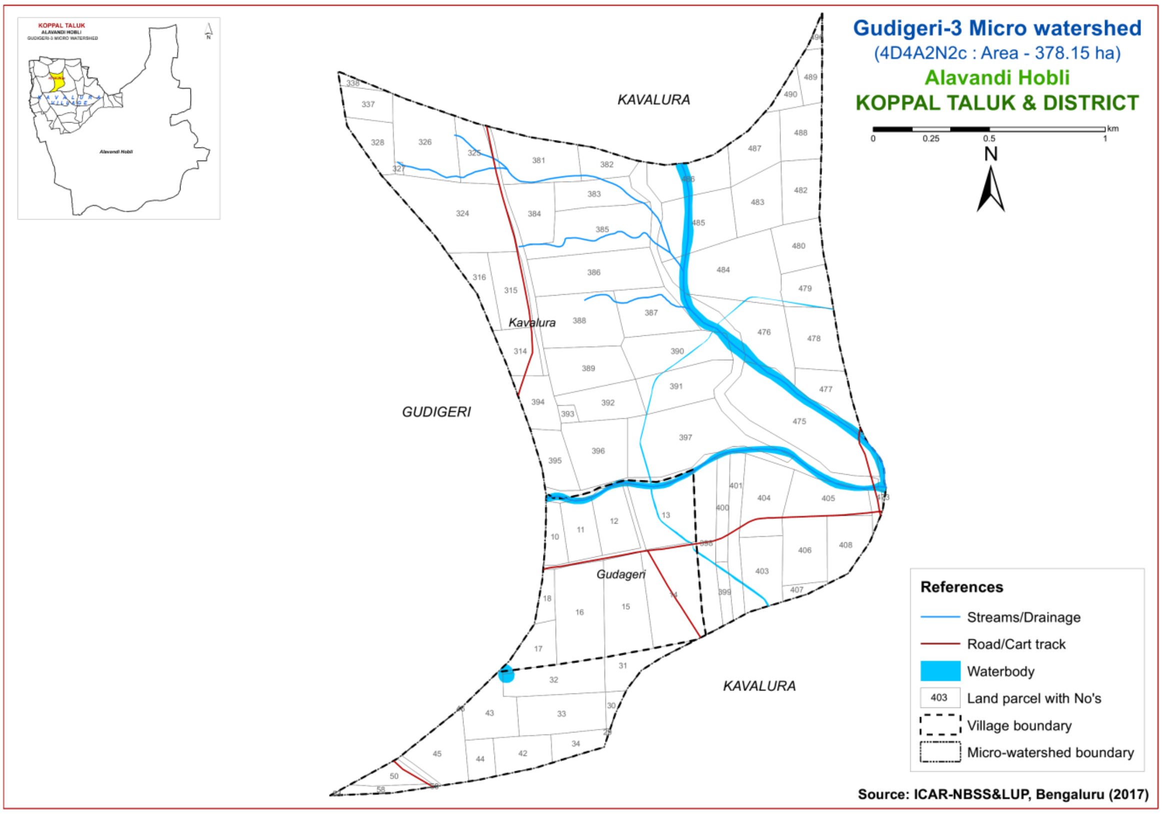


Fig 3.1 Scanned and Digitized Cadastral map of Gudigeri-3 Microwatershed

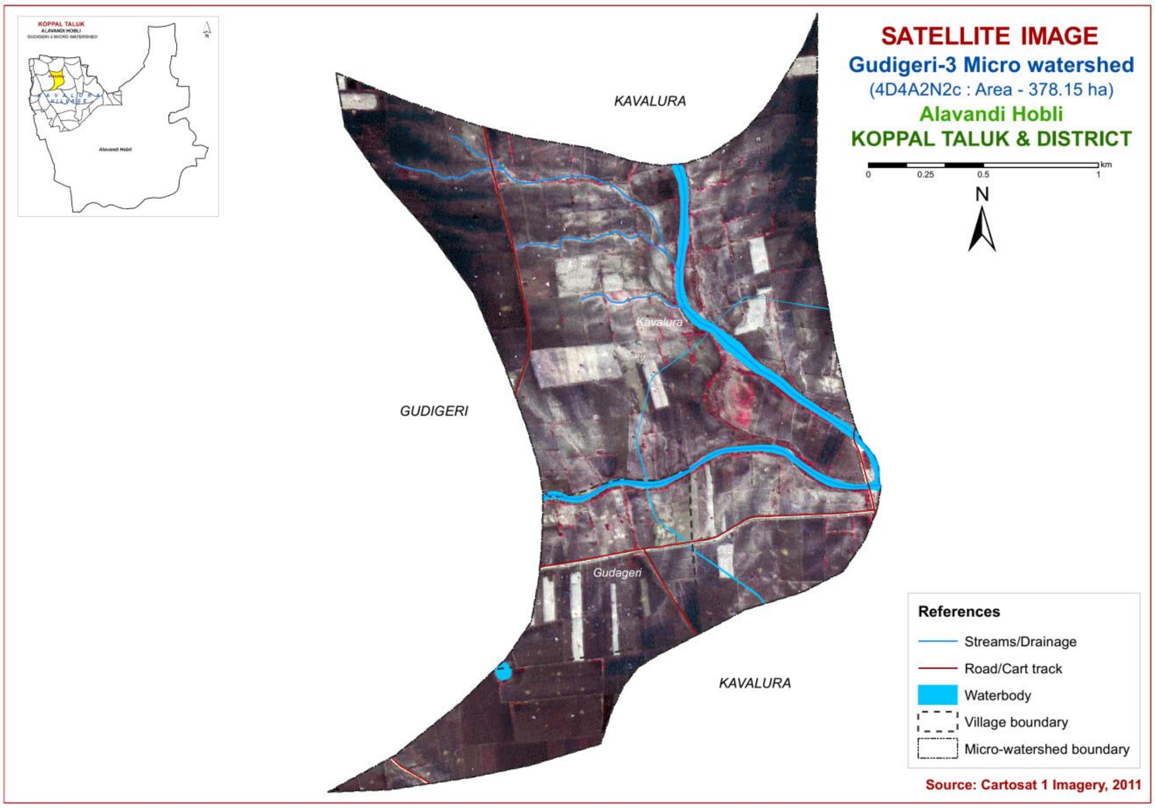


Fig.3.2 Satellite Image of Gudigeri-3 Microwatershed

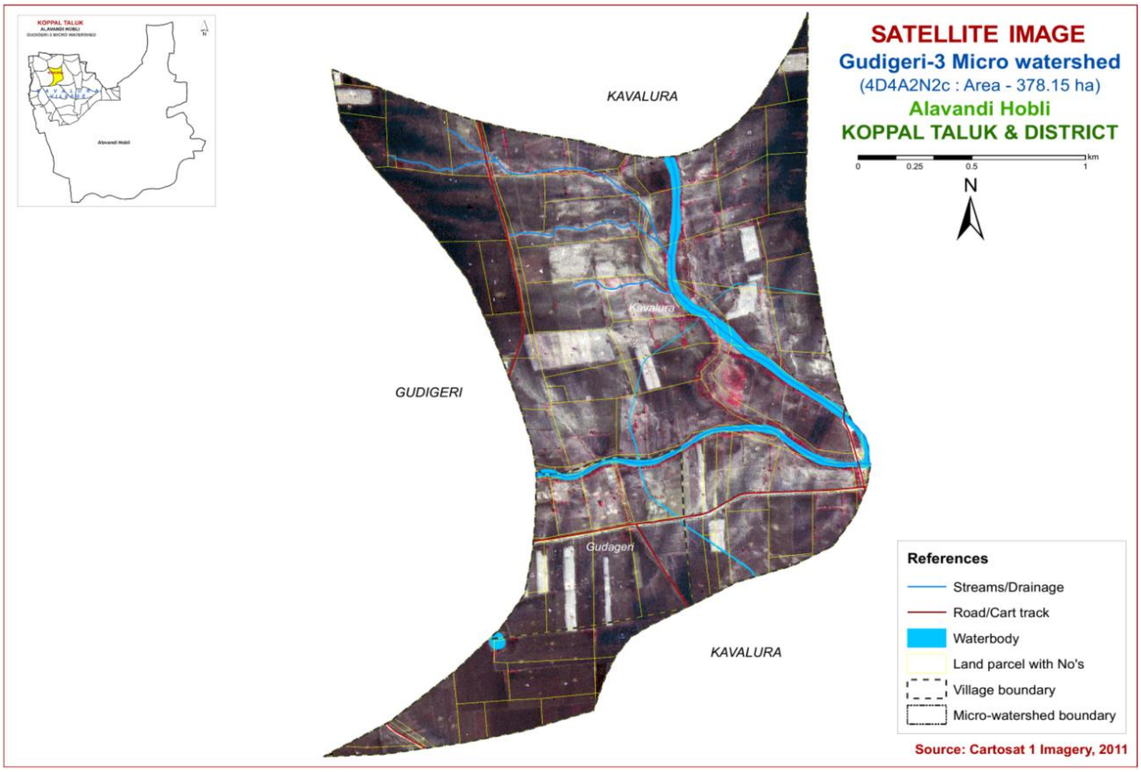


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Gudigeri-3 Microwatershed

3.3 Field Investigation

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

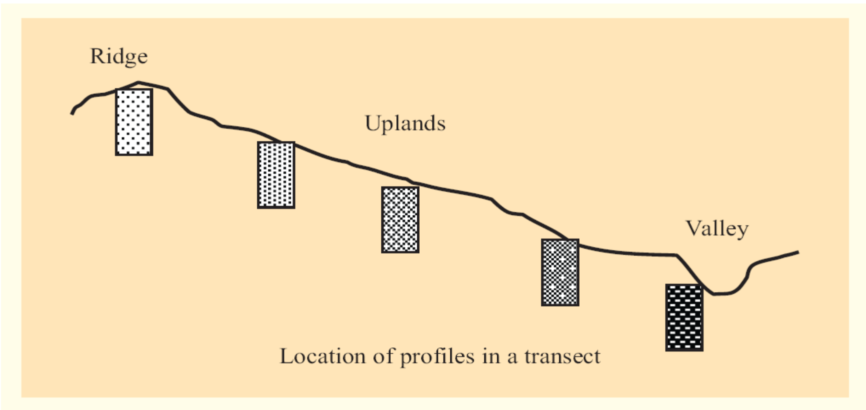


Fig: 3.4. Location of profiles in a transect

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

Based on the soil characteristics, the soils were grouped into different soil series. Soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management. Soil depth, texture, colour, kind of horizon and horizon sequence, amount and nature of gravel present, calcareousness, nature of substratum etc, were used as the major differentiating characteristics for identifying soil series occurring in the area. The differentiating characteristics used for identifying the soil series are given in Table 3.1. Based on the above characteristics, 9 soil series were identified in Gudigeri-3 Microwatershed.

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

Sl.No	Soil Series	Depth (cm)	Colour (moist)	Texture	Gravel (%)	Horizon sequence	Calcareo-usness
Soils of Granite Gneiss Landscape							
1	Nagalapur (NGP)	100-150	5YR2.5/2,3/2, 2.5YR3/6,4/6	gsc-gc	>35	Ap-Bt-Cr	-
Soils of Alluvial Landscape							
2	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
3	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
4	Bardur (BDR)	>150	10YR 2/1, 3/1, 3/2,	c	<15	Ap-Bss	es
5	Dambarahalli (DRL)	75-100	10YR 2/1, 3/1, 4/3	c	<15	Ap-Bw-Ck	e-es
6	Narasapura (NSP)	75-100	10 YR 3/1, 3/2, 4/2,	c		Ap-Bw-Cr	e-es
7	Gatareddihal (GRH)	100-150	10YR 2/1, 3/1, 2.5Y 4/3, 5/4	c	<15	Ap-Bw-BC-C	es
8	Kavalur (KVR)	100-150	10 YR 2/2, 3/1, 3/2, 3/3, 4/4	c		Ap-Bss-Bck-Cr	es-ev
9	Murlapur (MLR)	>150	10YR 2/1, 2/2, 3/1, 3/2, 4/1,	c	10-20	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 18 mapping units representing 9 soil series occurring in the microwatershed. The soil map unit (soil legend) description is presented in Table 3.2. The soil phase map (management units) shows the distribution of 18 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 Laboratory Characterization

Soil samples for each series were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected in the year 2017 from Gudigeri-3 farmer's fields (36 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.

3.6 Land Use Classes (LUCs)

The 18 soil phases identified and mapped in the microwatershed were regrouped into 7 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 choosen for identification and delineation of LUCs. For Gudigeri -3 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.

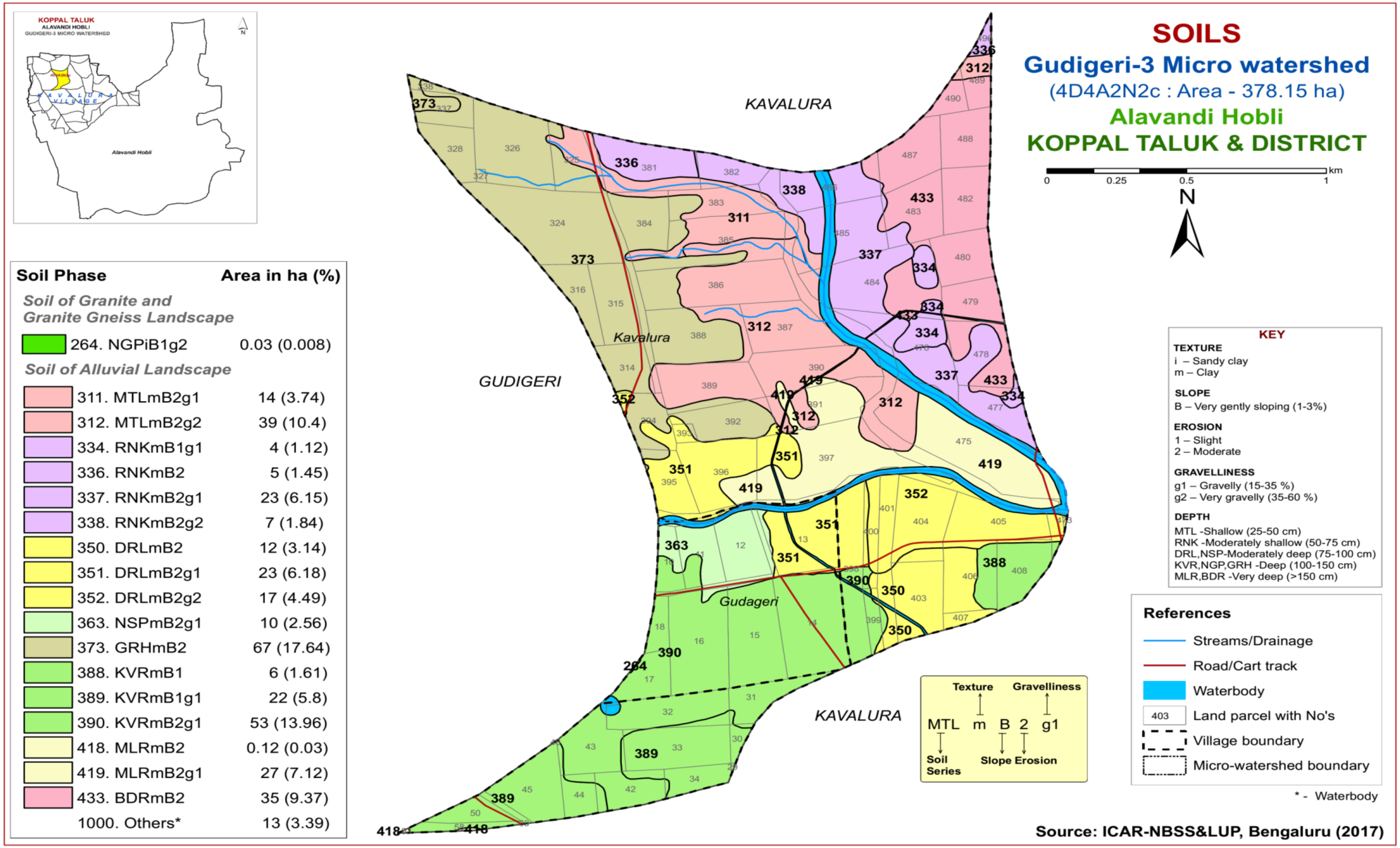


Fig 3.5 Soil Phase or Management Units- Gudigeri-3 Microwatershed

Table 3.2 Soil map unit description of Gudigeri-3 Microwatershed

Soil map unit no*	Soil Series	Soil Phase Symbol	Mapping Unit Description	Area in ha (%)
Soils of Granite gneiss Landscape				
	NGP	Nagalapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red, gravelly sandy clay to clay red soils occurring on very gently sloping uplands under cultivation		**0.03(0.01)**
264		NGPiB1g2	Sandy clay surface, slope 1-3%, slight erosion, very gravelly (35-60%)	0.03 (0.01)
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		**53(14.14)**
311		MTLmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	14(3.74)
312		MTLmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	39(10.40)
	RNK	Ravanaki soils are moderately shallow (50-75 cm), moderately well drained, have dark brown to very dark grayish brown and dark gray, calcareous clayey black soils occurring on very gently sloping uplands under cultivation		**39(10.56)**
334		RNKmB1g1	Clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	4(1.12)
336		RNKmB2	Clay surface, slope 1-3%, moderate erosion	5(1.45)
337		RNKmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	23(6.15)
338		RNKmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	7(1.84)
	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		**52(13.81)**
350		DRLmB2	Clay surface, slope 1-3%, moderate erosion	12(3.14)
351		DRLmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	23(6.18)
352		DRLmB2g2	Clay surface, slope 1-3%, moderate erosion, very gravelly (35-60%)	17 (4.49)
	NSP	Narasapura soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown and very dark gray, black cracking clay soils occurring on very gently sloping uplands under cultivation		**10(2.56)**
363		NSPmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	10(2.56)
	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		**67 (17.64)**
373		GRHmB2	Clay surface, slope 1-3%, moderate erosion	67 (17.64)

	KVR	Kavalur soils are deep (100-150 cm), moderately well drained, have dark yellowish brown to very dark brown and very dark gray, calcareous black cracking clay soils occurring on very gently sloping uplands under cultivation		**81 (21.37)**
388		KVRmB1	Clay surface, slope 1-3%, slight erosion	6 (1.61)
389		KVRmB1g1	Clay surface, slope 1-3%, slight erosion, gravelly (15-35%)	22 (5.80)
390		KVRmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	53 (13.96)
	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		**27.13 (7.15)**
418		MLRmB2	Clay surface, slope 1-3%, moderate erosion	0.12 (0.03)
419		MLRmB2g1	Clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	27 (7.12)
	BDR	Bardur soils are very deep (>150 cm), moderately well drained, have very dark grayish brown to very dark gray, black cracking clay soils occurring on nearly level to very gently sloping uplands under cultivation		**35 (9.37)**
433		BDRmB2	Clay surface, slope 1-3%, moderate erosion	35 (9.37)
1000		Others	Habitation & Waterbody	13 (3.39)

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

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Gudigeri-3 Microwatershed is provided in this chapter. The microwatershed area has been identified as Granite gnesis and Alluviual Landscapes based on geology. In all, 9 soil series are identified. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. The soil formation is dominantly influenced by the parent material, climate and relief.

A brief description of each of the 9 soil series identified followed by 18 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-3 microwatershed is given in Table 4.1. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristic that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of Granite and Granite gneiss

In this landscape, only one soil series is identified and mapped. The brief description of the soil series and the phases identified in the microwatershed are given below.

4.1.1 Nagalapur (NGP) Series: Nagalapur soils are deep (100-150 cm), well drained, have dark reddish brown to dark red gravelly sandy clay to clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands.

The thickness of the solum ranges from 105 to 145 cm. The thickness of A-horizon ranges from 14 to 20 cm. Its colour is in 7.5 YR hue with value and chroma 3 to 4. The texture ranges from sandy loam to sandy clay with 10 to 50 per cent gravel. The thickness of B horizon ranges from 90 to 128 cm. Its colour is in 2.5 YR, 5 YR and 7.5 YR hue with value 3 to 5 and chroma 3 to 6. Texture is sandy clay to clay with 35 to 80 per cent gravel. The available water capacity is low (51-100 mm/m). Only soil phase was identified and mapped.

Landscape Soil Profile Characteristics of Nagalapur (NGP) Series

4.2 Soils of Alluvial Landscape

In this landscape, 8 soil series are identified and mapped. Of these, Kavalur (KVR) occupies maximum area of about 81 ha (21%), Gatareddihal (GRH) 67 ha (18%), Muttal (MTL) 53 ha (14%), Dambarahalli (DRL) 52 ha (14%) and others occur in a small area. The brief description of each soil series along with the soil phases identified and mapped is given below.

4.2.1 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 uplands. 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 sandy clay to clay. The available water capacity is low (51-100 mm/m). Two soil phases were identified and mapped.

Landscape and soil profile characteristics of Muttal (MTL) Series

4.2.2 Ravanaki (RNK) Series: Ravanaki soils are moderately shallow (50-75 cm), well drained, have dark brown to very dark grayish brown, calcareous clayey soils. They have developed from alluvium and occur on nearly level to very gently sloping uplands. The Ravanaki series has been classified as a member of the very fine, smectitic, isohyperthermic (calc) family of Typic 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 sandy clay to clay and are calcareous with gravel content of 10 to 20 per cent. The available water capacity is low (51-100 mm/m). Four soil phases were identified and mapped.

Landscape and Soil Profile Characteristics of Ravanaki (RNK) Series

4.2.3 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 are calcareous. The available water capacity is high (151-200 mm/m). Three soil phases are identified and mapped.

Landscape and soil profile characteristics of Dambarahalli (DRL) Series.

4.2.4 Narsapura (NSP) Series: Narasapura soils are moderately deep (75-100 cm), moderately well drained, have dark grayish brown to very dark grayish brown and very dark gray, black calcareous cracking clay soils They have developed from alluvium and occur on very gently sloping uplands. The Narsapura series has been classified as a member of the Very fine, Smectitic, isohyperthermic (Calc) family of Typic Haplustepts.

The thickness of the solum is 76 to 98 cm. The thickness of A horizon ranges from 15 to 19 cm. Its colour is in 10 YR hue with value 3 and chroma 1 to 2.The texture is clay with no gravel. The thickness of B horizon ranges from 57 to 83 cm. Its colour is in 10 YR hue with value 3 to 5 and chroma 1 to 3. Its texture is clay. The available water capacity is medium (101-150 mm/m). Only one soil phase was identified and mapped.

Landscape and soil profile characteristics of Narsapura (NSP) Series

4.2.5 Gatareddihal (GRH) Series: Gatareddihal soils are deep (100-150 cm), moderately well drained have black or dark grey to light olive brown calcareous 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 and are calcareous with less than 15 per cent gravel. The available water capacity is very high (>200 mm/m). Only one soil phase was identified and mapped.

Landscape and soil profile characteristics of Gatareddihal (GRH) Series

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

The thickness of the solum is 113 to 143 cm. The thickness of A horizon ranges from 9 to 24 cm. Its colour is in 10 YR hue with value 3 and chroma 1. The texture is clay and are calacreous with no gravel. The thickness of B horizon ranges from 89 to 134 cm. Its colour is in 10 YR hue with value 3 and chroma 1. Its texture is clay. The available water capacity is very high (>200 mm/m). Three soil phases were identified and mapped.

Landscape and soil profile characteristics of Kavalur (KVR) Series

4.2.7 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 uplands. 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 are calacreous. 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

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

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 15 to 19 cm. Its colour is in 10 YR hue with value 2 and chroma 1 with clay texture. The thickness of B horizon ranges from 146 to 180 cm. Its colour is in 10 YR hue with value 2 to 3 and chroma 1 to 2. Its texture is clay and are calcareous with less than 15 per cent gravel. The available water capacity is very high (>200 mm/m). Only one soil phase was identified and mapped.

Landscape and soil profile characteristics of Bardur (BDR) Series

Table: 4.1 Physical and Chemical Characteristics of Soil Series identified in Gudigeri-3 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: Ravanaki (RNK), **Pedon:** RM-20
Location: 15⁰14'22.7"N, 75⁰57'45.8"E, Gatareddihalla village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Very fine, smectitic, isohyperthermic (calc) Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-28	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: Narsapura (NSP), **Pedon:** A2/RM-2

Location: $15^0$19'86.9"N, $75^0$57'86.1"E, Kavalura village, Koppal taluk and district

Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Very fine, smectitic, isohyperthermic (Calc) Typic Haplustepts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-29	Ap	31.32	16.52	52.16	5.51	5.40	5.51	9.83	5.08	10	c	38.86	27.64
29-52	Bw1	13.30	22.08	64.62	2.52	2.41	2.41	3.67	2.29	05	c	49.88	40.05
52-77	BW2	13.22	17.39	69.40	3.56	2.41	1.95	2.76	2.53	05	c	51.33	41.55

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}							%	%
0-29	9.16			0.615	0.23	9.36			0.72	10.98		51.09	0.98		21.49
29-52	8.69			2.01	0.5	8.64			0.55	24.42		60.63	0.94		40.27
52-77	8.52			2.68	0.46	7.68			0.50	25.65		60.74	0.88		42.24

Contd…..

Series Name: Gatareddihalla (GRH), **Pedon:** RM-2
Location: $15^0$24'01"N, $76^0$09'29"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: Kavalura (KVR), **Pedon:**A2/RM-9
Location: $15^0$18'86.8"N, $75^0$56'56.3"E, Kavalura village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Fine smectitic, isohyperthermic (Calc) Typic Haplusterts

Depth (cm)	Horizon	Size class and particle diameter (mm)								Coarse fragments w/w (%)	Texture Class (USDA)	% Moisture	
		Total			Sand								
		Sand (2.0-0.05)	Silt (0.05-0.002)	Clay (<0.002)	Very coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very fine (0.1-0.05)			1/3 Bar	15 Bar
0-24	Ap	36.18	17.80	46.02	7.04	7.47	6.62	9.28	5.76	10	c	28.20	18.75
24-50	Bss1	38.79	15.36	45.85	6.25	6.25	9.70	10.67	5.93	05	c	27.16	18.81
50-85	Bss2	36.80	14.66	48.54	9.63	8.23	7.03	7.58	4.33	<5	c	30.16	22.17
85-124	Bss3	22.66	17.24	60.09	4.18	3.85	5.28	5.06	4.29	<5	c	40.34	31.42

Depth (cm)	pH (1:2.5)			E.C. (1:2.5)	O.C.	$CaCO_3$	Exchangeable bases					CEC	CEC/ Clay	Base saturation	ESP
							Ca	Mg	K	Na	Total				
	Water	$CaCl_2$	M KCl	dS m^{-1}	%	%	cmol kg^{-1}							%	%
0-24	8.4	-	-	0.265	0.2	8.04	-	-	0.97	0.65		43.25	0.94		1.50
24-50	9.27	-	-	0.23	0.37	8.04	-	-	0.31	3.21		41.66	0.91		7.70
50-85	9.44	-	-	0.297	0.41	8.64	-	-	0.35	6.43		43.99	0.91		14.63
85-124	9.37	-	-	0.46	0.41	11.40	-	-	0.42	7.99		51.09	0.85		15.65

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

Contd…..

Series Name: Bardur (BDR), Pedon: R-4
Location: $15^0$14'31.7"N, $76^0$01'19.1"E, Moranali village, Koppal taluk and district
Analysis at: NBSS&LUP, Regional Centre, Bangalore. **Classification:** Very fine, smectitic, isohyperthermic calacreous 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
0-25	Ap	21.78	22.78	55.44	2.17	3.68	4.44	6.61	4.88	-	c	36.78	26.95
25-53	BA	18.62	18.56	62.82	2.23	4.24	3.46	5.24	3.46	-	c	41.25	29.87
53-90	Bss1	15.87	18.60	65.53	2.23	1.34	4.25	3.91	4.13	-	c	44.73	33.64
90-126	Bss2	13.66	20.02	66.32	1.68	2.80	2.35	3.70	3.14	-	c	49.24	38.37
126-152	Bss3	11.64	20.79	67.57	1.69	1.81	1.81	3.50	2.82	-	c	53.50	41.90
152-210	Bss4	11.38	23.21	65.42	2.16	2.16	1.93	3.07	2.05	-	c	51.53	39.64

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}							%	%
0-25	8.73	-	-	0.203	0.24	5.76	-	-	0.65	4.43	-	40.56	0.73	-	10.93
25-53	9.17	-	-	0.295	0.45	4.92	-	-	0.32	10.47	-	74.70	1.19	-	14.02
53-90	9.27	-	-	0.388	0.66	6.00	-	-	0.24	10.49	-	76.20	1.16	-	13.77
90-126	9.22	-	-	0.608	0.57	5.88	-	-	0.21	15.93	-	77.20	1.16	-	20.63
126-152	9.21	-	-	0.936	0.33	6.60	-	-	0.37	20.88	-	80.90	1.20	-	25.81
152-210	9.03	-	-	1.47	0.33	8.16	-	-	0.24	15.34	-	73.10	1.12	-	20.98

Chapter 5

INTERPRETATION FOR LAND RESOURCE MANAGEMENT

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

5.1 Land Capability Classification

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The 18 soil map units identified in the Gudigeri-3 microwatershed are grouped under two land capability classes and four land capability subclasses (Fig. 5.1).

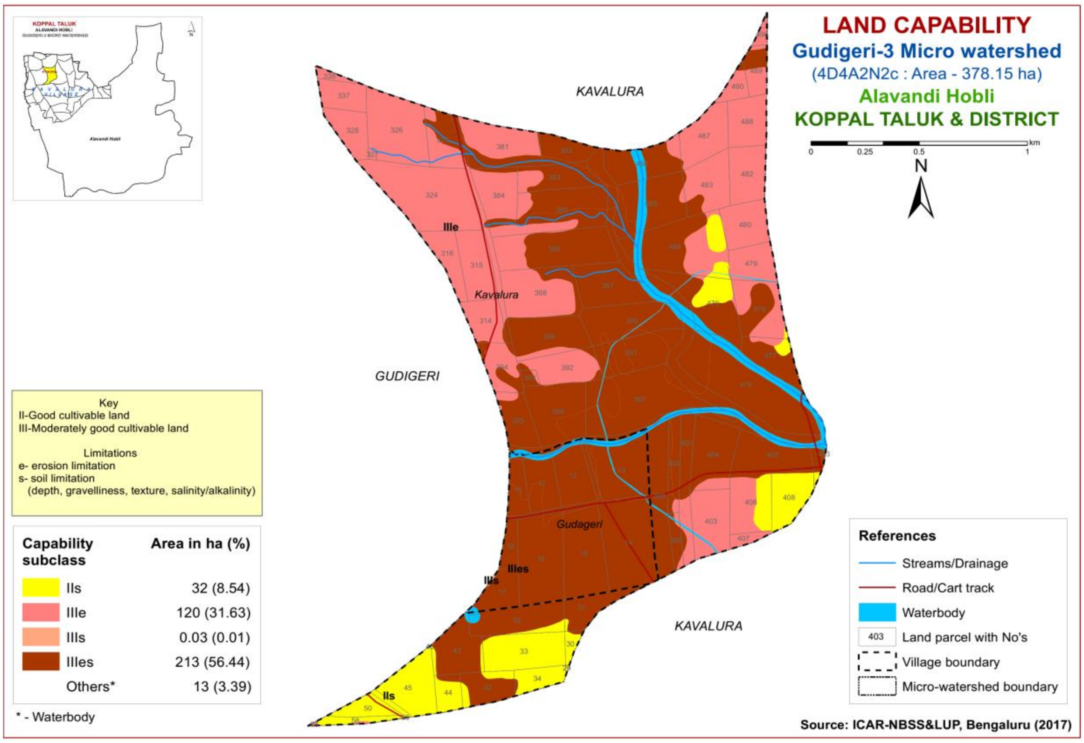


Fig. 5.1 Land Capability map of Gudigeri-3 Microwatershed

Entire area is suitable for agriculture. Good lands cultivable lands (Class II) cover an area of 9 per cent and are distributed in the southern and eastern part of the microwatershed with moderate problems of soil. Moderately good cultivable lands (Class III) cover a major area of about 88 per cent and are distributed in all parts of the microwatershed with moderate problems of soil and erosion.

5.2 Soil Depth

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

An area of 53 ha (14%) has shallow soils (25-50 cm) and are distributed in the northern and central part of the microwatershed. An area of about 40 ha (11%) is moderately shallow (50-75 cm) and are distributed in the northern and northeastern part of the microwatershed. Moderately deep (75-100 cm) and Deep (100-150 cm) soils occupy an area of about 210 ha (55%) and occur in the northwestern and southwestern part of the microwatershed. Very deep (>150 cm) soils occupy an area of about 62 ha (17%) and are distributed in the northeastern part of the microwatershed.

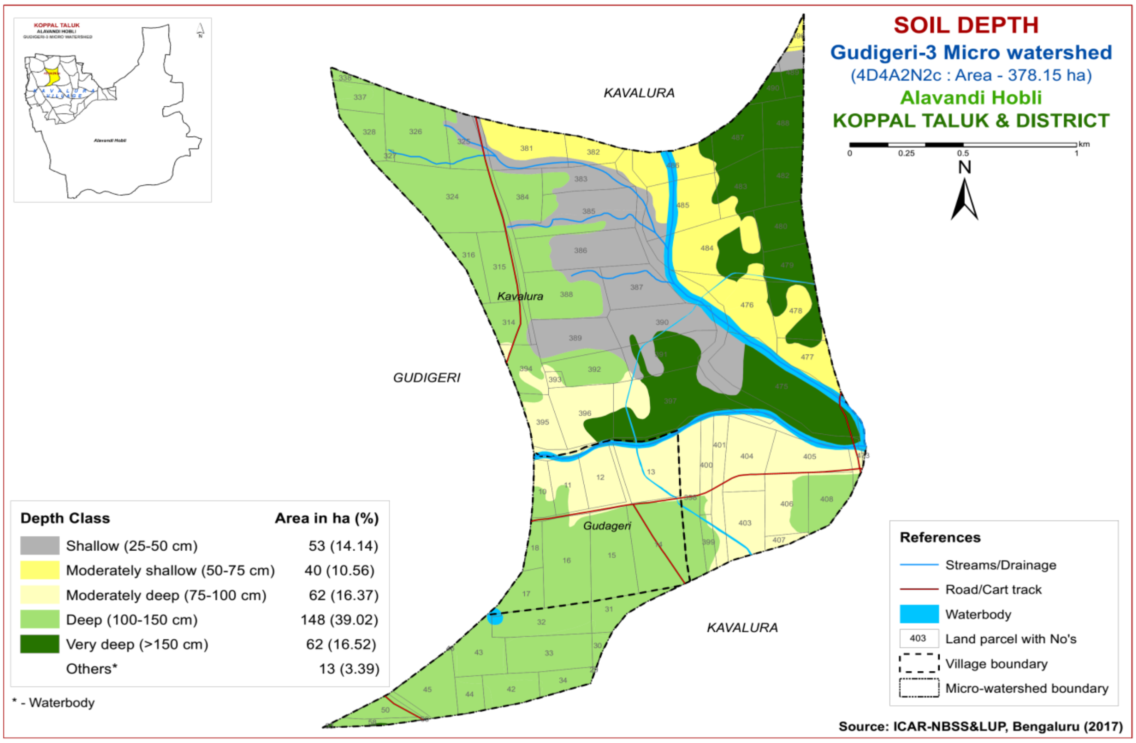


Fig. 5.2 Soil Depth map of Gudigeri-3 Microwatershed

The most problem lands with an area of about 53 ha (14%) having shallow rooting depth are not suitable for growing agricultural crops but well suited for pasture, forestry or other recreational purposes. Occasionally, short duration crops may be grown if rainfall is normal. The most productive lands cover about 210 ha (56%) where all climatically adopted long duration crops be grown.

5.3 Surface Soil Texture

Texture is an expression to indicate the coarseness or fineness of the soil as determined by the relative proportion of primary particles of sand, silt and clay. It has a direct bearing on the structure, porosity, adhesion and consistence. The surface layer of a soil to a depth of about 25 cm is the layer that is most used by crops and plants. The surface soil textural class provides a guide to understanding soil-water retention and availability, nutrient holding capacity, infiltration, workability, drainage, physical and chemical behaviour, microbial activity and crop suitability.

Entire area has soils that are clayey at the surface (Fig. 5.3) and 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.

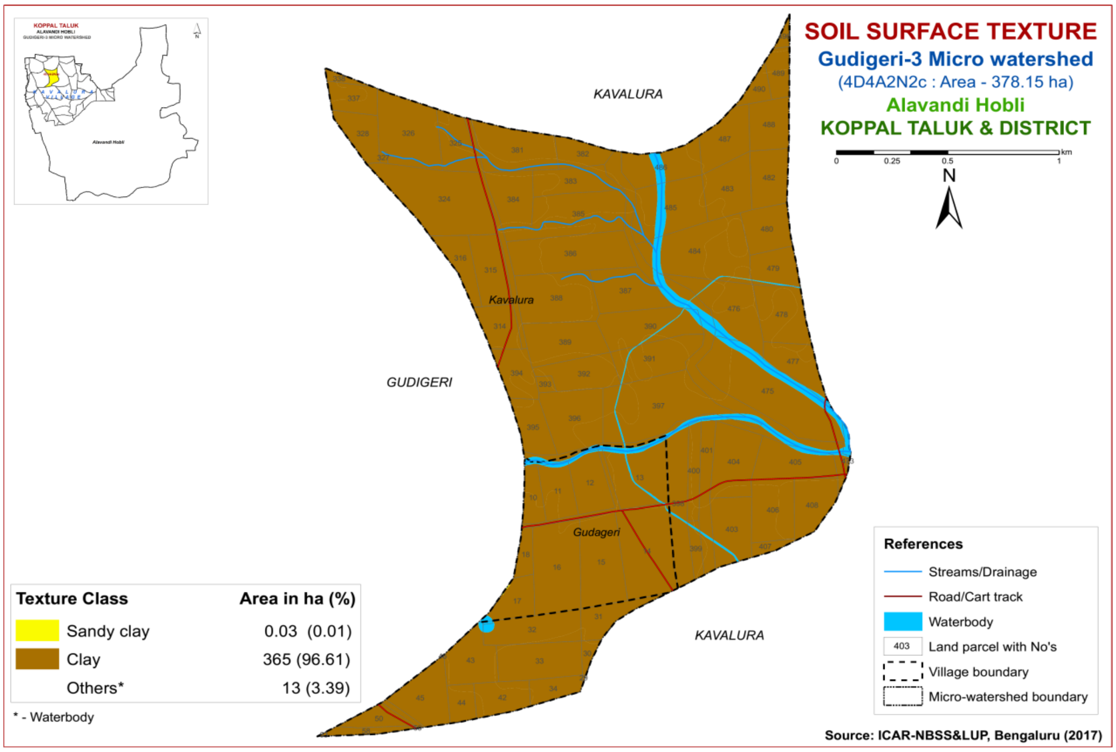


Fig. 5.3 Surface Soil Texture map of Gudigeri-3 Microwatershed

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 soils that are non-gravelly (<15% gravel) cover an area of about 126 ha (32%) and are distributed in the northwestern and northeastern part of the microwatershed. Major area of 176 ha (47%) is covered by gravelly (15-35% gravel) soils and are distributed in the central and southern part of the microwatershed. An area of about 63 ha (17%) has soils that are very gravelly (35-60% gravel) and are distributed in the northern and central part of the microwatershed (Fig. 5.4).

The most productive lands with respect to gravelliness are found to be 33%. They are non-gravelly with less than 15 per cent gravel and have potential for growing both annual and perennial crops. The problem soils (17%) that are very gravelly (35-60%) where only short duration crops can be grown.

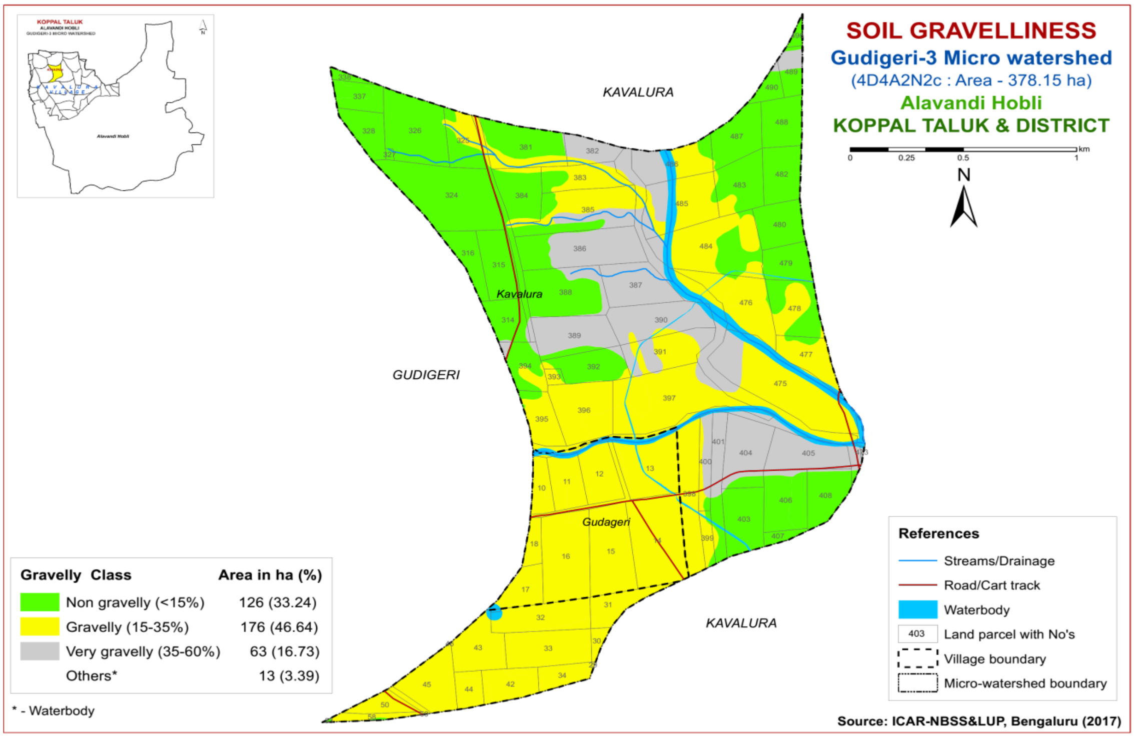


Fig. 5.4 Soil Gravelliness map of Gudigeri-3 Microwatershed

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 93 ha (25%) has soils that are low (51-100 mm/m) in available water capacity and are distributed in the central and northern part of the microwatershed. An area of about 62 ha (16%) is medium (101-150 mm/m) in available water capacity and are distributed in the southern part of the microwateshed and about 210 ha (56%) area is very high in available water capacity and are distributed in all parts of the microwatershed.

An area of about 93 ha (25%) 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 210 ha (56%) has soils that have high potential (>200 mm/m) with regard to available water capacity where all climatically adapted long duration crops can be grown successfully.

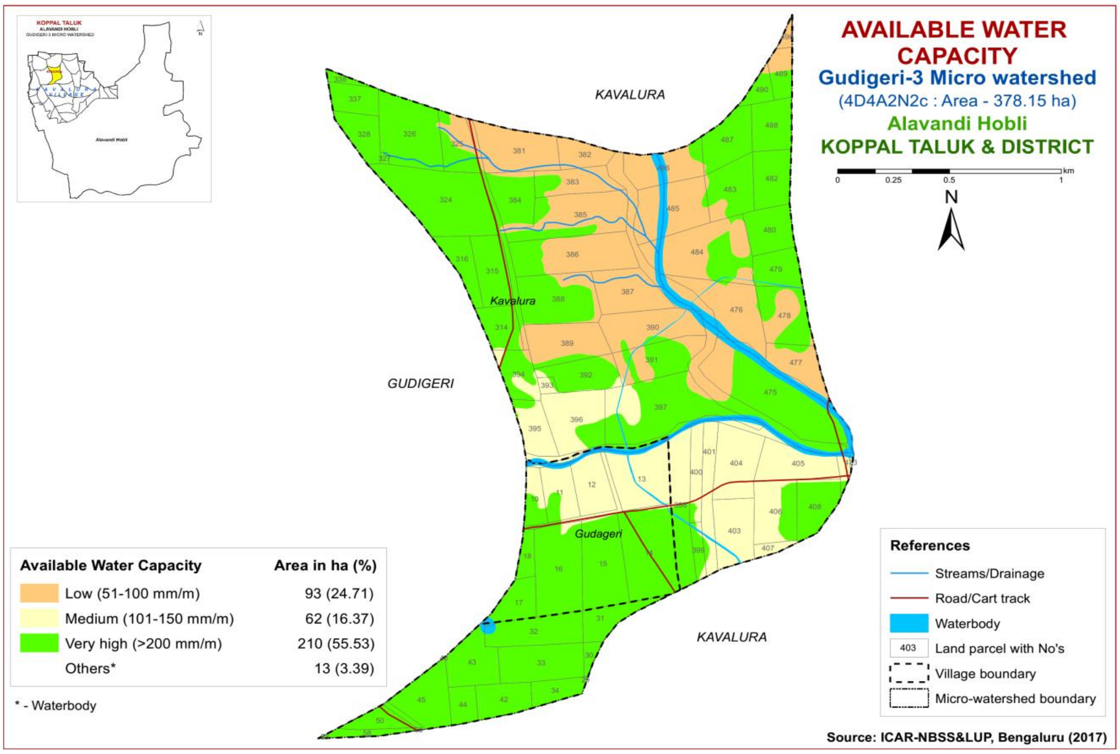


Fig. 5.5 Soil Available Water Capacity map of Gudigeri-3 Microwatershed

5.6 Soil Slope

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

Entire area falls under very gently sloping (1-3% slope) lands. 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.

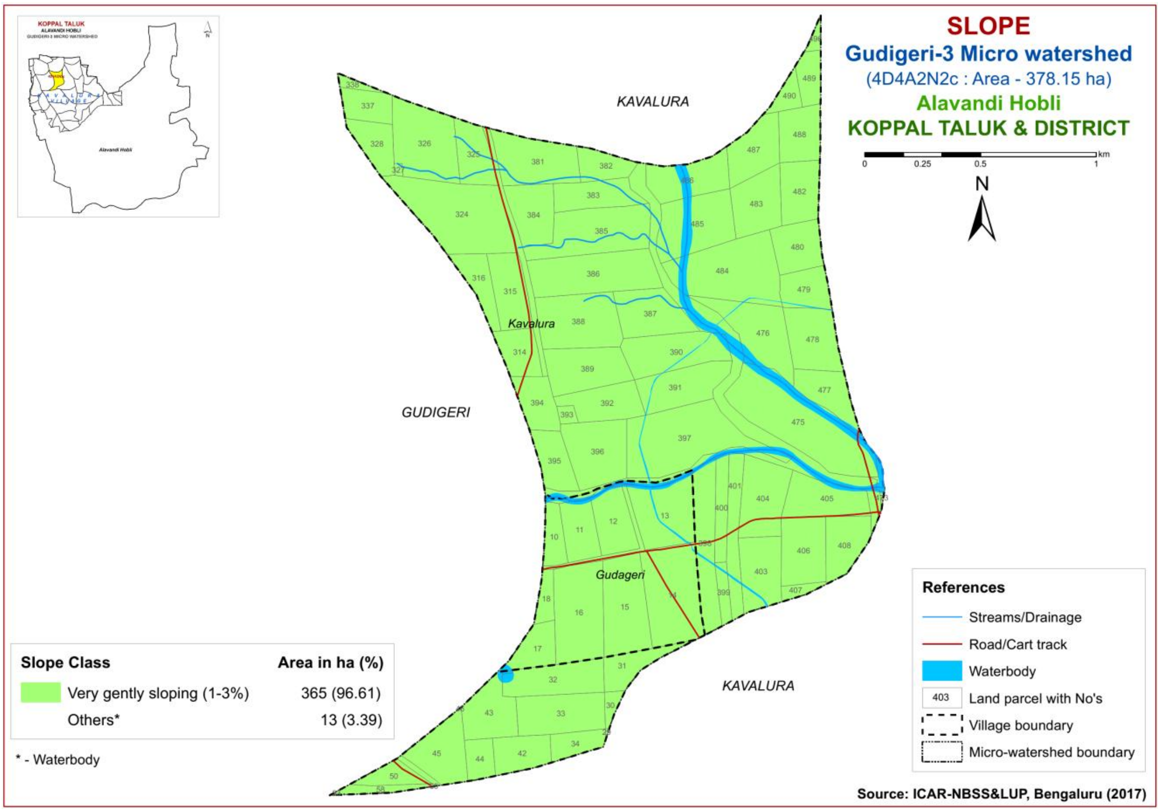


Fig. 5.6 Soil Slope map of Gudigeri-3 Microwatershed

5.7 Soil Erosion

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

Major area of 333 ha (88%) has soils that are moderately eroded (e2 class). These are problematic and need appropriate soil and water conservation and other land development measures and small area of about 32 ha (9%) has soils that are slightly eroded (e1 class).

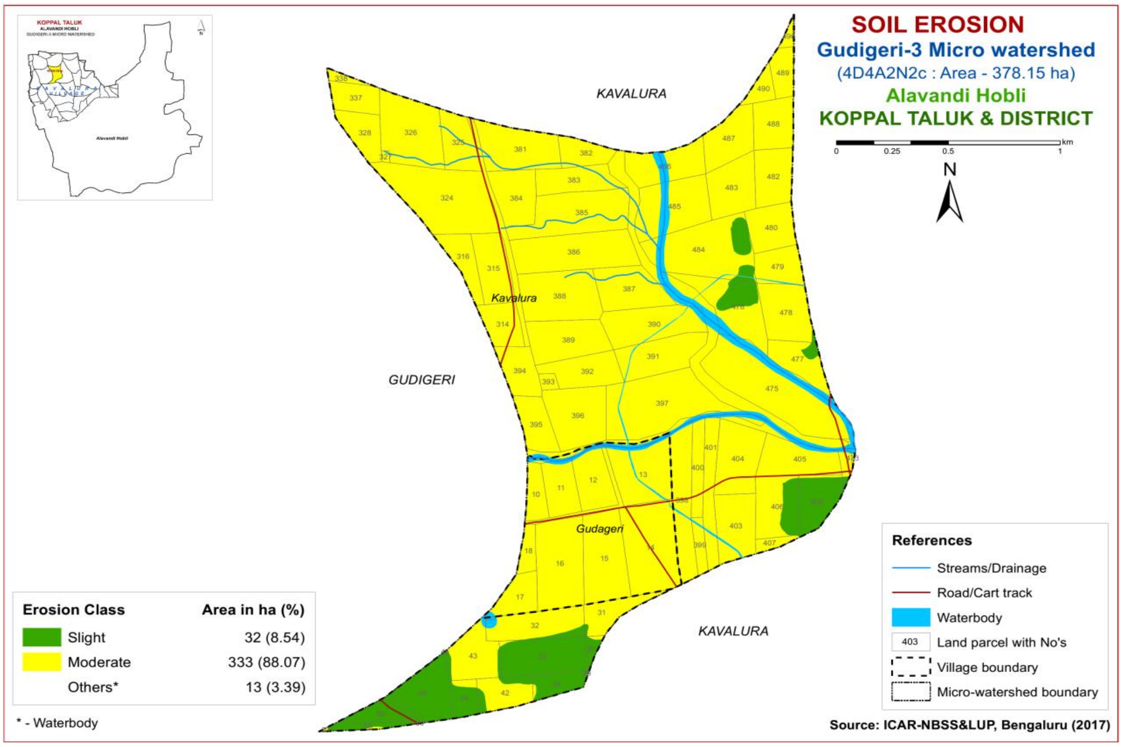


Fig. 5.7 Soil Erosion map of Gudigeri-3 Microwatershed

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 by using the Kriging method under GIS. The village/survey number wise fertility data for the microwatershed is given in Appendix-II.

6.1 Soil Reaction (pH)

The soil analysis of the Gudigeri-3 microwatershed for soil reaction (pH) showed that an area of about 121 ha (32%) is under strongly alkaline (pH 8.4-9.0) and is distributed in the northwestern and southern part of the microwatershed. Major area of about 243 ha (65%) is very strongly alkaline (pH > 9.0) and are distributed in all parts of the microwatershed (Fig.6.1). thus all the 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 medium (0.5-0.75%) covering an area of about 57 ha (15%) and is distributed in the western and eastern part of the microwatershed. Major area of 297 ha (79%) is low (<0.5%) in organic carbon content and is distributed in all parts of the microwatershed. Small area of about 10 ha (3%) is high (>0.75%) in organic carbon content and occur in the southern part of the microwatershed (Fig.6.3).

6.4 Available Phosphorus

Major area of 352 ha (93%) is low (<23 kg/ha) in available phosphorus and are distributed in all parts of the microwatershed. A small area of about 11 ha (3%) is medium (23-57 kg/ha) in available phosphorus and are distributed in the southern part of the microwatershed. A small area of about 1 ha (<1%) is high (>57 kg/ha) in available phosphorus and are distributed in the southern part of the microwatershed (Fig 6.4). There is an urgent need to increase the dose of phosphorous for all the crops by 25 per cent over the recommended dose in low and medium areas to realize better crop performance

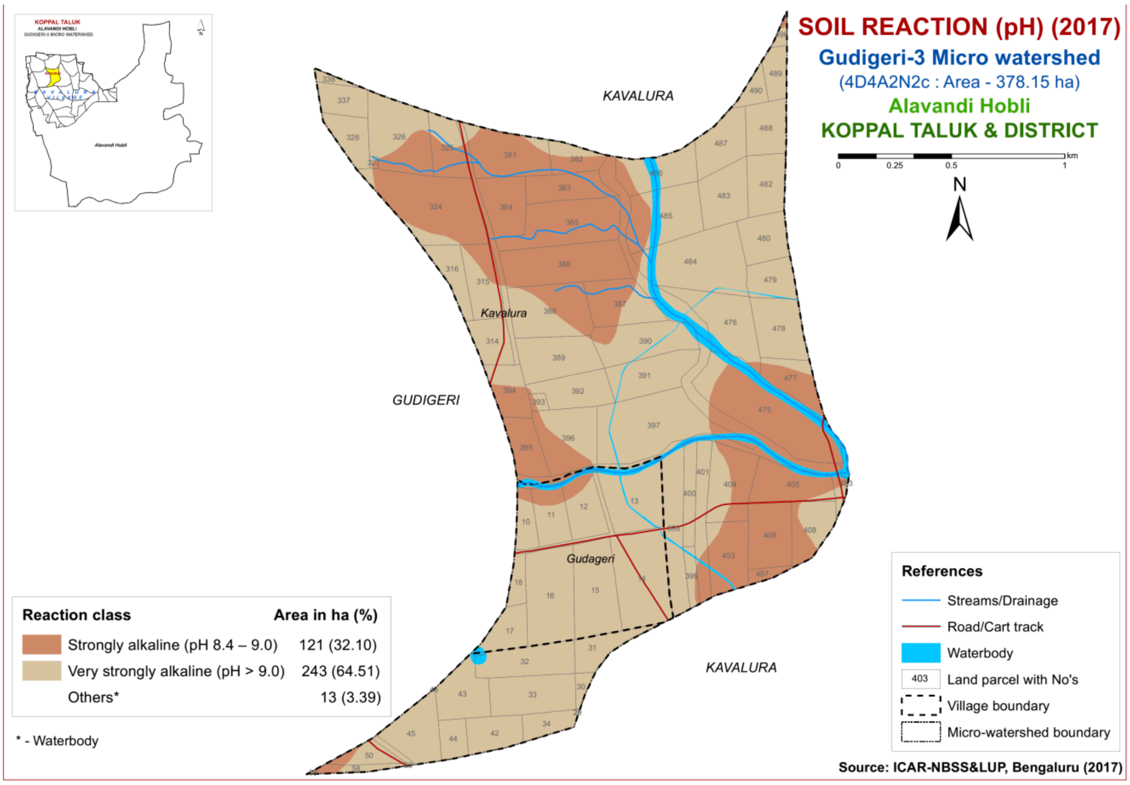


Fig.6.1 Soil Reaction (pH) map of Gudigeri-3 Microwatershed

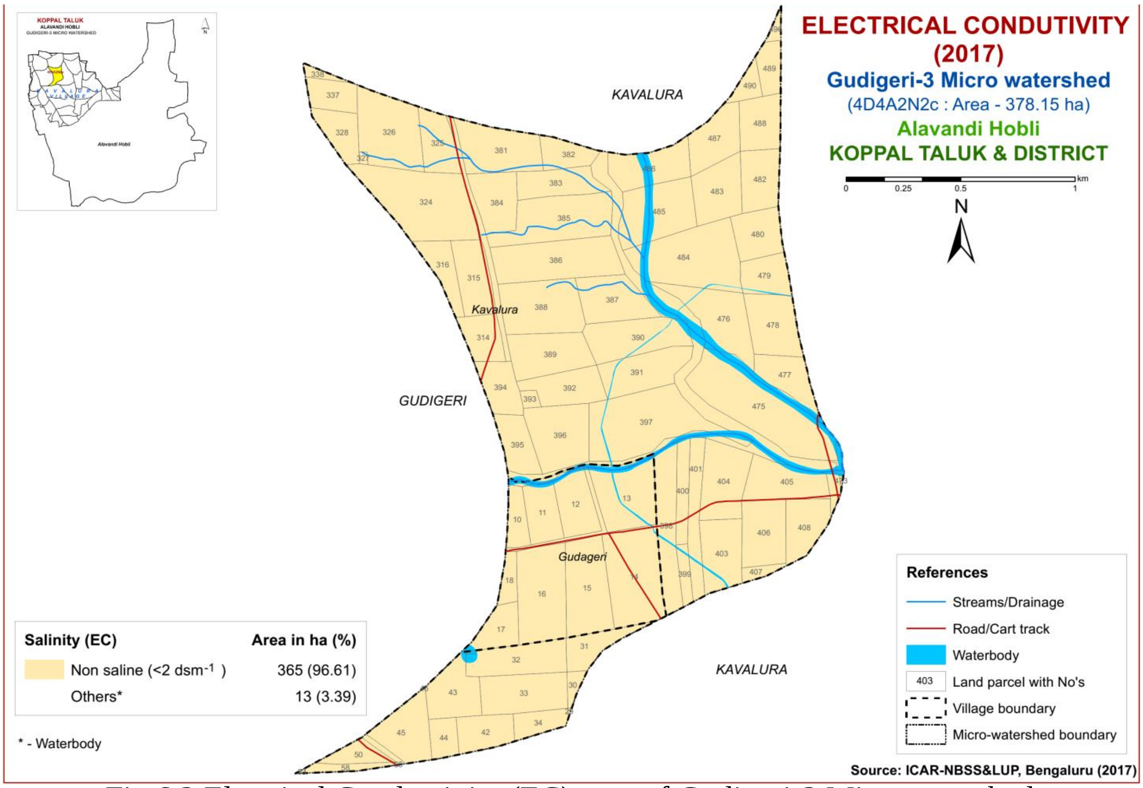


Fig.6.2 Electrical Conductivity (EC) map of Gudigeri-3 Microwatershed

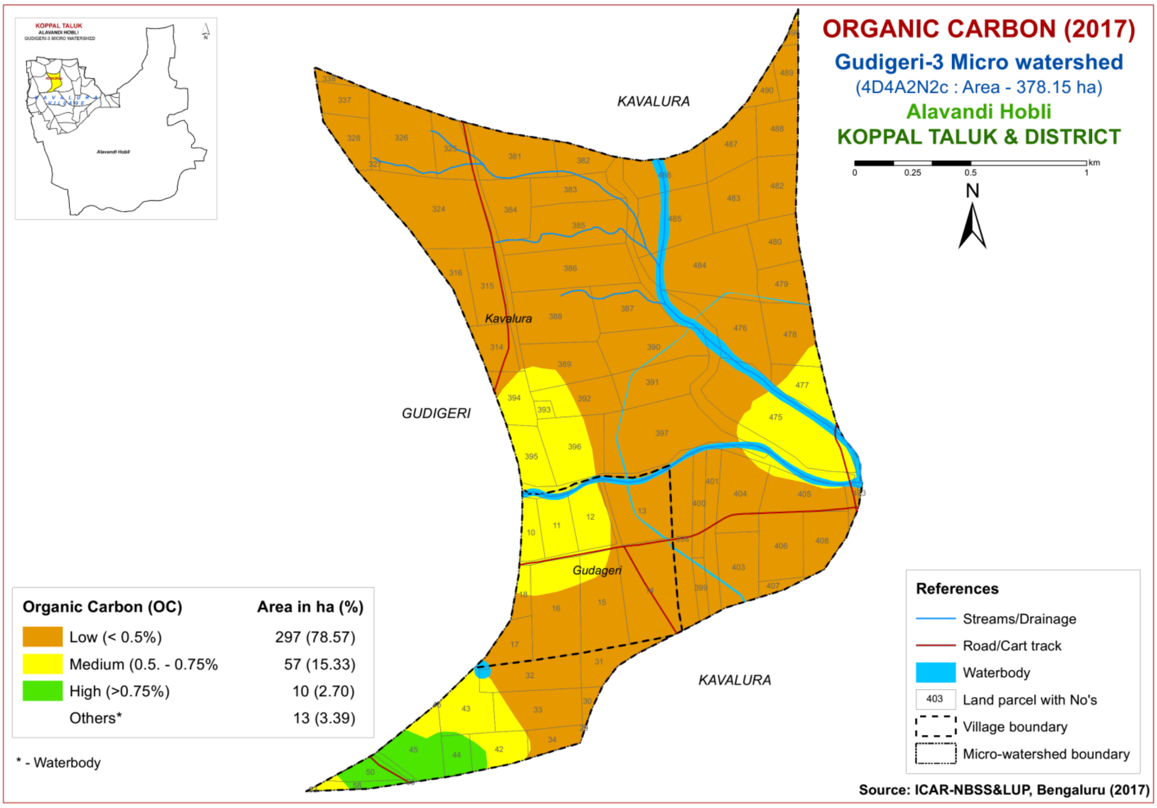


Fig.6.3 Soil Organic Carbon map of Gudigeri-3 Microwatershed

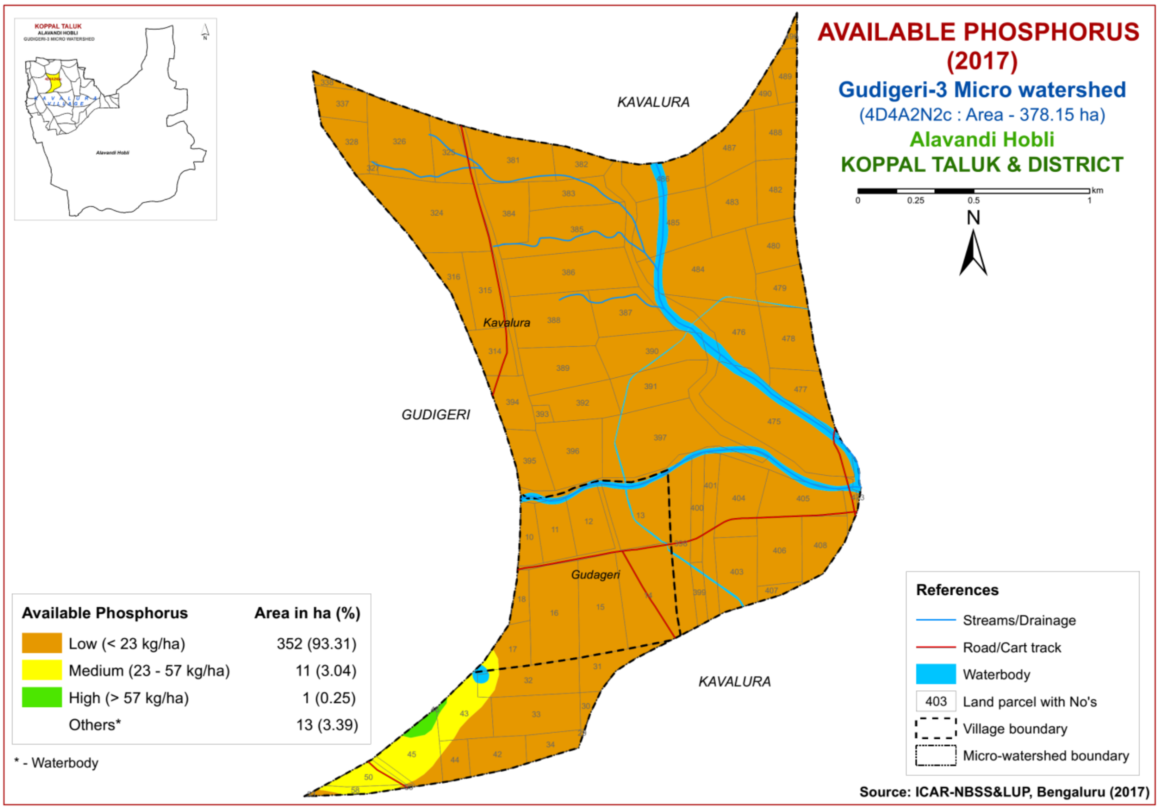


Fig.6.4 Soil Available Phosphorus map of Gudigeri-3 Microwatershed

6.5 Available Potassium

Major area of about 356 ha (94%) is high (>337 kg/ha) in available potassium (Fig.6.5). Hence, in these plots, for all the crops, 25% less potassium than recommended may be applied. Medium (145-337 kg/ha) in small area of about 8 ha (2%) and occur in the eastern part of the microwatershed.

6.6 Available Sulphur

An area of 104 ha (28%) is low (<10 ppm) in available sulphur and is distributed in the northeastern, southern and northwestern part of the microwatershed. An area of about 5 ha (1%) is medium (10-20 ppm) in available sulphur and is distributed in the southwestern part of the microwatershed. Major area of about 255 ha (68%) is high (>20 ppm) in available sulphur and are distributed in all parts of the microwatershed (Fig.6.6). The areas that are low and medium in available sulphur need to be applied with magnesium sulphate or gypsum or factomphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.

6.7 Available Boron

Available boron content is low (<0.5 ppm) in maximum area of 243 ha (65%) in the microwatershed and is distributed in all parts of the microwatershed. An area of about 121 ha (32%) is medium (0.5-1.0 ppm) in available boron and is distributed in the central and eastern part of the microwatershed (Fig.6.7).

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in maximum area of 341 ha (90%) and a small area of 24 ha (6%) is deficient in available iron (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 major area 364 ha (96%) and a minor area of 1 ha is sufficient (>0.6 ppm) in available zinc in the microwatershed (Fig 6.11).

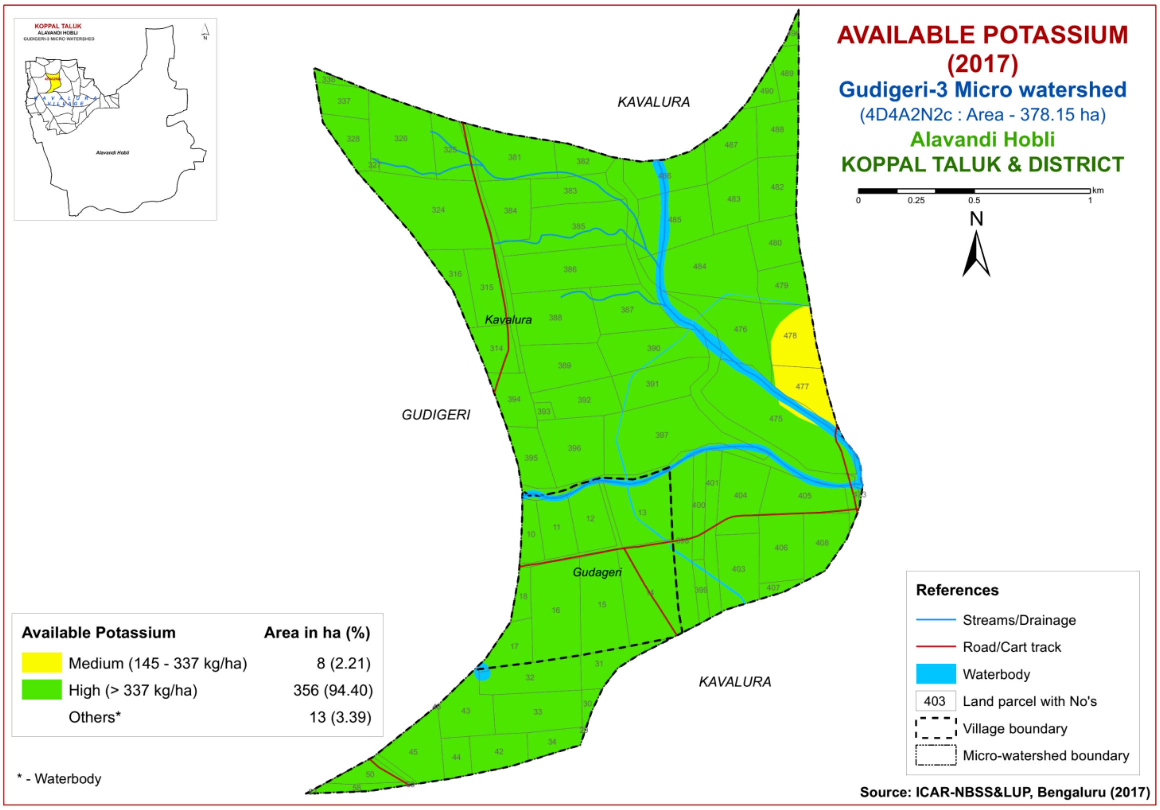


Fig.6.5 Soil Available Potassium map of Gudigeri-3 Microwatershed

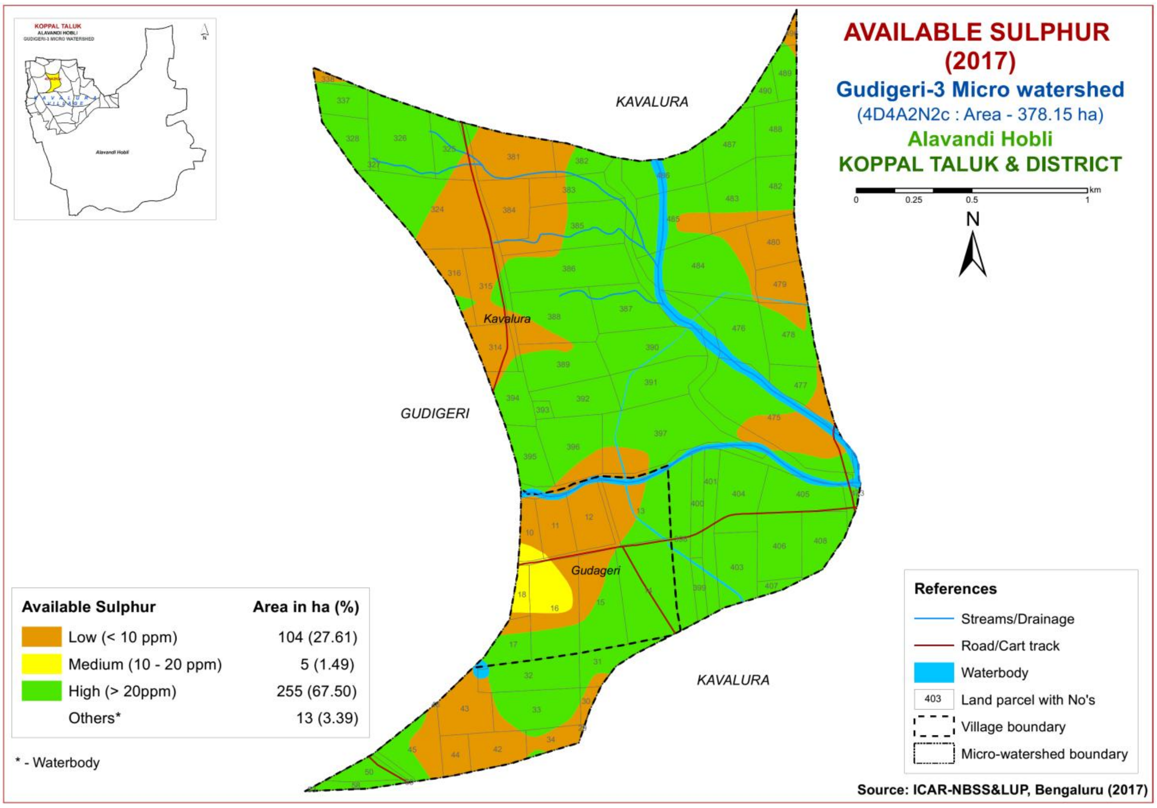


Fig.6.6 Soil Available Sulphur map of Gudigeri-3 Microwatershed

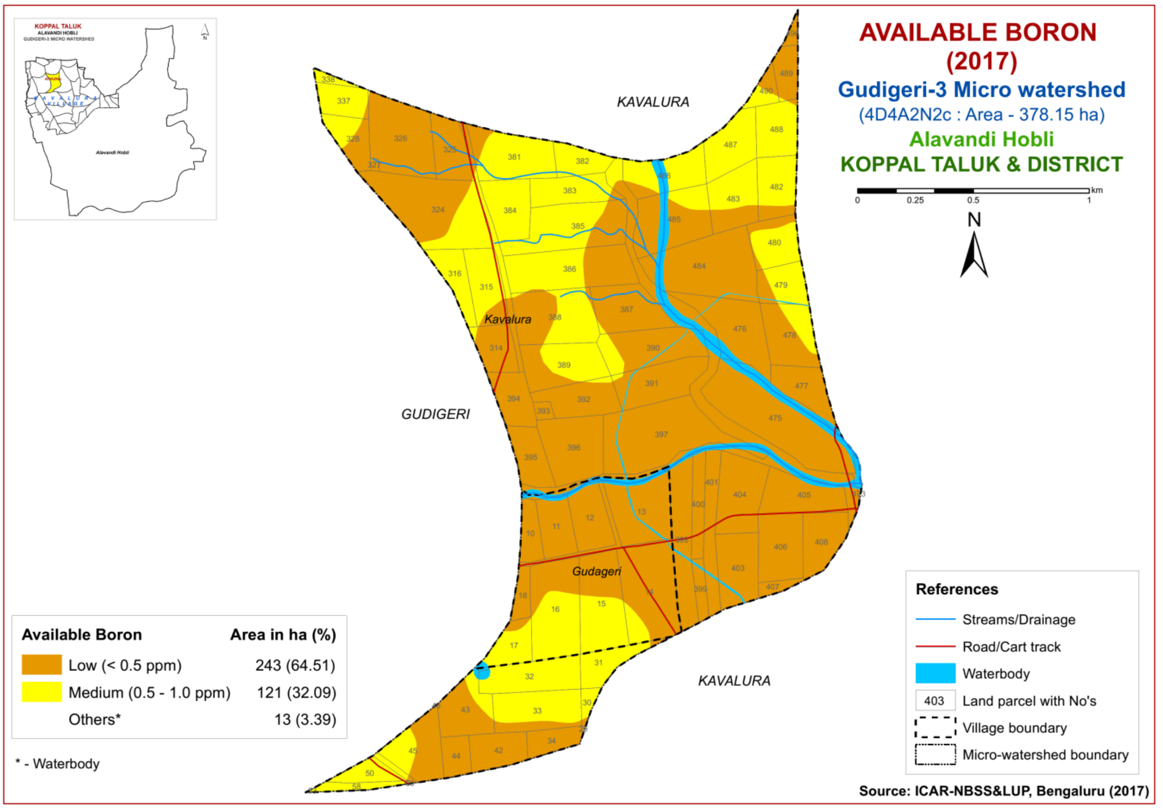


Fig.6.7 Soil Available Boron map of Gudigeri-3 Microwatershed

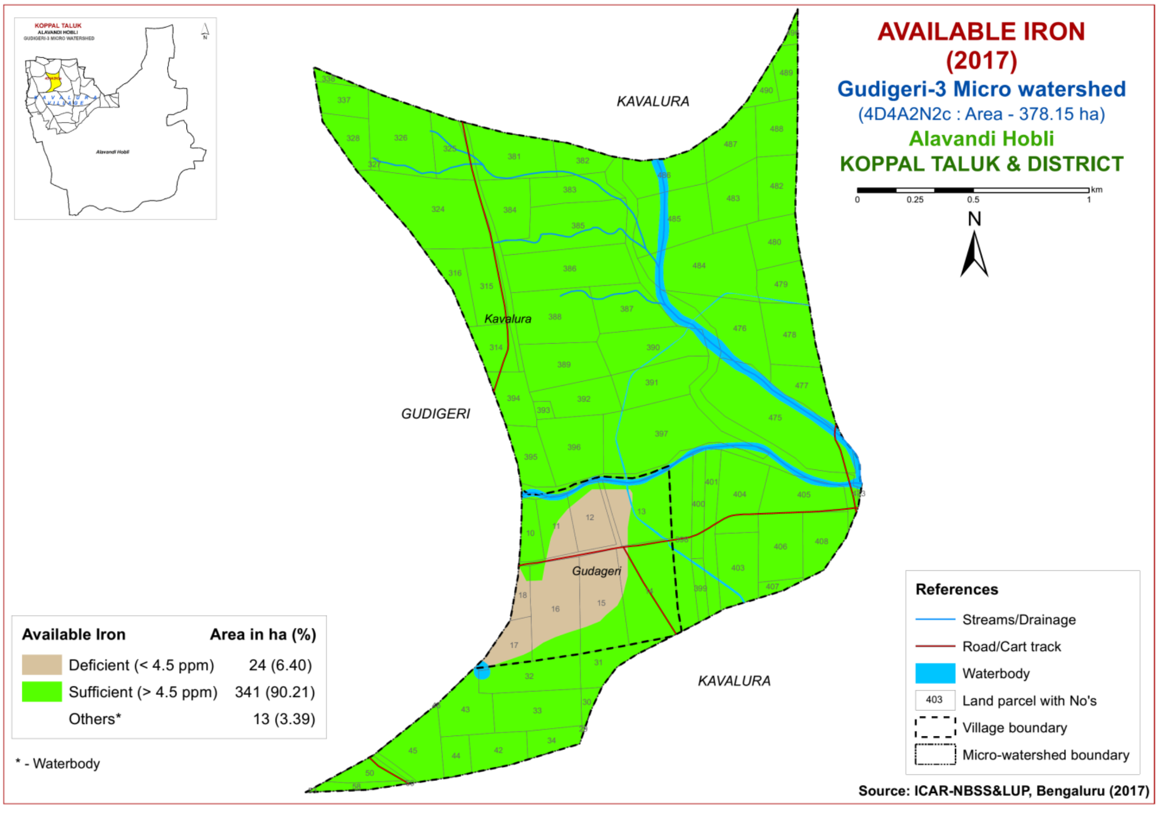


Fig.6.8 Soil Available Iron map of Gudigeri-3 Microwatershed

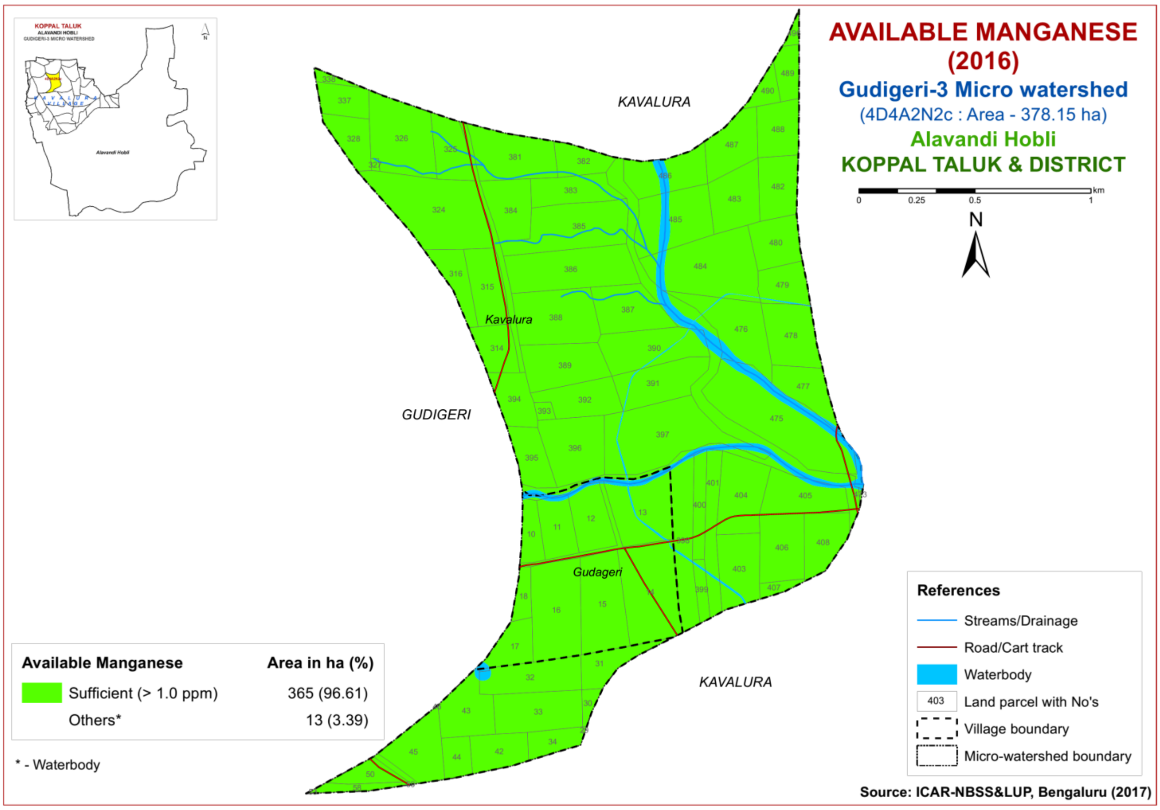


Fig.6.9 Soil Available Manganese map of Gudigeri-3 Microwatershed

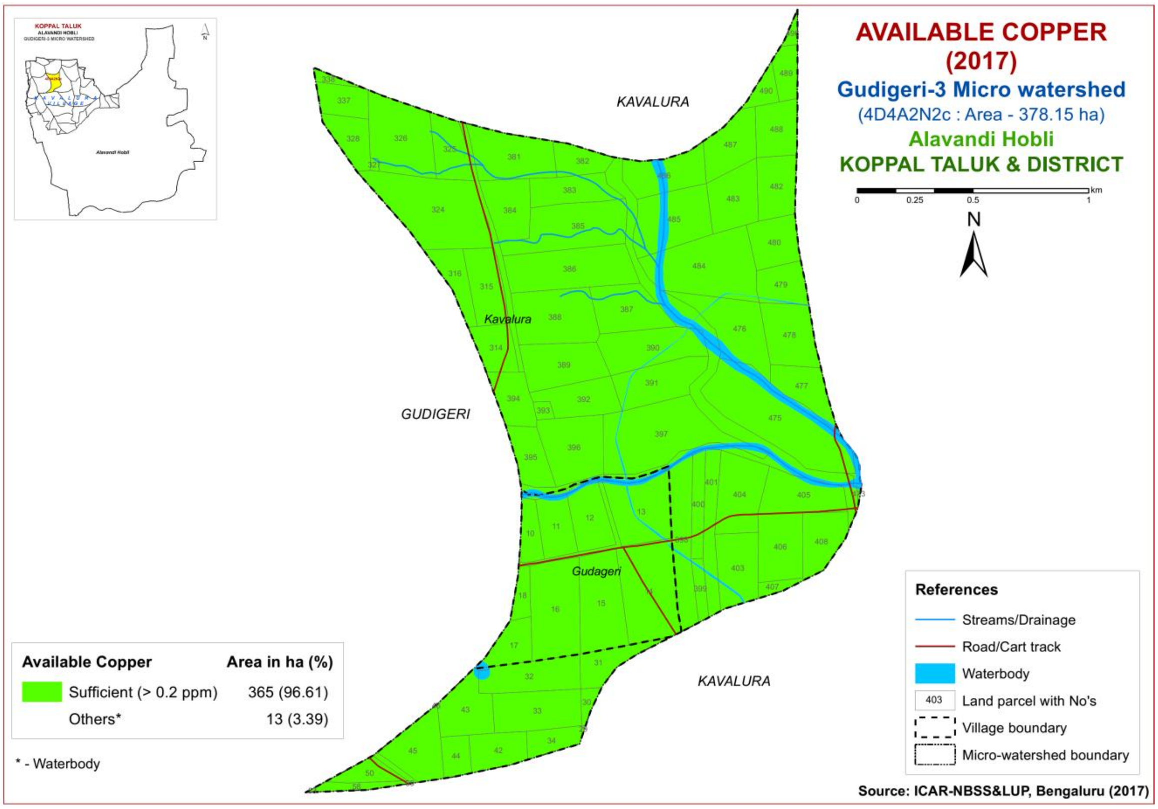


Fig.6.10 Soil Available Copper map of Gudigeri-3 Microwatershed

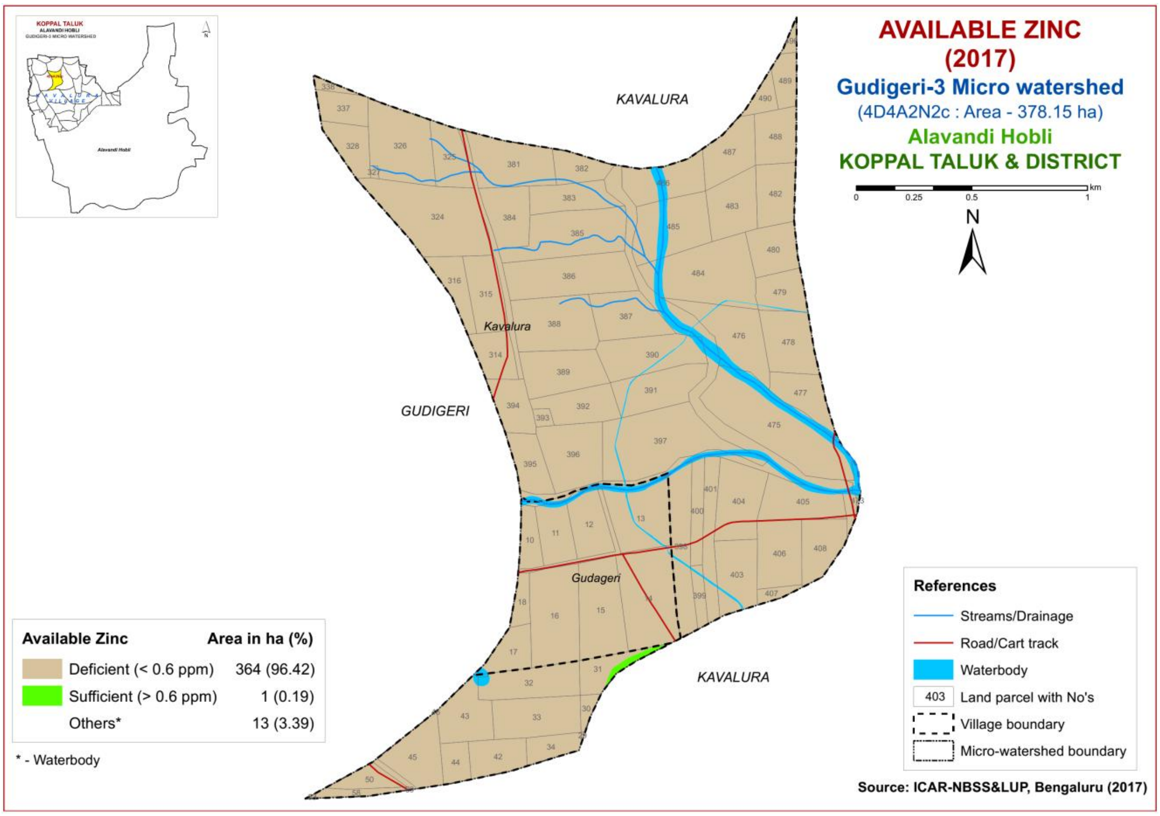


Fig.6.11 Soil Available Zinc map of Gudigeri-3 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Gudigeri-3 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, N1 and N2 are divided into subclasses based on the kinds of limitations encountered. The limitations that affect crop production are 'c' for erratic rainfall and its distribution and length of growing period (LGP), 'e' for erosion hazard, 'r' for rooting condition, 't' for lighter or heavy texture, 'g' for gravelliness or stoniness, 'n' for nutrient availability, 'l' for topography, 'm' for moisture availability, 'z' for calcareousness 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 annual and perennial 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 a land suitability map for growing sorghum was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed are given in Figure. 7.1.

Highly suitable (Class S1) land occupy an area of about 45 ha (12%) for growing sorghum and occur in the northeastern part of the microwatershed. Maximum area of about 267 ha (71%) is moderately suitable (Class S2) for growing sorghum and are distributed in all parts of the microwatershed.

Table 7.1 Soil-Site Characteristics of Gudigeri-3 Microwatershed

Soil Map Units	Climate (P) (mm)	Growing period (Days)	Drainage Class	Soil depth (cm)	Soil texture		Gravelliness		AWC (mm/m	Slope (%)	Erosion	pH	EC	ESP	CEC [Cmol $(p^{+})kg^{-1}$]	BS (%)
					Surf-ace	Sub-surface	Sur-face	Sub-surface								
MTLmB2g1	662	<90	WD	25-50 25-50	c	c	15-35	15-35	51-100	1-3	moderate	8.27	0.20	0.69	36.64	-
MTLmB2g2	662	<90	WD	50-75	c	c	35-60	15-35	51-100	1-3	moderate	8.27	0.20	0.69	36.64	-
RNKmB1g1	662	<90	MWD	50-75	c	c	15-35	<15	51-100	1-3	slight	8.86	0.48	16.94	37.00	-
RNKmB2	662	<90	MWD	50-75	c	c	-	<15	51-100	1-3	moderate	8.86	0.48	16.94	37.00	-
RNKmB2g1	662	<90	MWD	50-75	c	c	15-35	,15	51-100	1-3	moderate	8.86	0.48	16.94	37.00	-
RNKmB2g2	662	<90	MWD	50-75	c	c	35-60	<15	51-100	1-3	moderate	8.86	0.48	16.94	37.00	-
DRLmB2	662	<90	MWD	75-100	c	c	-	<15	151-200	1-3	moderate	-	-	-	-	-
DRLmB2g1	662	<90	MWD	75-100	c	c	15-35	<15	151-200	1-3	moderate	-	-	-	-	-
DRLmB2g2	662	<90	MWD	75-100	c	c	35-60	<15	151-200	1-3	moderate	-	-	-	-	-
NSPmB2g1	662	<90	MWD	75-100	c	c	15-35	-	101-150	1-3	moderate	9.16	0.615	21.4	51.09	
GRHmB2	662	<90	MWD	100-150	c	c	-	<15	>200	1-3	moderate	8.27	1.11	11.7	31.60	
KVRmB1	662	<90	MWD	100-150	c	c	-	-	>200	1-3	slight	8.4	0.26	1.50	43.25	
KVRmB1g1	662	<90	MWD	100-150	c	c	15-35	-	>200	1-3	slight	8.4	0.26	1.50	43.25	
KVRmB2g1	662	<90	MWD	100-150	c	c	15-35	-	>200	1-3	moderate	8.4	0.26	1.50	43.25	
NGPiB1g2	662	<90	WD	100-150	sc	sc-c	35-60	>35	51-100	1-3	slight	-	-	-	-	
MLRmB2	662	<90	MWD	>150	c	c	-	10-20	>200	1-3	moderate	9.19	0.313	13.4	42.08	
MLRmB2g1	662	<90	MWD	>150	c	c	15-35	10-20	>200	1-3	moderate	9.19	0.313	13.4	42.08	-
BDRmB2	662	<90	MWD	>150	c	c	-	<15	.200	1-3	moderate					

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

They have minor limitations of gravelliness, nutrient availability and calcareousness. An area of about 53 ha (14%) is marginally suitable (Class S3) for growing sorghum and occur in the northern part of the microwatershed with moderate limitations of gravelliness, 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	5.5-8.0	5.0-5.5, 7.8,8.4	8.4-9.0	>9.0
Surface soil texture	Class	c, sicl, sc	l, scl, sil, sic cl,	Sl, ls	S, fragmental skeletal
Soil depth	Cm	100-75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity(ESP)	%	5-8	8-10	10-15	>15

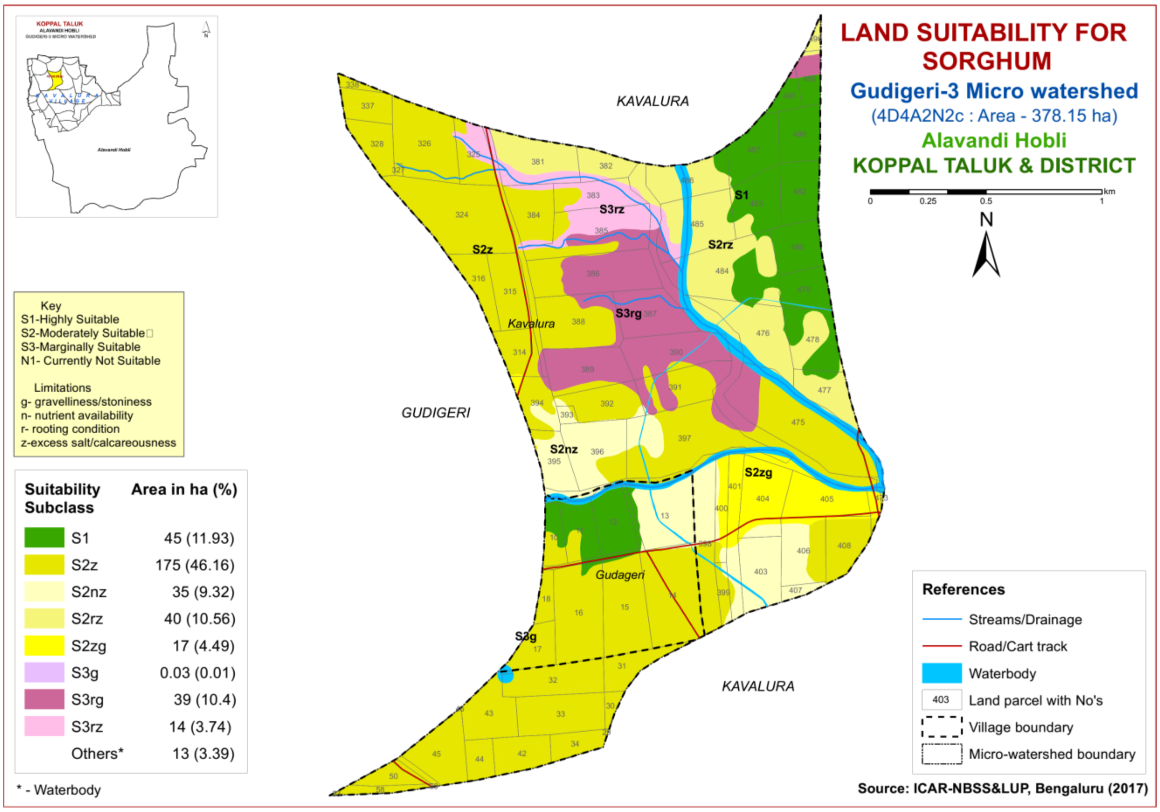


Fig. 7.1 Land Suitability map of Sorghum

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. Entire area has marginally suitable (Class S3) lands. They have moderate limitations of gravelliness, 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, sc	C(s-s), c, sicl, sic	Sl ,ls	S,fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<15	15-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	2.0-4.0	
Sodicity (ESP)	%	<10	10-15	>15	

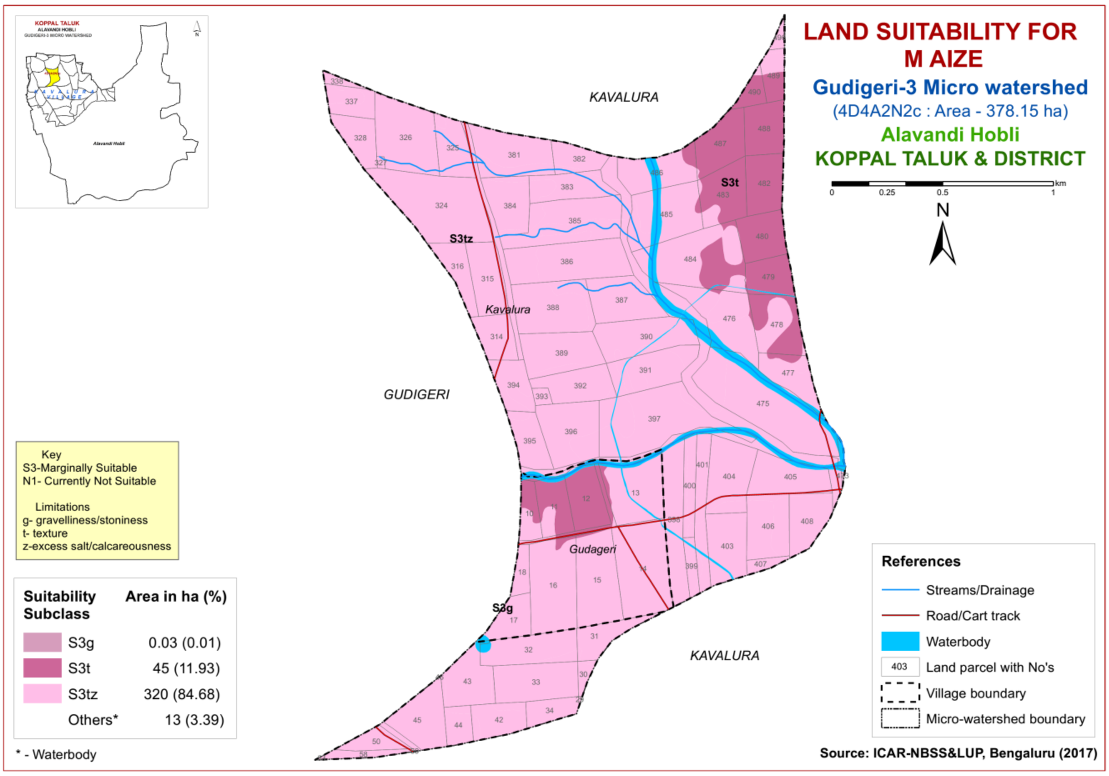


Fig. 7.2 Land Suitability map of Maize

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 (Table 7.4) for growing bajra 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. Entire area has marginally suitable (Class S3) lands. They have moderate limitations of gravelliness, 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, l,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

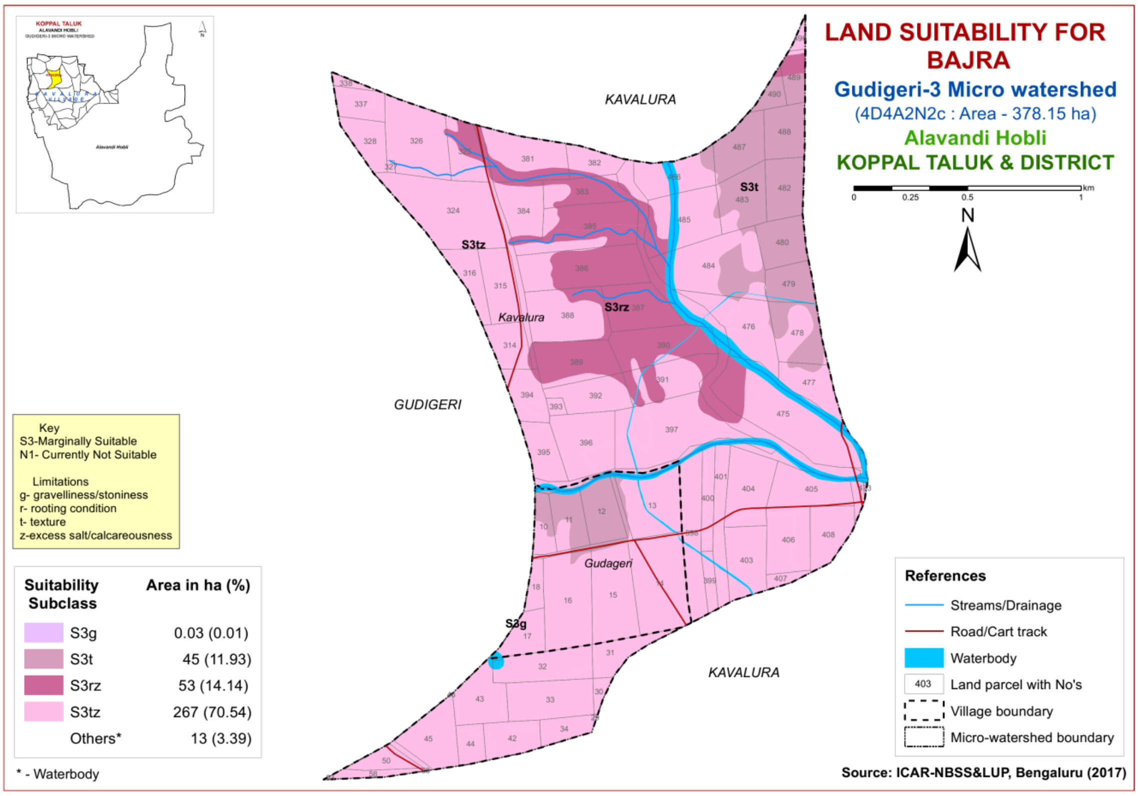


Fig. 7.3 Land Suitability map of Bajra

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, sil, sicl	cl, Sc, sic, sl	S,ls,c(>60%)	S,fragmental
Soil depth	Cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-60	>60	
$CaCO_3$ 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	

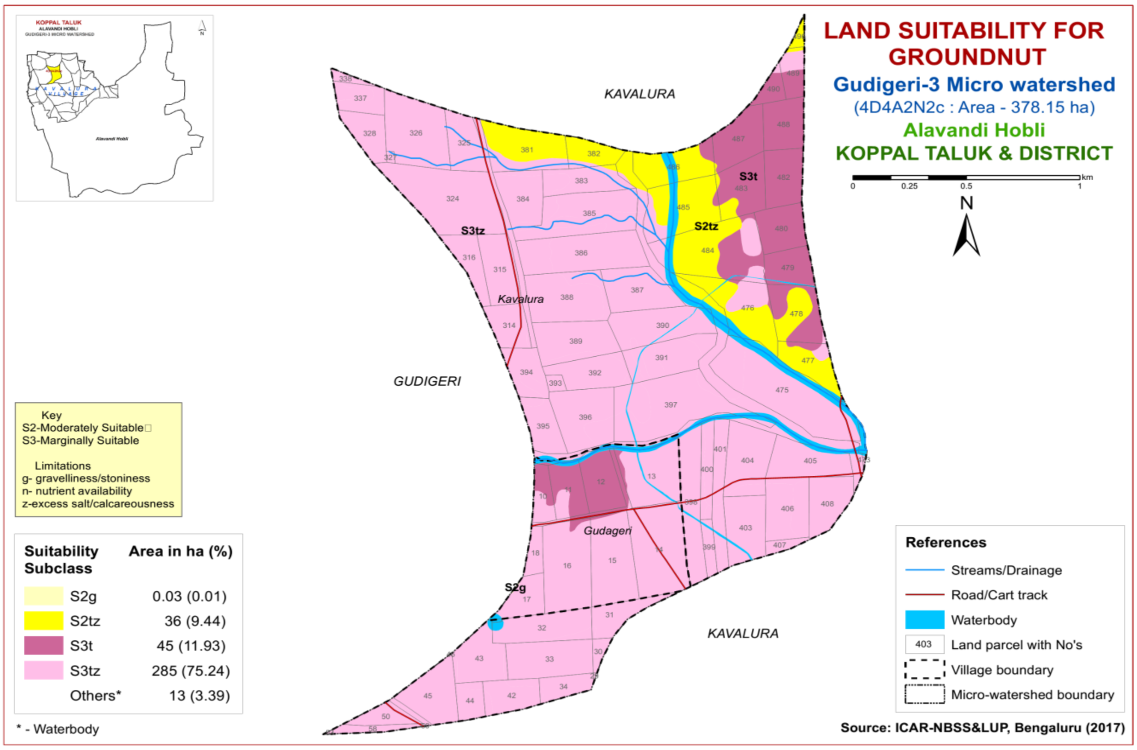


Fig. 7.4 Land Suitability map of Groundnut

An area of about 36 ha (9%) is moderately suitable (Class S2) for groundnut and are distributed in the northeastern part of the microwatershed. They have minor limitations of gravelliness, texture and calcareousness. Marginally suitable (Class S3) lands occupy major area of about 330 ha (87%) and are distributed in all parts 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.

An area of about 35 ha (9%) is highly suitable (S1) for growing sunflower and is distributed in the northeastern part of the microwatershed. Major area of about 237 ha (62%) is moderately suitable (Class S2) for growing sunflower and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth and calcareousness. Marginally suitable (Class S3) lands occupy small area of about 40 ha (11%) and are distributed in the northeastern part of the microwatershed with moderate limitations of gravelliness, rooting depth and calcareousness. An area of about 53 ha (11%) is not suitable (Class N1) for growing sunflower and occur in the central and northern part of the microwatershed with severe limitations of gravelliness, calcareousness and rooting depth.

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	6.5-7.8	7.8-8.4,5.5-6.5	8.4-9.0;5.0-5.5	>9.0,<5.0
Surface soil texture	Class	l, cl, sil, sc	Scl, sic	ls sl	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	

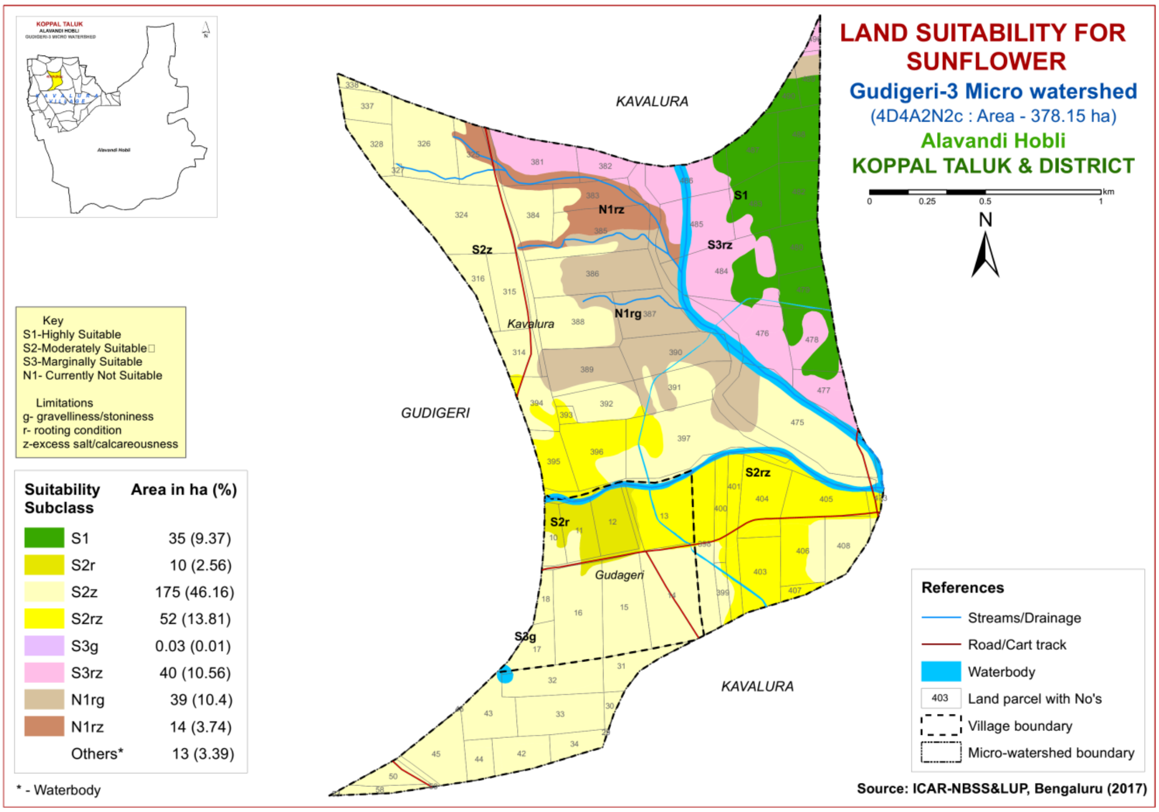


Fig. 7.5 Land Suitability map of Sunflower

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.

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 growing season	^{0}c	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, ic,c(m/k)	C(ss), ls, s	
Soil depth	Cm	>75	50-75	25-50	<25
Gravelcontent	% 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	

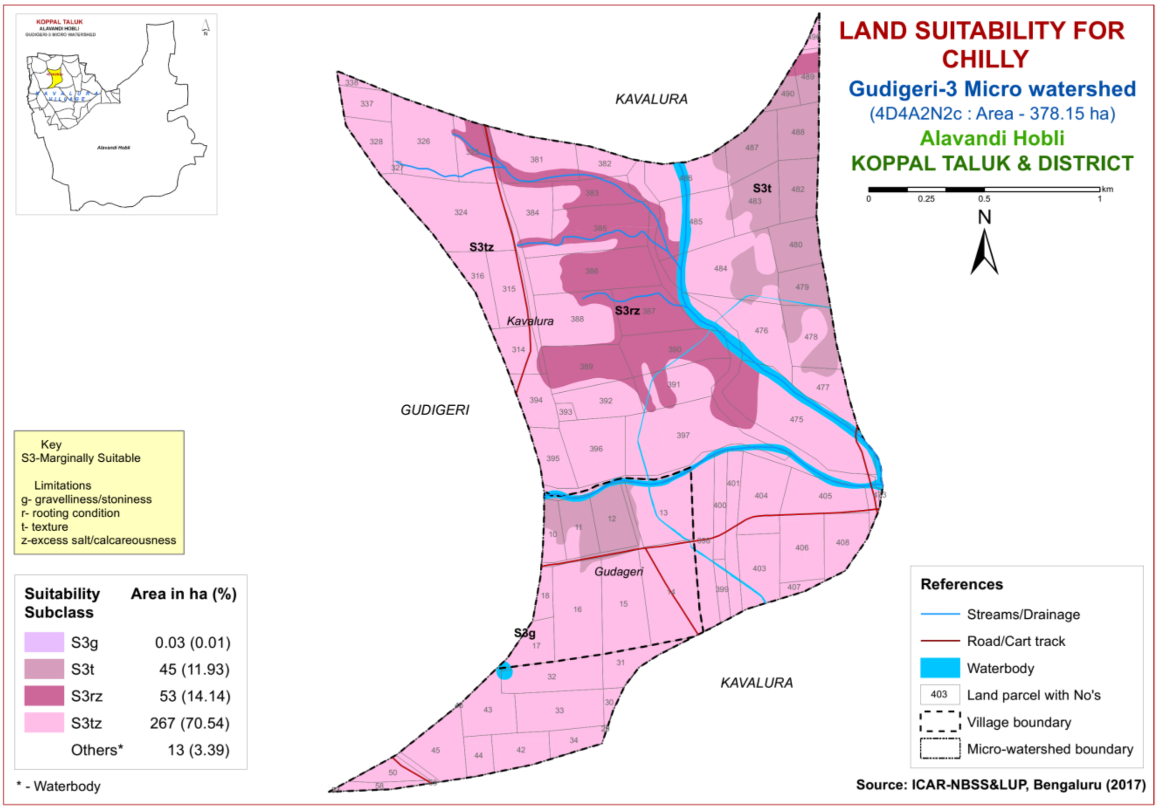


Fig. 7.6 Land Suitability map of Chilli

There are no highly (S1) and moderately suitable (S2) lands for growing Chilli. Entire area has marginally suitable (Class S3) lands for growing chilli with moderate limitations of gravelliness, texture, rooting depth and calcareousness.

7.7 Land Suitability for Tomato (*Solanum lycopersicum*)

Tomato is one of the most important vegetable crop grown in an area of 0.65 lakh ha in almost all the districts of the State. The crop requirements (Table 7.8) 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. Entire area has marginally suitable (Class S3) lands for growing tomato with moderate limitations of gravelliness, rooting depth, texture 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

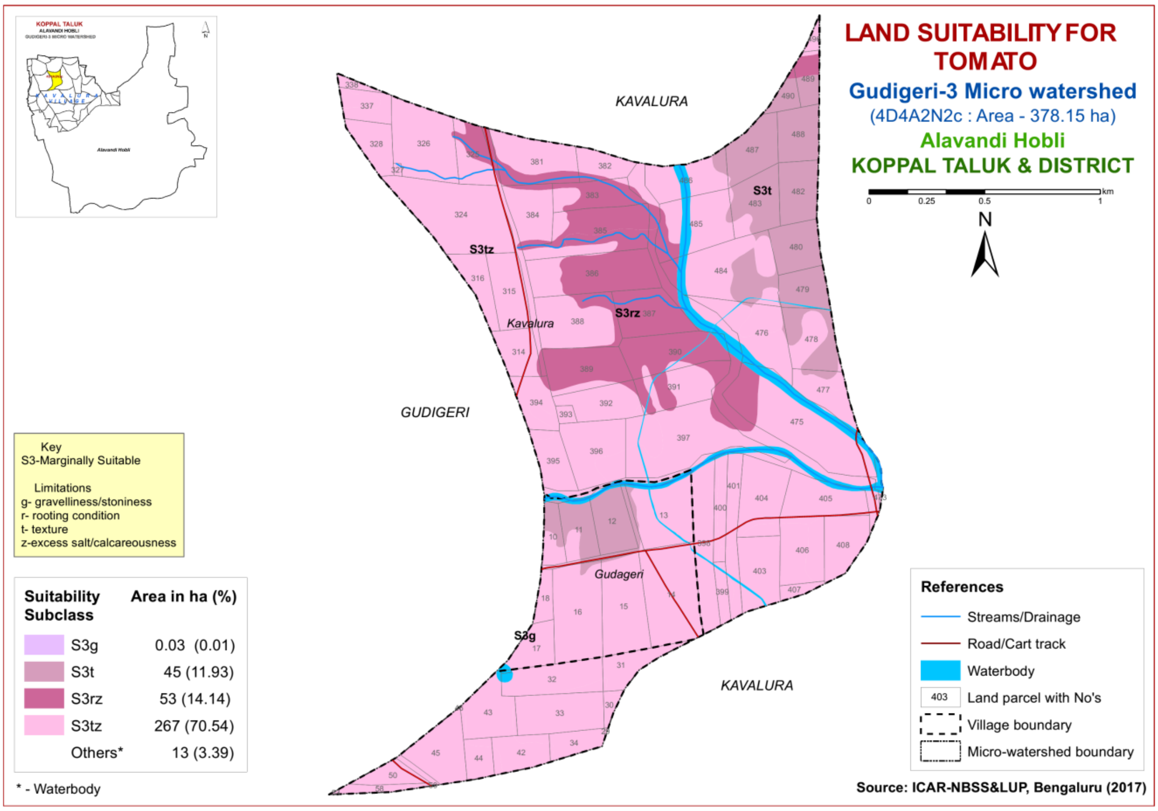


Fig. 7.7 Land Suitability map of Tomato

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 7.1) and a land suitability map for growing drumstick was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.8.

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	Mod.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
	Gravel content	% vol.	0-35	35-60	60-80	>80
Erosion	Slope	%	0-3	3-10	-	>10

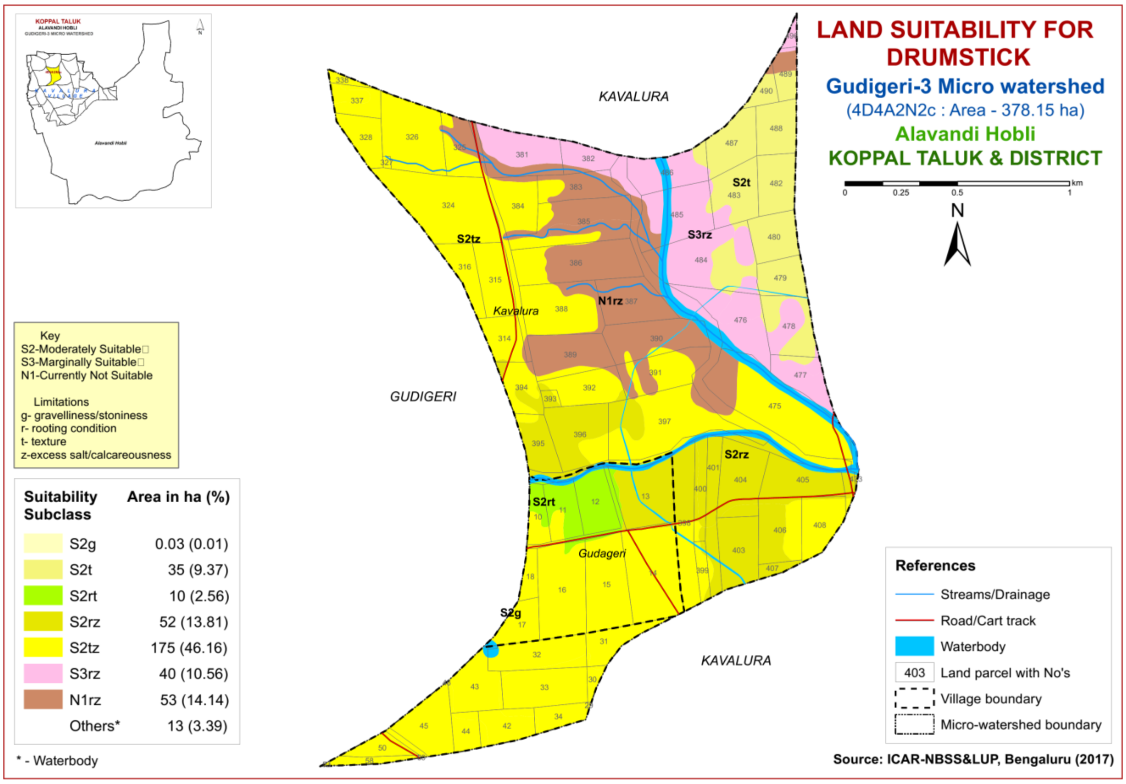


Fig. 7.8 Land Suitability map of Drumstick

Moderately suitable (Class S2) lands occupy major area of about 272 ha (72%) and occur in all parts of the microwatershed. They have minor limitation of gravelliness, rooting depth, texture and calcareousness. A small area of 40 ha (11%) is marginally (Class S3) suitable for growing drumstick with moderate limitations of rooting depth and calcareousness and distributed in the northeastern part of the microwatershed and an area of about 53 ha (14%) is not suitable (Class N1) and occur in the northern part of the microwatershed and have severe limitations of rooting depth and calcareousness.

7.9 Land Suitability for Mulbery (*Morus nigra*)

Mulbery is an 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 is 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

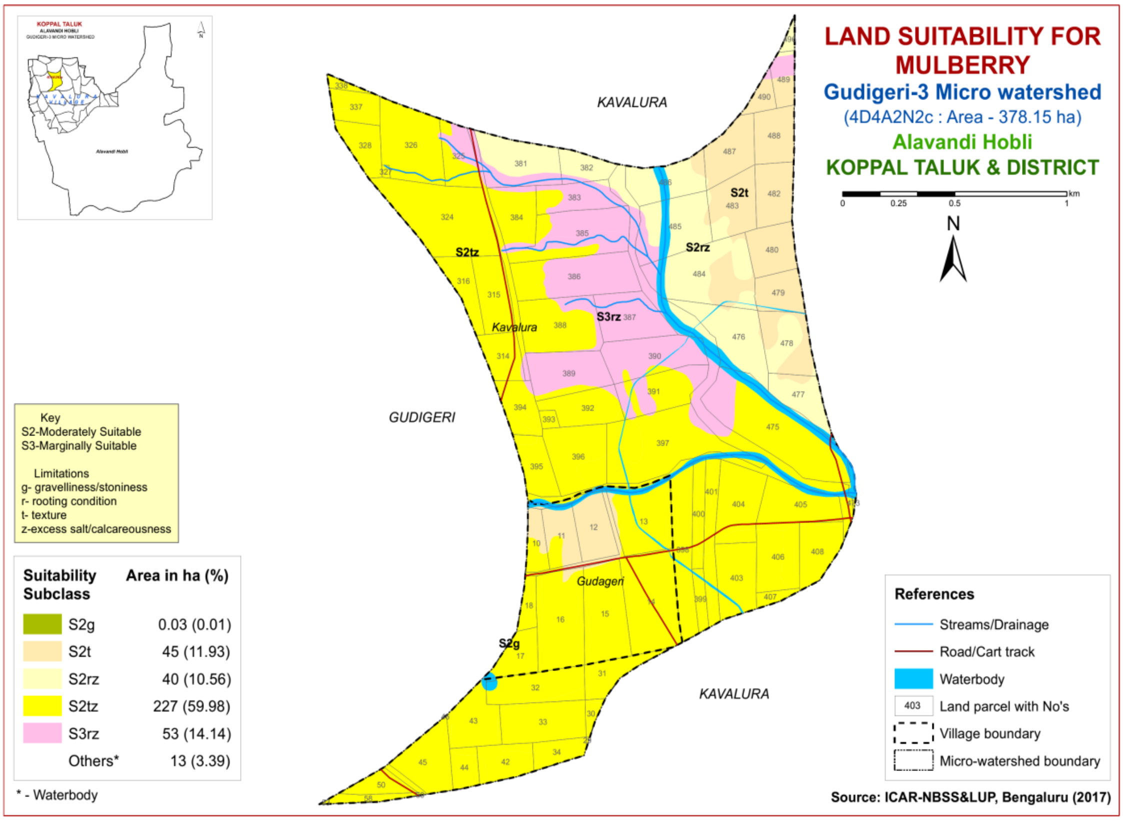


Fig. 7.9 Land Suitability map of Mulberry

Moderately suitable (Class S2) lands occupy maximum area of about 312 ha (82%) and occur in all parts of the microwatershed. They have minor limitations of texture, gravelliness and calcareousness. Marginally suitable lands cover an area of about 53 ha (14%) and occur in the central 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.

Moderately suitable (Class S2) lands cover an area of about 81 ha (21%) for growing mango with minor limitations of rooting depth and calacreousness and occur in the southern part of the microwatershed. Marginally suitable (Class S3) lands cover a maximum area of about 191 ha (41%) and occur in all parts of the microwatershed. They have moderate limitations of rooting depth, gravelliness, texture and calcareousness and about 93 ha (25%) is not suitable (Class N1) for growing mango and occur in the central and southern part of the microwatershed with severe limitations of texture, calacreousness and rooting depth.

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 growing season	^{0}C	28-32	24-27 33-35	36-40	20-24
	Min. temp. before flowering	^{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	sc, sic, l, c	C (<60%), ls, sl	C (>60%),
	pH	1:2.5	5.5-7.5	7.6-8.55.0-5.4	8.6-9.04.0-4.9	>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	Non saline	<2.0	2.0-3.0	>3.0
	Sodicity	%	Non sodic	<10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

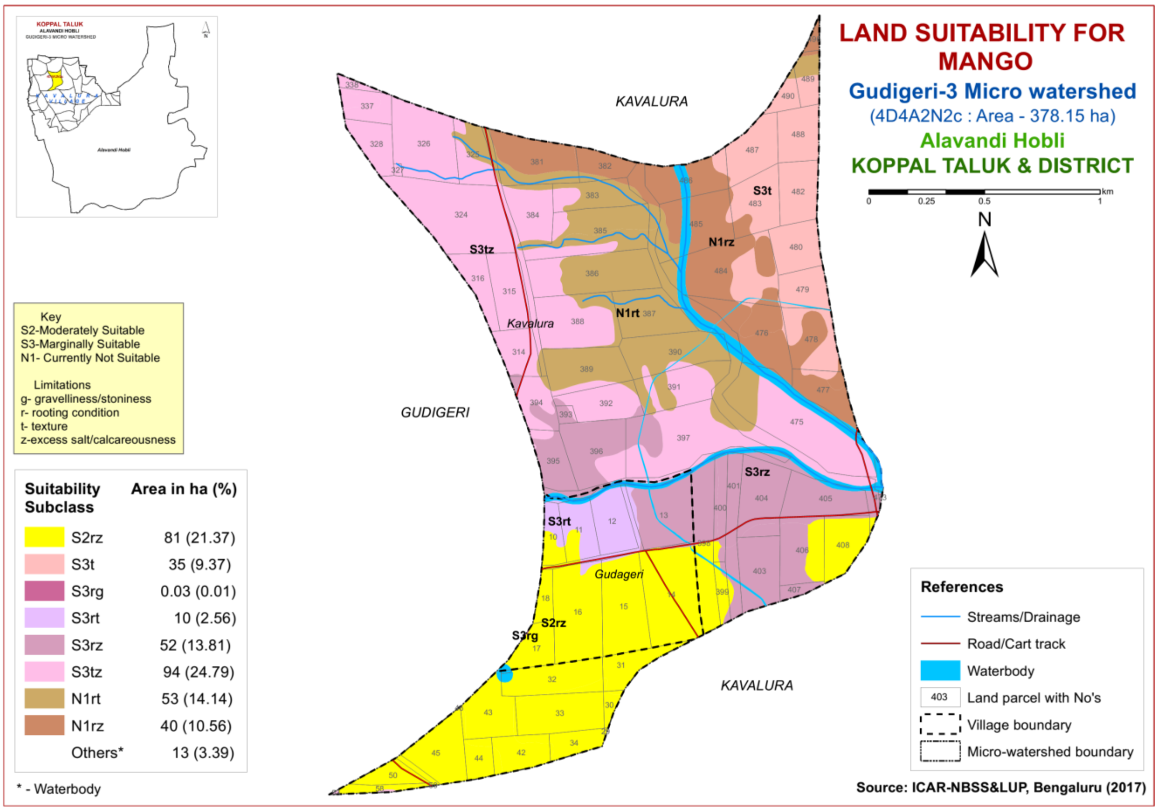


Fig. 7.10 Land Suitability map of Mango

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.

There are no highly (S1) and moderately suitable (S2) lands for growing sapota. Marginally suitable (Class S3) lands cover a maximum area of about 312 ha (82%) and occur in all parts of the microwatershed. They have moderate limitations of rooting depth, texture, gravelliness and calcareousness and an area of about 53 ha (14%) is not suitable (Class N1) for growing sapota and occur in the central and southern part of the microwatershed with severe limitations of calcareousness and rooting depth.

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	Mod.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-.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

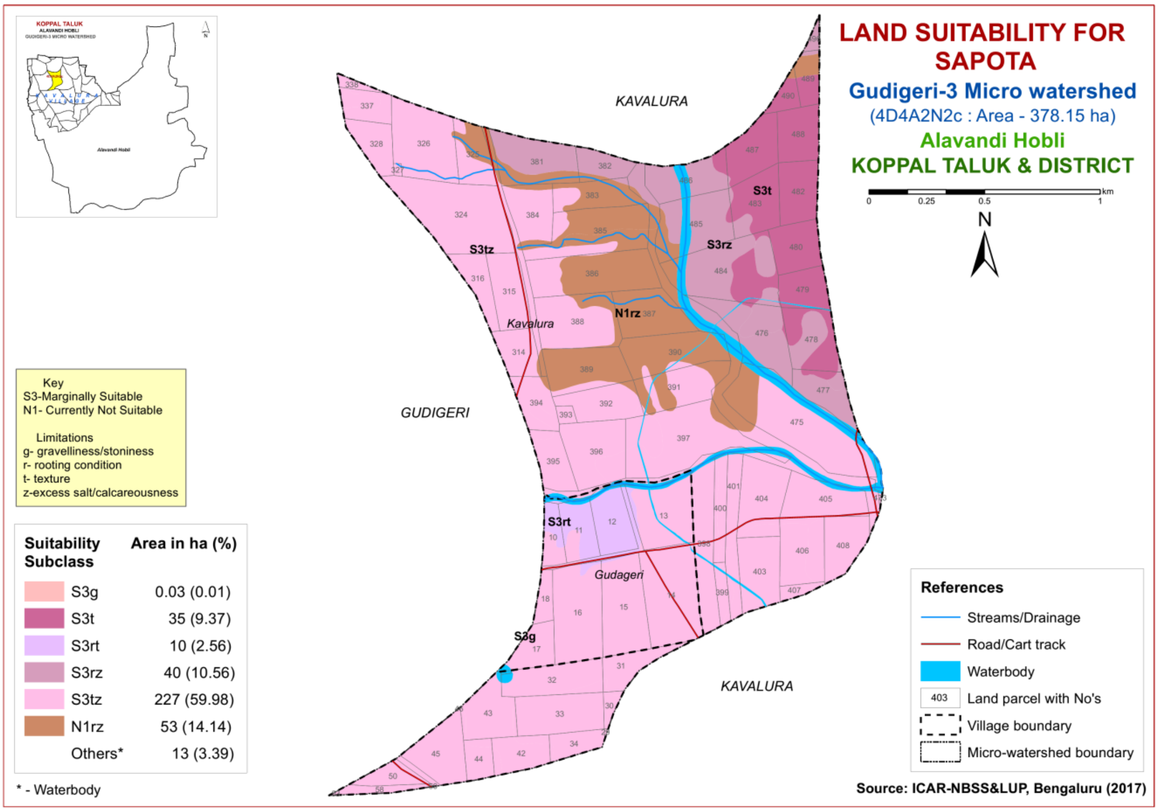


Fig. 7.11 Land Suitability map of Sapota

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.

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	

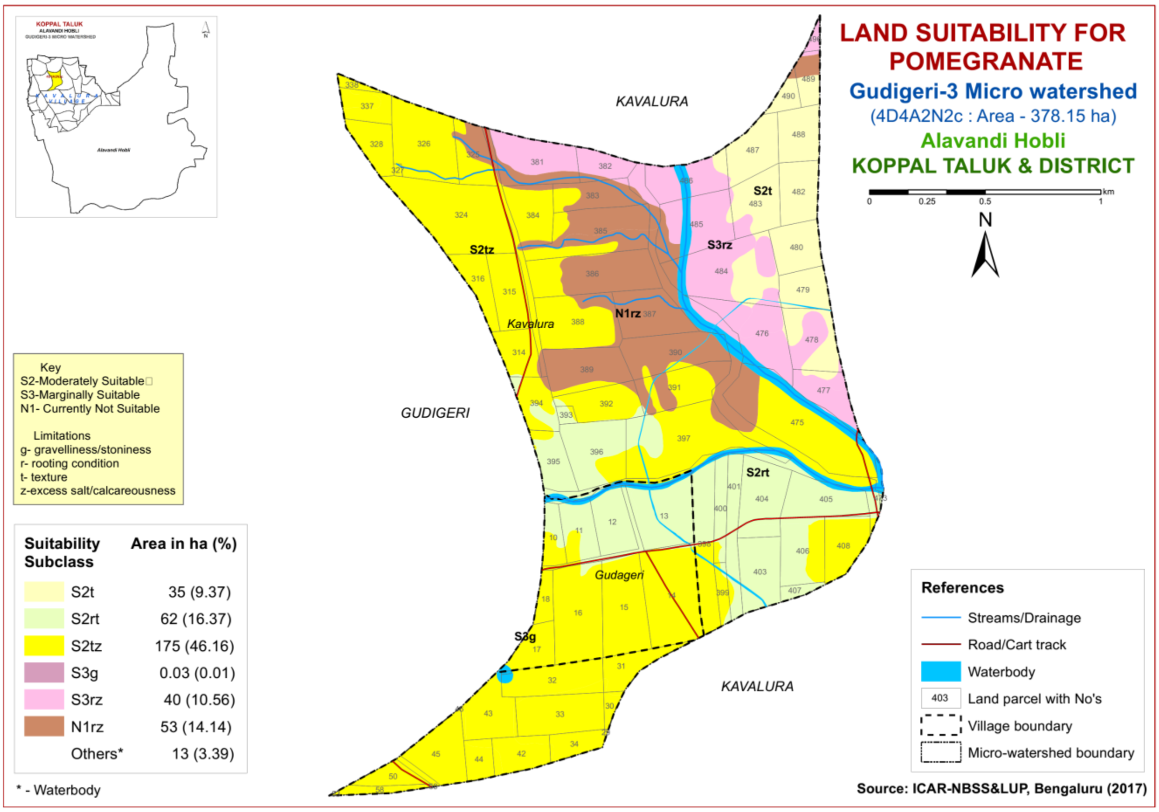


Fig. 7.12 Land Suitability map of Pomegranate

Moderately suitable (Class S2) lands occupy major area of about 272 ha (72%) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, calcareousness and texture. Marginally suitable (Class S3) lands for growing pomegranate occupy a small area of about 40 ha (11%) and are distributed in the southern part of the microwatershed with moderate limitations of gravelliness and an area of about 53 ha (14%) is not suitable (Class N1) for growing pomegranate and occur in the central and southeastern part of the microwatershed and have severe limitations of calcareousness and rooting depth.

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.

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	^0C	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 sc, c (red)	Sl,sicl,sic	C (<60%),ls	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

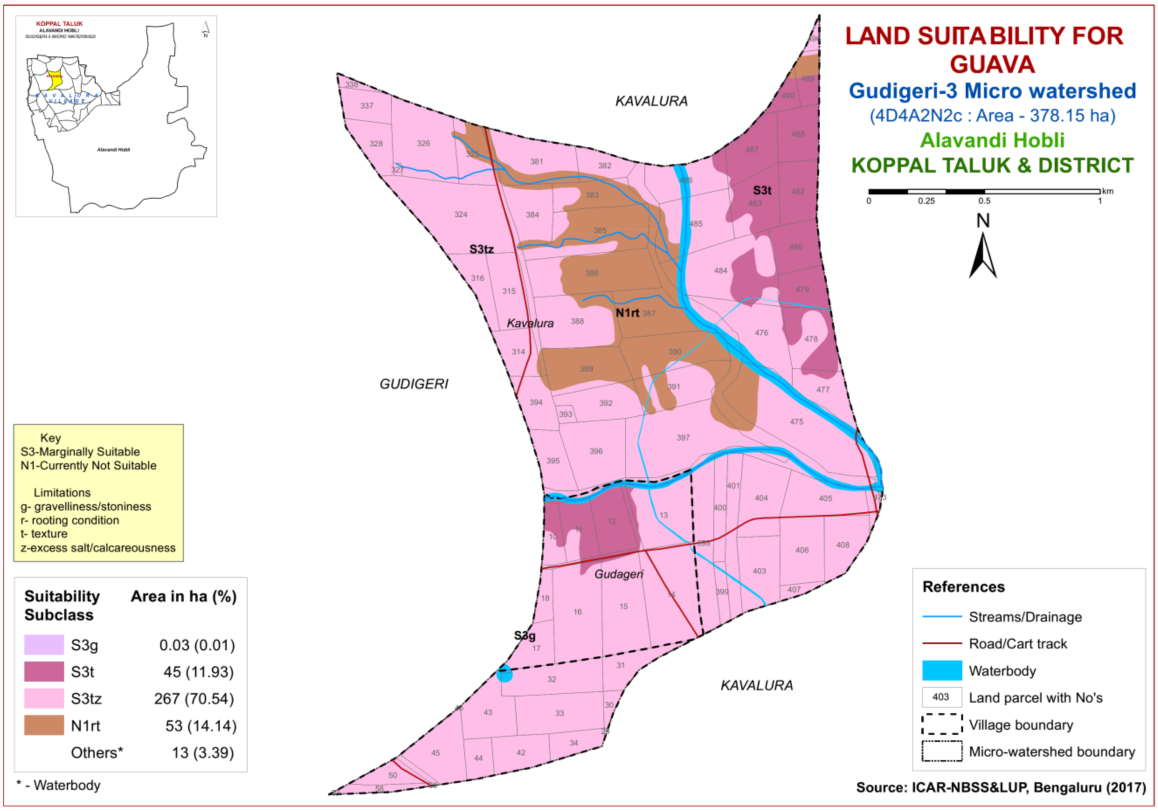


Fig. 7.13 Land Suitability map of Guava

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 312 ha (82%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, texture and calcareousness and about 53 ha (14%) is not suitable (Class N1) for growing guava and occur in the central part of the microwatershed with severe limitations of rooting depth and texture.

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 (Table 7.15) for growing jackfruit were matched with the soil-site characteristics 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 (Class S1) and moderately suitable (Class S2) lands for jackfruit. Marginally suitable (Class S3) lands cover a maximum area of about 312 ha (82%) and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, texture and calcareousness and about 53 ha (14%) is not suitable (Class N1) for growing jackfruit guava and occur in the central part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.15 Crop 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	-

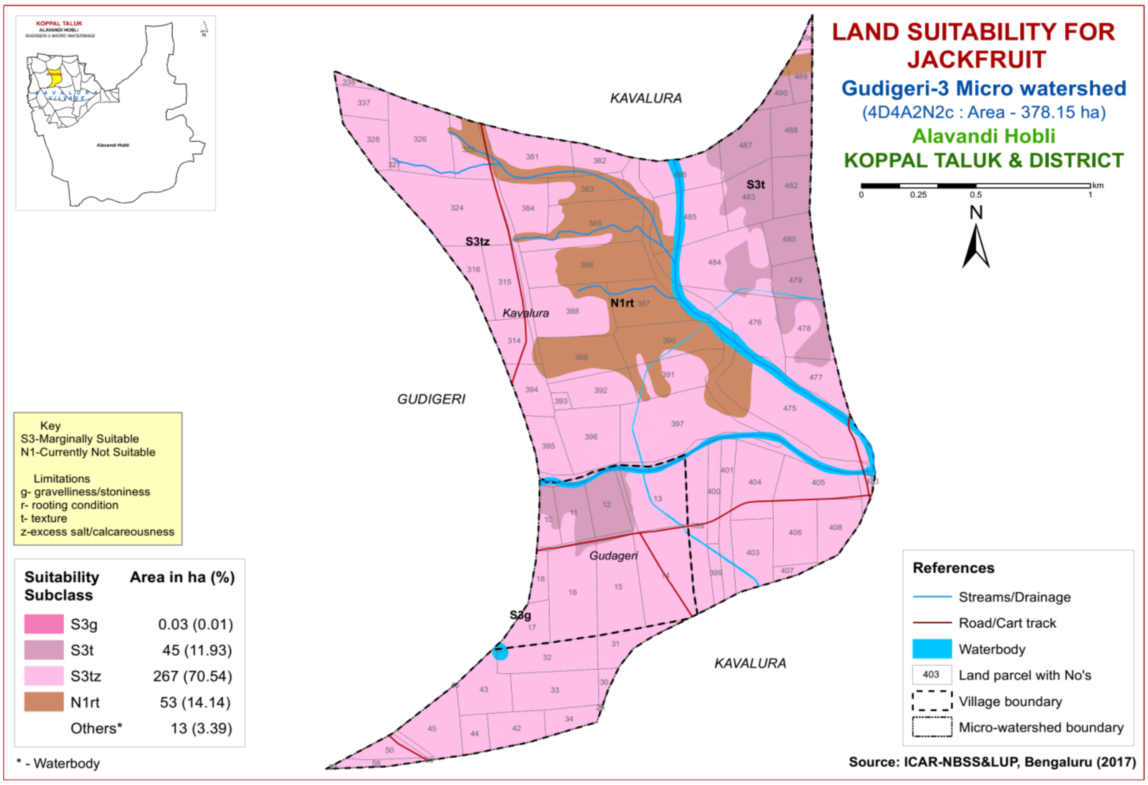


Fig. 7.14 Land Suitability map of Jackfruit

7.15 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is one of the important fruit crop grown in almost all the districts of the state. The crop requirements (Table 7.16) for growing jamun were matched with the soil-site characteristics 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 210 ha (56%) is moderately suitable (Class S2) and occur in all parts of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. The marginally suitable (Class S3) lands cover maximum area of about 102 ha (27%) and are distributed in the northern and central part of the microwatershed with moderate limitations of rooting depth, calcareousness, gravelliness and texture. An area of about 53 ha (14%) is not suitable (Class N1) for growing jamun and are distributed in the central part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.16 Crop 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

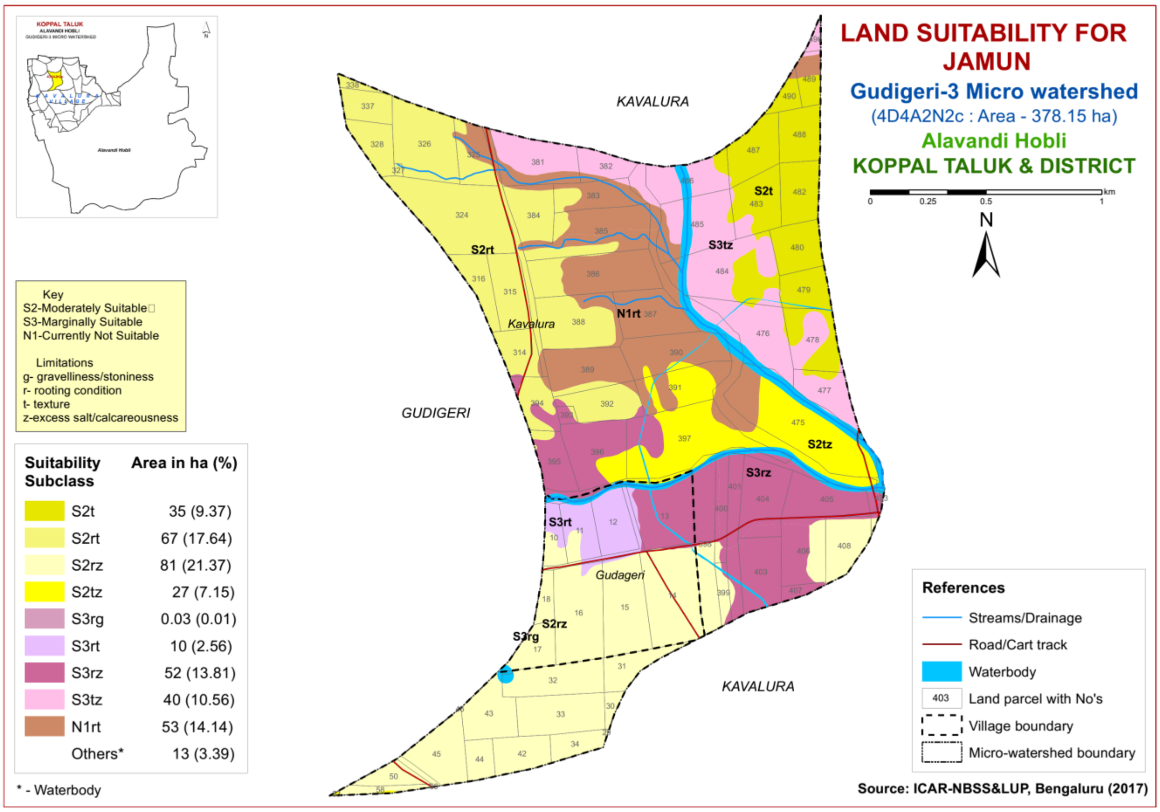


Fig. 7.15 Land Suitability map of Jamun

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 (Table 7.17) for growing musambi were matched with the soil-site characteristics (Table 7.14) 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.

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%),ls	S
	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
	Gravelcontent	% vol.	Nongravelly	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	

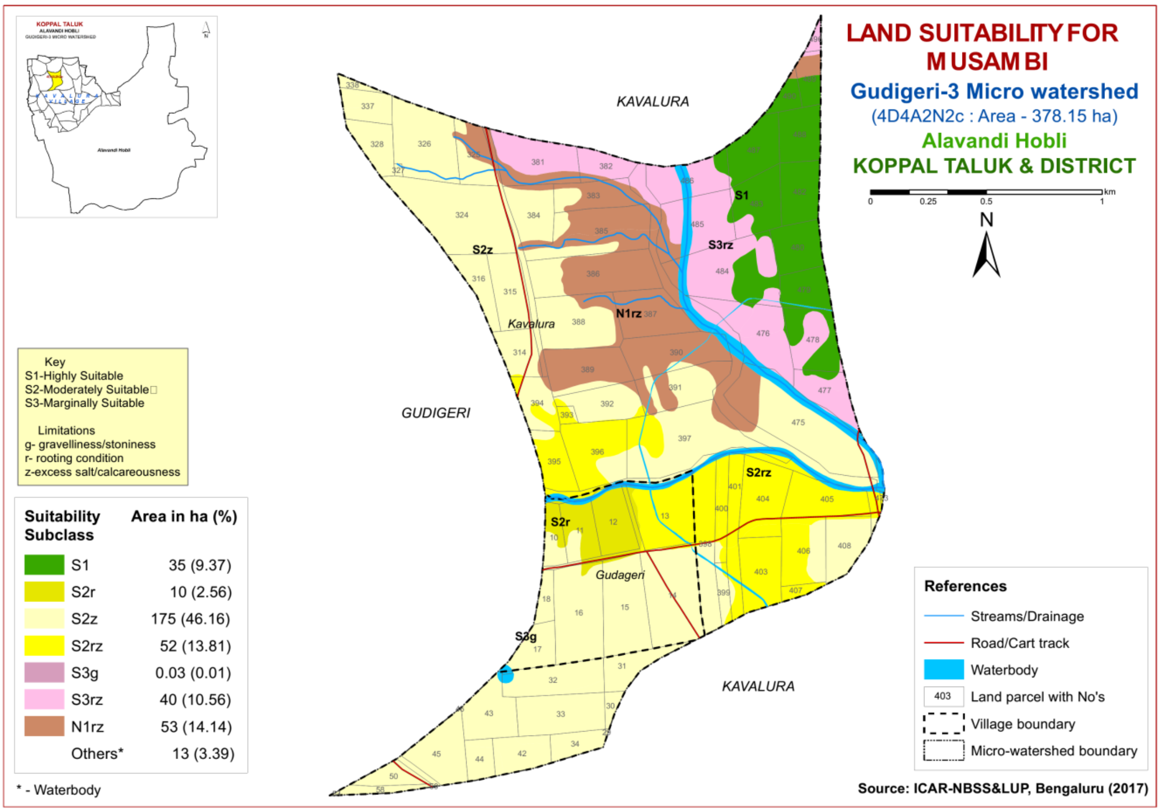


Fig. 7.16 Land Suitability map of Musambi

A small area of about 35 ha (9%) is highly suitable (Class S1) for growing musambi. An area of about 237 ha (63%) is moderately suitable (Class S2) for growing musambi and are distributed in the southern and northwestern part of the microwatershed. They have minor limitations of rooting depth and calcareousness. A small area of about 40 ha (11%) is marginally suitable (Class S3) for growing musambi and are distributed in the northern part of the microwatershed with moderate limitations of gravelliness, rooting depth and calcareousness. An area of about 53 ha (14%) is not suitable (Class N1) for growing musambi and are distributed in the northern part of the microwatershed with severe limitations of rooting depth and calcareousness.

7.18 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 (Table 7.18) for growing lime (Table 7.15) 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 imperfectly drained	Poorly	Very poorly
Nutrient availability	Texture	Class	Scl, l, sicl, cl, s	Sc, sc, c	C(>70%), ls	S
	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	

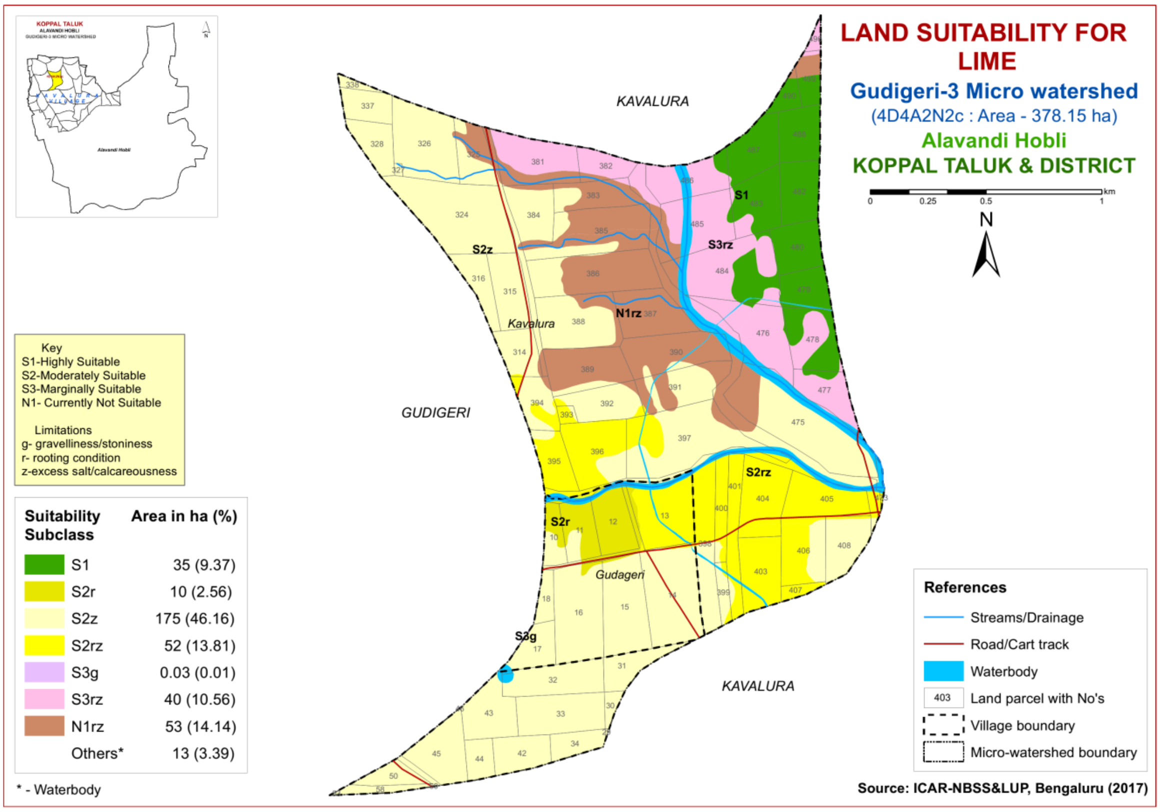


Fig. 7.17 Land Suitability map of Lime

An area of about 35 ha (9%) is highly suitable (Class S1) for growing lime. An area of about 237 ha (63%) is moderately suitable (Class S2) for growing lime and are distributed in the northwestern and southwestern part of the microwatershed. They have minor limitations of rooting depth and calcareousness. A small area of about 40 ha (11%) is marginally suitable (Class S3) for growing lime and are distributed in the northern part of the microwatershed with moderate limitations of rooting depth, gravelliness and calcareousness. An area of about 53 ha (%) is not suitable (Class N1) for growing lime and are distributed in the northern part of the microwatershed with severe limitations of rooting depth and calcareousness.

7.18 Land Suitability for Cashew (*Anacardium occidentale)*

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

Very minor area of <1 ha has marginally suitable (Class S3) lands with moderate limitations of gravelliness. Maximum area of 365 ha (97%) is not suitable (Class N1) for growing cashew in the microwatershed with severe limitations of texture, rooting depth and calcareousness.

Table 7.19 Crop 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	

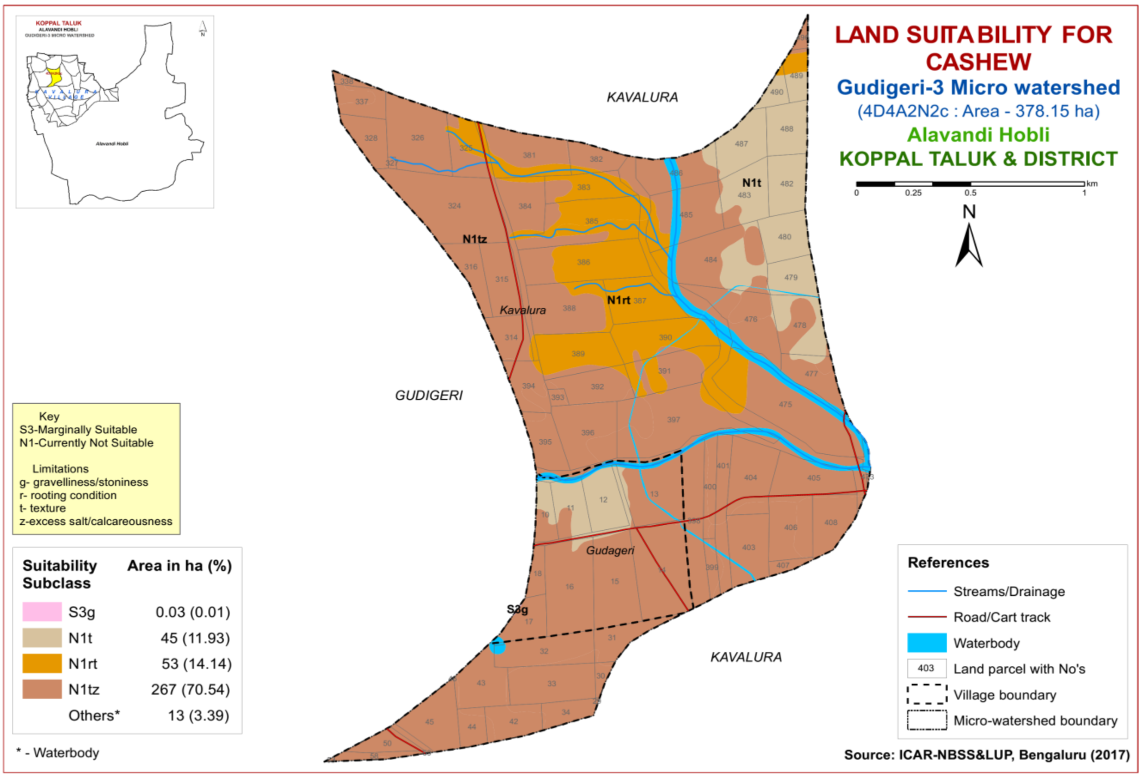


Fig. 7.18 Land Suitability map of Cashew

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 (Table 7.20) for growing custard apple 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.

Small area of about 45 ha (12%) is highly suitable (Class S1) for growing custard apple. They are distributed in the northeastern part of the microwatershed. Maximum area of about 267 ha (71%) is moderately suitable (Class S2) and occur in major parts of the microwatershed. They have minor limitations of gravelliness, rooting depth and calcareousness. Small area of about 53 ha (14%) is marginally suitable (Class S3) for growing custard apple and are distributed in the northern part of the microwatershed with moderate limitations of calcareousness.

Table 7.20 Crop 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	-

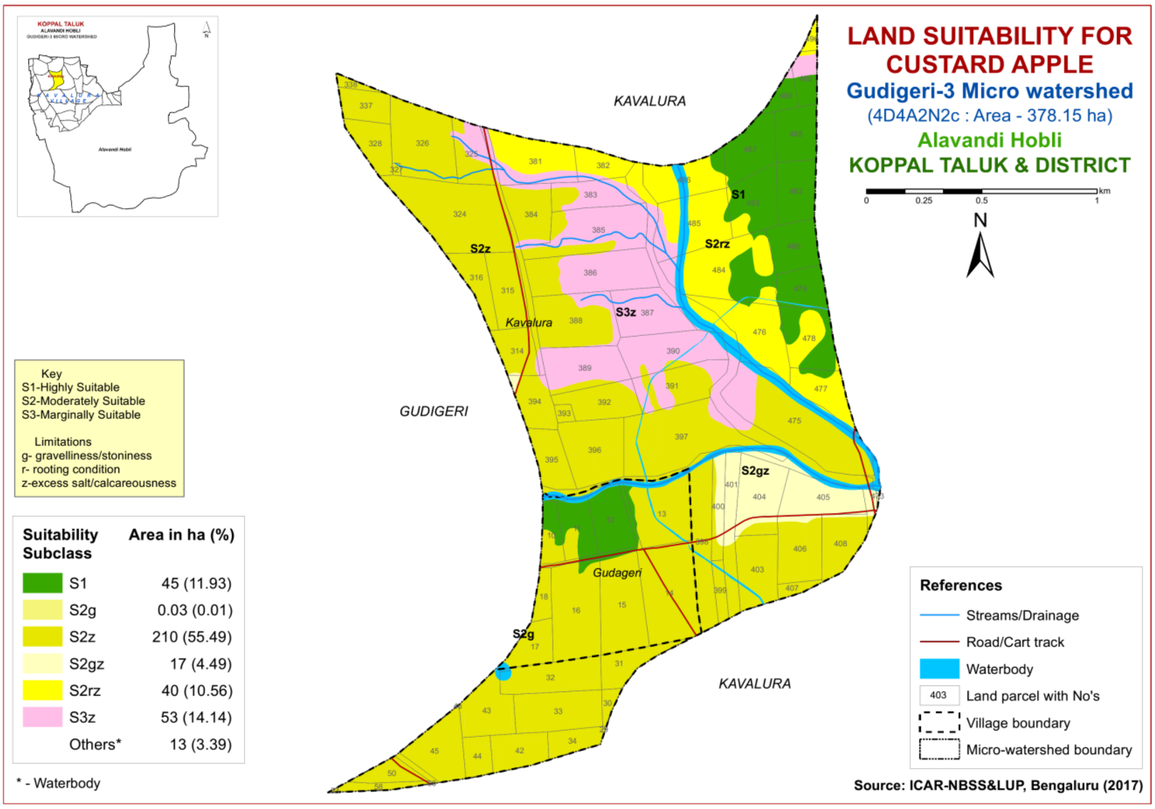


Fig. 7.19 Land Suitability map of Custard Apple

7.20 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of 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 (Table 7.21) growing amla were matched with the soil-site characteristics 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 312 ha (82%) has soils that are moderately suitable (Class S2) and are distributed in all parts of the microwatershed. They have minor limitations of gravelliness, rooting depth, texture and calcareousness. The marginally suitable (Class S3) lands cover an area of about 53 ha (14%) and occur in the northern part of the microwatershed with moderate problems of calcareousness and texture.

Table 7.21 Crop 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

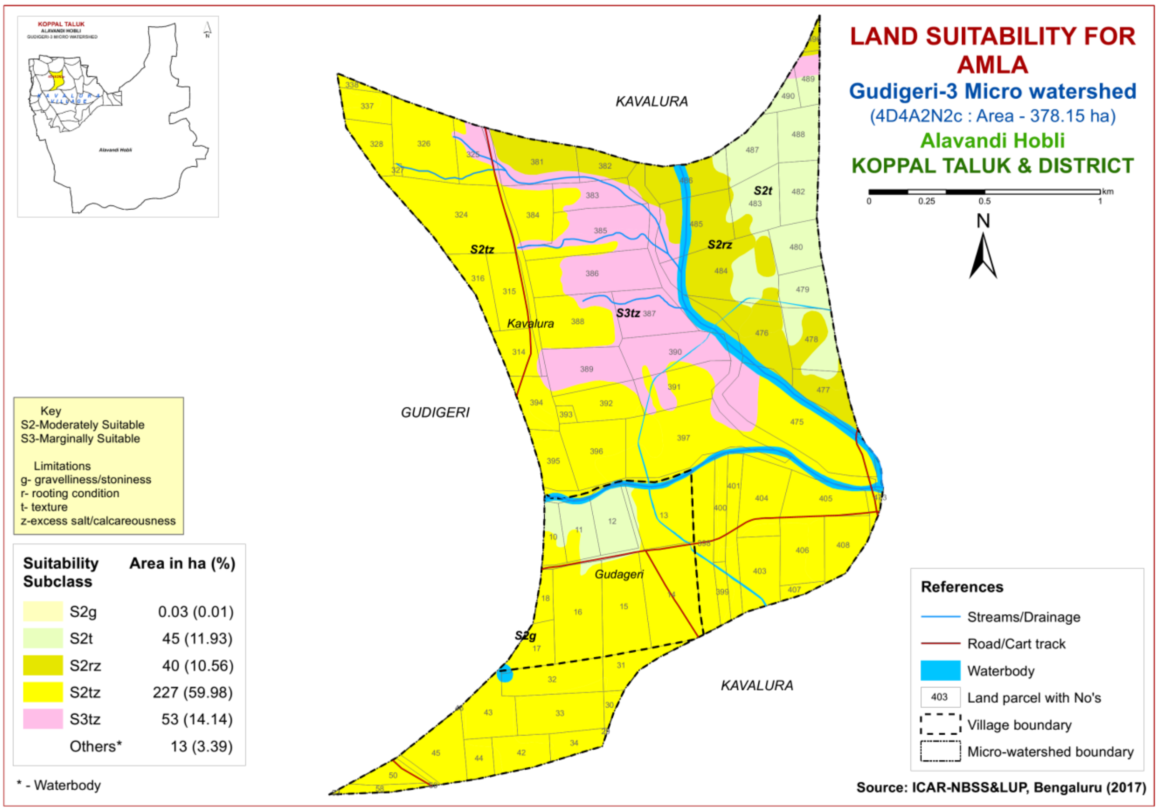


Fig. 7.20 Land Suitability map of Amla

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 (Table 7.22) for growing tamarind were matched with the soil-site characteristics 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. Maximum area of about 210 ha (56%) is moderately suitable (Class S2) and occurs in all parts of the microwatershed. They have minor limitations of calcareousness, texture and rooting depth. An area of about 62 ha (16%) is marginally suitable (Class S3) and occur in the southern part of the microwatershed. They have moderate limitations of rooting depth, gravelliness and calcareousness. An area of about 93 ha (25%) is not suitable (Class N1) for growing tamarind and are distributed in the northern part of the microwatershed. They have severe limitations of rooting depth and calcareousness.

Table 7.22 Crop 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

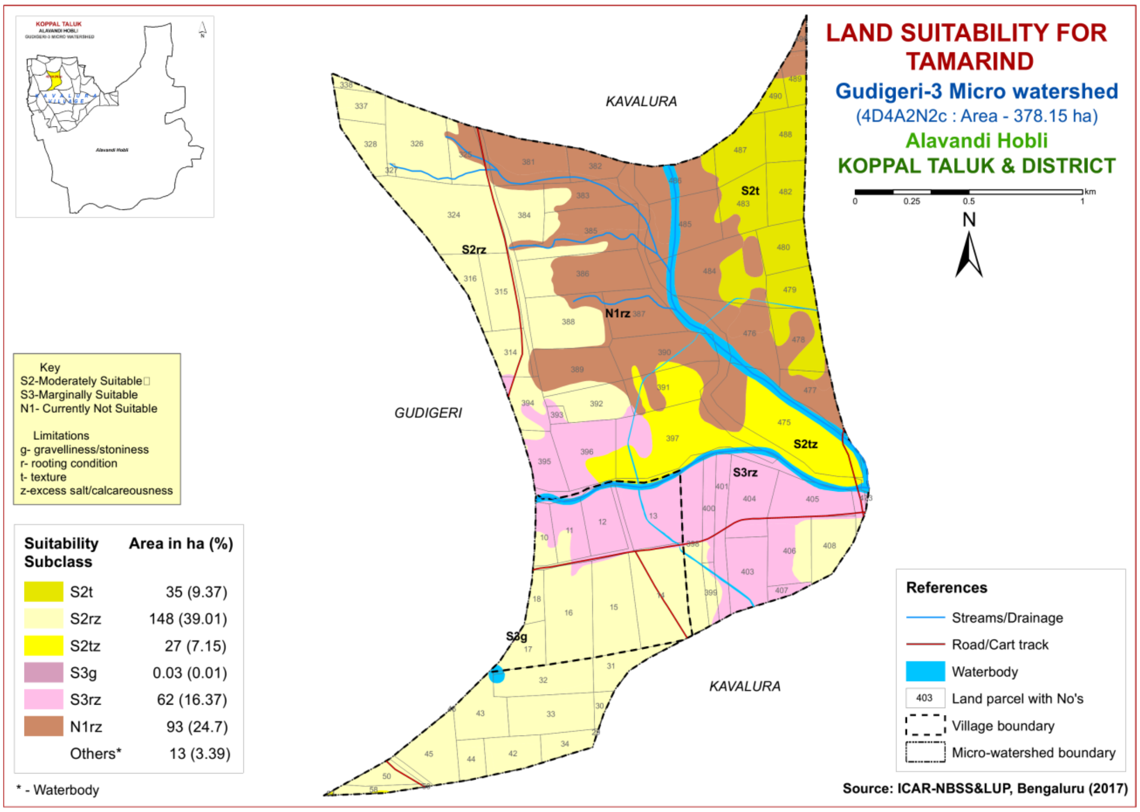


Fig. 7.21 Land Suitability map of Tamarind

7.22 Land Suitability for Marigold (*Tagetes erecta*)

Marigold is one of the most important flower crop grown in an area of 9108 ha in almost all the districts of the state. The crop requirements (Table 7.23) for growing marigold were matched with the soil-site characteristics 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 312 ha (82%) is moderately suitable (Class S2) for growing marigold and occur in all parts of the microwatershed. They have minor limitations of calcareousness, rooting depth and texture and an area of about 53 ha (14%) is marginally suitable (Class S3) for growing marigold and occur in the northern part of the microwatershed. They have moderate limitations of gravelliness, rooting depth and calcareousness.

Table 7.23 crop 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	Mod.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	-

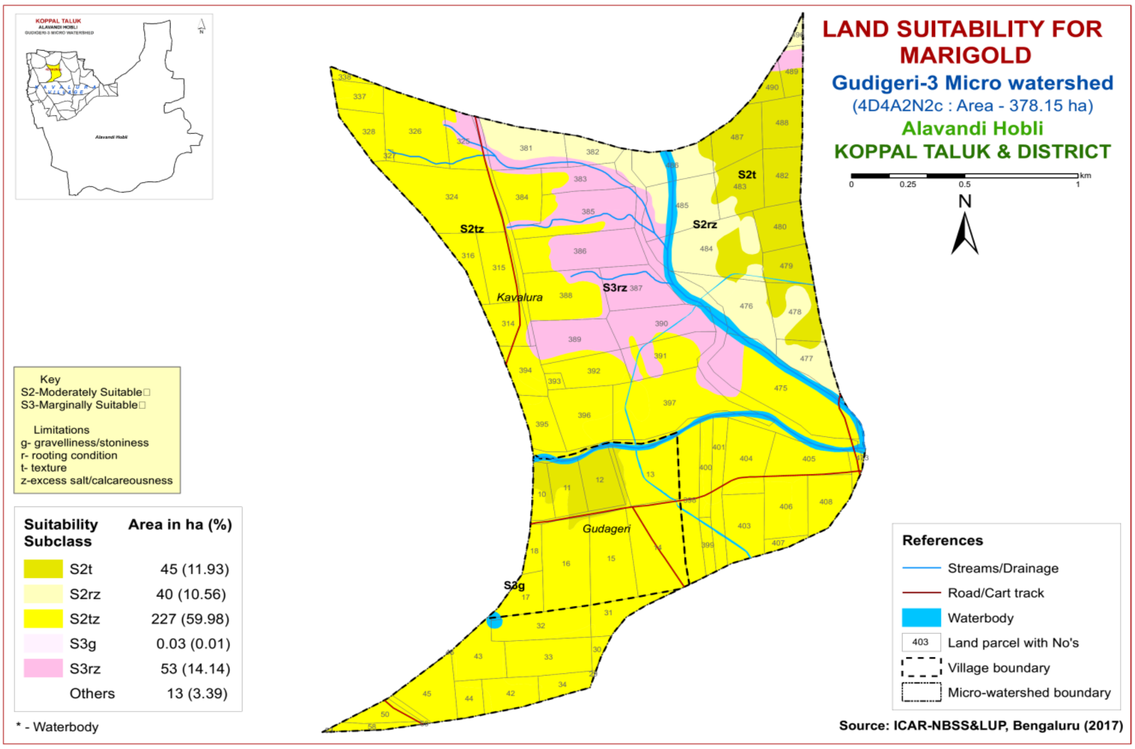


Fig. 7.22 Land Suitability map of Marigold

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 (Table 7.24) for growing chrysanthemum 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.

Table 7.24 Crop 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		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, si	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	

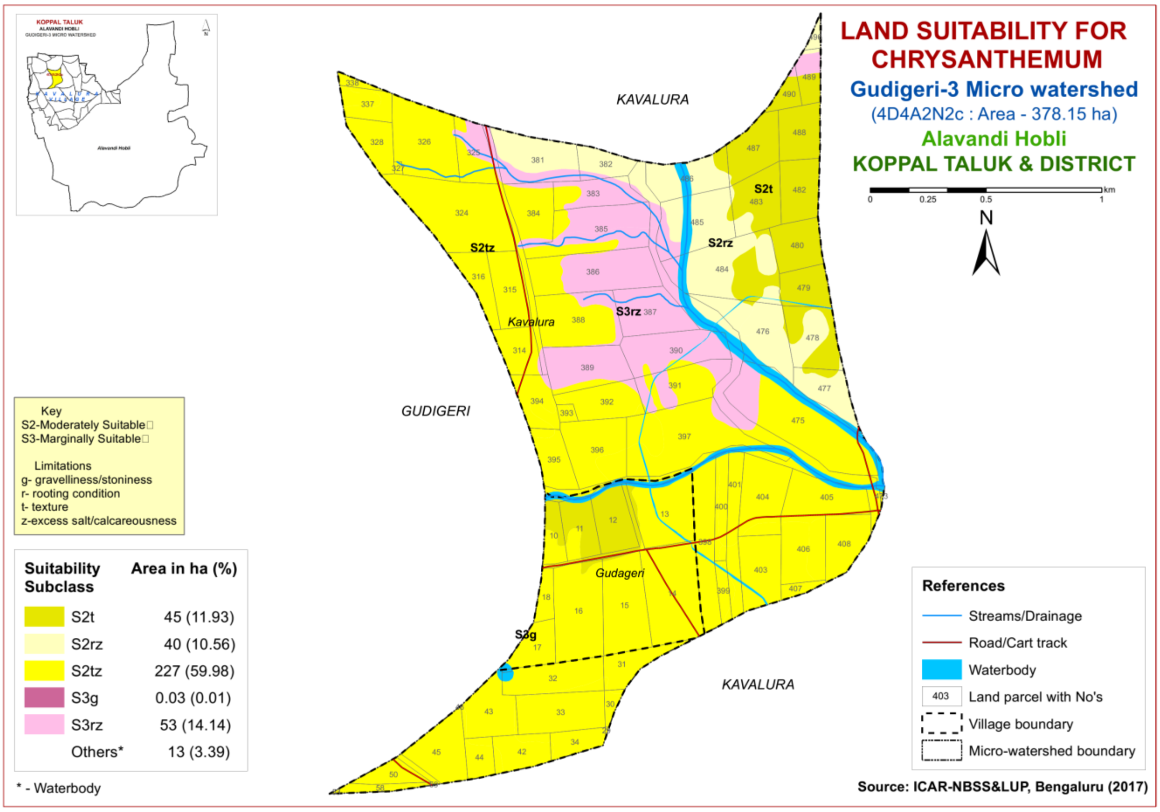


Fig. 7.23 Land Suitability map of Chrysanthemum

Maximum area of about 312 ha (82%) is moderately suitable (Class S2) for growing chrysanthemum and occur in all parts of the microwatershed. They have minor limitations of calcareousness, rooting depth and texture and an area of about 53 ha (14%) is marginally suitable (Class S3) for growing chrysanthemum and occur in the northern and central part of the microwatershed. They have severe limitations of gravelliness, rooting depth and calcareousness.

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.

An area of about 40 ha (11%) is moderately suitable (Class S2) for growing jasmine and occur in the northeastern part of the microwatershed. They have minor limitations of calcareousness and rooting depth and maximum area of about 325 ha (86%) is marginally suitable (Class S3) for growing jasmine and occur in all parts of the microwatershed. They have moderate limitations of gravelliness, rooting depth, texture and calcareousness.

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	

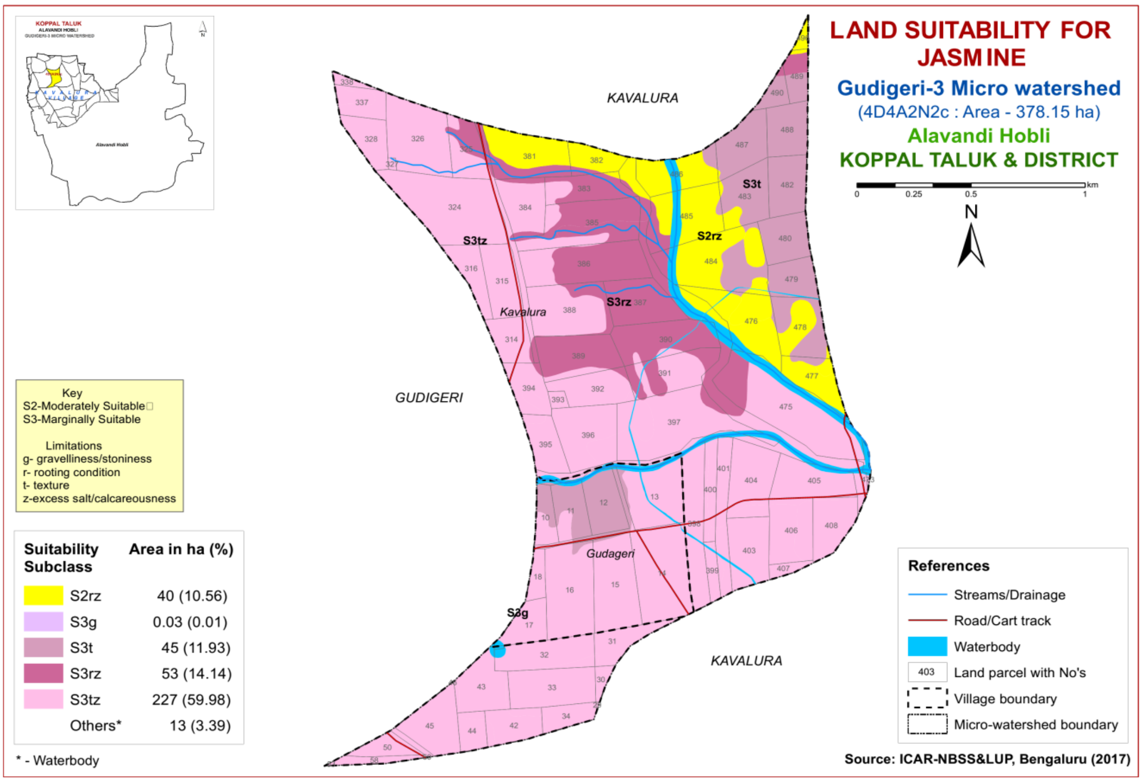


Fig. 7.24 Land Suitability map of Jasmine

7.25 Land Management Units (LMU)

The 18 soil map units identified in Gudigeri-3 microwatershed have been grouped into 7 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 map (Fig.7.25) 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 seven Land Management Units along with brief description of soil and site characteristics are given below.

LMU	Mapping unit	Soil and site characteristics
1	433. BDRmB2	Very deep, black clayey soils with slopes of 1-3%, moderate erosion
2	373. GRHmB2 388. KVRmB1 389.KVRmB1g1 390.KVRmB2g1 418. MLRmB2 419.MLRmB2g1	Deep to Very deep, calcareous black clay soils with slopes of 1-3%, slight to moderate erosion, gravelly (15-35%)
3	264. NGPiB1g2	Deep, red gravelly clay soils with slopes of 1-3%, slight erosion, very gravelly (35-60%)
4	363. NSPmB2g1	Moderately deep, black clayey soils with slopes of 1-3%, moderate erosion, gravelly (15-35%)
5	350.DRLmB2 351. DRLmB2g1 352. DRLmB2g2	Moderately deep, calcareous black clay soils with slopes of 1-3%, moderate erosion, gravelly to very gravelly (15-60%)
6	336. RNKmB2 337.RNKmB2g1 338.RNKmB2g2 334.RNKmB1g1	Moderately shallow, calcareous black gravelly clayey soils with slopes of 1-3%, slight to moderate erosion, gravelly to very gravelly (15-60%)
7	311.MTLmB2g1 312.MTLmB2g2	Shallow, calcareous black gravelly clay soils with slopes of 1-3%, moderate erosion, gravelly to very gravelly (15-60%)

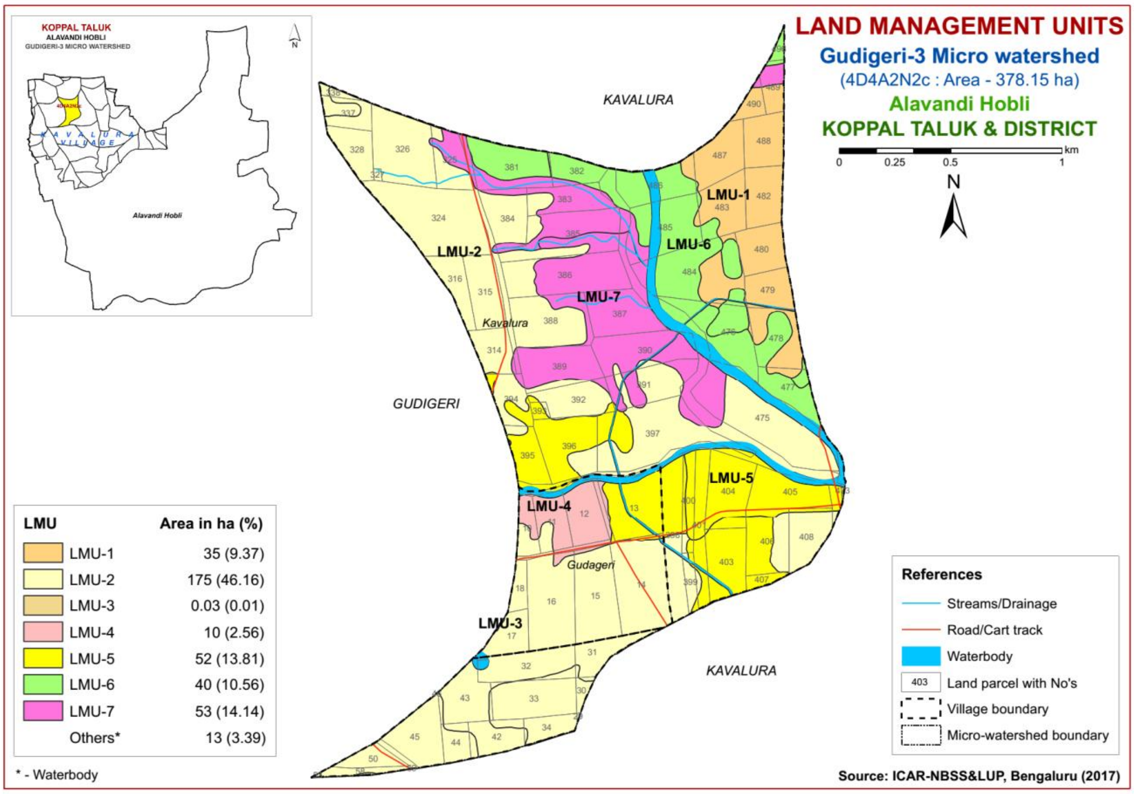


Fig 7.25 Land Use Classes map of Gudigeri-3 microwatershed

7.26 Proposed Crop Plan for Gudigeri-3 Microwatershed

After assessing the land suitability for the 24 crops, the proposed crop plan has been prepared for the 7 identified LUCs by considering only the highly (Class S1) and moderately (Class S2) suitable lands for each of the 24 crops. The resultant proposed crop plan is presented in Table 7.26.

Table 7.26 Proposed Crop Plan for Gudigeri-3 Microwatershed

Proposed Land Use Class	Soil Map Units	Survey Number	Field Crops	Horticulture Crops	Suitable Interventions
1	433. BDRmB2 (Very deep, black clayey soils)	**Kavalura:** 478,479,480,482,483,487,488,489, 490	Cotton, Sorghum, Sunflower, , Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Tamarind, Pomegranate, Amla, Custard apple, Jamun, Lime, Musambi, **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable conservation practises
2	373. GRHmB2 388. KVRmB1 389. KVRmB1g1 390. KVRmB2g1 418. MLRmB2 419. MLRmB2g1 (Deep to Very deep, calcareous black clay soils)	**Gudageri:** 10,14,15,16,17,18 **Kavalura:** 29,30,31,32,33,34,42,43,44, 45,46, 50,53,58,59,314,315,316,324,325, 326,327,328,337,338,384,388,391, 392,394, 397,399,408,475	Sunflower, Sorghum, Cotton, Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Amla, Custard apple, Jamun, Lime, Musambi, Tamarind, Pomegranate **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable conservation practises
3	264. NGPiB1g2 (Deep, red gravelly clay soils)	**Gudageri:** 17	Groundnut, Sorghum, Sunflower	**Fruit crops:** Amla, Custard apple, Pomegranate, Cashew **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Marigold,Chrysanthemum	Drip irrigation, mulching, suitable conservation practises (Crescent Bunding with Catch Pit etc)

4	363. NSPmB2g1 (Moderately deep, black clayey soils)	**Gudageri:** 11,12	Sorghum, Sunflower, Bengal gram, Bajra	**Fruit crops:** Lime Musambi, Custard apple, Amla, Pomegranate **Vegetables:** Drumstick, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable conservation practises
5	350.DRLmB2 351. DRLmB2g1 352. DRLmB2g2 (Moderately deep, calcareous black clay soils)	**Gudageri:** 13 **Kavalura**: 393,395,396,398,400, 401,403,404,405,406, 407,473	Sunflower , Sorghum, Bengal gram	**Fruit crops:** Amla, Custard apple, Lime, Pomegranate **Vegetables:** Drumstick, Coriander **Flowers:** Marigold, Chrysanthemum, Jasmine	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable conservation practises
6	336. RNKmB2 337. RNKmB2g1 338. RNKmB2g2 334. RNKmB1g1 (Moderately shallow calcareous black gravelly clayey soils)	**Kavalura:** 381,382,476,477,484,485, 486,496	Bengal gram, Sorghum	**Fruit crops:** Amla, Custard apple **Flowers:** Marigold, Chrysanthemum, Jasmine	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable conservation practises
7	311. MTLmB2g1 312.MTLmB2g2 (Shallow, calcareous black gravelly clay soils)	**Kavalura:** 383,385,386,387,389, 390	Bengal gram, Horsegram	**Agri-Silvi-Pasture:**Hybrid Napier, *Styloxanthes hamata*, *Styloxanthes scabra*	Use of medium duration varieties, and deep rooted crops, sowing across the slope, drip irrigation and mulching is recommended

Chapter 8

SOIL HEALTH MANAGEMENT

8.1 Soil 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 characterististics of a healthy soil are

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

Characteristics of Gudigeri-3 Microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of GRH (167 ha), KVR (81 ha), DRL (48 ha), MTL (53 ha) and other series in a small area.
- As per land capability classification, entire area in the microwatershed falls under arable land category (Class II and III). The major limitations identified in the arable lands were soil and erosion.
- On the basis of soil reaction, an area of about 121 ha (32%) under strongly alkaline (pH 8.4-9.0), 243 ha (65%) (pH >9.0) very strongly alkaline in reaction. 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. About 333 ha (88%) 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, raddish, potato etc) but not ideal for crops that need stagnant water like lowland paddy. Heavy textured soils are poor in water infiltration and percolation. They are prone for sheet erosion; such soils can be improved by sand mulching. The technology that is developed by the AICRP-Dryland Agriculture, Vijayapura, Karnataka can be adopted.
- ❖ **Gravelliness:** More gravel content is favorable for run-off harvesting but poor in soil moisture storage and nutrient availability. It is a significant parameter that decides the kind of crop to be raised.
- ❖ **Land Capability Classification:** The land capability map shows the areas suitable and not suitable for agriculture and the major constraints in each of the plot/survey number. Hence, one can decide what kind of enterprise is possible in each of these units. In general, erosion and soil are the major constraints in Gudigeri-3 Microwatershed.
- ❖ **Organic Carbon:** The OC content is medium (0.5-0.75%) in an area of about 57 ha (15%), low in maximum area of (<0.5%) in 297 ha (79%) and high (>0.5%) in about 10 ha (3%). The areas that are low and medium in OC needs to be further improved by applying farmyard manure and rotating crops with cereals and legumes or mixed cropping.
- ❖ **Promoting green manuring:** Growing of green manuring crops costs Rs. 1250/ha (green manuring seeds) and about Rs. 2000/ha towards cultivation that totals to Rs. 3250/- per ha. On the other hand, application of organic manure @ 10 tons/ha costs

Rs. 5000/ha. The practice needs to be continued for 2-3 years or more. Nitrogen fertilizer needs to be supplemented by 25% in addition to the recommended level in 354 ha area where OC is less than 0.75%. 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**: Major area is low (<23 kg/ha) in about 352 ha (93%), medium (23-57 kg/ha) in 11 ha (3%) area in available phosphorus. Hence for all the crops, 25% additional P-needs to be applied and high (>57 kg/ha) in small area of 1 ha (<1%).
- ❖ **Available Potassium:** Available potassium is high in major area of 356 ha (94%) and small area of 8 ha (2%) is medium in the microwatershed. For all crops, 25 % less potassium may be applied in areas where potassium is high.
- ❖ **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. Available sulphur is low (<10 ppm) in 104 ha (28%) area and medium in an area of about 5 ha (1%) in the microwatershed. These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertitilizer (13% sulphur) for 2-3 years for the deficiency to be corrected. It is high in 255 ha (68%) area of the microwatershed**.**
- ❖ **Available Boron:** Major area of about 243 ha (65%) is low (<0.5 ppm) in available boron and an area of 121 ha (32%) is medium (05 -1.0 ppm) in available boron content. These areas need to be applied with sodium borate @ 10kg/ha as a soil application or 0.2% borax as foliar spray to correct the deficiency
- ❖ **Available iron:** It is sufficient (>4.5 ppm) in major area of 341 ha (90%) and deficient (<4.5 ppm) in 24 ha (6%) in the microwatershed. to manage iron deficiency, iron sulphate @25 kg/ha needs to be applied for 2-3 years.
- ❖ **Available Zinc:** It is deficient (<0.6 ppm) in the major area of 364 ha (96%). Application of zinc sulphate @ 25kg/ha is to be followed in areas that are deficient in available zinc and one per cent area is sufficient (>0.6 ppm) in available zinc.
- ❖ **Soil alkalinity:** The entire area in the microwatershed has soils that are moderately 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 for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting depth and salinity/alkalinity are the major constraints in various plots. With suitable management interventions, the productivity can be enhanced. In order to increase water holding capacity of light textured soils, growing of green manure crops and application of organic manure is recommended.

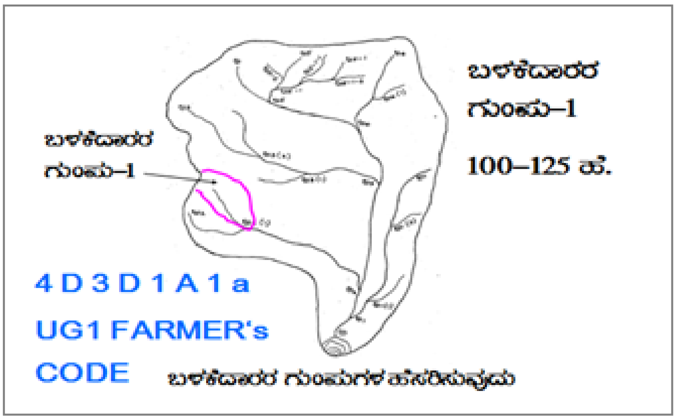
Chapter 9

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Gudigeri-3 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 has to be collected.



Steps for Survey and Preparation of Treatment Plan

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

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

9.1 Treatment Plan

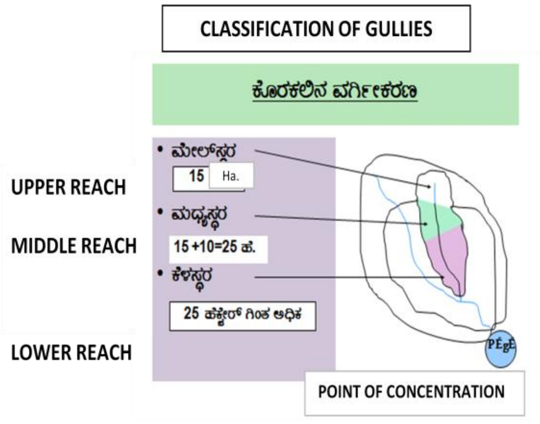
The treatment plan recommended for arable lands is briefly described below.

9.1.1 Arable Land Treatment

A. BUNDING

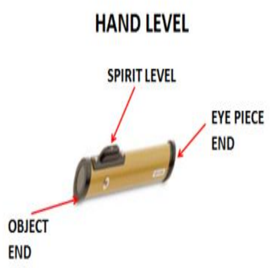
Steps for Survey and Preparation of Treatment Plan	
Cadastral map (1:7920 scale) is enlarged to a scale of 1:2500 scale Existing network of waterways, pothissa boundaries, grass belts, natural drainage lines/ watercourse, cut ups/ terraces are marked on the cadastral map to the scale Drainage lines are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

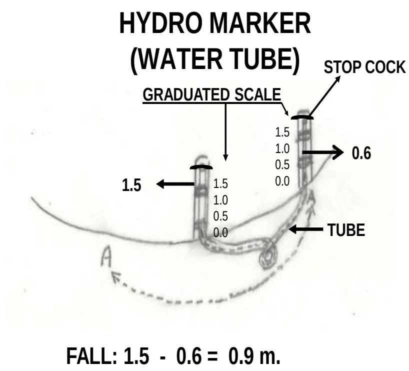
USER GROUP-1



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.

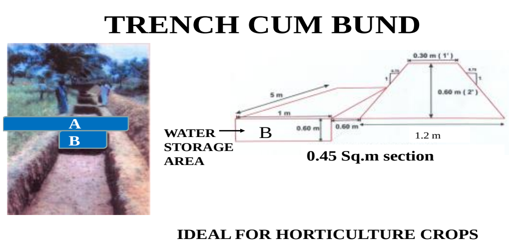
Recommended Bund Section

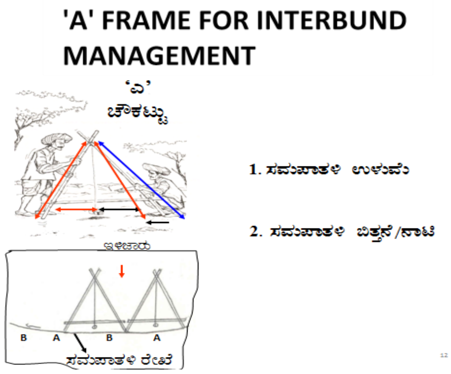
Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soils	
0.3	1.2	0.6	0.75:1	0.45		
0.3	1.5	0.6	01:01	0.54	Red sandy loam	
0.3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

Formation of Trench cum Bund

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

Details of Borrow Pit dimensions are given below





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

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

B. Waterways

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

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

c) The design details are given in the Manual.

C. Farm Ponds

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

D. Diversion Channel

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

9.1.2 Non-Arable Land Treatment

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

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. Major area of about 365 ha (97%) needs graded bunding and very minor area of 0.03 ha (0.01%) area needs trench cum 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.

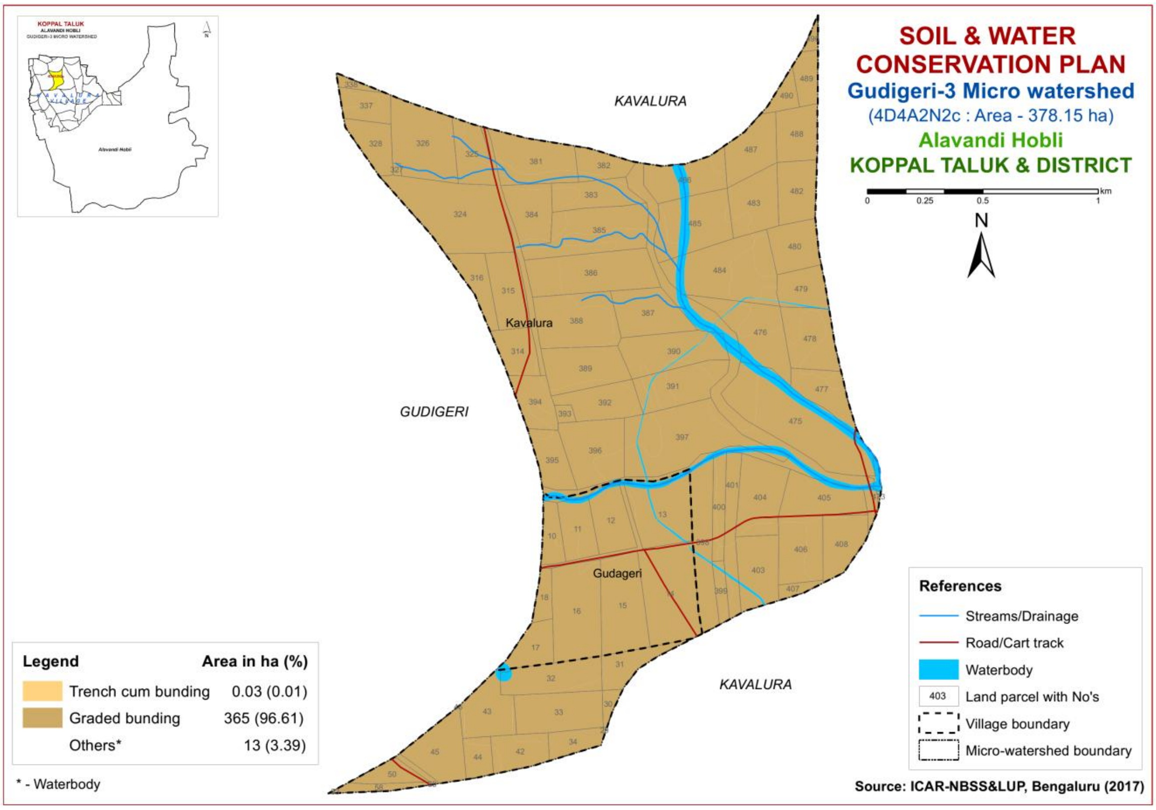


Fig. 9.1 Soil and Water Conservation Plan map of Gudigeri-3 Microwatershed

9.3 Greening of Microwatershed

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

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

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

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

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Appendix I

Gudigeri-3 Microwatershed

Soil Phase Information

Village	Survey No	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Gudageri	10	2.24	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Sunflower+Maize (Sf+Mz)	Not Available	IIIes	Graded bunding
Gudageri	11	3.7	NSPmB2g1	LMU-4	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Sunflower+Jowar (Sf+Jw)	Not Available	IIIes	Graded bunding
Gudageri	12	4.36	NSPmB2g1	LMU-4	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Currentfallow+Fallow land (Cf+Fl)	Not Available	IIIes	Graded bunding
Gudageri	13	7.02	DRLmB2g1	LMU-5	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Maize+Fallow land (Mz+Fl)	Not Available	IIIes	Graded bunding
Gudageri	14	9.83	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Jowar (Cf+Jw)	Not Available	IIIes	Graded bunding
Gudageri	15	7.83	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Gudageri	16	8.84	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Bengalgram (Bg)	Not Available	IIIes	Graded bunding
Gudageri	17	3.11	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Gudageri	18	1.5	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Onion (Cf+On)	Not Available	IIIes	Graded bunding
Kavalura	29	0.04	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Current fallow (Cf)	Not Available	IIs	Graded bunding
Kavalura	30	0.82	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Currentfallow+Bengalgram (Cf+Bg)	Not Available	IIs	Graded bunding
Kavalura	31	3.17	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	32	5.66	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Bengalgram (Jw+Bg)	Not Available	IIIes	Graded bunding
Kavalura	33	6.34	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram (Bg)	Not Available	IIs	Graded bunding
Kavalura	34	2.32	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram (Bg)	Not Available	IIs	Graded bunding
Kavalura	42	3.62	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	43	4.98	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	44	2.08	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram (Bg)	Not Available	IIs	Graded bunding
Kavalura	45	5.34	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram+Current fallow (Bg+Cf)	Not Available	IIs	Graded bunding
Kavalura	46	0.01	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Jowar (Jw)	Not Available	IIs	Graded bunding
Kavalura	50	2.06	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Current fallow+Jowar (Cf+Jw)	Not Available	IIs	Graded bunding

Village	Survey No	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kavalura	53	0.05	MLRmB2	LMU-2	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
Kavalura	58	1.21	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram+Current fallow (Bg+Cf)	Not Available	IIs	Graded bunding
Kavalura	59	0	KVRmB1g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Bengalgram (Bg)	Not Available	IIs	Graded bunding
Kavalura	314	3.29	GRHmB2	LMU-2	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	1 Farm pond	IIIe	Graded bunding
Kavalura	315	4.71	GRHmB2	LMU-2	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
Kavalura	316	3.15	GRHmB2	LMU-2	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	1 Farm pond	IIIe	Graded bunding
Kavalura	324	12.45	GRHmB2	LMU-2	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Jowar (Cf+Jw)	Not Available	IIIe	Graded bunding
Kavalura	325	3.87	GRHmB2	LMU-2	Deep (100-150 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
Kavalura	326	8.42	GRHmB2	LMU-2	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
Kavalura	327	0.19	GRHmB2	LMU-2	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
Kavalura	328	3.25	GRHmB2	LMU-2	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
Kavalura	337	2.85	GRHmB2	LMU-2	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
Kavalura	338	0.61	KVRmB1g1	LMU-2	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
Kavalura	381	6.92	KVRmB1g1	LMU-6	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
Kavalura	382	2.73	KVRmB2g1	LMU-6	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	383	4.27	KVRmB2g1	LMU-7	Shallow (25-50 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	384	4.71	KVRmB1g1	LMU-2	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
Kavalura	385	8.93	KVRmB1g1	LMU-7	Shallow (25-50 cm)	Clay	Gravelly (15-35%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	Not Available	IIIes	Graded bunding
Kavalura	386	9.24	KVRmB2g1	LMU-7	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Jowar (Cf+Jw)	Not Available	IIIes	Graded bunding
Kavalura	387	5.64	KVRmB2g1	LMU-7	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	388	8.06	KVRmB1g1	LMU-2	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
Kavalura	389	6.25	KVRmB1g1	LMU-7	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	390	6.82	KVRmB1g1	LMU-7	Shallow (25-50 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	391	5.88	KVRmB1g1	LMU-2	Very deep (>150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding

Village	Survey No	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kavalura	392	4.62	MLRmB3	LMU-2	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
Kavalura	393	0.58	KVRmB1g1	LMU-5	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	394	3.56	KVRmB1g1	LMU-2	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
Kavalura	395	3.56	GRHmB2	LMU-5	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	396	6.98	GRHmB2	LMU-5	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Currentfallow+Sunflower (Cf+Sf)	Not Available	IIIes	Graded bunding
Kavalura	397	12.57	MLRmB2g1	LMU-2	Very deep (>150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIes	Graded bunding
Kavalura	398	6.29	DRLmB2g1	LMU-5	Moderately deep (75-100 cm)	Clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow+Jowar (Cf+Jw)	Not Available	IIIes	Graded bunding
Kavalura	399	1.3	KVRmB2g1	LMU-2	Deep (100-150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	400	2.48	DRLmB2g2	LMU-5	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	401	4.01	DRLmB2g2	LMU-5	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	403	5.39	DRLmB2	LMU-5	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIe	Graded bunding
Kavalura	404	6.33	DRLmB2g2	LMU-5	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIes	Graded bunding
Kavalura	405	5.44	DRLmB2g2	LMU-5	Moderately deep (75-100 cm)	Clay	Very gravelly (35-60%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Sunflower (Sf)	Not Available	IIIes	Graded bunding
Kavalura	406	5.56	DRLmB2	LMU-5	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	1 Farm pond	IIIe	Graded bunding
Kavalura	407	0.86	DRLmB2	LMU-5	Moderately deep (75-100 cm)	Clay	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Current fallow (Cf)	Not Available	IIIe	Graded bunding
Kavalura	408	4.27	KVRmB1	LMU-2	Deep (100-150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Slight	Current fallow (Cf)	Not Available	IIs	Graded bunding
Kavalura	473	0.08	DRLmB2g2	LMU-5	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
Kavalura	475	14.63	MLRmB2g1	LMU-2	Very deep (>150 cm)	Clay	Gravelly (15-35%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Bengalgram (Jw+Bg)	Not Available	IIIes	Graded bunding
Kavalura	476	7.24	RNKmB2g1	LMU-6	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
Kavalura	477	4.01	RNKmB2g1	LMU-6	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
Kavalura	478	5.68	BDRmB2	LMU-1	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Currentfallow+Jowar (Cf+Jw)	Not Available	IIIe	Graded bunding
Kavalura	479	3.44	BDRmB2	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
Kavalura	480	4.18	BDRmB2	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	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	AWC	Slope	Soil Erosion	Current Land Use	WELLS	Land Capability	Conservation Plan
Kavalura	482	4.39	BDRmB2	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
Kavalura	483	5.24	BDRmB2	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
Kavalura	484	11.21	RNKmB2g1	LMU-6	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
Kavalura	485	7.78	RNKmB2g1	LMU-6	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)	Not Available	IIIes	Graded bunding
Kavalura	486	5.4	RNKmB2g2	LMU-6	Moderately shallow (50-75 cm)	Clay	Very gravelly (35-60%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Current fallow (Jw+Cf)	Not Available	IIIes	Graded bunding
Kavalura	487	4.81	BDRmB2	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
Kavalura	488	4.15	BDRmB2	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
Kavalura	489	2.23	BDRmB2	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
Kavalura	490	1.49	BDRmB2	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
Kavalura	496	0.53	RNKmB2	LMU-6	Moderately shallow (50-75 cm)	Clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIIe	Graded bunding

Appendix II

Gudigeri-3 Microwatershed
Soil Fertility Information

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Gudageri	10	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)
Gudageri	11	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)
Gudageri	12	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Gudageri	13	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)
Gudageri	14	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)
Gudageri	15	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Gudageri	16	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Gudageri	17	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Gudageri	18	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)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	29	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	30	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	31	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	32	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	33	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	34	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	42	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	43	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Medium (23 - 57 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	44	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	High (>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	45	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	High (>0.75%)	Medium (23 - 57 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	46	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	High (> 57 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	50	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	High (>0.75%)	Medium (23 - 57 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	53	Strongly alkaline (pH 8.4 – 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 No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	58	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	High (>0.75%)	Medium (23 - 57 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	59	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	High (>0.75%)	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	314	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	315	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	316	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	324	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)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	325	Strongly alkaline (pH 8.4 – 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	326	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	327	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	328	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	337	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	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	381	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	382	Strongly alkaline (pH 8.4 – 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	383	Strongly alkaline (pH 8.4 – 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	384	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	385	Strongly alkaline (pH 8.4 – 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	386	Strongly alkaline (pH 8.4 – 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	387	Strongly alkaline (pH 8.4 – 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	388	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	389	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	390	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	391	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	392	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)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	393	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)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	394	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	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	395	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	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	396	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)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2 ppm)	Deficient (< 0.6 ppm)
Kavalura	397	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	398	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	399	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	400	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	401	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	403	Strongly alkaline (pH 8.4 – 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	404	Strongly alkaline (pH 8.4 – 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	405	Strongly alkaline (pH 8.4 – 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	406	Strongly alkaline (pH 8.4 – 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	407	Strongly alkaline (pH 8.4 – 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	408	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	473	Strongly alkaline (pH 8.4 – 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	475	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	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	476	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	477	Strongly alkaline (pH 8.4 – 9.0)	Non saline (<2 dsm)	Medium (0.5 - 0.75%)	Low (< 23 kg/ha)	Medium (145 - 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	478	Very strongly alkaline (pH > 9.0)	Non saline (<2 dsm)	Low (< 0.5%)	Low (< 23 kg/ha)	Medium (145 - 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	479	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	480	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	482	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	483	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)

Village	Survey No	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
Kavalura	484	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	485	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	486	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	487	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	488	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	489	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	490	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	496	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)

Appendix III

Gudigeri-3 Microwatershed

Soil Suitability Information

Village	Survey No	Mango	Maize	Sapota	Sorgham	Guava	Tamarind	Lime	Sunflower	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Drumstick	Mulberry
Gudageri	10	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Gudageri	11	S3rt	S3t	S3rt	S1	S3t	S3rz	S2r	S2r	S2t	S3t	S1	N1t	S3rt	S2r	S3t	S3t	S3t	S2t	S2t	S2rt	S3t	S3t	S2rt	S2t
Gudageri	12	S3rt	S3t	S3rt	S1	S3t	S3rz	S2r	S2r	S2t	S3t	S1	N1t	S3rt	S2r	S3t	S3t	S3t	S2t	S2t	S2rt	S3t	S3t	S2rt	S2t
Gudageri	13	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Gudageri	14	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Gudageri	15	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Gudageri	16	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Gudageri	17	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Gudageri	18	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	29	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	30	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	31	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	32	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	33	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	34	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	42	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	43	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	44	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	45	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	46	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	50	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	53	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	58	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	59	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	314	S3tz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rt	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz

Village	Survey No	Mango	Maize	Sapota	Sorgham	Guava	Tamarind	Lime	Sunflower	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Drumstick	Mulberry
Kavalura	315	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	316	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	324	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	325	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	326	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	327	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	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	337	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	381	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	382	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	383	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	384	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	385	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	386	N1rt	S3tz	N1rz	S3rg	N1rt	N1rz	N1rz	N1rg	S3tz	N1rt	S3z	N1rt	N1rt	N1rz	S3tz	S3rz	S3rz	S3rz	S3rz	N1rz	S3rz	S3rz	N1rz	S3rz
Kavalura	387	N1rt	S3tz	N1rz	S3rg	N1rt	N1rz	N1rz	N1rg	S3tz	N1rt	S3z	N1rt	N1rt	N1rz	S3tz	S3rz	S3rz	S3rz	S3rz	N1rz	S3rz	S3rz	N1rz	S3rz
Kavalura	388	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	389	N1rt	S3tz	N1rz	S3rg	N1rt	N1rz	N1rz	N1rg	S3tz	N1rt	S3z	N1rt	N1rt	N1rz	S3tz	S3rz	S3rz	S3rz	S3rz	N1rz	S3rz	S3rz	N1rz	S3rz
Kavalura	390	N1rt	S3tz	N1rz	S3rg	N1rt	N1rz	N1rz	N1rg	S3tz	N1rt	S3z	N1rt	N1rt	N1rz	S3tz	S3rz	S3rz	S3rz	S3rz	N1rz	S3rz	S3rz	N1rz	S3rz
Kavalura	391	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	392	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	393	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	394	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	395	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	396	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	397	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	398	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	399	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz

Village	Survey No	Mango	Maize	Sapota	Sorgham	Guava	Tamarind	Lime	Sunflower	Amla	Jackfruit	Custard-apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Jasmine	Drumstick	Mulberry
Kavalura	400	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	401	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	403	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	404	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	405	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	406	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	407	S3rz	S3tz	S3tz	S2nz	S3tz	S3rz	S2rz	S2rz	S2tz	S3tz	S2z	N1tz	S3rz	S2rz	S3tz	S3tz	S3tz	S2tz	S2tz	S2rt	S3tz	S3tz	S2rz	S2tz
Kavalura	408	S2rz	S3tz	S3tz	S2z	S3tz	S2rz	S2z	S2z	S2tz	S3tz	S2z	N1tz	S2rz	S2z	S3tz	S3tz	S3tz	S2tz	S2tz	S2tz	S3tz	S3tz	S2tz	S2tz
Kavalura	473	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	475	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	476	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	477	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	478	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	479	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	480	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	482	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	483	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	484	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	485	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	486	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	487	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	488	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	489	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	490	S3t	S3t	S3t	S1	S3t	S2t	S1	S1	S2t	S3t	S1	N1t	S2t	S1	S3t	S3t	S3t	S2t	S2t	S2t	S3t	S3t	S2t	S2t
Kavalura	496	N1rz	S3tz	S3rz	S2rz	S3tz	N1rz	S3rz	S3rz	S2rz	S3tz	S2rz	N1tz	S3tz	S3rz	S2tz	S3tz	S3tz	S2rz	S2rz	S3rz	S3tz	S2rz	S3rz	S2rz

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-3 micro-watershed is located in between $15^0$18' – $15^0$20' North latitudes and $75^0$54' – $75^0$56' East longitudes, covering an area of about 378.15 and bounded by Kavalura and Gudigeri villages 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 65 to 35 per cent to the total sample population.*
- *Younger age groups of population is around 55 per cent to the total population.*
- *Literacy population is around 70 per cent.*
- *Wood is the source of energy for a cooking among 80 per cent.*
- *Majority of farm households (100 %) are having MGNREGA card for rural employments.*
- *Dependence on ration cards through public distribution system is around 80 per cent*
- *Swach bharath program providing closed toilet facilities around 80 per cent of sample households.*
- *Institutional participation is only 10 per cent of sample households.*
- *Women participation is decision making is 20 % of sample households.*

Economic Indicators

- *The average land holding is 3.06 ha indicates that majority of farm households are belong to marginal and small farmers.*
- *Agriculture is the main occupation only among 31 per cent and agricultural labours is predominant subsidiary occupation for 59 per cent of sample households.*
- *The average value of domestic assets is around Rs 15911 per household. Mobile and television are mass popular mass communication media.*

- *The average farm assets values is around 1.6 lakhs, about 40 per cent of sample farmers are owing tractors.*
- *The average livestock value is around Rs 12695 per livestock, around 60 per cent of households having live stocks.*
- *The average milk produced is 245 litters per animal per year and about 1417 kg of average fodder is available per season for the livestock feeding.*
- *The average per capita food consumption is around 736 grams (1701 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 9353 per household. About 100 per cent of farm households are below poverty line.*
- *The per capita monthly expenditure is around Rs 823 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 14565 per ha/year. The total cost of annual soil nutrients is around Rs 5303798 per year for the total area of 378.15 ha.*
- *The average value of ecosystem service for food production is around Rs 1602/ ha/year. Per ha food production services is maximum in sunflower (Rs 3055 /ha) followed by red gram (Rs 3926/ha), green gram (Rs 2115), ground nut (Rs 823), bengal gram (Rs 275).*
- *The average value of ecosystem service for fodder production is around Rs 1405/ ha/year. Per ha fodder production services is maximum in maize (Rs 3705 /ha) followed by sorghum (Rs 1482 /ha), bajra (Rs 889 /ha) and groundnut (Rs 659/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 bengal gram (Rs 29851), bajra (Rs 25705), red gram (Rs 21515), maize (Rs 15092), sorghum (Rs 15057) and ground nut (Rs 11453).*

Economic Land Evaluation;

- *The major cropping pattern is bajra (27%) followed by green gram (19 %), sorghum (15 %), red gram (15 %), bengal gram (12%, groundnut (9 %)) and maize (3 %).*
- *In Gudigeri-3 micro watershed, major soils are Muttal (MTL) series are having shallow soil deep covers around 14 per cent of area. On this soil farmers are presently growing bajra (50 %), green gram (22 %) and red gram (28 %). Ravanki (RNK) soil series are having moderately shallow soil depth cover around 11 per cent of area; major crops grown are bengal gram (56 %) and sorghum (44 %). Gatarediahal (GRH) soil series are having deep soil depth covers around 18 % of area, the major crop grown is bengal gram and Murlapur (MLR) soil series are very deep soil deep cover*

around 7 % of area, the crops grown are green gram (43 %), groundnut (43 %) and maize (14 %).

- *The total cost of cultivation in the study area for green gram ranges between Rs.14919/ha in MTL soil (with BCR of 1.36) and Rs.13215/ha in MTL soil (with BCR of 1.16).*
- *In bengal gram the cost of cultivation range between Rs. 30525/ha in GRH soil (with BCR is 1.08) and Rs.15329/ha in RNK soil (with BCR of 1.18).*
- *In maize the cost of cultivation in MTL soil is Rs.10439/ha (with BCR of 1.07).*
- *In red gram the cost of cultivation in MTL soil is Rs.11354/ha (with BCR of 1.39).*
- *In sorghum cost of cultivation in RNK soil is Rs.10624/ha (with BCR of 1.07) and ground nut cost of cultivation in MLR soil is Rs.19760/ha (with BCR of 1.07).*

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 bajra (13.3 %), bengal gram (9.0 %), green gram (6.3 %), groundnut (9.0 %), maize (57.5 %), red gram (13.8 %) and sorghum (18.8 %).*

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.

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 are jowar, maize, bajra, groundnut, pulses, sunflower, cotton and sugarcane.

The Gudigeri-3 micro-watershed (Koppal taluk and district) is located in between $15^0$18’ – $15^0$20’ North latitudes and $75^0$54’ – $75^0$56’ East longitudes, covering an area of about 378.15 and bounded by Kavalura and Gudigeri villages. 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).

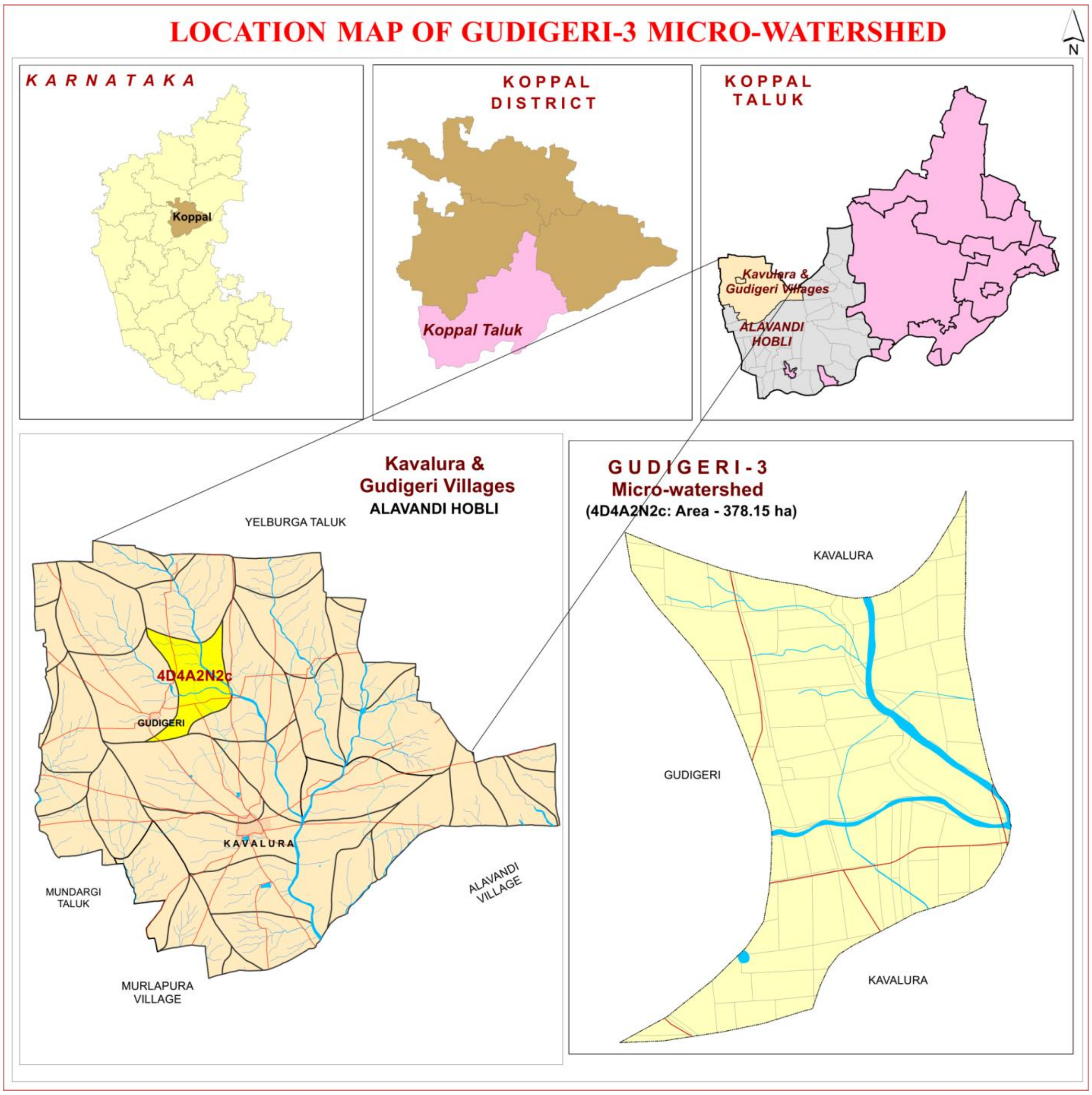


Figure 1: Location of study area

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.

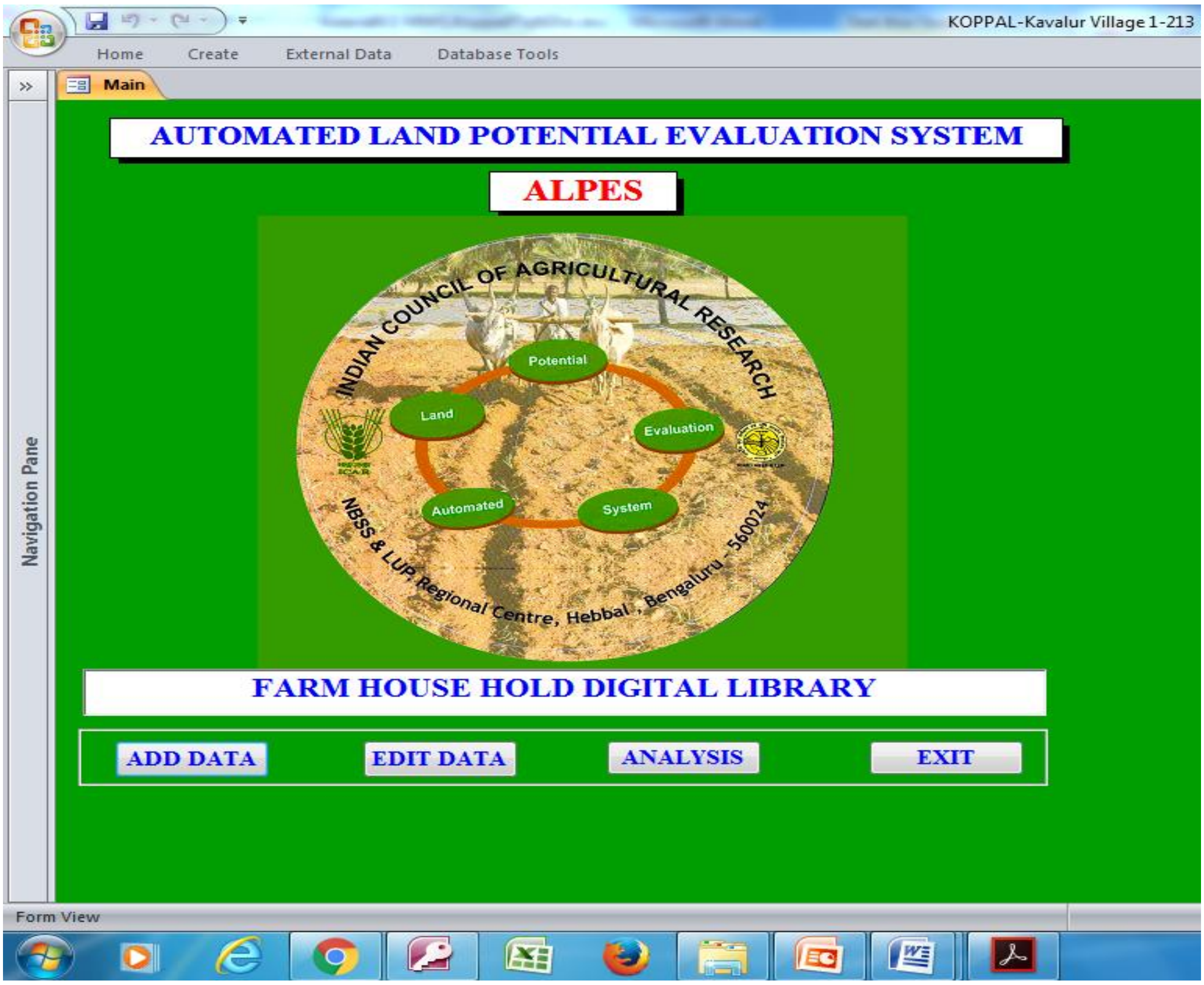
2 • Download the names of the farmers who are owning the land for each cadastral number in the Karnataka BHOOMI Website.

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 .



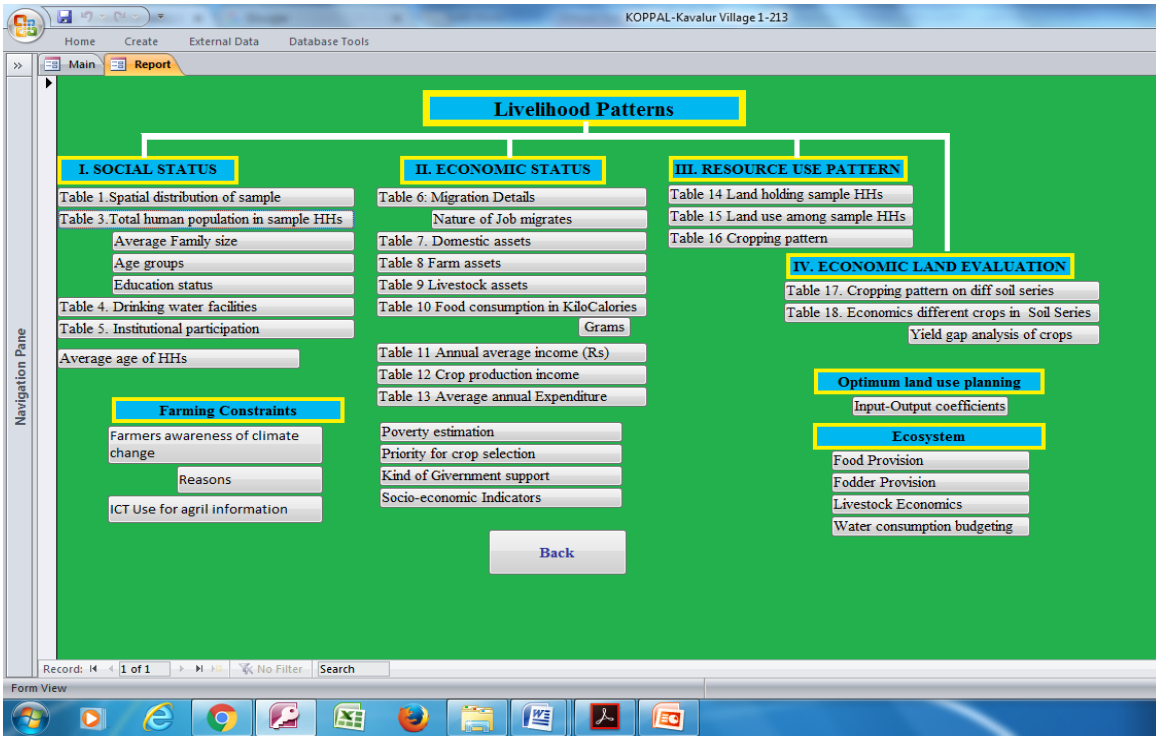


Figure 2: ALPES FRAMEWORK

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.

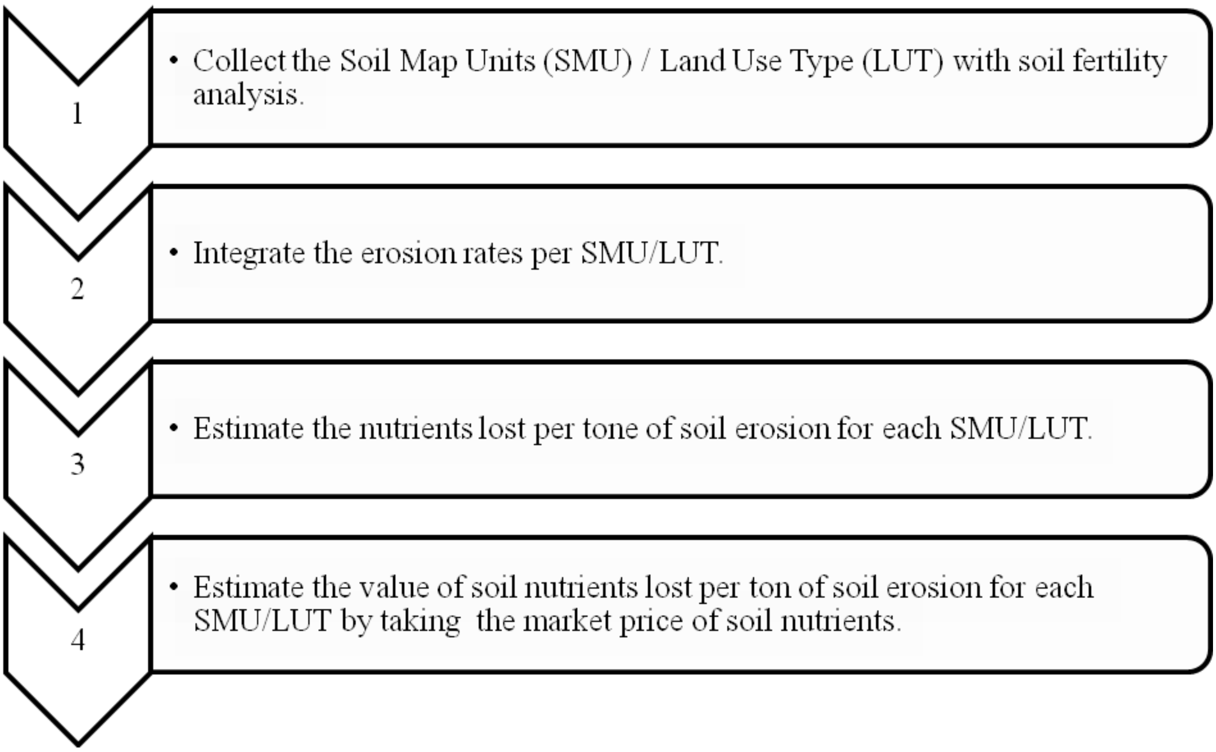
Economic suitability classes: once each land use –land area combination has been assigned an economic value by the land evaluation, the question arises as to its ‘suitability’, that is, the degree to which it satisfies the land user. The FAO framework defines two suitability orders: ’S’(suitable if benefit 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 the watershed area was 20, out of which 65 per cent were males and 35 per cent female. Average family size of the households is 4. 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 30 to 50 years (35%), followed by 0 to18 years (25 %), 18 to 30 years (20 %) and more than 50 years (20 %). 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 30 per cent of respondents were illiterate and 70 per cent literate (Table 1).

Table 1: Human population among sample households in Gudigeri-3 Microwatershed

Particulars	**Unit**	**Value**
Total human population in sample HHs	Number	20.0
Male	% to total Population	65.0
Female	% to total Population	35.0
Average family size	Number	4.0
Age group		
0 to 18 years	% to total Population	25.0
18 to 30 years	% to total Population	20.0
30 to 50 years	% to total Population	35.0
>50 years	% to total Population	20.0
Average age	years	36.5
Education Status		
Illiterates	% to total Population	30.0
Literates	% to total Population	70.0
Primary School (<5 class)	% to total Population	10.0
Middle School (6- 8 Class)	% to total Population	25.0
High School (9- 10 Class)	% to total Population	25.0
Others	% to total Population	10.0

The ethnic groups among the sample farm households found to be 100 per cent are belonging to Other Backward Castes (OBC) (Table 2 and Figure 3). About 80 per cent of sample households are using fire wood as source of fuel for cooking. All the sample farmers (100 %) are having electricity connection. About 60 per cent households are having health cards. Majority (100 %) are having MNREGA job cards. About 80 per cent of farm households are having ration cards for taking food grains from public distribution system. About 80 per cent of farm households are having toilet facilities.

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

Particulars	**Unit**	**value**
Social groups		
OBC	% to Households	100.0
Types of fuel use for cooking		
Fire wood	% to Households	80.0
Gas	% to Households	20.0
Energy supply for home		
Electricity	% to Households	100.0
Number of households having Health card		
Yes	% to Households	60.0
No	% to Households	40.0
MGNREGA Card		
Yes	% to Households	100.0
No	% to Households	0.0
Ration Card		
Yes	% to Households	80.0
No	% to Households	20.0
Households with toilet		
Yes	% to Households	80.0
No	% to Households	20.0
Drinking water facilities		
Tank	% to Households	40.0
Tube Well	% to Households	60.0

The data collected on the source of drinking water in the study area is presented in Table 2. Majority of the sample respondents were having tube well source for water supply for domestic purpose (60 %) and tank (40 %).

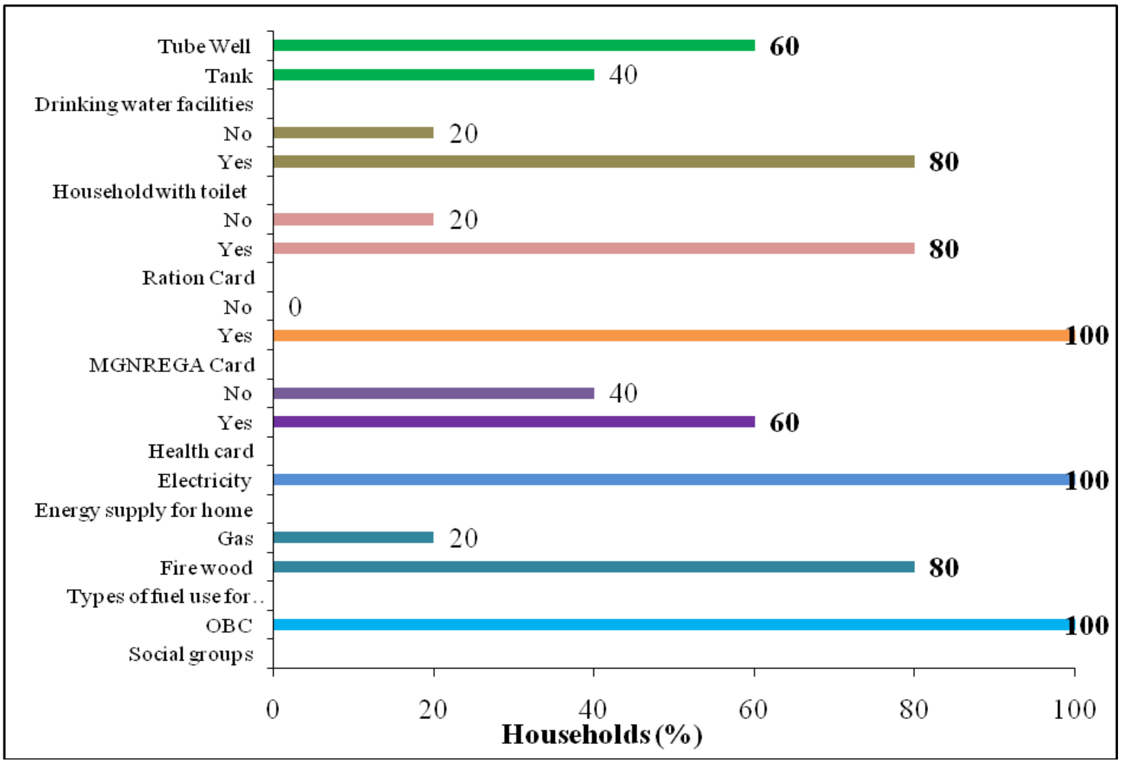


Figure 3: Basic needs of sample households in Gudigeri-3 Microwatershed

Only 10 per cent of the farmers are participating in community based organizations (Table 3). Among them majority are participating in Self help Group organization (10 %) like Sri Dharmasthala Swasahaya Sangha, Stri Shakhti Sangha.

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

Particulars	**Unit**	**Value**
No. Of people participating	**% of Households**	10
Self help groups	% of Participating Households	10
No. Of people not participating	**% of Households**	90

The occupational patterns (Table 4) among sample households shows that agriculture is the main occupation for 31.8 per cent of farmers followed by subsidiary occupations like agricultural labour (59.1 %) and Sheep/goat rearing as main occupation of 9 per cent.

Table 4: Occupational pattern in sample households in Gudigeri-3 Microwatershed

Particulars		**% to total population**
Main	**Subsidiary**	
Agriculture	Agriculture	31.8
	Agriculture Labour	59.1
Sheep/goat rearing		9.1
Grand Total		100.0
Family labour availability		**(Man days/ month)**
Male		38
Female		33
Total		71

The important assets especially with reference to domestic assets were analyzed and are given in Table 5 and Figure 4. The important domestic assets possessed by all categories of farmers are Mobile phones (100 %) followed by Television (100 %) and Motor bike (60 %). The average value of domestic assets is around Rs 15911 per household.

Table 5: Domestic assets among the sample households in Gudigeri-3 Microwatershed

Particulars	% of households	Average value in Rs
Mobile Phone	100.0	3000
Motorcycle	60.0	39333
Television	100.0	5400
Average value	15911	

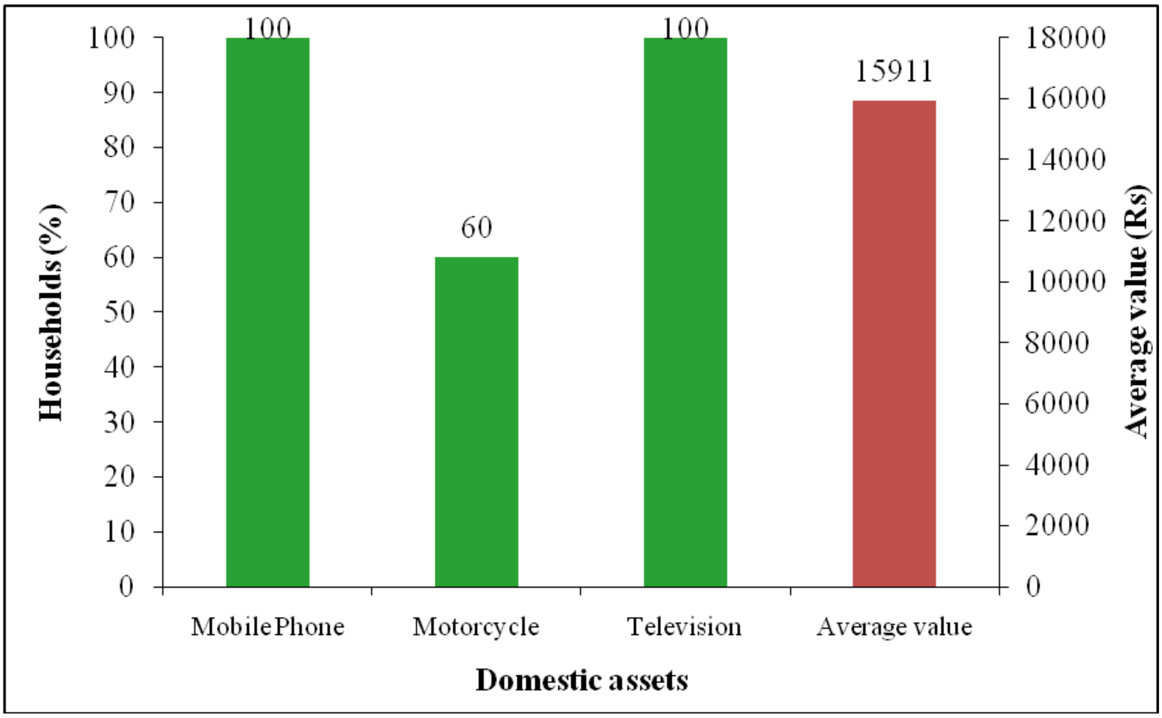


Figure 4: Domestic assets among the sample households in Gudigeri-3 Microwatershed

The most popularly owned farm equipments were sickles, plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer, thresher, plough and sickle were commonly present in all the sampled farmers; these were primary implements in agriculture the per cent of farm households owned Tractor (40 %) and was found highest among the sample farmers followed by the Plough (40 %) and Bullock cart (20%) (Table 6 and Figure 5).

Table 6: Farm assets among samples households in Gudigeri-3 Microwatershed

Particulars	% of households	Average value in Rs
Plough	40.0	650
Tractor	40.0	500000
Bullock cart	20.0	1000
Average value	167217	

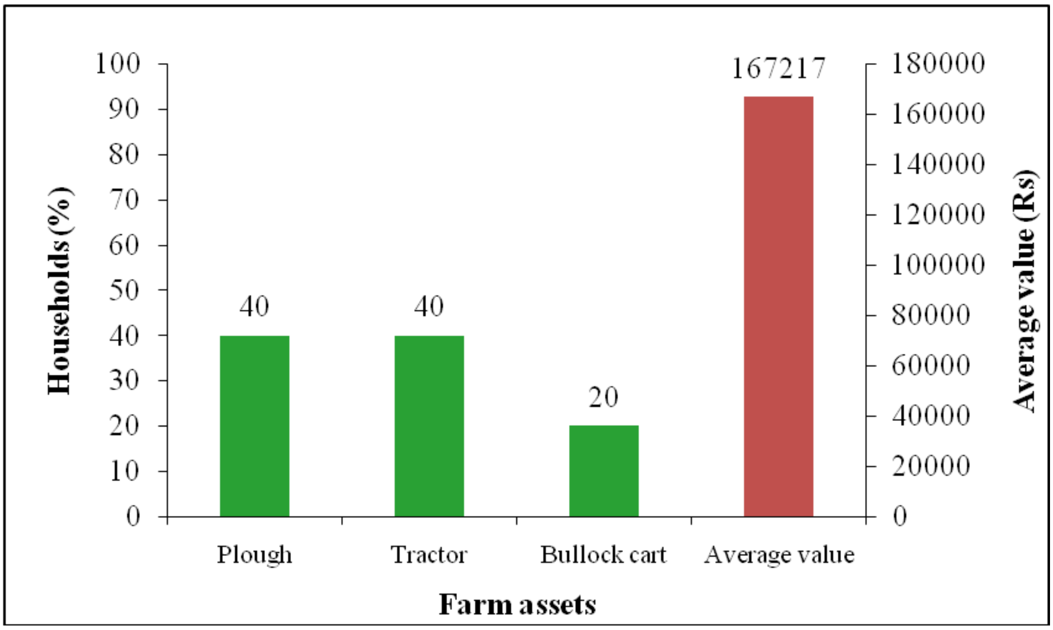


Figure 5: Farm assets among samples households in Gudigeri-3 Microwatershed

Livestock is an integral component of the conventional farming systems (Table 7 and Figure 6).The highest livestock population is Local mulching were around 40 per cent followed by the mulching buffalos, local dry cow, bullocks and sheep's were (20 %), each. The average livestock value was Rs 12695 per livestock.

Table 7: Livestock assets among sample households in Gudigeri-3 Microwatershed

Particulars	% of livestock population	Average value in Rs
Local Dry Cow	20.0	8000
Local Milching Cow	40.0	12500
Milching Buffalos	20.0	30000
Bullocks	20.0	8000
Sheeps	20.0	5000
Average value	12695	

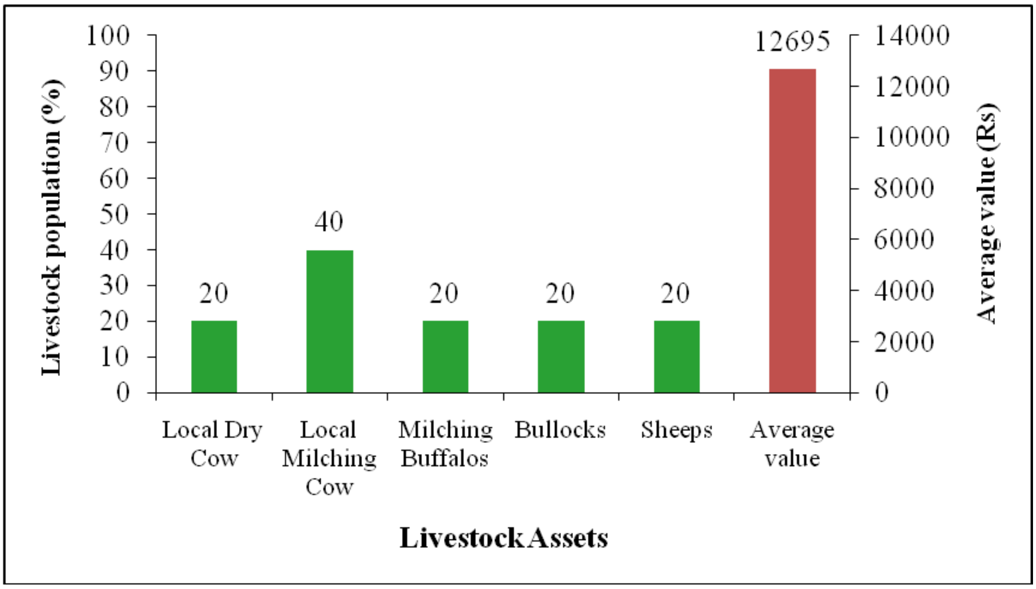


Figure 6: Livestock assets among sample households in Gudigeri-3 Microwatershed

Among the farm households (Table 8) mulching buffaloes and Local mulching cow are milk produced. The average milk produced were 245 litters per animal per year. For Bajra, Maize, groundnut and sorghum are the main crops grown for domestic food and fodder for animals. About 1417 kg of average fodder is available per season for the livestock feeding.

Table 8: Milk produced & fodder availability of sample households in Gudigeri-3 Microwatershed

Particulars	**Grand Total**
Name of the Livestock	**Ltr./Lactation/animal**
Milching Buffalos	300
Local Milching Cow	585
Average milk produced	245
Fodder produces	**Fodder yield (kg/ha.)**
Maize	2500
Bajra	1375
Sorghum	1000
Groundnut	833
Average food availability	1417
% of Livestock have Households	60
Livestock population (numbers)	9

For twenty per cent women participation for the decision making of local organisation, earning for her family requirement and taking decision in the family and agriculture related activities are reported in this Microwatershed (Table 9).

Table 9: Women empowerment of sample households in Gudigeri-3 Microwatershed

% to Grand Total

Particulars	**Yes**	**No**
Women participation in local organization activities	20	80
Women elected as panchayat member	0	100
Women earning for her family requirement	20	80
Women taking decision in her family and agriculture related activities	20	80

Table 10: Per capita daily consumption of food among the sample farmers in Gudigeri-3 Microwatershed

Particulars	**NIN recommendation (gram/ per day/ person)**	**Present level of consumption (gram/ per day/ person)**	**Kilo Calories /day/person**
Cereals	396	324.60	1103.7
Pulses	43	51.11	175.3
Milk	200	163.49	106.3
Vegetables	143	147.62	35.4
Cooking Oil	31	49.21	280.5
Egg	0.48	0.00	0.0
Meat	14.2	0.00	0.0
Total	827.68	736.03	1701.1
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		75	100
% Above NIN		25	0

Note: * day/person

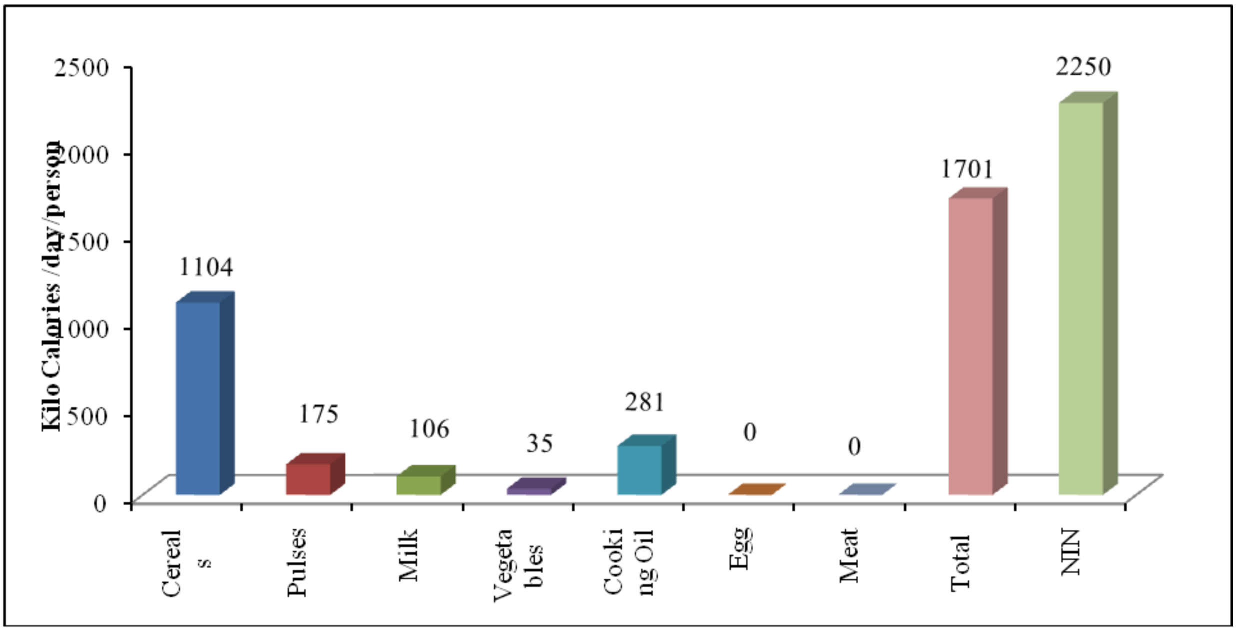


Figure 7: Per capita daily consumption of food among the sample farmers in Gudigeri-3 Microwatershed

The food intake in terms of kilo calorie (kcal) per person per day was calculated and presented in the Table 10 and Figure 7. More quantity of cereals are consumed by sample farmers which accounted for 1103.1 kcal per person. The other important food items consumed was pulses 175.3 kcal followed by cooking oil 280.5 kcal and milk 106.3 kcal. In the sampled households, farmers were consuming less (1701 kcal) than NIN- recommended food requirement (2250 kcal).

Annual income of the sample HHs: The average annual household income is around Rs 5976. Major source of income to the farmers in the study area is from crop production (Rs 3243). The income from livestock income was very low at Rs 2733. The monthly per capita income is Rs.125, 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 are very meagre (Table 11).

Table 11: Annual average income of HHs from various sources in Gudigeri-3 Microwatershed

Particulars	**Income***
Nonfarm income (Rs)	0
Livestock income (Rs)	2733 (60)
Crop Production (Rs)	3243(100)
Total Annual Income (Rs)	***5976***
Average monthly per capita income (Rs)	125
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. 32808) 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 823 and about 100 per cent of farm households are below poverty line (Table 12 and Figure 8)

Table 12: Average annual expenditure of sample HHs in Gudigeri-3 Microwatershed

Particulars	Value in Rupees	Per cent
Food	32808	83.0
Education	1600	4.0
Clothing	2400	6.1
Social functions	1700	4.3
Health	1000	2.5
Total Expenditure (Rs/year)	39508	100.0
Monthly per capita expenditure (Rs)	823	

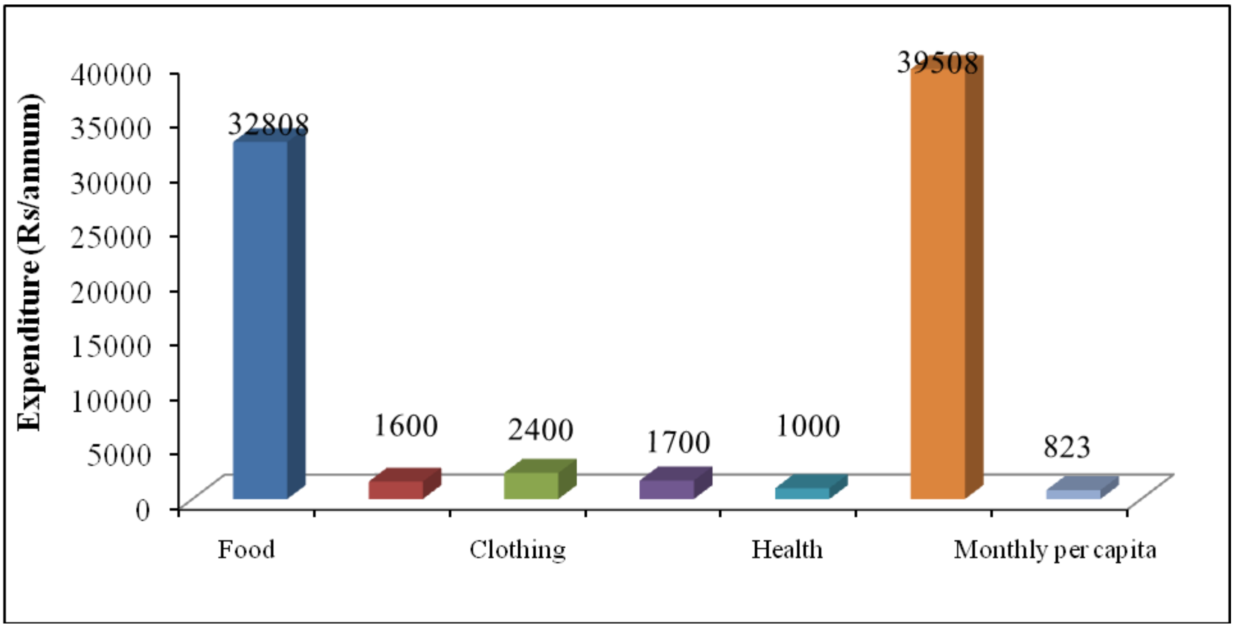


Figure 8: Average annual expenditure of sample HHs in Gudigeri-3 Microwatershed

The total land owned by the sample households are 15.32 ha which is under dry land. The average land holding per household worked out to be 3.06 ha (Table 13)

Table 13: Land holding among samples households in Gudigeri-3 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	0.0	0
Rainfed Land	100.0	15.32
Fallow Land	0	0.00
Total land holding	100.0	15.32
Average land holding	3.06	

In the watershed, the prevalent present land uses under perennial plants are banyan tree (31 %) followed by neem trees (69 %) (Table 14).

Table 14: Number of trees/plants covered in sample farm households in Gudigeri-3 Microwatershed

Particulars	Number of trees/Plants	Per cent
Banyan tree (Alada)	4	30.8
Neem trees	9	69.2
Grand Total	13	100.0

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

The present dominant crops grown in dry lands in the study area were bajra (27 %) followed by green gram (19 %), red gram (15 %), sorghum (15%), groundnut (9 %) and maize (3 %) which are taken during *Kharif* season and bengal gram (12 %) during *Rabi* season respectively. The cropping intensity was 113.6 per cent (Table 15 and Figure 9).

Table 15: Present cropping pattern and cropping intensity in Gudigeri-3 Microwatershed

% to Grand Total

Crops	Kharif	Rabi	Total
Bajra	27.0	0.0	27.0
Green gram	19.0	0.0	19.0
Sorghum	15.0	0.0	15.0
Bengal gram	0.0	12.0	12.0
Groundnut	9.0	0.0	9.0
Maize	3.0	0.0	3.0
Red gram	15.0	0.0	15.0
Grand Total	***88.0***	***12.0***	***100.0***
Cropping intensity (%)		113.6	

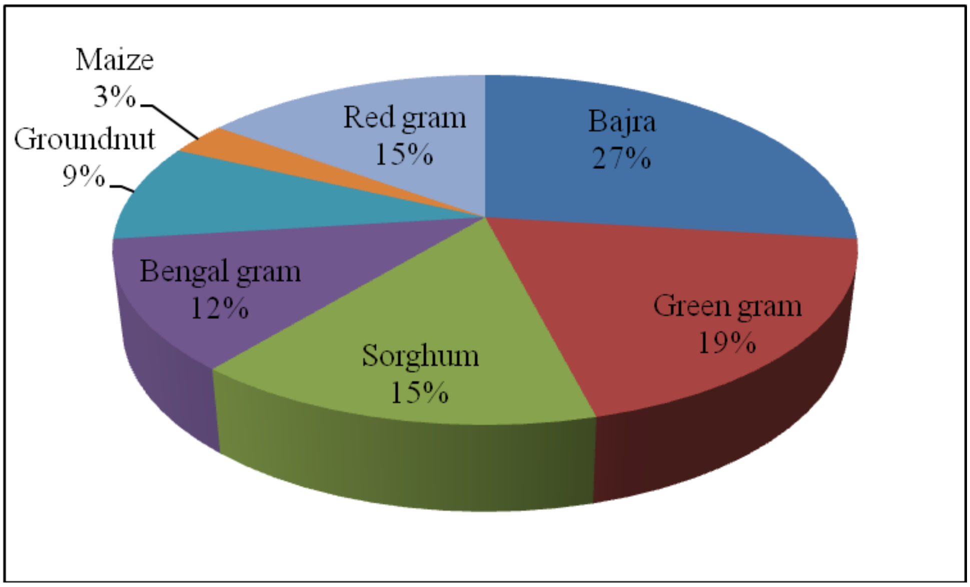


Figure 9: Present cropping pattern in Gudigeri-3 Microwatershed

Economic land evaluation

In Gudigeri-3 micro-watershed 8 soil series are identified and mapped (Table 16). The distribution of major soil series are Kavalura covering an area of 81 ha (47 %) followed by Gatareddihal 66 ha (17.64 %), Muttal 53 ha (14.14 %), Dambarahalli 52 ha (13.81 %), Ravanaki 39 ha (10.56 %), Muralpur 27 ha (7.15%), Narasapura 10 ha (2.56%) and Nagalapur 0.03 ha (0.01 %).

Table 16: Distribution of soil series in Gudigeri-3 Microwatershed

Sl. No	Soil Series	Area in ha (%)
1	Muttal (MTL)	53 (14.14)
2	Dambarahalli (DRL)	52 (13.81)
3	Gatareddihal (GRH)	66 (17.64)
4	Kavalur (KVR)	81 (21.37)
5	Murlapur (MLR)	27.13 (7.15)
6	Nagalapur (NGP)	0.03 (0.01)
7	Narasapura (NSP)	10 (2.56)
8	Ravanaki (RNK)	39 (10.56)
	Others	13 (3.39)
	Total	378.15

Present cropping pattern on different soil series are given in Table 17. Crops grown on Muttal soils are Bajra, Green gram and Red gram. Bengal gram and Sorghum on Ravanaki soils, Bengal gram on Gatareddihal soils, Green gram, Groundnut and Maize on Murlapur soils is grown.

Table 17: Cropping pattern on major soil series in Gudigeri-3 micro-watershed

Soil Series	Soil Depth	Crops	Dry		Grand Total
			Kharif	Rabi	
Muttal	Shallow (25-50 cm)	Bajra	50	0	50
		Green gram	22.22	0	22.22
		Redgram	27.78	0	27.78
Ravanaki	Moderately shallow (50-75 cm)	Bengal gram	0	44.44	44.44
		Sorghum	55.56	0	55.56
Gatareddihal	Deep (100-150 cm)	Bengal gram	0	100	100
Murlapur	Very deep (>150 cm)	Green gram	42.86	0	42.86
		Groundnut	42.86	0	42.86
		Maize	14.29	0	14.29

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-3 Microwatershed

Soil Series	Small Farmers	Medium Farmers	Large Farmers
MTL		Bajra (1.17), Green gram (1.36)	Bajra (1.2), Red gram (1.39)
RNK		Bengal gram (1.18), Sorghum (1.07)	
GRH	Bengal gram (1.08)		
MLR	Green gram (1.16), Groundnut (1.07), Maize (1.07)		

The productivity of different crops grown in Gudigeri-3 micro-watershed under different soil series and potential yield of the crops is given in Table 19.

Table 19: Economic land evaluation and bridging yield gap for different crops in Gudigeri-3 Microwatershed

Particulars	MTL			RNK		GRH	MLR		
	Bajra	Green gram	Red gram	Bengal gram	Sorg hum	Bengal gram	Green gram	Ground nut	Maize
Total cost (Rs/ha)	10439	14919	11354	15329	10624	30525	13215	19760	26495
Gross Return (Rs/ha)	12375	20254	15808	18155	11362	32851	15314	21242	28405
Net returns (Rs/ha)	1935	5335	4454	2826	738	2326	2100	1482	1910
B:C	1.19	1.36	1.39	1.18	1.07	1.08	1.16	1.07	1.07
Farmers Practices (FP)									
FYM (t/ha)	0.8	0.6	0.5	1.3	1.0	0.0	0.8	0.0	0.0
Nitrogen (kg/ha)	42.3	48.3	36.4	38.3	38.3	42.5	45.4	70.2	70.2
Phosphorus (kg/ha)	38.3	45.8	30.9	31.6	31.6	90.0	7.1	51.5	51.5
Potash (kg/ha)	6.1	2.7	9.6	0.0	0.0	0.0	7.1	3.5	3.5
Grain (Qtl/ha)	5.8	5.0	4.0	4.4	5.0	8.8	5.0	4.2	12.5
Price of Yield (Rs/Qtl)	2000	4100	4000	4200	2000	3800	3100	5000	2000
Soil test based fertilizer Recommendation (STBR)									
FYM (t/ha)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Nitrogen (kg/ha)	62.5	16.3	31.3	16.3	81.3	16.3	16.3	31.3	125.0
Phosphorus (kg/ha)	31.3	31.3	62.5	31.3	50.0	31.3	31.3	62.5	62.5
Potash (kg/ha)	0.0	18.8	18.8	18.8	30.0	18.8	18.8	18.8	18.8
Grain (Qtl/ha)	13.3	6.3	13.8	9.0	18.8	9.0	6.3	9.0	57.5
% of Adoption/yield gap (STBR-FP) / (STBR)									
FYM (%)	89.2	91.7	93.3	83.3	86.7	100.0	88.9	100.0	100.0
Nitrogen (%)	32.3	-197.1	-16.4	-135.4	52.9	-161.5	-179.5	-124.7	43.8
Phosphorus (%)	-22.7	-46.5	50.6	-1.2	36.8	-188.0	77.3	17.7	17.7
Potash (%)	0.0	85.8	48.7	100.0	100.0	100.0	62.2	81.1	81.1
Grain (%)	56.4	20.0	70.9	51.4	73.3	2.8	20.0	53.7	78.3
Impact of Land Resources Information (Rs)									
Additional fertilisers cost (Rs/ha)	6495	6173	8513	6345	8425	4975	7613	7823	8948
Additional yield benefits (Rs/ha)	15035	5125	39000	19425	27500	950	3875	24167	90000
Net change Income (Rs/ha)	8540	-1048	30488	13081	19076	-4025	-3738	16344	81053

The data on cost of cultivation and BCR of different crops across soil series is given in Tables 19. The total cost of cultivation in the study area for green gram ranges between

Rs.14919/ha in MTL soil (with BCR of 1.36) and Rs.13215/ha in MTL soil (with BCR of 1.16), Bengal gram cultivation range between Rs. 30525/ha in GRH soil (with BCR is 1.08) and Rs.15329/ha in RNK soil (with BCR of 1.18), Maize cultivation in MTL soil is Rs.10439/ha (with BCR of 1.07), Red gram cultivation in MTL soil is Rs.11354/ha (with BCR of 1.39), Sorghum cost of cultivation in RNK soil is Rs.10624/ha (with BCR of 1.07) and Ground nut cost of cultivation in MLR soil is Rs.19760/ha (with BCR of 1.07).

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 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 81053 in maize and a minimum of Rs 8540 in bajra 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 10. The average value of soil nutrient loss is around Rs 14565 per ha/year. The total cost of annual soil nutrients is around Rs 5303798 per year for the total area of 378.15 ha.

Table 20: Estimation of onsite cost of soil erosion in Gudigeri-3 micro-watershed

Particulars	Quantity (kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	1946	708793	12263	4465398
Phosphorus	1.07	390	47.1	17156
Potash	60.15	21903	1203.0	438063
Iron	2.14	780	102.8	37418
Manganese	1.8	654	494.1	179910
Cupper	0.26	93	143.7	52322
Zinc	0.05	17	1.9	686
Sulphur	7.64	2782	305.6	111290
Boron	0.11	39	4.3	1554
Total	2020	735452	14565	5303798

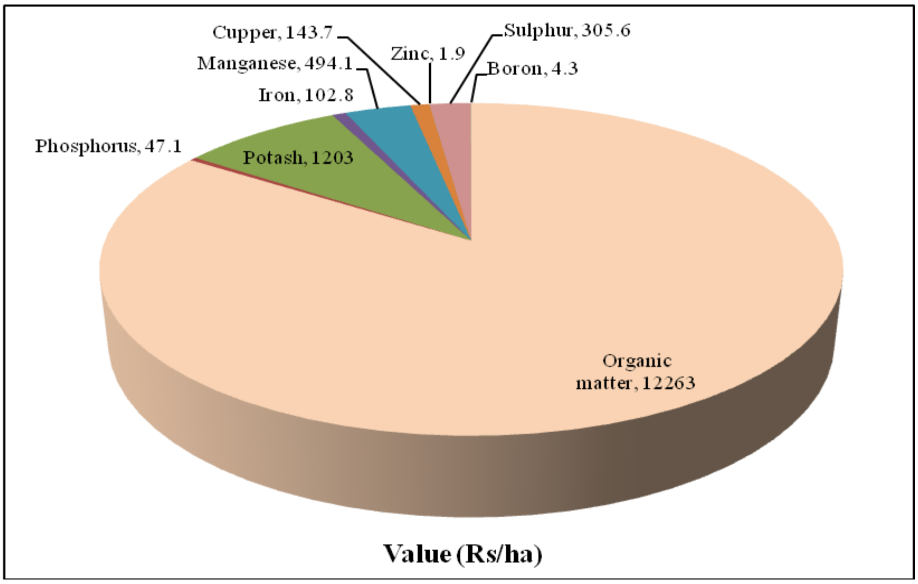


Figure 10: Estimation of onsite cost of soil erosion in Gudigeri-3 micro-watershed

The average value of ecosystem service for food production is around Rs 1602/ ha/year (Table 21 and Figure 11). Per ha food production services is maximum in sunflower (Rs 3055 /ha) followed by Red gram (Rs 3926/ha), green gram (Rs 2115), ground nut (Rs 823), Bengal gram (Rs 275) and maize, bajra and sorghum are negative returns.

Table 21: Ecosystem services of food production in Gudigeri-3 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	Bajra	3.6	5.7	2000	11486	11751	41850	-265
	Maize	0.4	12.4	2000	24700	29719	10000	-5019
	Sorghum	2.0	4.9	2000	9880	12580	20000	-2700
Pulses	Bengal gram	1.6	4.3	4200	18155	17879	29400	275
	Green gram	2.8	4.9	3600	17784	15669	50400	2115
	Red gram	2.0	4.0	4000	15808	11882	32000	3926
Oil seeds	Groundnut	1.2	4.1	5000	20583	19760	25000	823
Grand Total		13.8	5.7	3156	17898	16296	246367	1602

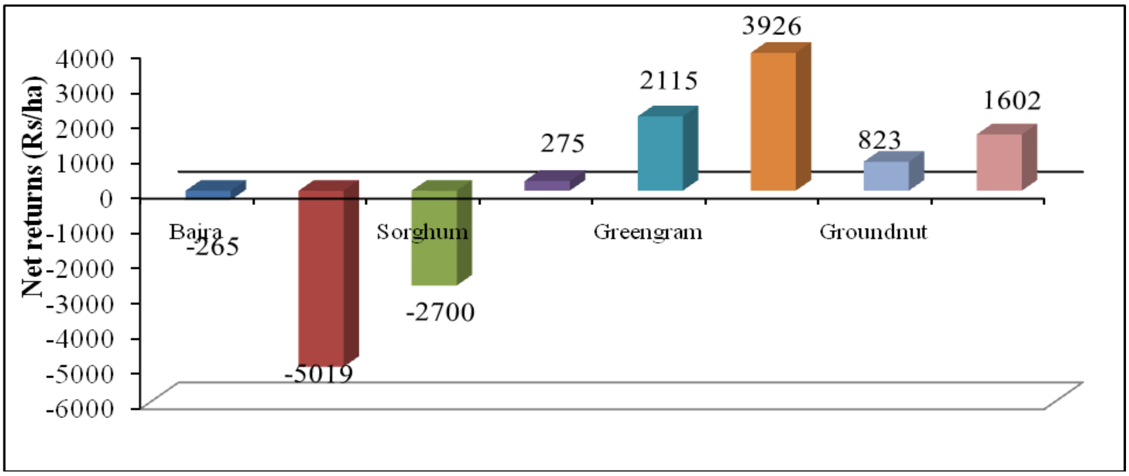


Figure 11: Ecosystem services of food production in Gudigeri-3 Microwatershed

The average value of ecosystem service for fodder production is around Rs 1405/ ha/year (Table 22). Per ha fodder production services is maximum in maize (Rs 3705 /ha) followed by sorghum (Rs 1482 /ha), Bajra (Rs 889 /ha) and Groundnut (Rs 659/ha).

Table 22: Ecosystem services of Fodder production in Gudigeri-3 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Returns (Rs/ha)	Total returns (Rs)
Cereals	Bajra	3.64	1.11	800	889	3240
	Maize	0.40	2.47	1500	3705	1500
	Sorghum	2.02	0.99	1500	1482	3000
Oil seeds	Groundnut	1.21	0.82	800	659	800
Grand Total		7.29	1.30	1080	1405	10238

The water demand for production of different crops was worked out in arriving at the ecosystem services of water support to crop growth. 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 12) in green gram (Rs 34116) followed by Bengal gram (Rs 29851), bajra (Rs 25705), Red gram (Rs 21515), Maize (Rs 15092), sorghum (Rs 15057) and Ground nut (Rs 11453).

Table 23: Ecosystem services of water supply in Gudigeri-3 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Bajra	5.74	2570	25705	448
Bengalgram	4.32	2985	29851	691
Greengram	4.94	3412	34116	691
Groundnut	4.12	1145	11453	278
Maize	12.35	1509	15092	122
Redgram	3.95	2151	21515	544
Sorghum	4.94	1506	15057	305
Grand Total	5.67	2362	23623	416

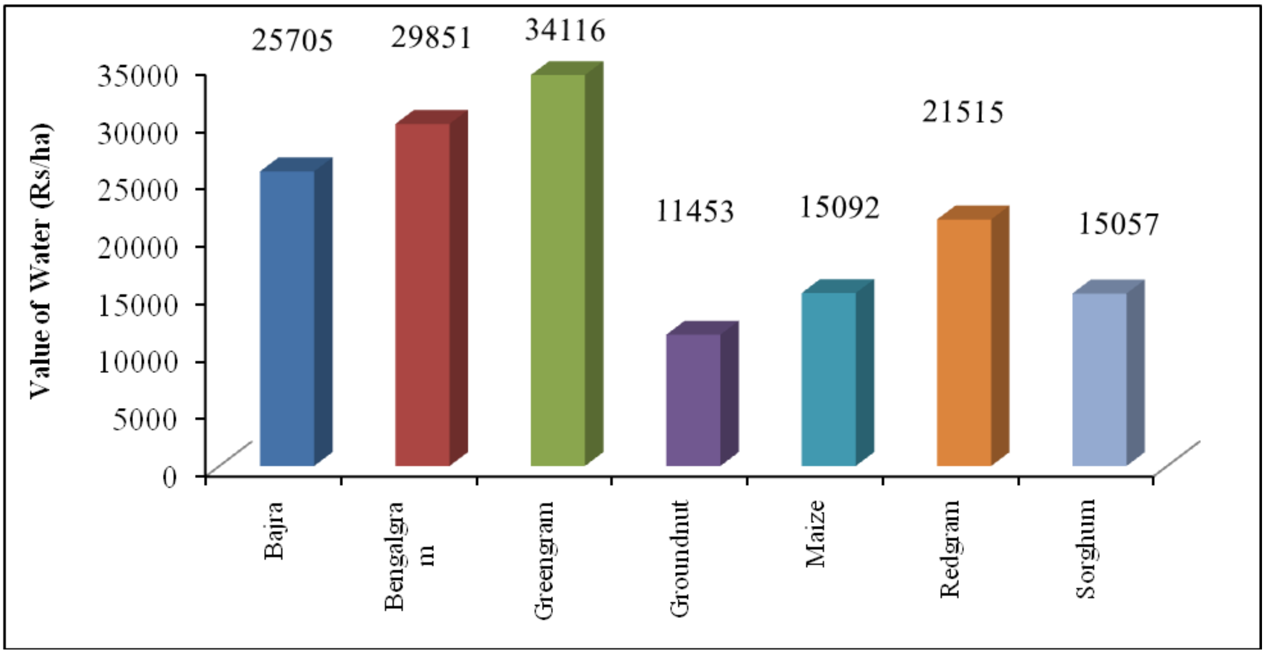


Figure 12: Ecosystem services of water supply in Gudigeri-3 Microwatershed

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-3 Microwatershed

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