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

KANEKAL-3 (4D5B1P1c) MICROWATERSHED

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

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

Nagpur **S.K. SINGH**
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PART-A

LAND RESOURCE INVENTORY

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EXECUTIVE SUMMARY

The land resource inventory of Kanekal-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 boundaries. The soil map shows the geographic distribution and extent, characteristics, classification, behaviour and use potentials of the soils in the microwatershed.

The present study covers an area of 547 ha in Kanekal-3 microwatershed in Yadgir taluk of Yadgir district, Karnataka. The climate is semiarid and categorized as drought-prone with an average annual rainfall of 866 mm, of which about 652 mm is received during south–west monsoon, 138 mm during north-east and the remaining 76 mm during the rest of the year. An area of about 99 per cent is covered by soils, 1 per cent by rock outcrops and others. The salient findings from the land resource inventory are summarized briefly below.

- *The soils belong to 13 soil series and 18 soil phases (management units) and 7 land use classes.*
- *The length of crop growing period is about 120-150 days starting from the 1st week of June to 4th week of October.*
- *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 26 major agricultural and horticultural crops were assessed and maps showing the degree of suitability along with constraints were generated.*
- *About 99 per cent area is suitable for agriculture and 1 per cent is not suitable for agriculture but well suited for forestry, pasture, agro-forestry, silvi-pasture, recreation, mining, installation of wind mills and as habitat for wildlife.*
- *About <1 per cent soils are very shallow (<25 cm), 17 per cent soils are shallow (25-50 cm), 35 per cent soils are moderately shallow (50-75 cm), 22 per cent of the soils are moderately deep (75-100cm) and about 24 per cent deep (100-150cm) to very deep (>150 cm) soils.*
- *About 72 per cent of the area has clayey soils, 18 per cent loamy soils and 9 per cent sandy soils at the surface.*
- *An area of about 84 per cent has non-gravelly and 15 per cent are gravelly.*

- *About 6 per cent of the area has soils that are very high (>200mm/m) in available water capacity, 15 per cent medium (100-150 mm/m) and about 78 per cent low (51-100 mm/m) to very low (<50 mm/m).*
- *Entire area of the microwatershed has very gently sloping (1-3%) lands.*
- *An area of about 91 per cent has soils that are moderately eroded (e2) and 8 per cent severely eroded (e3).*
- *An area of about 1 per cent is slightly acid (pH 6.0-6.5), 56 per cent has neutral (pH 6.5-7.3), 26 per cent has slightly alkaline (pH 7.3-7.8) and about 16 per cent has soils that are moderately alkaline (pH 7.8 to 8.4) in soil reaction.*
- *The Electrical Conductivity (EC) of the soils are dominantly <2 dsm^{-1} indicating that the soils are non-saline.*
- *About 31 per cent medium (0.5-0.75%) and 67 per cent high (>0.75%) in organic carbon.*
- *An area of 21 per cent has soils that are low (<23 kg/ha), 63 per cent medium (23-57 kg/ha) and 15 per cent high (>57 kg/ha) in available phosphorus.*
- *About 5 per cent low (<145 kg/ha), 92 per cent medium (145-337 kg/ha) and 2 per cent high (>337 kg/ha) in available potassium.*
- *Available sulphur is low (<10 ppm) in about 69 per cent area and medium (10-20 ppm) in 30 per cent area of the microwatershed.*
- *Available boron is low (<0.5 ppm) in about 52 per cent, 38 per cent medium (0.5-1.0 ppm) and high (>1.0 ppm) in about 9 per cent area of the microwatershed.*
- *About 11 per cent area has soils that are deficient (<4.5 ppm) in available iron and 88 per cent sufficient (>4.5 ppm).*
- *Available manganese and copper are sufficient in all the soils of the microwatershed.*
- *Entire area of the microwatershed is deficient (<0.6 ppm) in available zinc.*
- *The land suitability for 26 major crops grown in the microwatershed was 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 Kanekal-3 microwatershed

Crop	***Suitability Area in ha (%)***			***Crop***	***Suitability Area in ha (%)***	
	Highly suitable (S1)	***Moderately suitable (S2)***			***Highly suitable (S1)***	***Moderately suitable (S2)***
Sorghum	*97 (18)*	*259 (47)*		*Sapota*	*35 (6)*	*185 (34)*
Maize	*97 (18)*	*228 (42)*		*Guava*	*35 (6)*	*185 (34)*
Red gram	*-*	*251(46)*		*Pomegranate*	*35 (6)*	*216 (39)*
Bajra	*-*	*251(46)*		*Jackfruit*	*31 (6)*	*168 (31)*
Ground nut	*35 (6)*	*307 (56)*		*Jamun*	*31 (6)*	*95 (17)*
Sunflower	*-*	*234 (43)*		*Musambi*	*35 (6)*	*216 (39)*
Cotton	*31 (6)*	*325 (59)*		*Lime*	*35 (6)*	*216 (39)*
Bengalgram	*31 (6))*	*325 (59)*		*Cashew*	*35 (6)*	*121 (22)*
Chilli	*-*	*373 (68)*		*Custard apple*	*132 (24)*	*224 (41)*
Tomato	*97 (18)*	*245 (45)*		*Amla*	*132 (24)*	*224 (41)*
Drumstick	*35 (6)*	*216 (39)*		*Tamarind*	*35 (6)*	*95 (17)*
Mulberry	*35 (6)*	*168 (31)*		*Marigold*	*-*	*373 (68)*
Mango	*35 (6)*	*47 (9)*		*Chrysanthemum*	*-*	*373 (68)*

Apart from the individual crop suitability, a proposed crop plan has been prepared for the seven identified LMUs by considering only the highly and moderately suitable lands for different crops and cropping systems with food, fodder, fibre and horticulture crops that helps in maintaining the ecological balance in the microwatershed

- *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 are edible, ecological and produce lot of biomass that helps to restore the ecological balance in the microwatershed.*

Chapter 1

INTRODUCTION

Soil being a vital natural resource on whose proper use depends the life supporting systems of a country and the socioeconomic development of its people. Soils provide food, fodder, fibre and fuel for meeting the basic human and animal needs. With the ever increasing growth in human and animal population, the demand on soil for more food and fodder production is on the increase. 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, agro-climatic 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. The soils have been degrading at an estimated rate of one million hectares per year and ground water levels have been receding at an alarming rate resulting in decline in the ground water resource. Further, land degradation has emerged as a serious problem which has already affected about 38 lakh ha of cultivated area in the State. Soil erosion alone has degraded about 35 lakh ha. Almost all the uncultivated areas are facing various degrees of degradation, particularly soil erosion; salinity and alkalinity has emerged as a major problem in more than 3.5 lakh ha in the irrigated areas of the State. Nutrient depletion and declining factor productivity is common in both rainfed and irrigated areas. The degradation is continuing at an alarming rate and there appears to be no systematic effort among the stakeholders to contain this process. In recent times, an aberration of weather due to climate change phenomenon has added another dimension leading to unpredictable situation 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 uses 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 has already been made to upscale the soil resource information from 1:250000 and 1:50000 scale to the LEU map in Goa and in some other states. Here, an attempt will be made later to uplink the LRI data generated under Sujala-III Project to the Landscape Ecological Units (LEUs) map.

The land resource inventory aims to provide site specific database for Kanekal-3 microwatershed in Yadgir Taluk and Yadgir District, Karnataka State for the Karnataka Watershed Development Department. The database was generated by using cadastral map of the village as a base along with high resolution IRS LISS IV and Cartosat-1 merged satellite imagery. Later, an attempt will be made to uplink this LRI data generated at 1:7920 scale under Sujala-III Project to the proposed Landscape Ecological Units (LEUs) map.

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

GEOGRAPHICAL SETTING

2.1 Location and Extent

The Kanekal-3 micro-watershed is located in the northeastern part of Karnataka in Yadgir Taluk, Yadgir District, Karnataka State (Fig.2.1). It comprises parts of Gudalagunta, Sambara, Kanekal and Balacheda villages. It lies between 16^0 35' and 16^0 36' north latitudes and 77^0 18' and 77^0 20' east longitudes and covers an area of 547 ha. It is about 35 km from Yadgir town and is surrounded by Gudalagunta on the north, Sambara on the northeast and east, Balacheda on the south and Kanekal village on the western side.

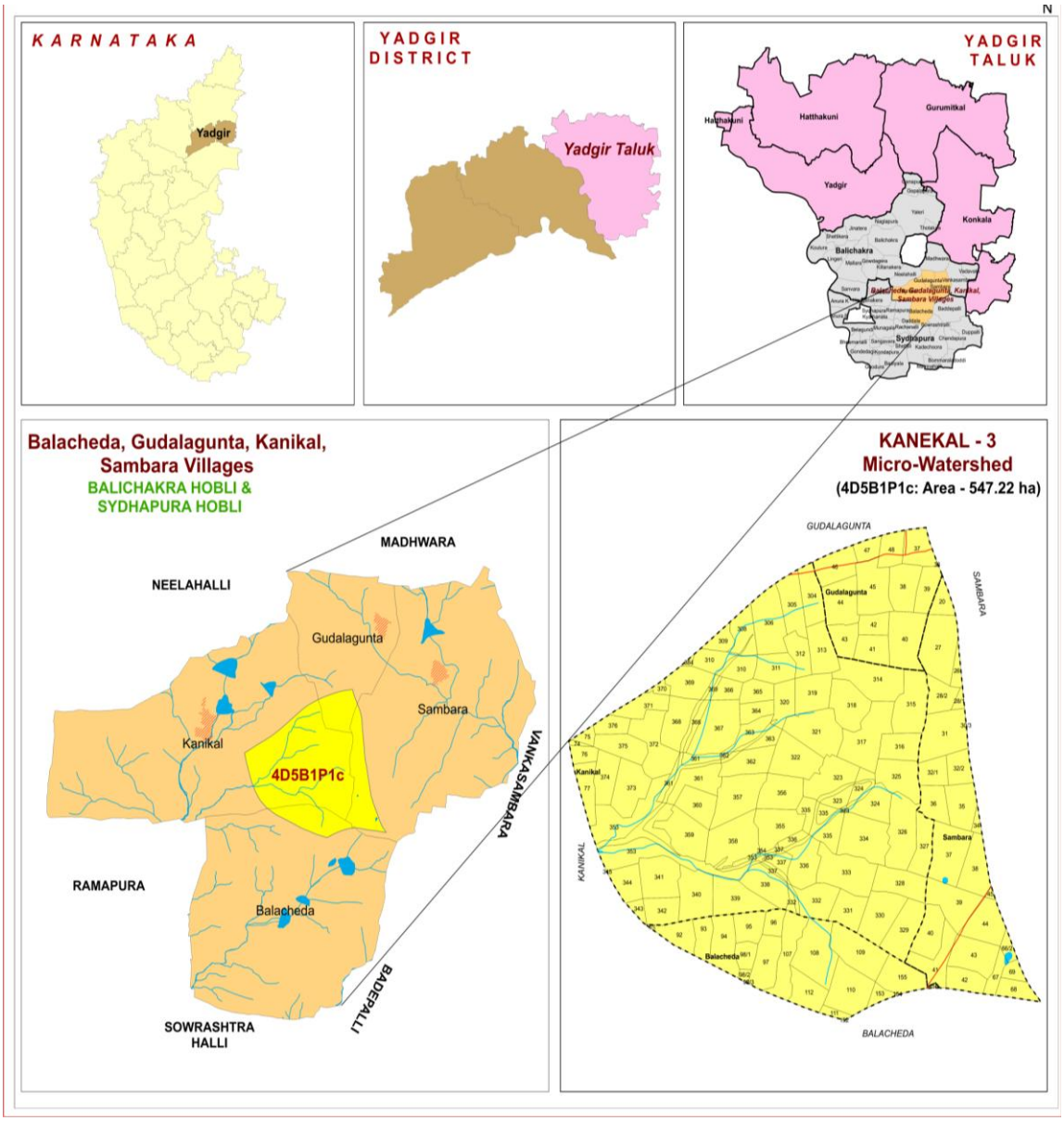


Fig.2.1 Location map of Kanekal-3 Microwatershed

2.2 Geology

Major rock formations observed in the microwatershed are granite gneiss (Figs.2.2). Granite gneisses are essentially pink to gray and are coarse to medium grained. They consist primarily of quartz, feldspar, biotite and hornblende. The gray granite gneisses are highly weathered, fractured and fissured upto a depth of about 10 m. Dolerite dykes and quartz veins are common with variable width and found to occur in the village.

Fig.2.2 Granite and granite gneiss rocks

2.3 Physiography

Physiographically, the area has been identified as granite gneiss landscape based on geology. The area has been further subdivided into five landforms, *viz;* mounds/ridges, summits, side slopes and very gently sloping uplands, plains and valleys based on slope and its relief features. The elevation ranges from 359-376 m above MSL. The mounds and ridges are mostly covered by rock outcrops.

2.4 Drainage

The area is drained by several parallel streams like Bori, Amerja and Kanga which finally join the river Bhima along its course. Though, they are not perennial, during rainy season they carry large quantities of rain water. The microwatershed has only few small tanks which are not capable of storing the water that flows during the rainy season. Due to this, the ground water recharge is very much affected. This is reflected in the failure of many bore wells in the villages. If the available rain water is properly harnessed by constructing new 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 parallel to sub parallel and dendritic.

2.5 Climate

The Yadgir district lies in the northern plains of Karnataka and falls under semiarid tract of the state and is categorized as drought- prone with total annual rainfall of 866 mm (Table 2.1). Of the total rainfall, maximum of 652 mm is received during the south–west monsoon period from June to September, the north-east monsoon from October to early December contributes about 138 mm, and the remaining 76 mm during the rest of the year. The summer season starts during the middle of February and continues up to the first week of June. The period from December to the middle of February is the cold season. December is the coldest month with mean daily maximum and minimum temperatures being 29.5^0C and 10^0C respectively. During peak summer, temperature shoots up to 45^0C. Relative humidity varies from 26% in summer to 62% in winter. Rainfall distribution is shown in Figure 2.3. The average Potential Evapo-Transpiration (PET) is 141 mm and varies from a low of 81 mm in December to 199 mm in the month of May. The PET is always higher than precipitation in all the months except July to end of September. Generally, the Length of crop Growing Period (LGP) is 120-150 days and starts from 1st week of June to 4th week of October.

Table 2.1 Mean Monthly Rainfall, PET, 1/2 PET at Yadgir Taluk

Sl.No.	Months	Rainfall	PET	1/2 PET
1	January	4.30	86.0	43.0
2	February	2.30	125.5	62.7
3	March	15.10	166.0	83.0
4	April	18.50	179.8	89.9
5	May	36.0	198.8	97.9
6	June	118.0	175.1	87.5
7	July	171.80	156.3	78.1
8	August	182.9	150.3	75.1
9	September	179.7	142.0	71.0
10	October	105.3	138.5	69.2
11	November	26.4	97.60	48.6
12	December	6.0	80.90	40.4
Total		**866.3**	**141.4**	

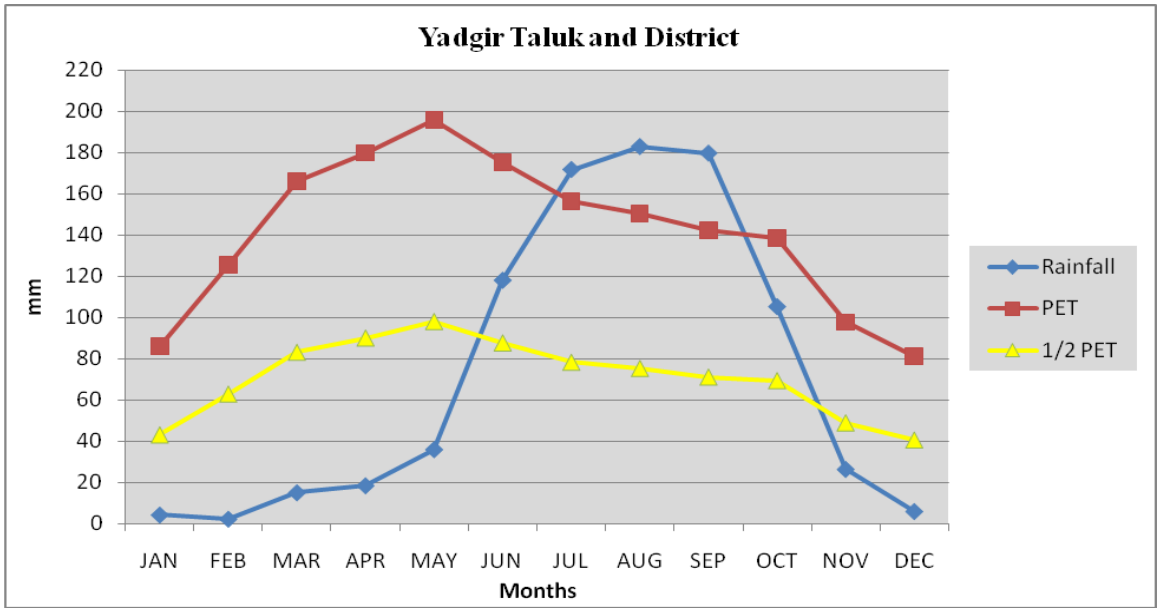


Fig 2.3 Rainfall distribution in Yadgir Taluk

2.6 Natural Vegetation

The natural vegetation is sparse comprising few tree species, shrubs and herbs. The mounds, ridges and boulders occupy very sizeable area which is 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.

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 that eventually result in the heavy siltation of tanks and reservoirs in the microwatershed.

2.7 Land Utilization

About 72 per cent area (Table 2.2) in Yadgir taluk is cultivated at present. An area of about 2 per cent is permanently under pasture, 20 per cent under current fallows and 6 per cent under non-agricultural land and 5 per cent under currently barren. Forests occupy an area of about 7 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, cotton, sunflower, groundnut, mango, pomegranate and and marigold. 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 Kanekal-3 microwatershed is presented in Fig.2.4. The different crops and cropping systems adopted in the microwatershed is presented in the Figures 2.5

and 2.6. Simultaneously, enumeration of wells (bore wells and open wells) and other conservation structures in the microwatershed was made and their location in different survey numbers is marked on the cadastral map. Map showing the location of wells, structures and other water bodies in the Kanekal-3 microwatershed is given in Fig.2.7.

Table 2.2 Land Utilization in Yadgir Taluk

Sl. No.	Agricultural land use	Area (ha)	Per cent
1.	Total geographical area	516088	
2.	Total cultivated area	373617	72.4
3.	Area sown more than once	74081	14.3
4.	Trees and grooves	737	0.14
5.	Forest	33773	6.54
6.	Cultivable wasteland	2385	0.46
7.	Permanent Pasture land	11755	2.28
8.	Barren land	27954	5.41
9.	Non- Agriculture land	29623	5.73
10.	Current Fallows	105212	20.4

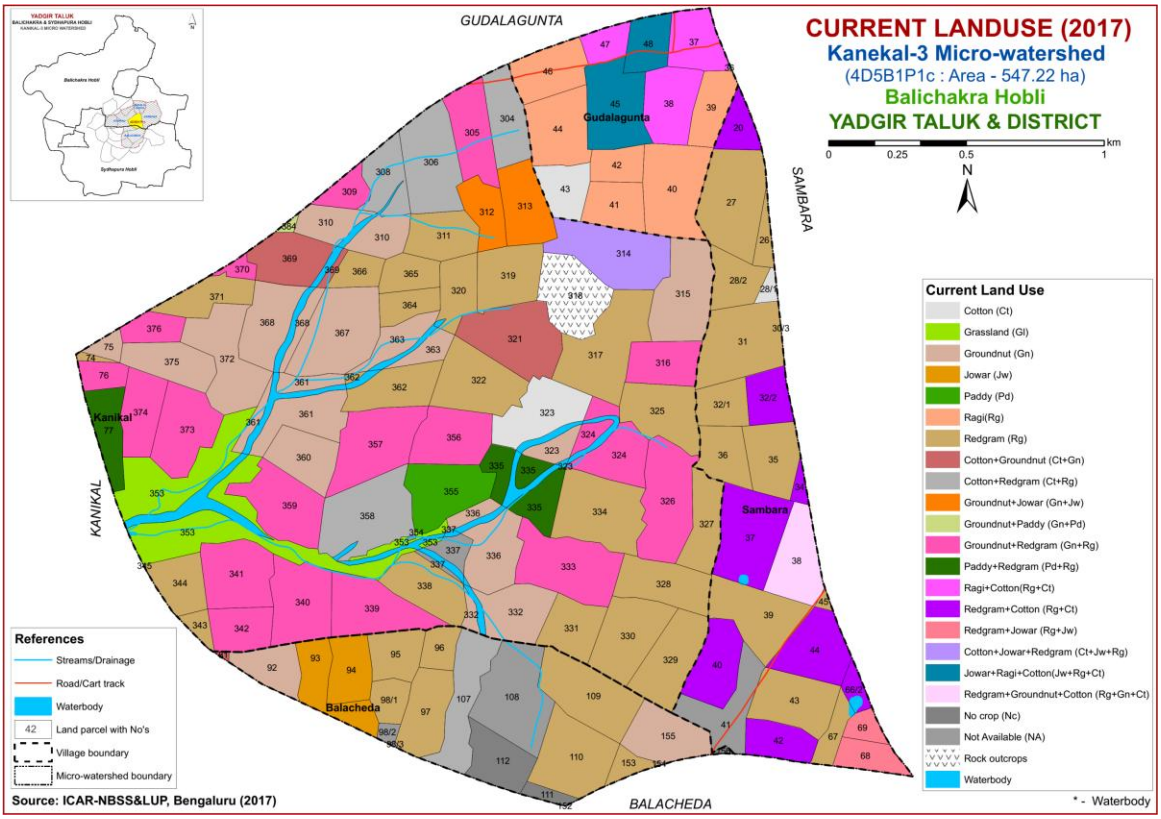


Fig.2.4 Current Land Use map of Kanekal-3 Microwatershed

Fig.2.5.a Different Crops and Cropping Systems in Kanekal-3 Microwatershed

Fig. 2.5.b Different Crops and Cropping Systems in Kanekal-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 Kanekal-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 of the land, 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 area extent and their geographic distribution on the microwatershed cadastral map. The detailed survey at 1:7920 scale was carried out in 547 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 rock types, the 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 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 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 landscape. It was divided into five landforms, *viz;* ridges and mounds, gently and very gently sloping uplands and lowlands based on slope and image characteristics. 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)
G3			Valleys/ lowlands
	G31		Valleys, pink tones
	G32		Valleys gray mixed with pink tones

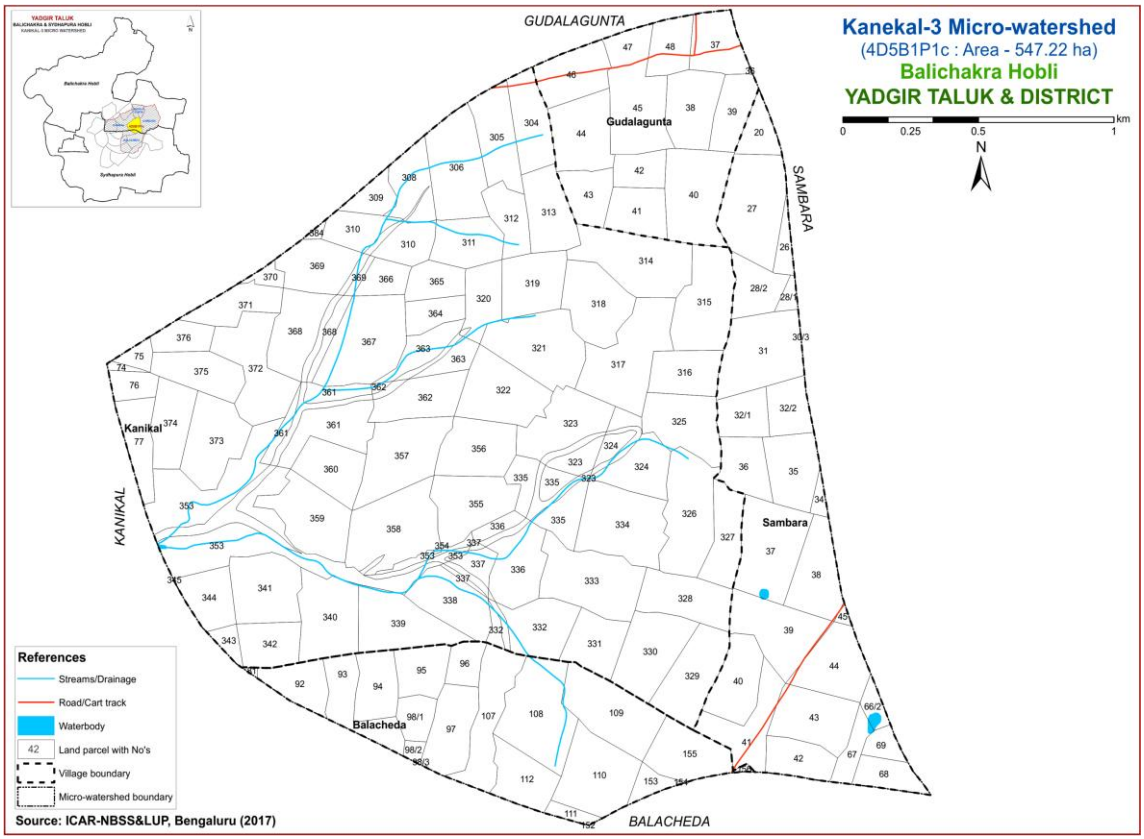


Fig 3.1 Scanned and Digitized Cadastral map of Kanekal-3 Microwatershed

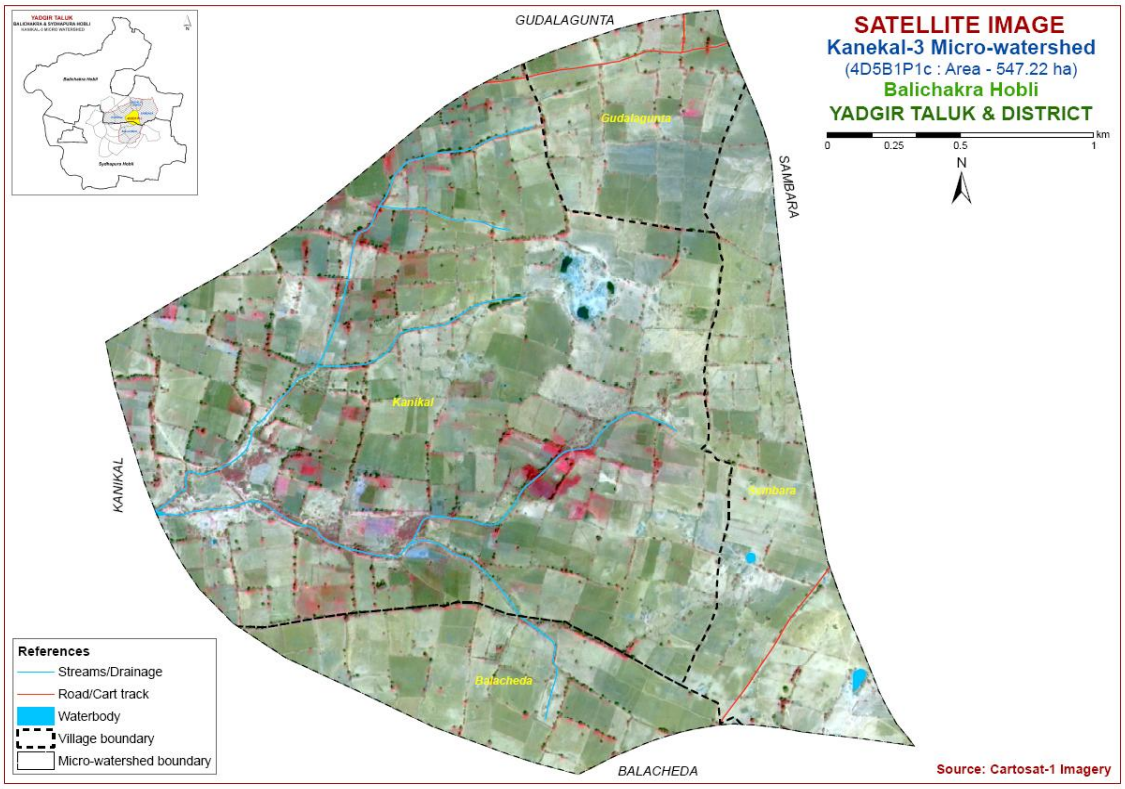


Fig.3.2 Satellite Image of Kanekal-3 Microwatershed

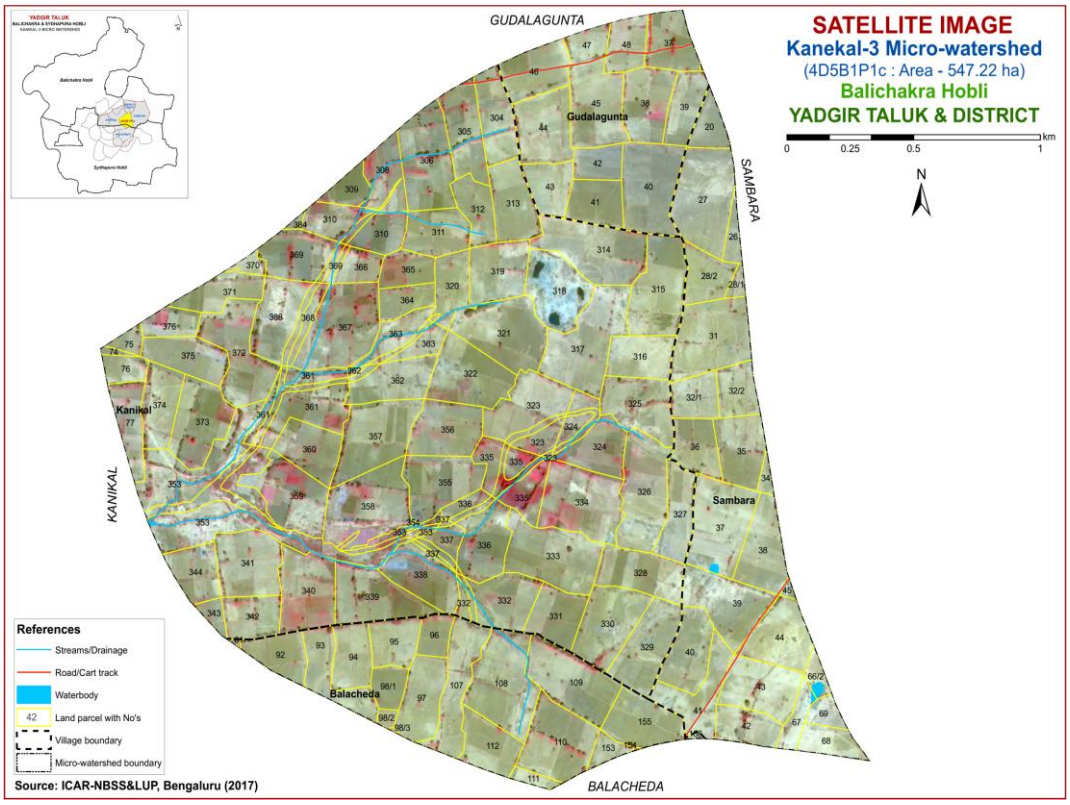


Fig.3.3 Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Kanekal-3 Microwatershed

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, *nalas*, 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 valleys 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)

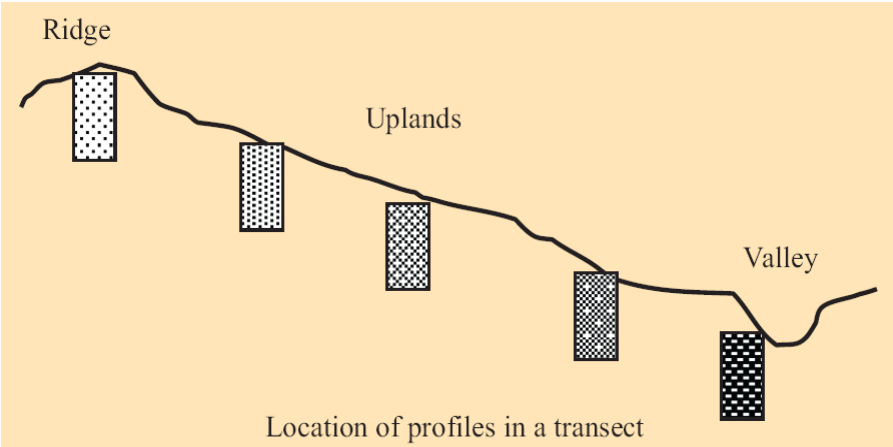


Fig: 3.4. Location of profiles in a transect

In the selected transect, soil profiles were located (Fig. 3.4) 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.

Based on the soil-site 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, 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 soil series are given in Table 3.1. Based on the above characteristics, 13 soil series were identified in the Kanekal-3 microwatershed.

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

SOILS OF GRANITE AND GRANITE GNEISS LANDSCAPE							
Sl. No.	**Soil Series**	**Depth (cm)**	**Colour(moist)**	**Texture**	**Gravel (%)**	**Horizon sequence**	**Calcar-eousness**
1	Baddeppalli (BDP)	<25	7.5YR 3/2,3/4	scl	<15	Ap-AC	es
2	Badiyala (BDL)	25-50	7.5YR2.5/3,2.5/2,3/3 10YR3/4,4/3	sl-scl	<15	Ap-Bw	e
3	Vanakanahalli (VNK)	25-50	2.5YR 3/4	sc	<15	Ap-Bt-Cr	-
4	Sambara (SBR)	50-75	10YR 7/1 7.5YR 7/4	ls	<15	Ap-AC	-
5	Duppali (DPL)	50-75	7.5YR 3/3, 5YR 3/4	sc	<15	Ap-Bt	-
6	Yalleri (YLR)	50-75	2.5YR 3/4,4/4 5YR 3/4, 7.5YR 4/4	c	15-35	Ap-Bt	-
7	Balichakra (BLC)	75-100	2.5YR 5/3,2.5/4 5YR 4/3,3/3	scl-sc	<15	Ap-Bt	e
8	Poglapur (PGP)	75-100	5YR 4/6,3/3 7.5YR 4/4	sc	<15	Ap-Bt	-
9	Yadgir (YDR)	100-150	10YR 4/3,4/4 2.5Y 4/3,5/3	ls-sl-scl	<15	Ap-AC	-
10	Gondedagi (GDG)	100-150	5YR 4/2, 7.5YR 4/2	scl	<15	Ap-Bt	e
11	Belagundi (BGD)	100-150	10YR 5/4,4/4 7.5YR 4/4	c	<15	Ap-Bw	-
12	Bhimanahalli (BMN)	>150	10YR 3/1	c	<15	Ap-Bw	es
13	Bomraldoddi (BMD)	>150	5YR 3/3,4/1,4/3,4/6	scl-sc	<15	Ap-Bt	e

3.4 Soil Mapping

The area under each soil series was further separated into 18 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 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 13 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 soil phases mapped in the microwatershed. Each mapping unit (soil phase) delineated on the map has similar soil and site characteristics. In other words, all the farms or survey numbers included in one phase will have similar management needs and have to be treated accordingly.

3.5 Land Use Classes (LUC's)

The 18 soil phases identified and mapped in the microwatershed were grouped into seven Land Use Classes (LUC's) for the purpose of preparing a Proposed Crop Plan for sustained development of the microwatershed. The database (soil phases) generated under LRI was utilized for identifying Land Use Classes (LUC's) based on the management needs. One or more than one soil site characteristic having influence on the management have been chosen for identification and delineation of LUCs. For Kanekal-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.

3.6 Laboratory Characterization

Soil samples for each soil series were collected from representative master profiles for laboratory characterization by following the methods outlined in the Laboratory Manual (Sarma *et al*, 1987). Surface soil samples collected in the year 2017 from farmer's fields (53 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 using Kriging method, soil fertility maps for the 11 elements including pH and EC were generated for the microwatershed.

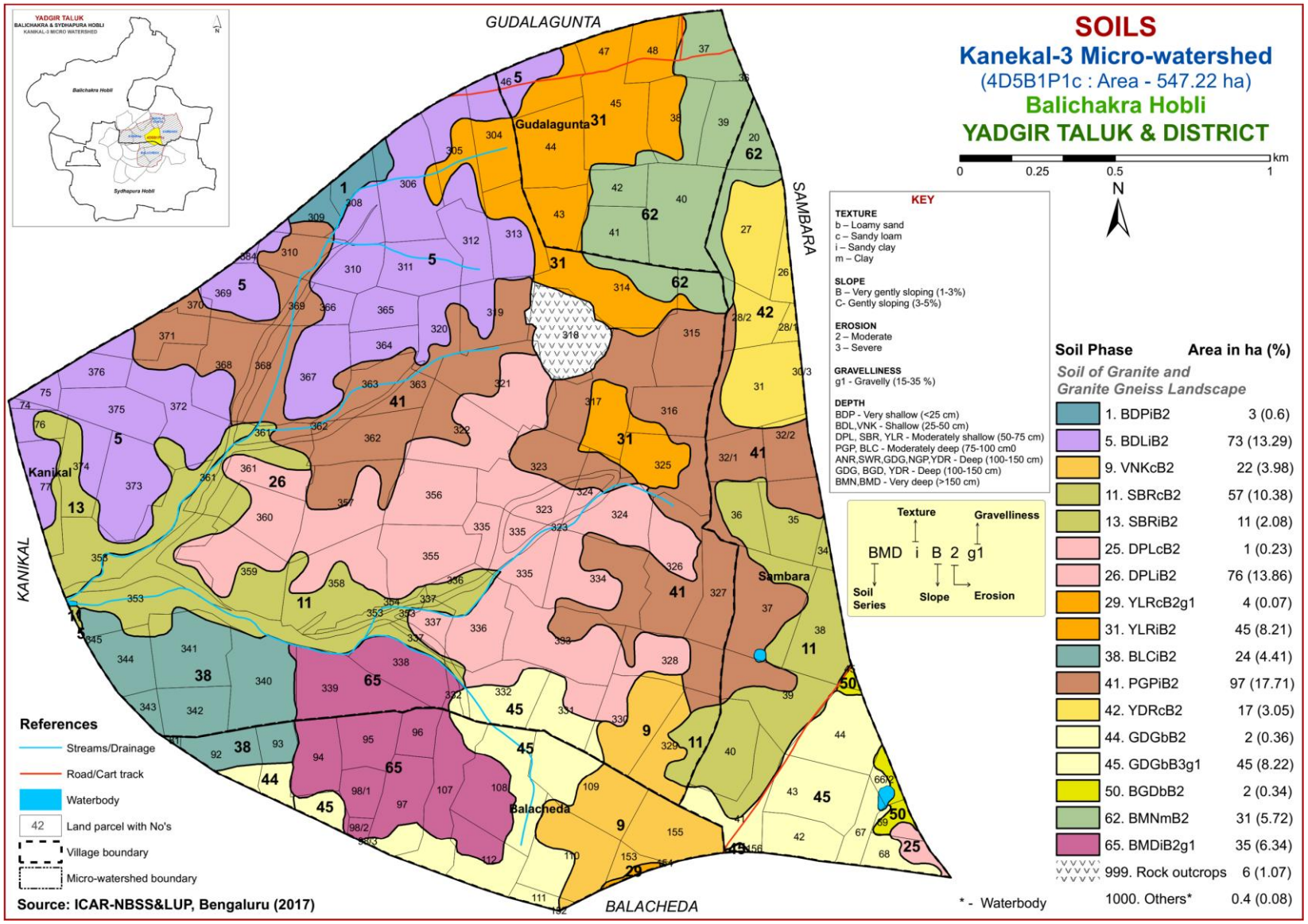


Fig 3.4 Soil phase or management units map of Kanekal-3 Microwatershe

Table 3.2 Soil Map Unit description of Kanekal-3 microwatershed

Soil Map unit No.	Soil Series	Soil Map Unit	Mapping Unit Description	Area in ha (%)
Soil of Granite and Granite Gneiss Landscape				
	BDP	Baddeppalli soils are very shallow (<25 cm), well drained, have dark brown to dark reddish brown, calcareous sandy clay loam red soils occurring on very gently sloping uplands under cultivation		**3 (0.6)**
1		BDPiB2	Sandy clay surface, slope 1-3%, moderate erosion	3 (0.6)
	BDL	Badiyala soils are shallow (25-50 cm), well drained, have dark brown to very dark brown and dark yellowish brown, slightly calcareous sandy loam to sandy clay loam soils occurring on very gently to gently sloping uplands under cultivation		**73 (13.29)**
5		BDLiB2	Sandy clay surface, slope 1-3%, moderate erosion	73 (13.29)
	VNK	Vanakanahalli soils are shallow (25-50 cm), well drained, have dark reddish brown, sandy clay red soils occurring on very gently sloping uplands under cultivation		**22 (3.98)**
9		VNKcB2	Sandy loam surface, slope 1-3%, moderate erosion	22 (3.98)
	SBR	Sambra soils are moderately shallow (50-75 cm), somewhat excessively drained, have light gray to pink, loamy sand soils occurring on very gently to gently sloping uplands under cultivation		**68 (12.46)**
11		SBRcB2	Sandy loam surface, slope 1-3%, moderate erosion	57 (10.38)
13		SBRiB2	Sandy clay surface, slope 1-3%, moderate erosion	11 (2.08)
	DPL	Duppali soils are moderately shallow (50-75 cm), well drained, have dark brown to dark reddish brown, sandy clay red soils occurring on very gently sloping uplands under cultivation		**77 (14.09)**
25		DPLcB2	Sandy loam surface, slope 1-3%, moderate erosion	1 (0.23)
26		DPLiB2	Sandy clay surface, slope 1-3%, moderate erosion	76 (13.86)
	YLR	Yalleri soils are moderately shallow (50-75 cm), well drained, have brown to reddish brown and dark reddish brown, gravelly clay red soils occurring on very gently to gently sloping uplands under cultivation		**45 (8.28)**
29		YLRcB2g1	Sandy loam surface, slope 1-3%, moderate erosion, gravelly (15-35%)	0.4 (0.07)
31	31	YLRiB2	Sandy clay surface, slope 1-3%, moderate erosion	45 (8.21)
	BLC	Balichakra soils are moderately deep (75-100 cm), moderately well drained, have reddish brown to dark reddish brown, slightly calcareous sandy clay loam to sandy clay red soils occurring on very gently sloping uplands under cultivation		**24 (4.41)**
38		BLCiB2	Sandy clay surface, slope 1-3%, moderate erosion	24 (4.41)
	PGP	Poglapur soils are moderately deep (75-100 cm), well drained, have brown to dark reddish brown and yellowish red, sandy clay red soils occurring on very gently sloping uplands under cultivation		**97 (17.71)**

41		PGPiB2	Sandy clay surface, slope 1-3%, moderate erosion	97 (17.71)
	YDR	Yadgir soils are deep (100-150 cm), well drained, have brown to dark yellowish brown and olive brown, loamy sand to sandy clay loam soils occurring on very gently sloping uplands under cultivation		**17 (3.05)**
42		YDRcB2	Sandy loam surface, slope 1-3%, moderate erosion	17 (3.05)
	GDG	Gondedagi soils are deep (100-150 cm), well drained, have brown to dark reddish gray, slightly calcareous sandy clay loam soils occurring on very gently sloping uplands under cultivation		**47 (8.58)**
44		GDGbB2	Loamy sand surface, slope 1-3%, moderate erosion	2 (0.36)
45		GDGbB3g1	Loamy sand surface, slope 1-3%, severe erosion, gravelly (15-35%)	45 (8.22)
	BGD	Belagundi soils are deep (100-150 cm), moderately well drained, have brown to dark yellowish brown, cracking clay soils occurring on very gently sloping uplands under cultivation		**2 (0.36)**
50		BGDbB2	Loamy sand surface, slope 1-3%, moderate erosion	2 (0.36)
	BMN	Bhimanahalli soils are very deep (>150 cm), moderately well drained, have very dark gray, calcareous cracking clay black soils occurring on very gently sloping uplands under cultivation		**31 (5.72)**
62		BMNmB2	Clay surface, slope 1-3%, moderate erosion	31 (5.72)
	BMD	Bomraldoddi soils are very deep (>150 cm), well drained, have dark gray, reddish brown to dark reddish brown and yellowish red slightly calcareous sandy clay loam to sandy clay red soils occurring on very gently sloping uplands under cultivation		**35 (6.34)**
65		BMDiB2g1	Sandy clay surface, slope 1-3%, moderate erosion, gravelly (15-35%)	35 (6.34)
999		Rock outcrops	Rock lands, both massive and bouldery	**6 (1.07)**
1000		Others (Habitation and Water bodies)		**0.4 (0.08)**

Chapter 4

THE SOILS

Detailed information pertaining to the nature, extent and distribution of different kinds of soils occurring in Kanekal-3 microwatershed is provided in this chapter. The microwatershed area has been identified as granite gneiss landscape. In all, 13 soil series were identified in this landscape. Soil formation is the result of the combined effect of environmental and terrain factors that are reflected in soil morphology. In the granite gneiss landscape, it is by parent material, relief, time and climate. A brief description of each of the 13 soil series identified followed by 18 soil phases (management units) mapped under each series are furnished below. The soils in any one map unit differ from place to place in their depth, texture, slope, gravelliness, erosion or any other site characteristics that affect management. The soil phase map can be used for identifying the suitability of areas for growing specific crops or for other alternative uses and also for deciding the type of conservation structures needed. The detailed information on soil and site-characteristics like soil depth, surface soil texture, slope, erosion, gravelliness, AWC, LCC etc, with respect to each of the soil phase identified is given village/survey number wise for the microwatershed in Appendix-I.

4.1 Soils of Granite and Granite Gneiss Landscape

In this landscape, 13 soil series are identified and mapped. Poglapur (PGP) series occupies a maximum area of 97 ha (18%) followed by Duppali (DPL) 77 ha (14%), Badiyala (BDL) 73 ha (13%), Gondedagi (GDG) 47 ha (9%), Yalleri (YLR) 45 ha (8%) and other soil series occupy minor area of the microwatershed. The brief description of these series along with the soil phases identified and mapped is given below.

4.1.1 Baddeppalli (BDP) Series: Baddeppalli soils are very shallow (<25cm), well drained, have dark brown to dark reddish brown, calcareous sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the soil is less than 25 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 and chroma 2 to 4. The texture varies from sandy clay loam to sandy clay. The available water capacity is very low (<50 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Baddeppalli (BDP) Series

4.1.2 Badiyala (BDL) Series: Badiyala soils are shallow (25-50 cm), well drained, have very dark brown, dark yellow brown and dark brown, slightly calcareous sandy loam to sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 28 to 50 cm. The thickness of A horizon ranges from 4 to 12 cm. Its colour is in 10YR hue with value 3 to 4 and chroma 3 to 4. The texture is loamy sand, sandy clay loam and sandy clay. The thickness of B horizon ranges from 27 to 45 cm. Its colour is in 10 YR and 7.5 YR hue with value 2 to 4 and chroma 3 to 4. Its texture is sandy loam to sandy clay loam and sandy clay and is slightly calcareous. The available water capacity is very low (<50mm/m). Only one phase was identified and mapped.


Landscape and Soil Profile characteristics of Badiyala (BDL) Series

4.1.3 Vanakanahalli (VNK) Series: Vanakanahalli soils are shallow (25-50 cm), well drained, have dark reddish brown sandy clay red soils. They have developed from weathered granite gneiss and occur on very gently sloping uplands under cultivation.

The thickness of the solum ranges from 25 to 49 cm. The thickness of A horizon ranges from 7 to 16 cm. Its colour is in 2.5 YR and 5 YR with value 3 and chroma 2 to 4. The texture is sandy loam to sandy clay loam and sandy clay. The thickness of B horizon ranges from 20 to 40 cm. Its colour is in 2.5 YR and 5 YR hue with value 3 to 4 and chroma 3 to 4. Its texture varies from sandy clay loam to sandy clay. The available water capacity is very low (<50 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Vanakanahalli (VNK) Series

4.1.4 Sambara (SBR) Series: Sambara soils are moderately shallow (50-75 cm), moderately well drained, have light grey to reddish yellow, loamy sand soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the soil ranges from 52-75 cm. Thickness of A horizon ranges from 8 to 23 cm. Its colour is in hue 10 YR and 7.5 YR with value 3 and chroma 1 to 4. The texture varies from loamy sand to sandy loam. The thickness of subsurface horizons ranges from 41 to 66 cm. Its colour is in 10 YR and 7.5 YR hue with value 3 to 5 and chroma 1 to 4. The texture is loamy sand. The available water capacity is very low (<50 mm/m). Two phases were identified and mapped.


Landscape and Soil Profile characteristics of Sambara (SBR) Series

4.1.5 Duppali (DPL) Series: Duppali soils are moderately shallow (50-75 cm), well drained, have dark brown to dark reddish brown, sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 51-75 cm. Thickness of A horizon ranges from 8 to 15 cm. Its colour is in hue 10 YR with value 4 and chroma 3 to 6. The texture varies from loamy sand to sandy clay. The thickness of B horizon ranges from 55 to 65 cm. Its colour is in 7.5 YR and 5 YR hue with value 3 to 4 and chroma 2 to 4. The texture is sandy clay. The available water capacity is low (51-100 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Duppali (DPL) Series

4.1.6 Yalleri (YLR) Series: Yalleri soils are moderately shallow (50-75 cm), well drained, have very dark reddish brown to dark brown gravelly clay red soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 50 to 74 cm. The thickness of A horizon ranges from 10 to 13 cm. Its colour is in 7.5 YR and 5 YR hue with value and chroma 2 to 4. The texture is sandy loam, loamy sand, and sandy clay loam. The thickness of B horizon ranges from 45 to 64 cm. Its colour is in 10 YR, 7.5 YR and 5 YR hue with value 2 to 4 and chroma 2 to 4. Its texture is clay with gravel content of 15-35 per cent. The available water capacity is low (51-100 mm/m). Two phases were identified and mapped.

Landscape and Soil Profile characteristics of Yalleri (YLR) Series

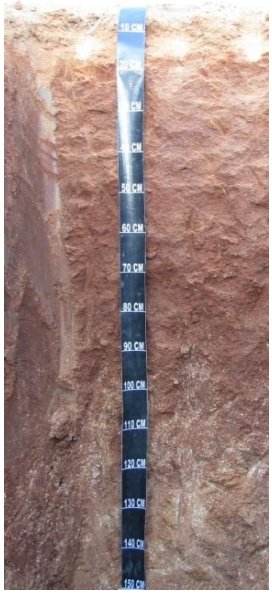
4.1.7 Balichakra (BLC) Series: Balichakra soils are moderately deep (75-100 cm), well drained, have dark reddish brown to reddish brown, slightly calcareous sandy clay loam to sandy clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 80 to 100 cm. The thickness of A horizon ranges from 10 to 16 cm. Its colour is in hue 5 YR with value and chroma of 3 to 4. Its texture varies from sandy clay loam and sandy clay. The thickness of B horizon ranges from 70 to 88 cm. Its colour is in hue 2.5 YR and 5 YR with value 3 to 5 and chroma 3 to 4. Its texture is sandy clay loam to sandy clay and is slightly calcareous. The available water capacity is medium (101-150 mm/m). Only one phase was identified and mapped.


Landscape and Soil Profile characteristics of Balichakra (BLC) Series

4.1.8 Poglapur (PGP) Series: Poglapur soils are moderately deep (75-100 cm), well drained, have dark brown to dark reddish brown and yellowish red sandy clay red soils. They have developed from granite gneiss and occur on very gently sloping uplands under cultivation.

The thickness of the solum ranges from 78 to 100 cm. The thickness of A horizon ranges from 8 to 17 cm. Its colour is in 7.5 YR hue with value 3 and chroma 3 to 4. Its texture varies from loamy sand to sandy clay loam and sandy clay. The thickness of B horizon ranges from 65 to 92 cm. Its colour is in 2.5 YR, 5 YR and 7.5 YR hue with value 2 to 4 and chroma 2 to 4. Its texture is sandy clay to clay. The available water capacity is medium (101-150 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Poglapur (PGP) Series

4.1.9 Yadgir (YDR) Series: Yadgir soils are deep (100-150 cm), well drained, have very dark yellowish brown to light olive brown, loamy sand to sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the soil ranges from 105 to 145 cm. The thickness of A horizon ranges from 6 to 10 cm. Its colour is in 10 YR hue with value 4 and chroma 3. The texture is loamy sand. The thickness of subsurface horizons ranges from 95 to 130 cm. Its colour is in 10 YR and 2.5 Y hue with value 4 to 5 and chroma 3 to 4. Texture varies from loamy sand to sandy loam and sandy clay loam. The available water capacity is low (51-100 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Yadgir (YDR) Series

4.1.10 Gondedagi (GDG) Series: Gondedagi soils are deep (100-150 cm), well drained, have dark reddish gray to dark brown, slightly calcareous sandy clay loam soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 105 to 148 cm. The thickness of A horizon ranges from 9 to 17 cm. Its colour is in 7.5 YR and 5 YR hue with value and chroma 3 to 4. The texture ranges from sandy loam to sandy clay. The thickness of B horizon ranges from 108 to 135 cm. Its colour is in 5 YR and 7.5 YR hue with value 2 to 4 and chroma 2 to 4. The texture is sandy clay loam and is slightly calcareous. The available water capacity is medium (101-150 mm/m). Two phases were identified and mapped.


Landscape and Soil Profile characteristics of Gondedagi (GDG) Series

4.1.11 Belagundi (BGD) Series: Belagundi soils are deep (100-150 cm), moderately well drained, have dark yellowish brown to yellowish brown and dark brown cracking clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum ranges from 100 to 145 cm. The thickness of A horizon ranges from 5 to 12 cm. Its colour is in 10 YR and 5 YR hue with value 5 and chroma 2 to 4. The texture varies from sandy to loamy sand. The thickness of B horizon ranges from 95 to 135 cm. Its colour is in 10 YR and 7.5 YR hue with value 4 to 5 and chroma 4. Texture is clay. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Belagundi (BGD) Series

4.1.12 Bhimanahalli (BMN) Series: Bhimanahalli soils are very deep (>150 cm), moderately well drained, very dark gray calcareous cracking clay soils. They are developed from weathered granite gneiss and occur on very gently to gently sloping uplands under cultivation.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 6 to 13 cm. Its colour is in 10 YR hue with value 3 to 4 and chroma 1 to 2 with clay texture. The thickness of B horizon ranges from 163 to 176 cm. Its colour is in 10 YR hue with value 2 to 4 and chroma 1. Its texture is clay and is calcareous. The available water capacity is very high (>200 mm/m). Only one phase was identified and mapped.

Landscape and Soil Profile characteristics of Bhimanahalli (BMN) Series

4.1.13 Bomraldoddi (BMD) Series: Bomraldoddi soils are very deep (>150 cm), well drained, have dark reddish brown to dark grey and reddish brown to dark brown and yellowish red, slightly calcareous sandy clay loam to sandy clay soils. They are developed from weathered granite gneiss and occur on nearly level to very gently sloping uplands under cultivation.

The thickness of the solum is more than 150 cm. The thickness of A horizon ranges from 11 to 17 cm. Its colour is in 5 YR hue with value 3 to 4 and chroma 1 to 5. Texture varies from sandy loam to sandy clay loam. The thickness of B horizon is more than 150 cm. Its colour is in hue 5 YR with value 4 and chroma 1 to 6. Texture varies from sandy clay loam to sandy clay and is slightly calcareous. The available water capacity is high (151-200 mm/m). Only one phase was identified and mapped.

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, 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: Depth, texture, gravel content, calcareousness.

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 moderate 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/alkali 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 Kanekal-3 microwatershed are grouped under 3 land capability classes and 3 land capability subclasses. Entire area in the microwatershed is suitable for agriculture (Fig. 5.1).

Good cultivable lands (Class II) cover about 73 per cent area and are distributed in the major part of the microwatershed with minor problems of soil and erosion. Moderately good cultivable lands (Class III) cover an area of about 26 per cent and are distributed in all parts of the microwatershed with moderate problems of soil and erosion. Fairly good lands (Class IV) occupy <1 per cent area and is distributed in the northwestern part of the microwatershed with severe limitation of soil.

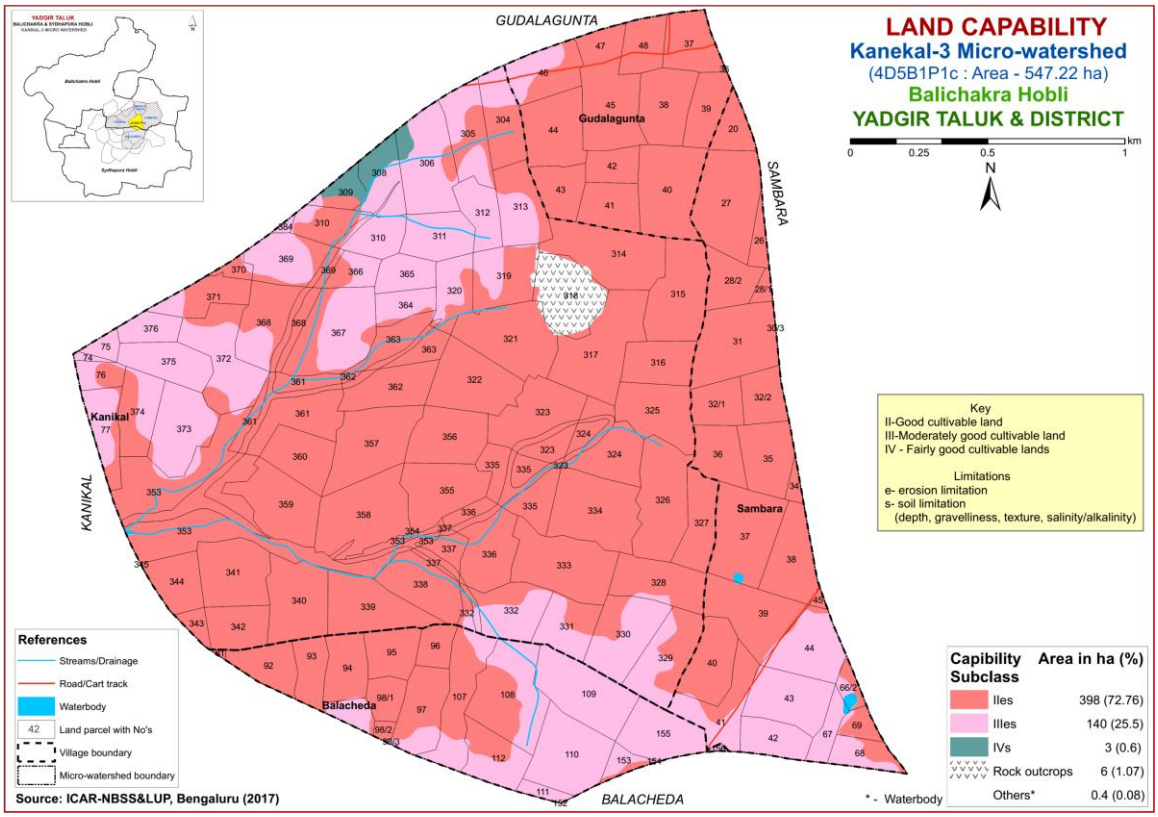


Fig. 5.1 Land Capability map of Kanekal-3 Microwatershed

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. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.2.

Very deep soils (>150 cm) cover an area of 66 ha (12%) and are distributed in the southern and northern part of the microwatershed. Deep soils (100-150 cm) occur in an area of 66 ha (12%) and are distributed in the southeastern, southern and northeastern part of the microwatershed. Moderately deep soils (75-100 cm) occur in an area of about 121 ha (22%) and are distributed in all parts of the microwatershed. Maximum area of about 191 ha (35%) is moderately shallow soils (50-75 cm) and are distributed in the major part of the microwatershed. Shallow soils (25-50 cm) occupy an area of about 95 ha (17%) and are distributed in the northwestern, western and southern part of the microwatershed. Very shallow soils (<25 cm) occur in very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed.

The most productive lands covering about 132 ha (24%) with respect to soil rooting depth where all climatically adapted annual and perennial crops can be grown are deep (100-150 cm) to very deep (>150 cm) occurring in all parts of the microwatershed.

The most problem lands occupying an area of about 98 ha (19%) having very shallow to shallow (<25-50 cm) rooting depth occur in the northwestern, western, northern and southern part of the microwatershed. They 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.

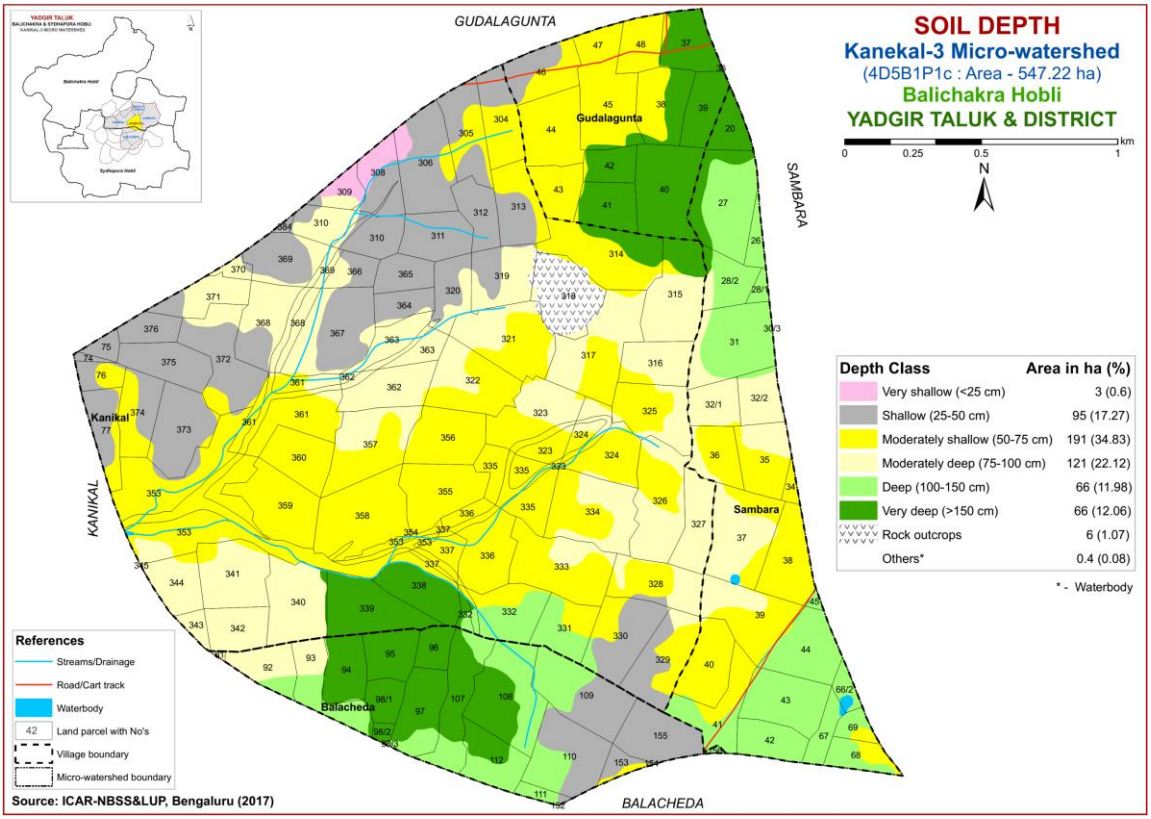


Fig. 5.2 Soil Depth map of Kanekal-3 Microwatershed

5.3 Surface Soil Texture

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

Maximum area of about 395 ha (72%) has clayey soils at the surface and are distributed in all parts of the microwatershed. Loamy soils occupy an area of about 97 ha

(18%) distributed in the northeastern, eastern, central, southeastern and southwestern part of the microwatershed. Sandy soils occupy small area of about 49 ha (9%) and are distributed in the southeastern and southern part of the microwatershed.

The most productive lands (72%) with respect to surface soil texture are the clayey soils that have high potential for soil-water retention and availability, and nutrient retention and availability, but have problems of drainage, infiltration, workability and other physical problems. The other productive lands (18%) are loamy soils which also have high potential for soil-water retention and nutrient availability but have no drainage or other physical problems. The problematic lands are sandy soils (9%) that have less run-off and less soil moisture, less capillary rise and less evaporation losses, but are amenable to good soil tilth and are ideal for root and tuber crops.

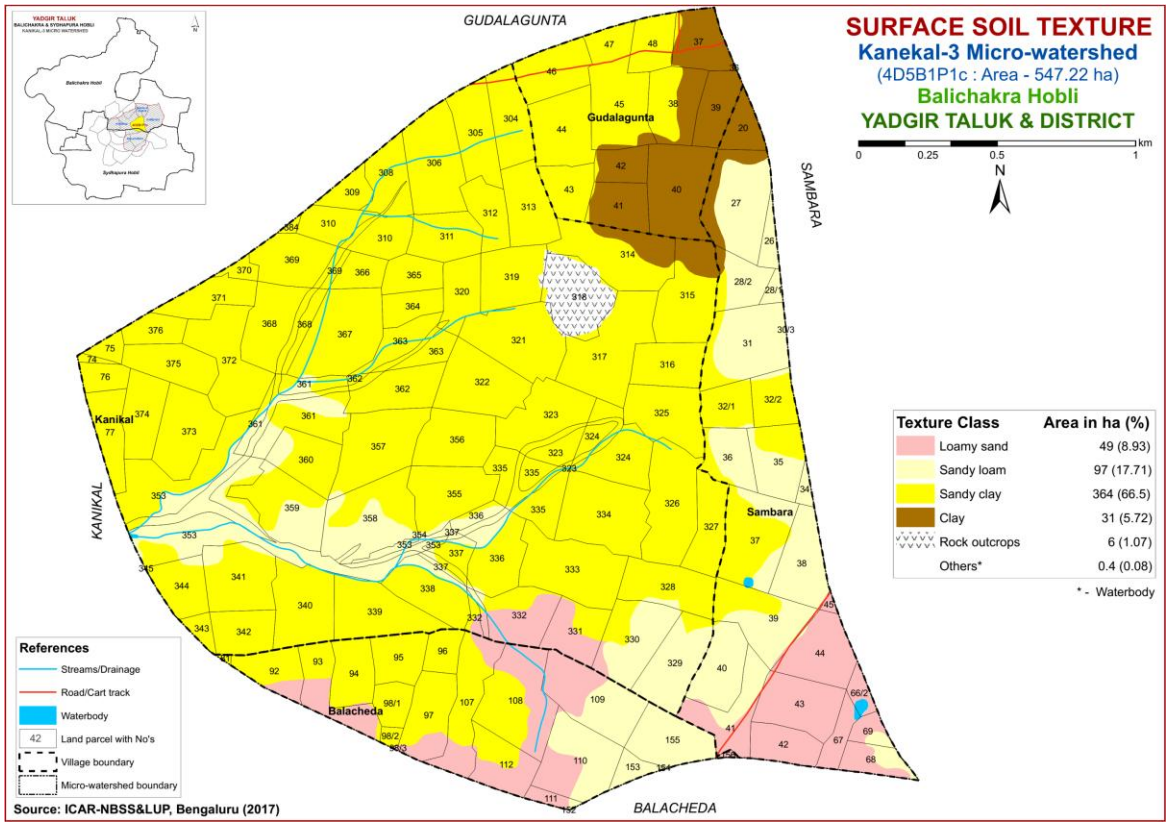


Fig. 5.3 Surface Soil Texture map of Kanekal-3 Microwatershed

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 the soil reduces the volume of soil responsible for moisture and nutrient storage, drainage, infiltration and runoff and hinders plant growth by impeding root growth and seedling emergence, intercultural operations and farm mechanization. The gravelliness classes used in LRI were used to classify the soils and using these classes a gravelliness map was generated. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.4.

An area of 461 ha (84%) has soils that are non gravelly (<15%) and are distributed in all parts of the microwatershed. An area of 80 ha (15%) is gravelly (15-35%) and is distributed in the southern and southwestern part of the microwatershed (Fig.5.4).

The most productive lands with respect to gravelliness are found to be 84 per cent. They are non gravelly (<15%) and have potential for growing all annual and perennial crops.

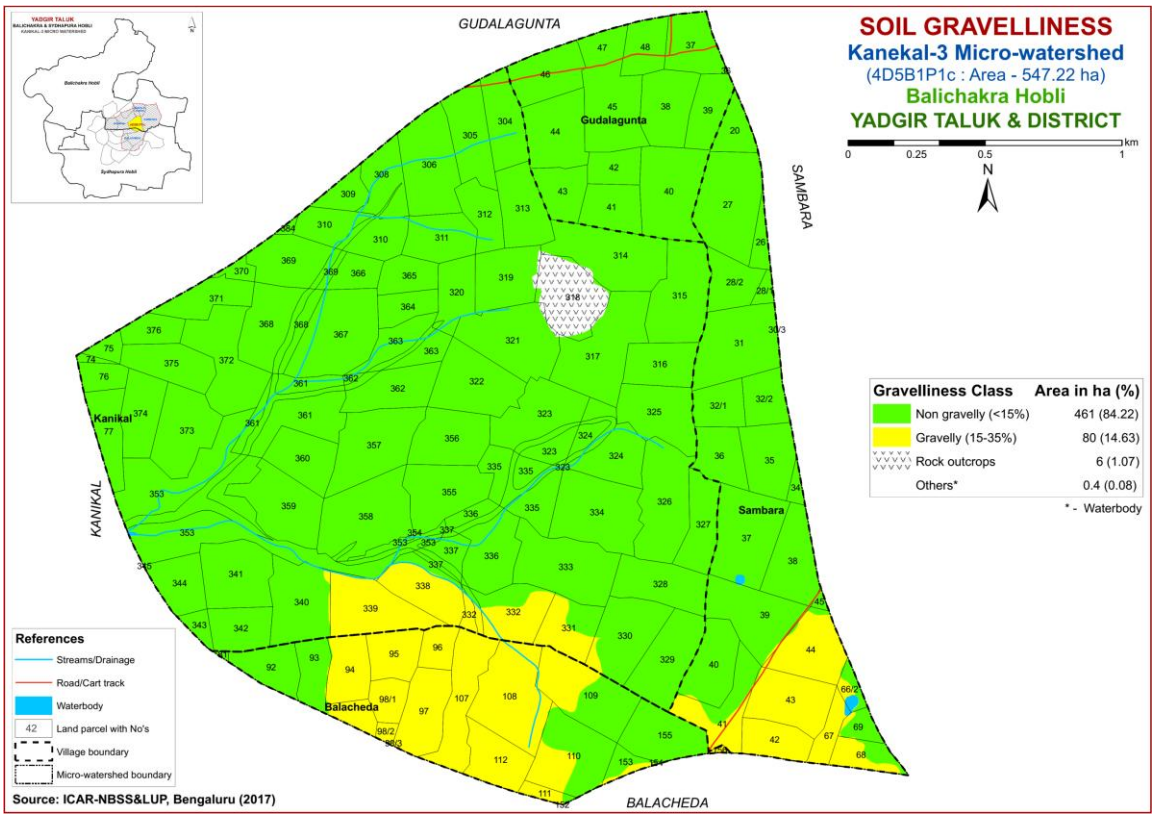


Fig. 5.4 Soil Gravelliness map of Kanekal-3 Microwatershed

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 classes an AWC map was generated. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.5.

An area of about 166 ha (30%) has soils that are very low (<50 mm/m) in available water capacity and are distributed in all parts of the microwatershed. Maximum area of about 260 ha (48%) has soils that are low (51-100 mm/m) in available water capacity and occur in the major part of the microwatershed. An area of 84 ha (15%) in the

microwatershed has soils that are medium (101-150 mm/m) in available water capacity and are distributed in the southern and southwestern part of the microwatershed. The soils that are very high (>200 mm/m) in AWC covering a small area of about 31 ha (6%) are distributed in the northern part of the microwatershed.

An area of about 31 ha (6%) has soils that have very high potential (>200 mm/m) with regard to available water capacity and are distributed in the northern part of the microwatershed. In these areas, if the rainfall is normal and well distributed, all climatically adapted long duration annual and perennial crops can be grown. Maximum area of 426 ha (78%) in the microwatershed has soils that are problematic with regard to available water capacity. Here, only the short or medium duration crops can be grown and the probability of crop failure is very high. These areas are best put to other alternative uses.

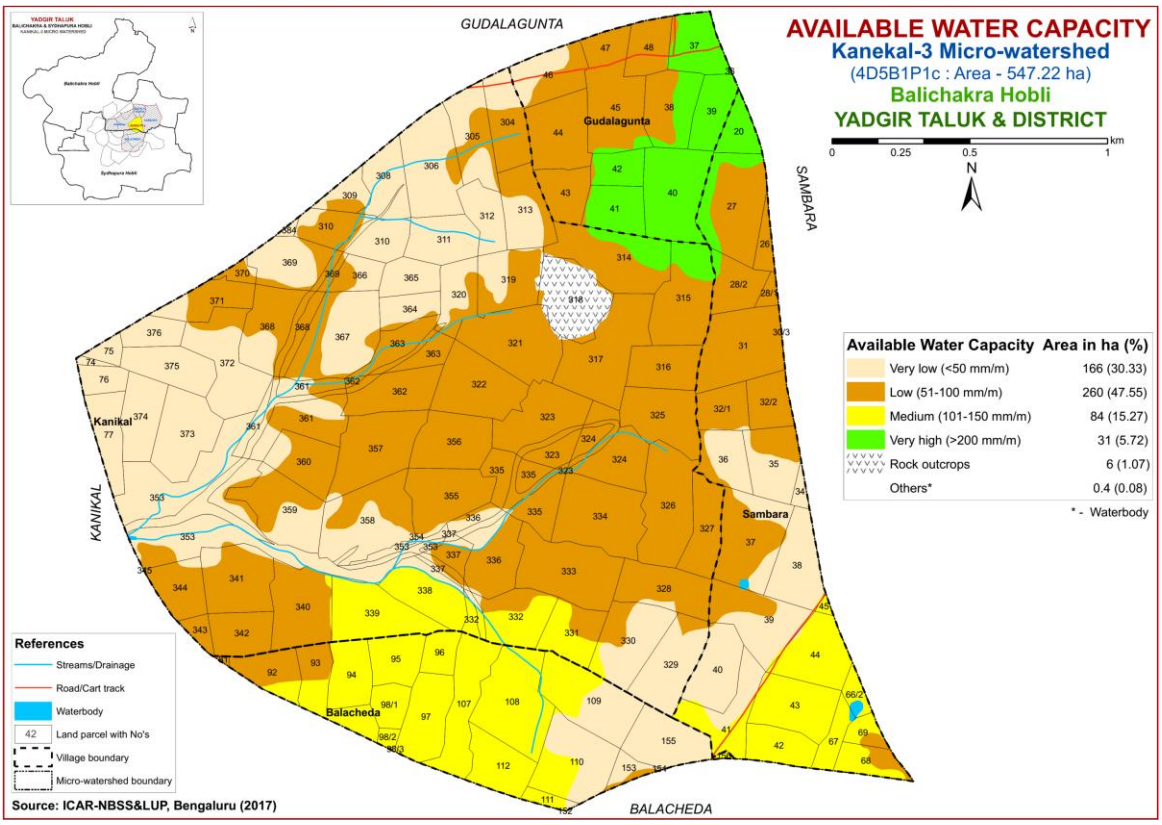


Fig. 5.5 Soil Available Water Capacity map of Kanekal-3 Microwatershed

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. The area extent and their geographical distribution in the microwatershed is shown in Figure 5.6.

Entire area in the microwatershed falls under very gently sloping (1-3%) slope class. It covers an area of about 541 ha (99%) and is distributed in all parts of the microwatershed.

In these areas, all climatically adapted annual and perennial crops can be grown without much soil and water conservation and other land development measures.

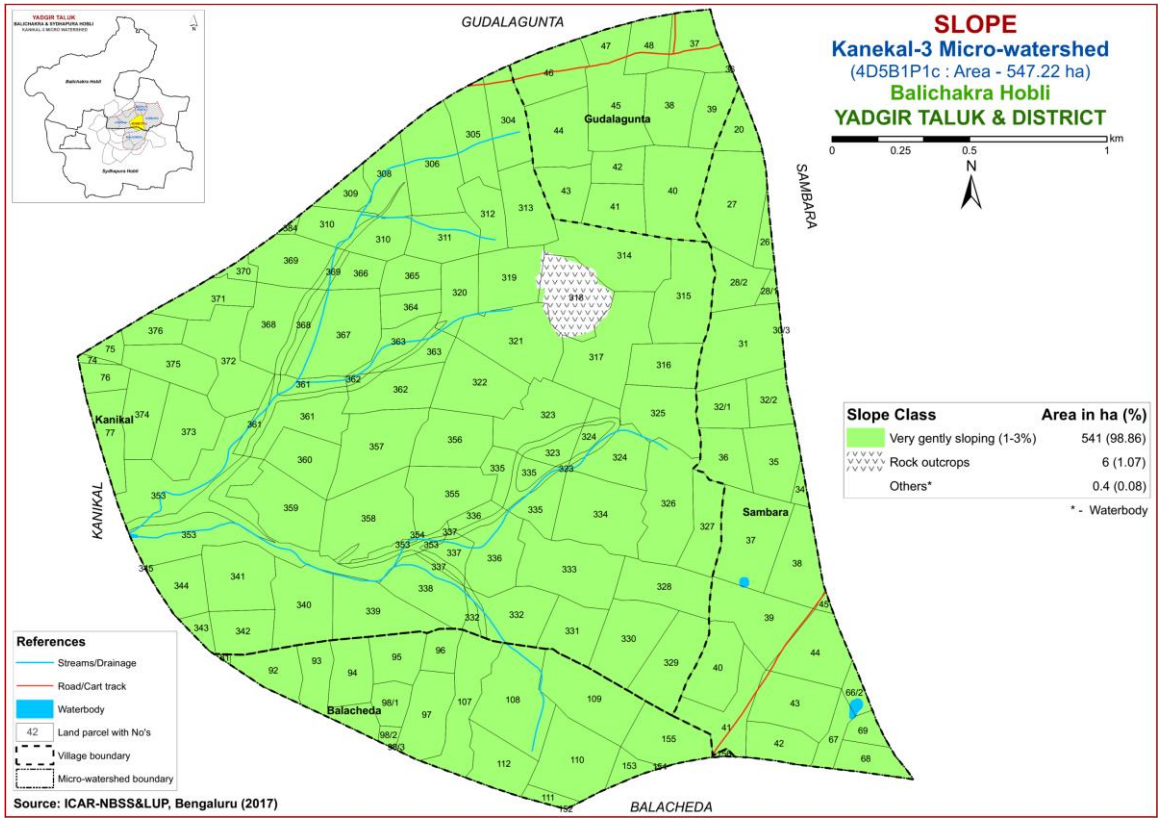


Fig. 5.6 Soil Slope map of Kanekal-3 Microwatershed

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 was generated. The area extent and their spatial distribution in the microwatershed is given in Figure 5.7.

Soils that are moderately eroded (e2 class) cover a major area of about 496 ha (91%) and are distributed in all parts of the microwatershed. Severely eroded (e3 class) soils cover a small area of about 45 ha (8%) and are distributed in the southern and southwestern part of the microwatershed.

Top priority is to be given to 45 ha area where they are severely eroded for taking up soil and water conservation and other land development measures followed by moderately eroded lands that cover about 496 ha.

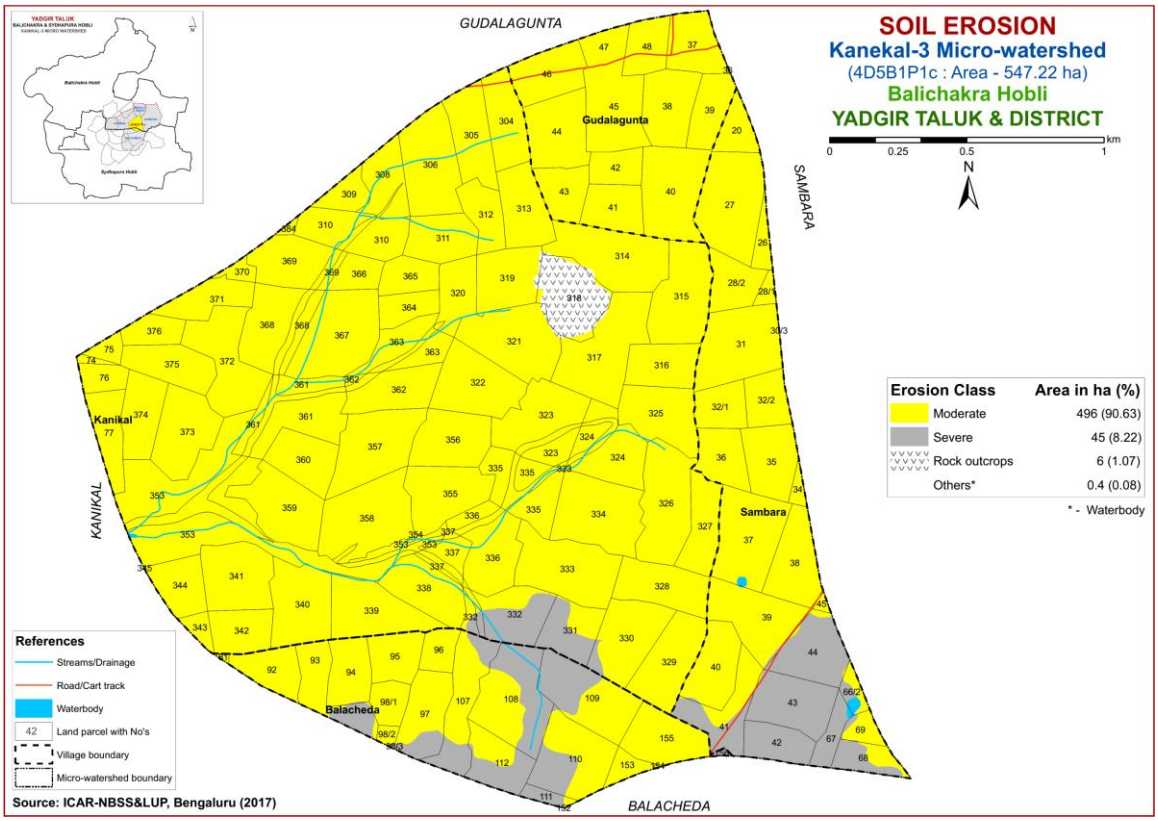


Fig. 5.7 Soil Erosion map of Kanekal-3 Microwatershed

Chapter 6

FERTILITY STATUS

Soil fertility plays an important role in increasing crop yield. The adoption of high yielding varieties that require high amounts of nutrients has resulted in deficiency symptoms in crops and plants due to imbalanced fertilization and poor inherent fertility status. 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 (28 samples) collected from the grid points (one soil sample at every 250 m 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, copper, iron and manganese, and secondary nutrient sulphur.

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

6.1 Soil Reaction (pH)

The soil fertility analysis of the Kanekal-3 microwatershed for soil reaction (pH) showed that an area of 88 ha (16%) is moderately alkaline (pH 7.8-8.4) in reaction and is distributed in the southwestern, central and western part of the microwatershed (Fig.6.1). Slightly alkaline (pH 7.3-7.8) is around 144 ha (26%) area and is distributed in the northeastern, central, western and southern part of the microwatershed. Maximum area of about 306 ha (56%) is neutral (pH 6.5-7.3) and is distributed in the major part of the microwatershed. Slightly acid (pH 6.0-6.5) is around 3 ha (1%) area and is distributed in the southern part of the microwatershed.

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 in the microwatershed are non-saline.

6.3 Organic Carbon

The soil organic carbon content (Fig.6.3) of the soils in the microwatershed is high (>0.75%) in a maximum area of about 369 ha (67%) and are distributed in the major part of the microwatershed. Medium (0.5-0.75%) organic carbon content accounts an area of about 172 ha (31%) and is distributed in the southwestern, southern, central and northeastern part of the microwatershed.

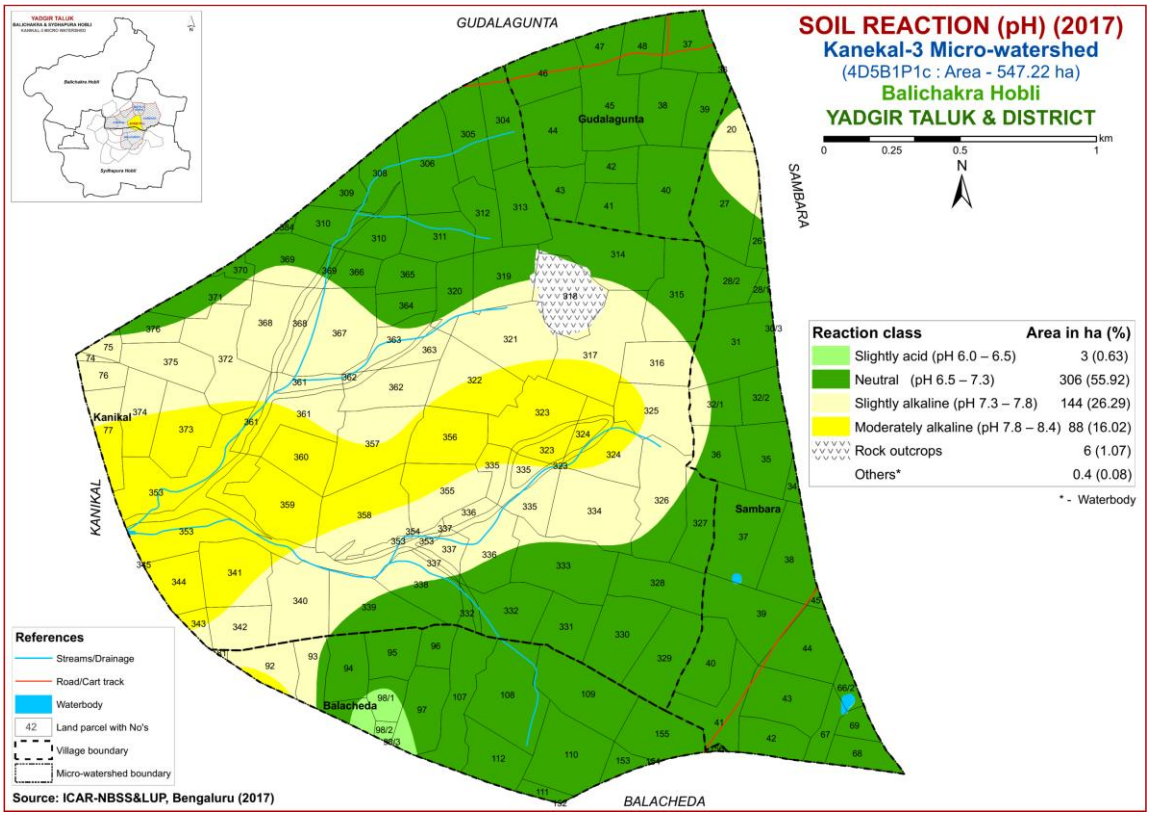


Fig.6.1 Soil Reaction (pH) map of Kanekal-3 Microwatershed

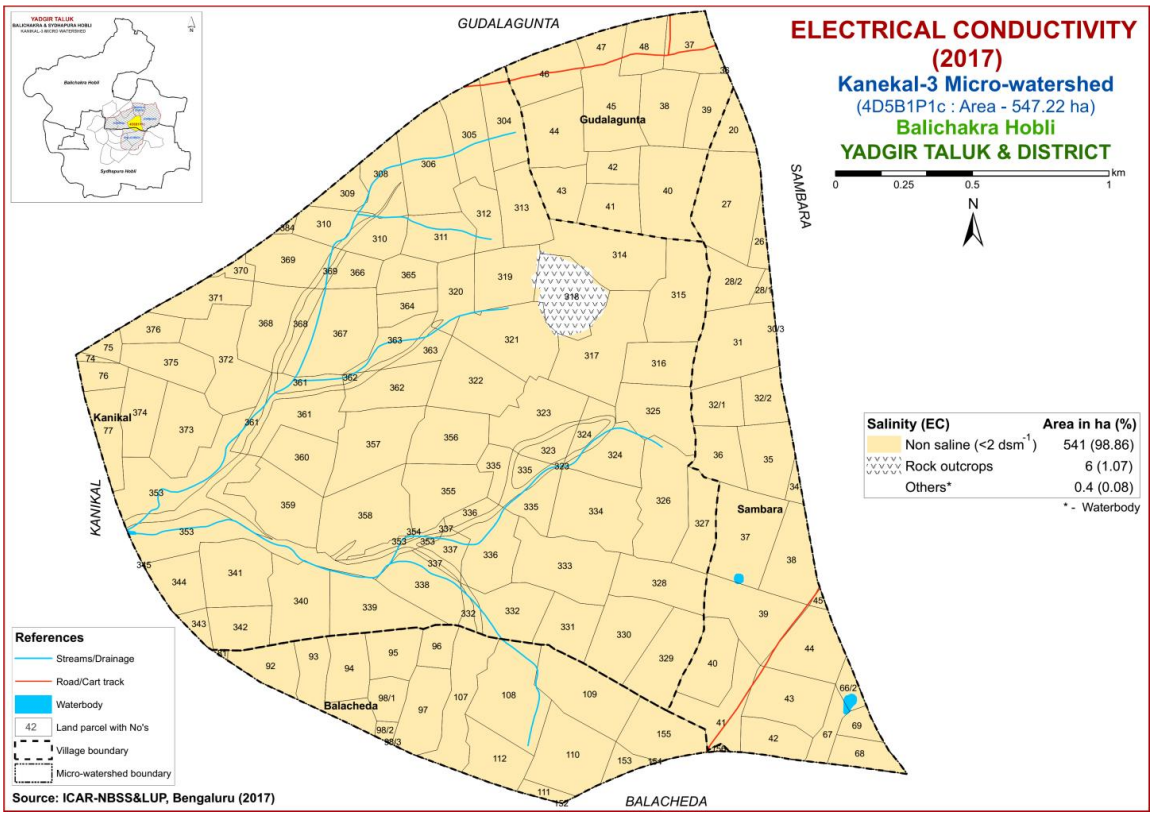


Fig.6.2 Electrical Conductivity (EC) map of Kanekal-3 Microwatershed

6.4 Available Phosphorus

The soil fertility analysis revealed that available phosphorus (Fig.6.4) is low (<23 kg/ha) in an area of about 113 ha (21%) and is distributed in the southeastern, central, northern, eastern and western part of the microwatershed. Major area of about 344 ha (63%) is medium (23-57 kg/ha) in available phosphorus and is distributed in the major part of the microwatershed. An area of about 84 ha (15%) is high (>57 kg/ha) in available phosphorus and is distributed in the southern part of the microwatershed. There is an urgent need to increase the dose of phosphorous in soils that are low and medium for all the crops by 25 per cent over the recommended dose to realize better crop performance.

6.5 Available Potassium

Available potassium content (Fig.6.5) is low (<145 kg/ha) in an area of 25 ha (5%) and are distributed in the southeastern part of the microwatershed. Medium (145-337 kg/ha) in a maximum area of 505 ha (92%) and is distributed in the major part of the microwatershed. High available potassium (>337 kg/ha) content accounts for small area of 11 ha (2%) and is distributed in the northwestern part of the microwatershed.

6.6 Available Sulphur

Available sulphur content is medium (10-20 ppm) in an area of about 165 ha (30%) and is distributed in the `southeastern, eastern and southwestern part of the microwatershed. Available sulphur is low (<10 ppm) in major area of 376 ha (69%) and is distributed in all parts of the microwatershed (Fig.6.6).

6.7 Available Boron

Available boron content (Fig.6.7) is medium (0.5-1.0 ppm) in an area of about 210 ha (38%) and is distributed in all parts of the microwatershed. Maximum area of about 285 ha (52%) is low (<0.5ppm) in available boron and are distributed in the major part of microwatershed. An area of about 47 ha (9%) is high (>1.0 ppm) in available boron and are distributed in the southeastern and southwestern part of microwatershed.

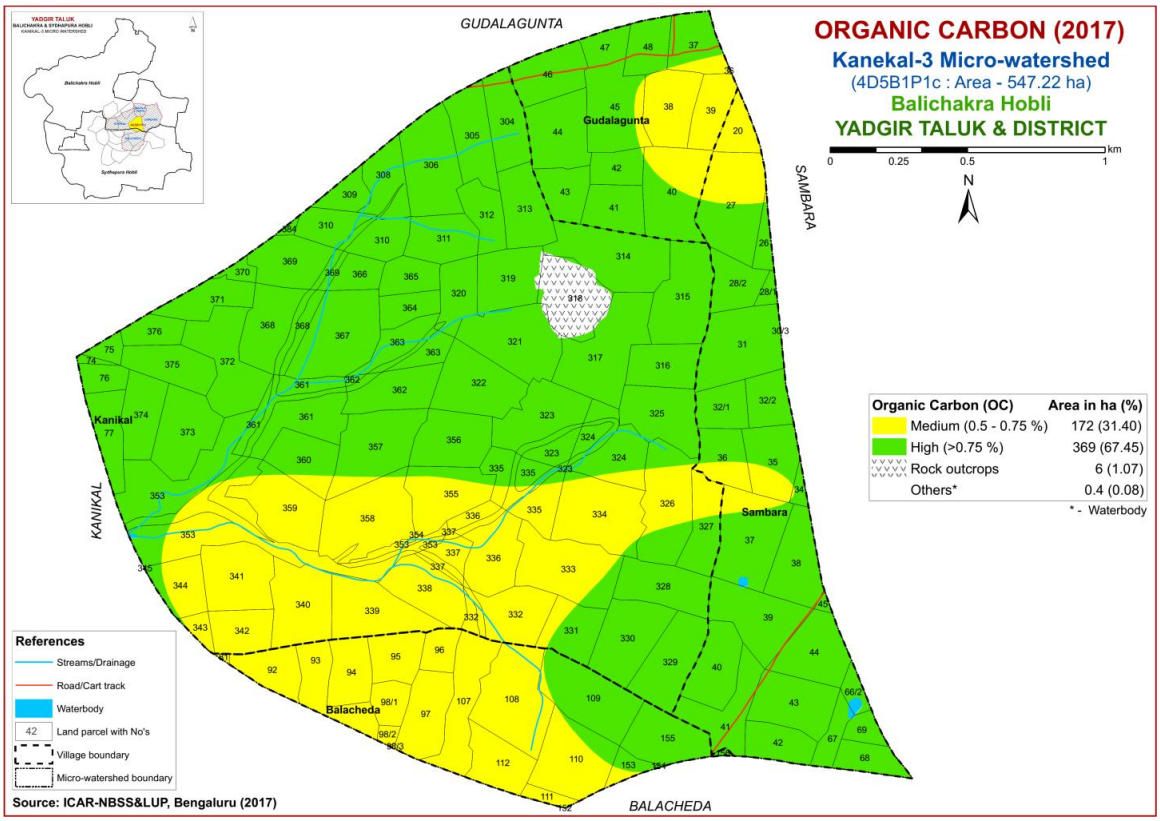


Fig.6.3 Soil Organic Carbon map of Kanekal-3 Microwatershed

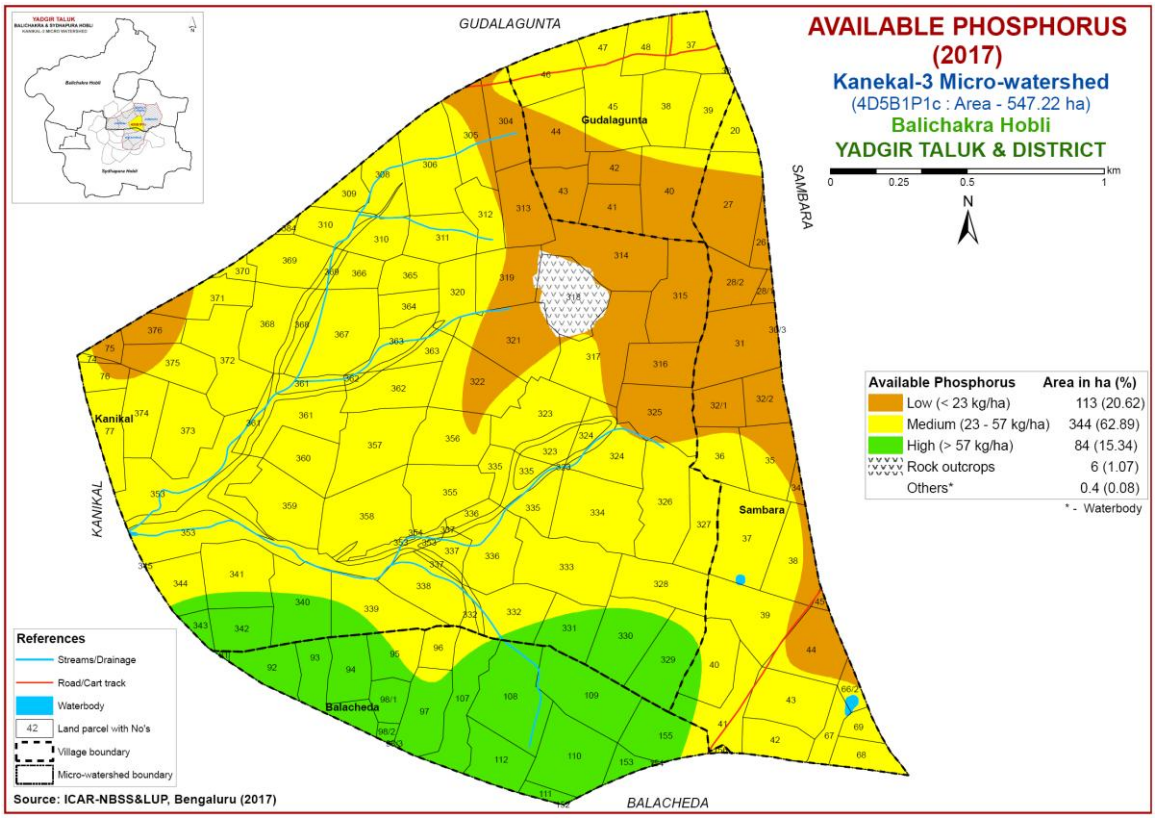


Fig.6.4 Soil available Phosphorus map of Kanekal-3 Microwatershed

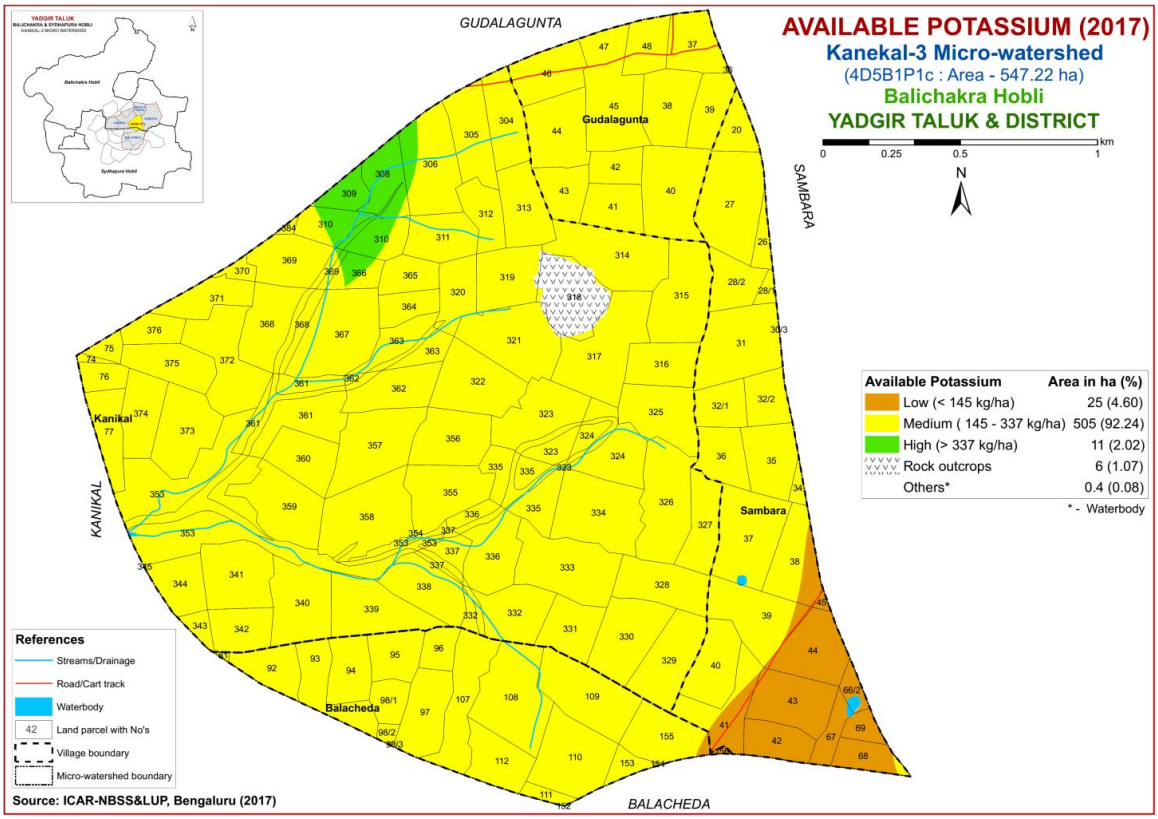


Fig.6.5 Soil available Potassium map of Kanekal-3 Microwatershed

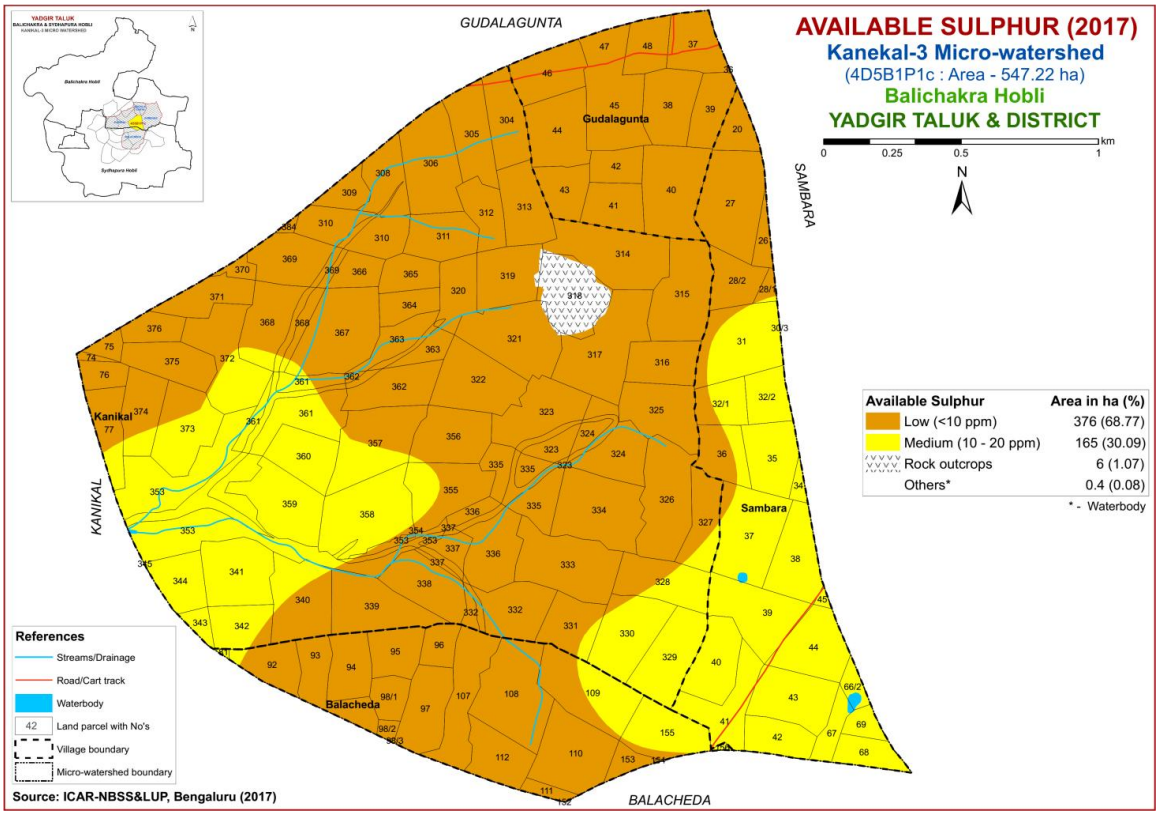


Fig.6.6 Soil available Sulphur map of Kanekal-3 Microwatershed

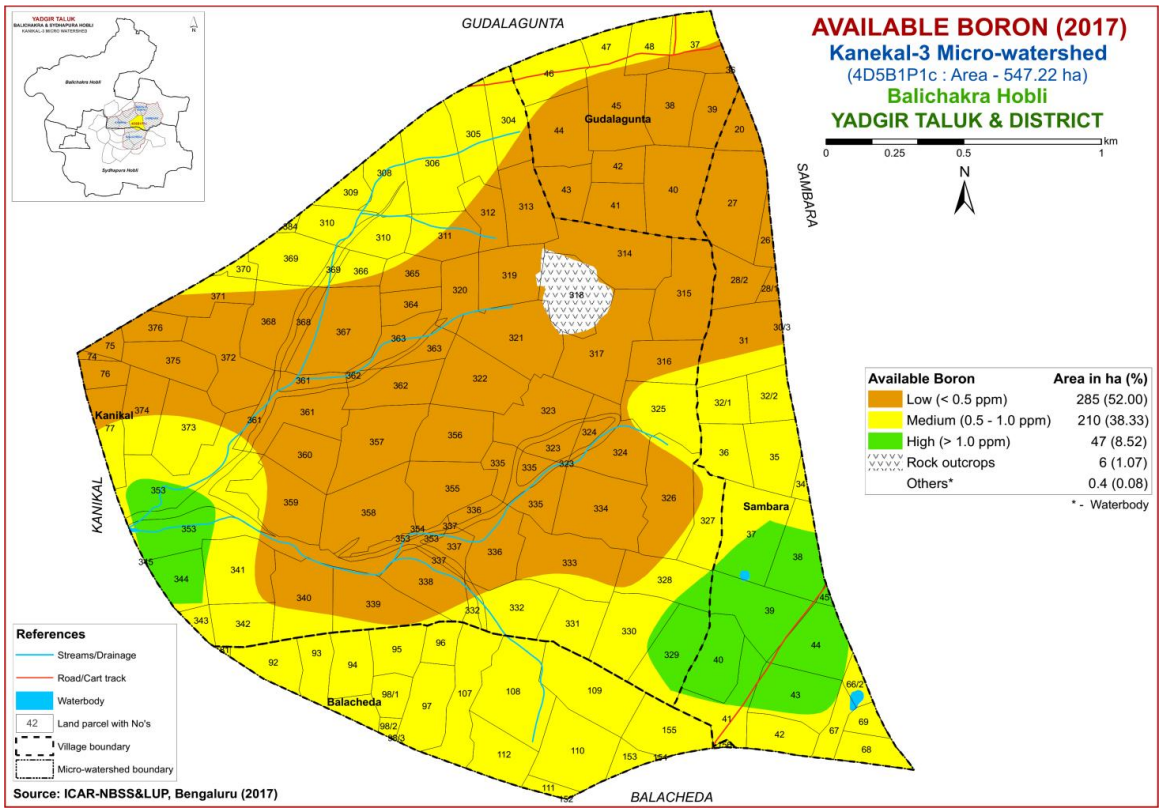


Fig.6.7 Soil available Boron map of Kanekal-3 Microwatershed

6.8 Available Iron

Available iron content is sufficient (>4.5 ppm) in major area of about 480 ha (88%) and is distributed in the major part of the microwatershed. It is deficient (<4.5 ppm) in an area of about 61 ha (11%) and is distributed in the northern, central, western and northeastern part of the microwatershed. (Fig 6.8).

6.9 Available Manganese

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

6.10 Available Copper

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

6.11 Available Zinc

Available zinc content is deficient (<0.6 ppm) in the entire area of about 541 ha (99%) and is distributed in all parts of the microwatershed (Fig 6.11).

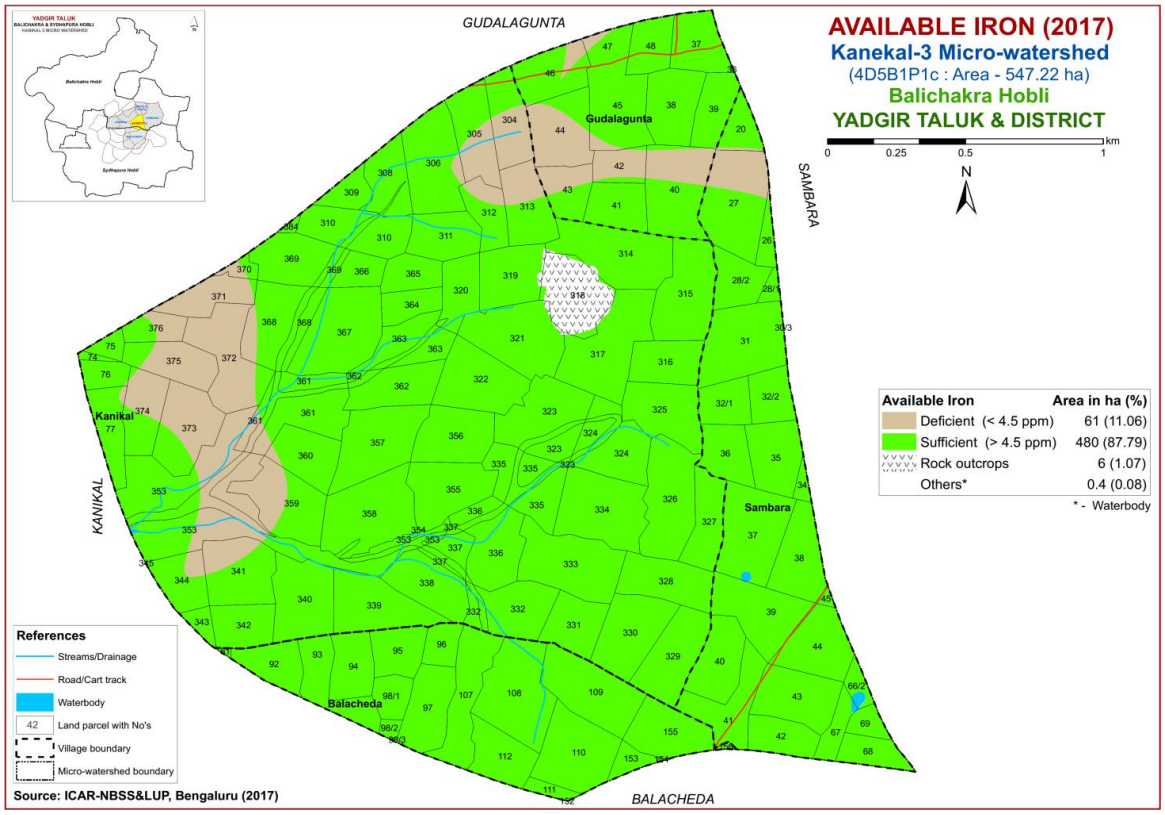


Fig.6.8 Soil available Iron map of Kanekal-3 Microwatershed

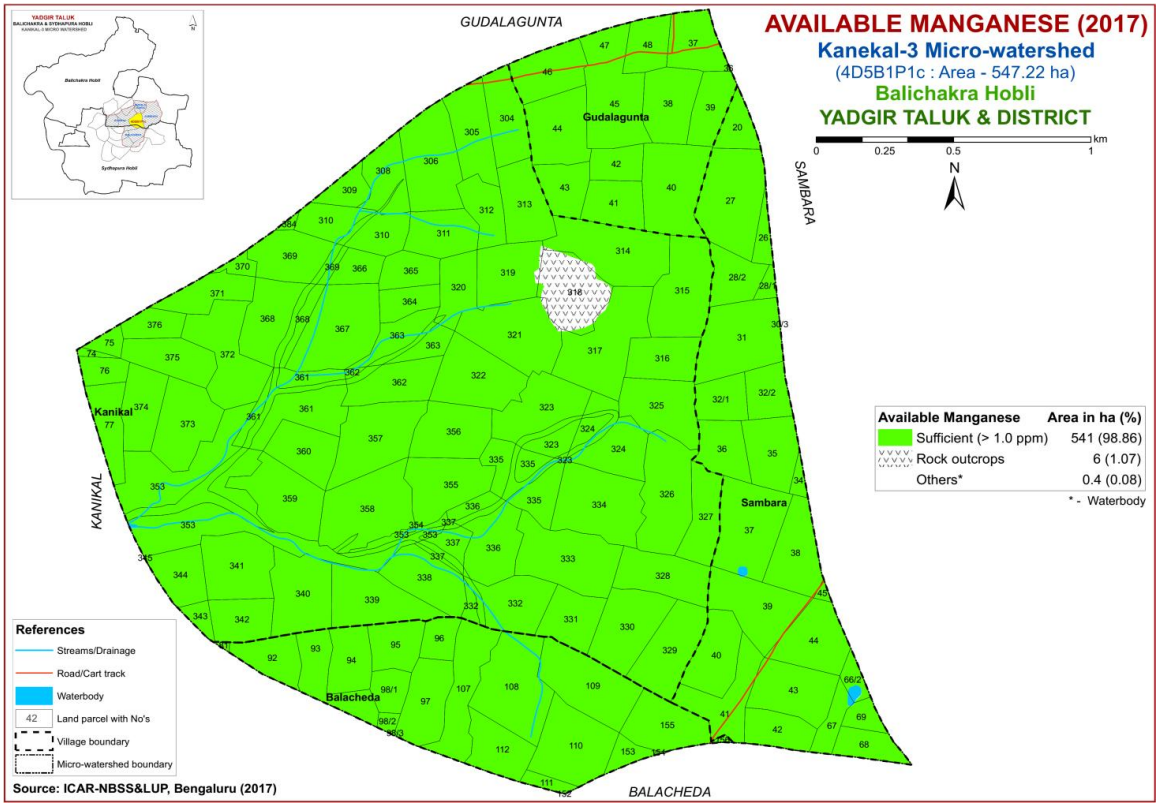


Fig.6.9 Soil available Manganese map of Kanekal-3 Microwatershed

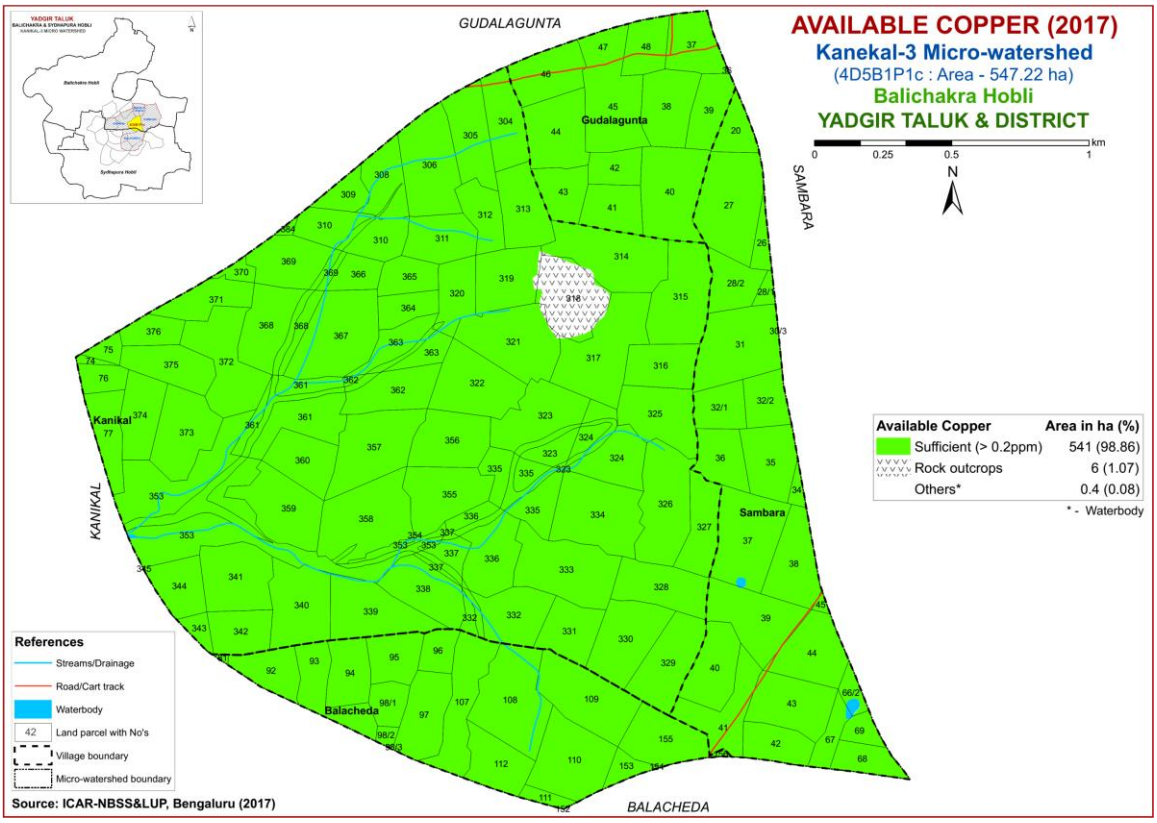


Fig.6.10 Soil available Copper map of Kanekal-3 Microwatershed

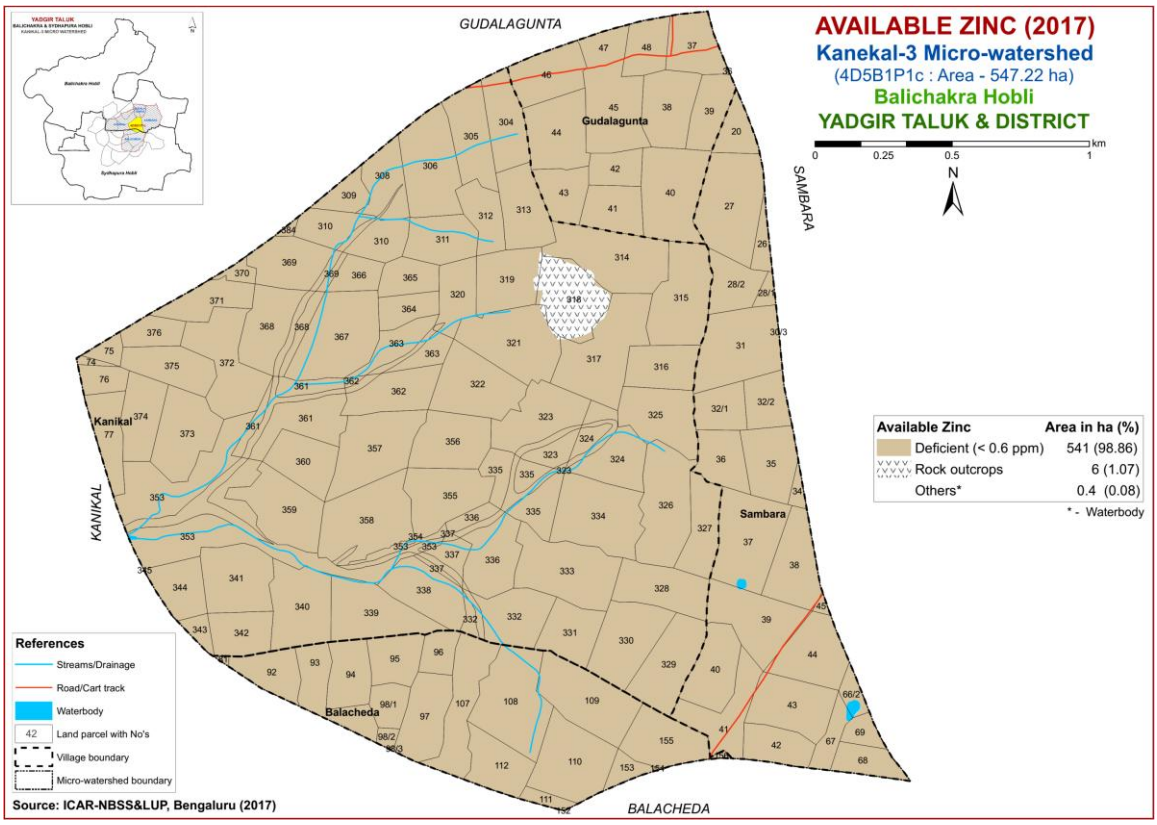


Fig.6.11 Soil available Zinc map of Kanekal-3 Microwatershed

Chapter 7

LAND SUITABILITY FOR MAJOR CROPS

The soil and land resource units (soil phases) of Kanekal-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 and N1 are divided into subclasses based on the kinds of limitations encountered. The limitations that affect crop production are 'c' for erratic rainfall and its distribution and length of growing period (LGP), 'e' for erosion hazard, 'r' for rooting condition, 't' for lighter or heavy texture, 'g' for gravelliness or stoniness, 'n' for nutrient availability, 'l' for topography, 'm' for moisture availability, '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 26 major agricultural and horticultural crops grown in the state 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 an area of 10.47 lakh ha of northern Karnataka in Bijapur, Kalaburgi, Raichur, Bidar, Belgaum, Dharwad and Bellary 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.

Table 7.1 Soil-Site Characteristics of Kanekal-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 (%)								
BDPiB2	866	150	WD	<25	sc	scl	<15	<15	<50	1-3	Moderate					
BDLiB2	866	150	WD	25-50	sc	sl-scl	<15	<15	<50	1-3	Moderate					
VNKcB2	866	150	WD	25-50	sl	ls-sc	<15	<15	<50	1-3	Moderate					
SBRcB2	866	150	WD	50-75	sl	ls-s	<15	<15	<50	1-3	Moderate					
SBRiB2	866	150	WD	50-75	sc	ls-s	<15	<15	<50	1-3	Moderate					
DPLcB2	866	150	WD	50-75	sl	sc	<15	<15	<100	1-3	Moderate					
DPLiB2	866	150	WD	50-75	sc	sc	<15	<15	<100	1-3	Moderate					
YLRcB2g1	866	150	WD	50-75	sl	sc	15-35	15-35	<100	1-3	Moderate					
YLRiB2	866	150	WD	50-75	sc	sc	<15	15-35	<100	1-3	Moderate					
BLCiB2	866	150	WD	75-100	sc	scl-sc	<15	<15	100-150	1-3	Moderate					
PGPiB2	866	150	WD	75-100	sc	sc	<15	<15	100-150	1-3	Moderate					
YDRcB2	866	150	WD	100-150	sl	ls-sl	<15	<15	<100	1-3	Moderate					
GDGbB2	866	150	WD	100-150	ls	scl	<15	<15	100-150	1-3	Severe					
GDGbB3g1	866	150	WD	100-150	ls	scl	15-35	<15	100-150	1-3	Moderate					
BGDbB2	866	150	WD	100-150	ls	c	<15	<15	100-150	1-3	Moderate					
BMNmB2	866	150	WD	>150	c	c	<15	<15	>200	1-3	Moderate					
BMDiB2g1	866	150	WD	>150	sc	scl-sc	15-35	<15	100-150	1-3	Moderate					

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

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing sorghum occupy an area of 97 ha (18%) and are distributed in the central, eastern and western part of the microwatershed. Major area of about 259 ha (47%) is moderately suitable (Class S2) for growing sorghum and are distributed in the major part of the microwatershed. They have minor limitations of drainage, calcareousness, gravelliness, texture and rooting depth. Marginally suitable lands (Class S3) occupy an area of 182 ha (33%) and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Not suitable (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

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. drained	imperfect	Poorly/ excessively	V. poorly
Soil reaction	pH	6.0-8.0	5.5-5.9,8.1-8.5	<5.5,8.6-9.0	>9.0
Surface soil texture	Class	c, cl, sicl, sc	l, sil, sic	sl, ls	s,fragmental skeletal
Soil depth	cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

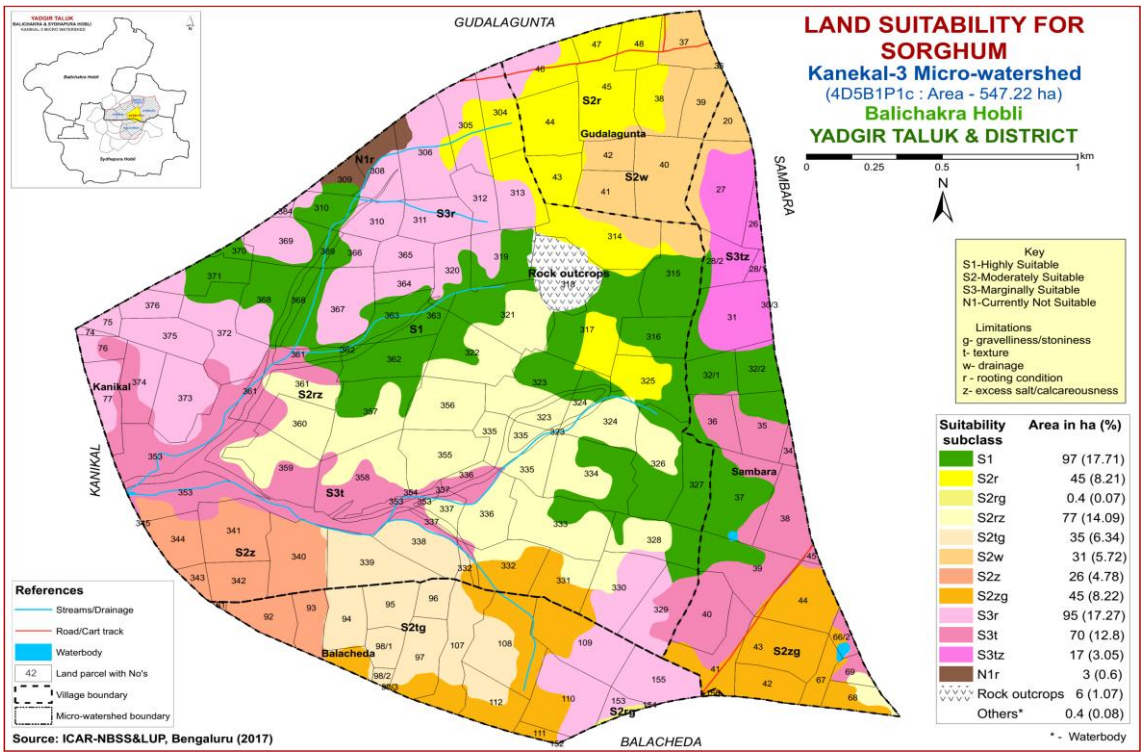


Fig. 7.1 Land Suitability map of Sorghum

7.2 Land Suitability for Maize (*Zea mays*)

Maize is one of the most important food crop grown in an area of 13.37 lakh ha in 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.

Table 7.3 Crop suitability criteria for Maize

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

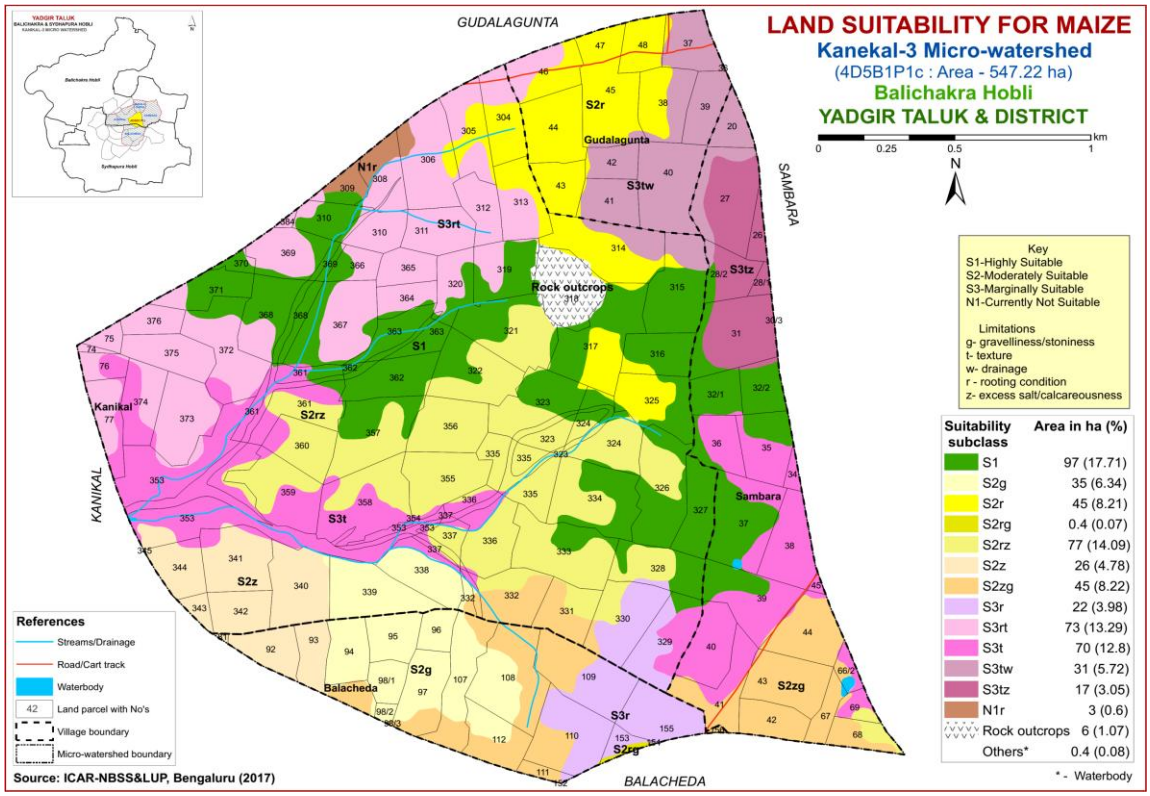


Fig. 7.2 Land Suitability map of Maize

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing maize occupy an area of 97 ha (18%) and are distributed in the central, eastern and western part of the microwatershed. Major area of about 228 ha (42%) is moderately

suitable (Class S2) for growing sorghum and are distributed in the major part of the microwatershed. They have minor limitations of calcareousness, gravelliness and rooting depth. Marginally suitable lands (Class S3) occupy an area of 213 ha (39%) and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture, drainage and calcareousness. Not suitable (Class N1) lands occur in a small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

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

Red gram is one of the major pulse crop grown in an area of 7.28 lakh ha mainly in northern Karnataka in Bijapur, Kalaburgi, Raichur, Bidar, Belgaum, Dharwad and Bellary districts. The crop requirements for growing red gram (Table 7.4) were matched with the soil-site characteristics (Table 7.1) of the soils of the microwatershed and a land suitability map for growing red gram was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.3.

In Kanekal-3 microwatershed, there are no lands that are highly (Class S1) suitable for growing redgram. An area of about 251 ha (46%) is moderately suitable (Class S2) for red gram and is distributed in all parts of the microwatershed. They have minor limitations of texture, rooting depth, gravelliness, calcareousness and drainage. Major area of about 287 ha (52%) is marginally suitable (Class S3) for growing red gram and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, gravelliness, texture and calcareousness. Not suitable (Class N1) lands occur in an area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

Table 7.4 Crop suitability criteria for Red gram

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	>210	180-210	150-180	<150
Soil drainage	class	Well drained	Mod. to well drained	Imperfectly drained	Poorly drained
Soil reaction	pH	6.5-7.5	5.0-6.5,7.6-8.0	8.0-9.0	>9.0
Surface soil texture	Class	l,scl,sil,cl, sl	sicl, sic, c(m)	ls	s,fragmental
Soil depth	cm	>100	85-100	40-85	<40
Gravel content	%vol.	<20	20-35	35-60	>60
Salinity (EC)	dSm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

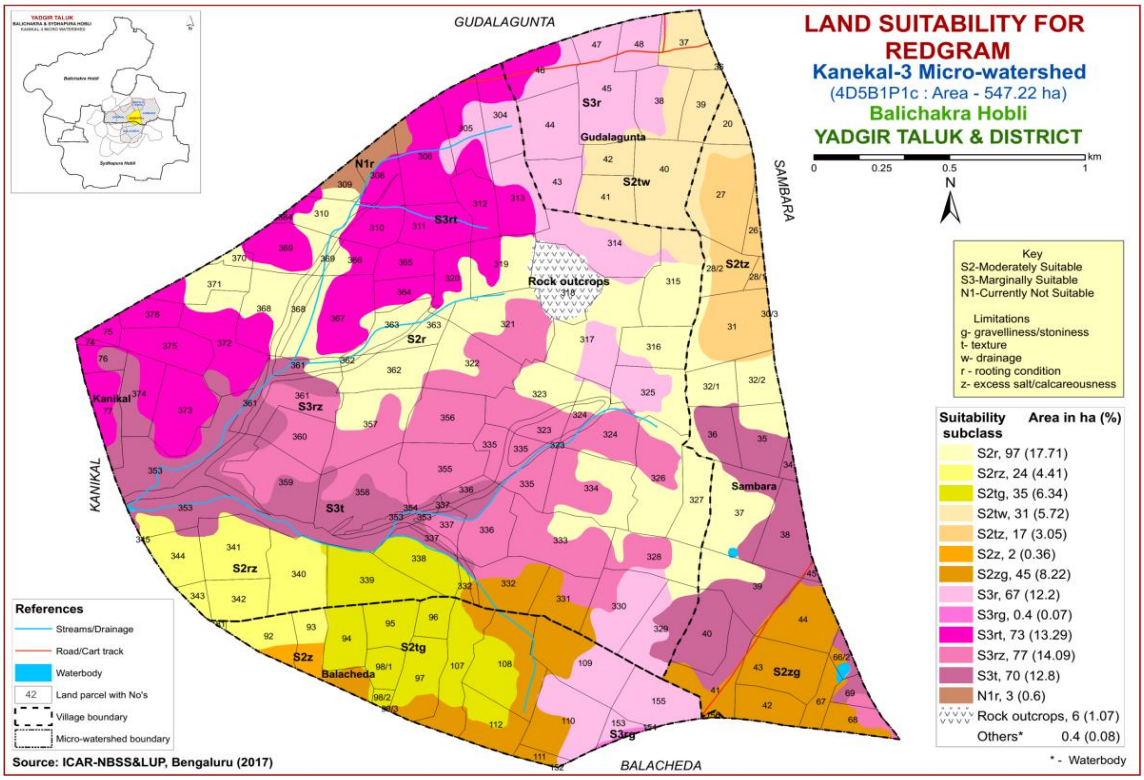


Fig. 7.3 Land Suitability map of Red gram

7.4 Land Suitability for Bajra (*Pennisetum glaucum)*

Bajra is one of the most important millet crop grown in an area of 2.34 lakh ha in the northern districts of Karnataka State. The crop requirements for growing bajra were matched with the soil-site characteristics and a land suitability map for growing bajra was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.4.

In Kanekal-3 microwatershed, there are no lands that are highly (Class S1) suitable for growing bajra. An area of about 251 ha (70%) is moderately suitable (Class S2) for growing bajra and are distributed in all parts of the microwatershed. They have minor limitations of drainage, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy maximum area of about 287 ha (52%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, gravelliness, calcareousness and texture. Not suitable (Class N1) lands occupy 3 ha (1%) and are distributed in the northeastern part of the microwatershed with severe limitation of rooting depth.

Table 7.5 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. drained	imperfect	Poorly/excessively	V. poorly
Soil reaction	pH	6.0-8.0	5.5-5.9,8.1-8.5	<5.5,8.6-9.0	>9.0
Surface soil texture	Class	c, cl, sicl, sc	l, sil, sic	sl, ls	s,fragmental skeletal
Soil depth	cm	100-75	50-75	30-50	<30
Gravel content	% vol.	5-15	15-30	30-60	>60
Salinity (EC)	dSm^{-1}	2-4	4-8	8-10	>10
Sodicity (ESP)	%	5-8	8-10	10-15	>15

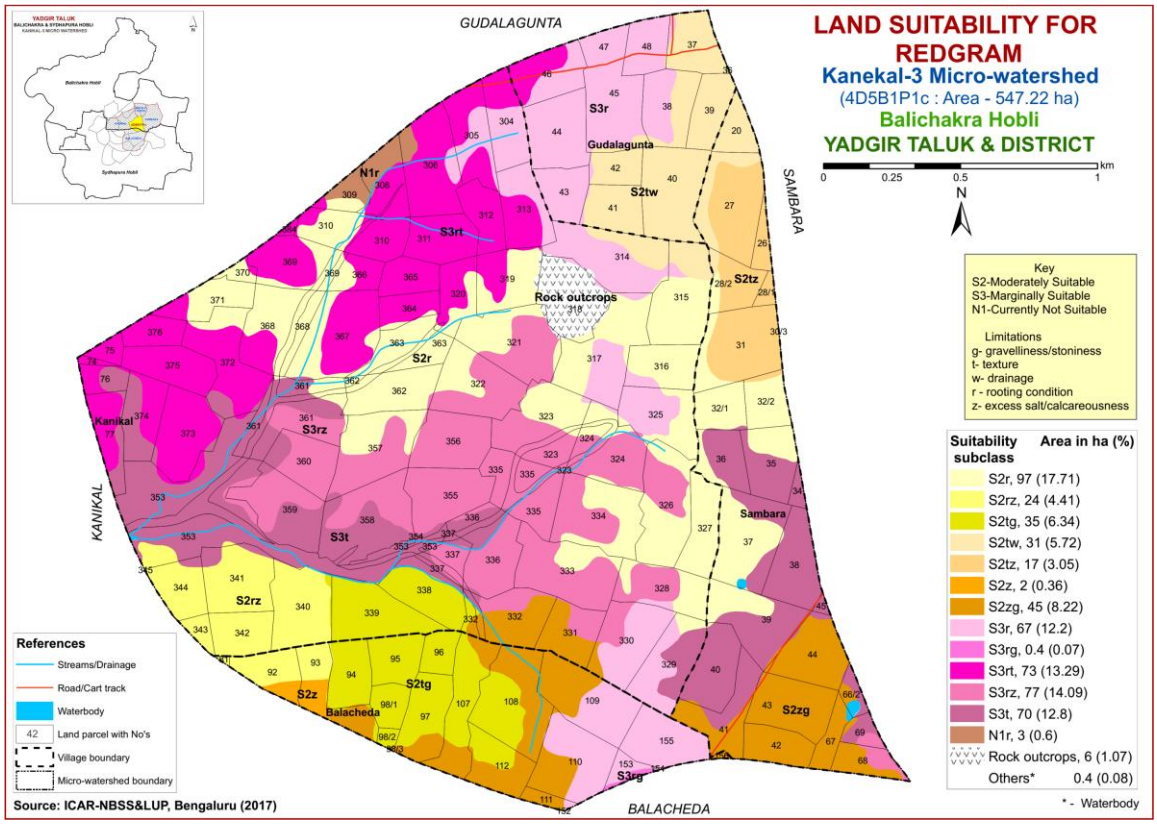


Fig. 7.4 Land Suitability map of Bajra

7.5 Land suitability for Groundnut (*Arachis hypogaea*)

Groundnut is one of the most important oilseed crop grown in an area of 6.54 lakh ha in almost all the districts of the State. The crop requirements for growing groundnut (Table 7.5) were matched with the soil-site characteristics (Table 7.1) of soils of the microwatershed and a land suitability map for growing groundnut was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.5.

Table 7.6 Land 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 rained	imperfectly drained	Poorly drained
Soil reaction	pH	6.0-8.0	8.1-8.5, 5.5-5.9	>8.5, <5.5	
Sub Surface soil texture	Class	l, cl, sil, scl, sicl	sc, sic, c,sl	s, ls,c (>60%)	
Soil depth	cm	>75	50-75	25-50	<25
Gravel content	% vol.	<35	35-50	>50	
$CaCO_3$ in root zone	%	low	Medium	high	
Salinity (EC)	dsm^{-1}	<2.0	2.0-4.0	4.0-8.0	
Sodicity (ESP)	%	<5	5-10	>10	

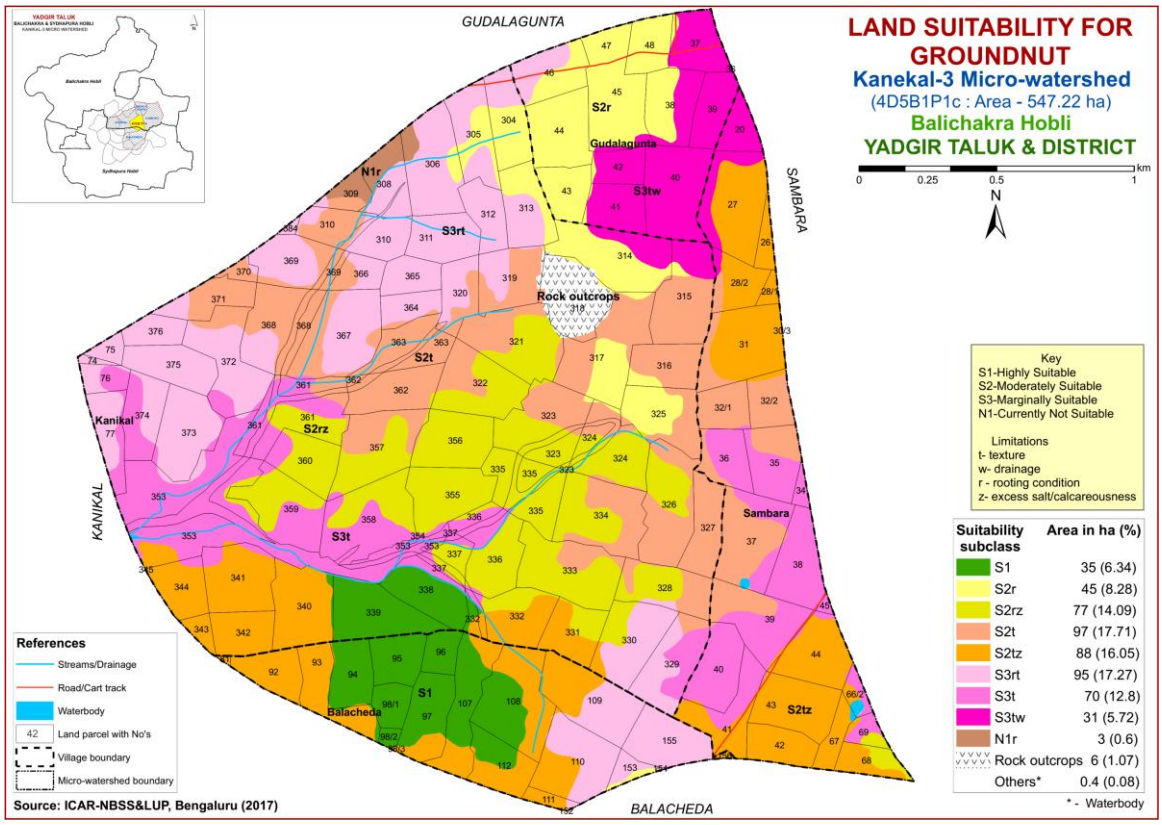


Fig. 7.5 Land Suitability map of Groundnut

In Kanekal-3 microwatershed, the highly suitable (Class S1) lands for growing groundnut occur in 35 ha (6%) and are distributed in the southern part of the microwatershed. The moderately suitable (Class S2) lands cover major area of 307 ha (56%) and occur in the major part of the microwatershed. They have minor limitations of calcareousness, texture and rooting depth. The marginally suitable (Class S3) lands cover an area of about 196 ha (36%) and occur in all parts of the microwatershed. They have

moderate limitations of texture, drainage and rooting depth. Not suitable (Class N1) lands occupy a small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

7.6 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 7.6.

In Kanekal-3 microwatershed, there are no lands that are highly (Class S1) suitable for growing sunflower. An area of about 234 ha (43%) is moderately suitable (Class S2) for sunflower and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, gravelliness, calcareousness and drainage. An area of about 207 ha (38%) is marginally suitable (Class S3) for growing sunflower and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, gravelliness, texture and calcareousness. An area of about 100 ha (18%) is not suitable (Class N) for growing sunflower and are distributed in the western, northwestern and southern part of the microwatershed. They have severe limitations of rooting depth and texture.

Table 7.7 Crop suitability criteria for Sunflower

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

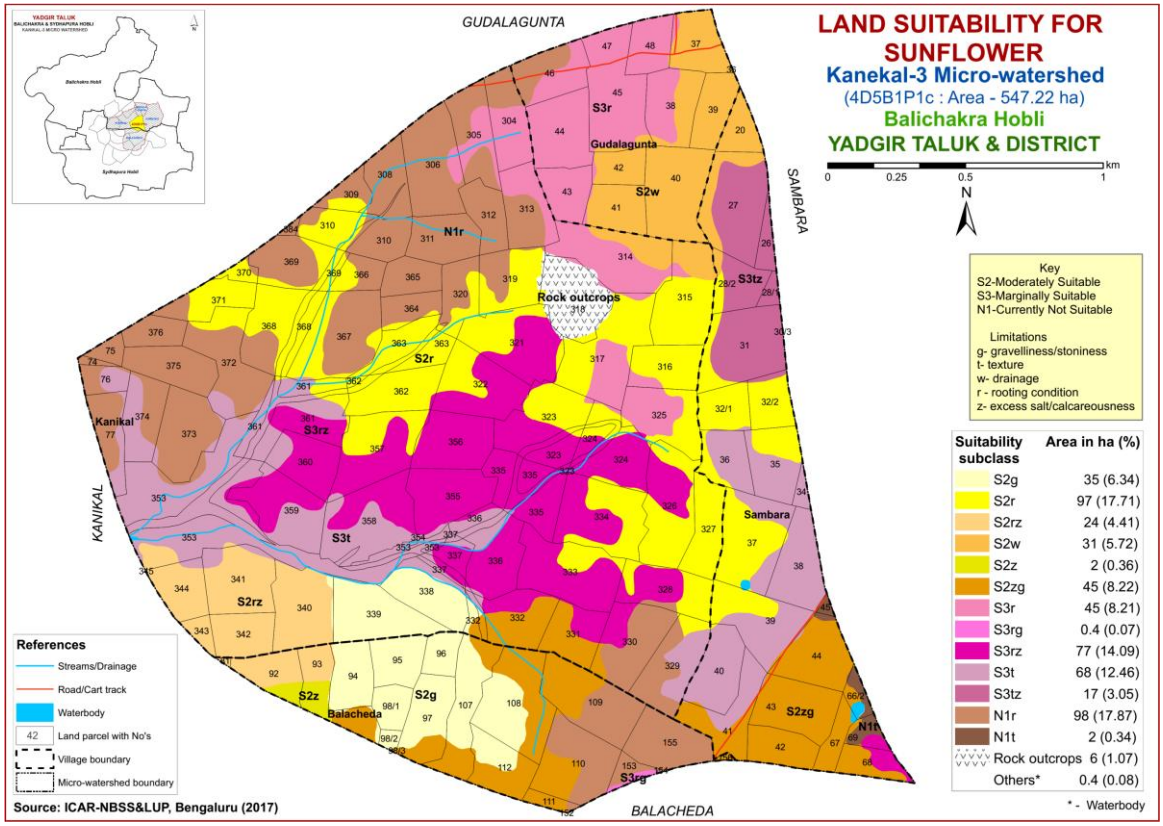


Fig. 7.6 Land Suitability map of Sunflower

7.7 Land Suitability for Cotton (*Gossypium hirsutum*)

Cotton is one of the most important fibre crop grown in the state in about 8.75 lakh ha area in Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga and Chamarajnagar districts. The crop requirements for growing cotton (Table 7.7) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing cotton was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.7.

In Kanekal-3 microwatershed the highly (Class S1) suitable lands for growing cotton occur in an area of 31 ha (6%) and are distributed in the northern part of the microwatershed. Major area of about 325 ha (59%) is moderately suitable (Class S2) for growing cotton and are distributed in all parts of the microwatershed. They have minor limitations of gravelliness, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 96 ha (17%) and are distributed in the northwestern, western, central and southern part of the microwatershed. They have moderate limitation of rooting depth. Not suitable (Class N1) lands occupy an area of 90 ha (16%) and are distributed in the northwestern, western, central, northeastern and southeastern part of the microwatershed with severe limitations of rooting depth, texture and calcareousness.

Table 7.8 Crop suitability criteria for Cotton

Crop requirement		Rating			
Soil–site characteristics	**Unit**	**Highly suitable(S1)**	**Moderately suitable(S2)**	**Marginally suitable(S3)**	**Not suitable(N)**
Slope	%	1-2	2-3	3-5	>5
LGP	Days	180-240	120-180	<120	
Soil drainage	class	Well to mod. well	imperfectly drained	Poor somewhat excessive	Stagnant/ excessive
Soil reaction	pH	6.5-7.5	7.6-8.0	8.1-9.0	>9.0 >6.5
Surface soil texture	Class	sic, c	sicl, cl	si, sil, sc, scl, l	sl, s,ls
Soil depth	cm	100-150	60-100	30-60	<30
Gravel content	% vol.	<5	5-10	10-15	15-35
$CaCO_3$ in root zone	%	<3	3-5	5-10	10-20
Salinity (EC)	dSm^{-1}	2-4	4.0-8.0	8.0-12	>12
Sodicity (ESP)	%	5-10	10-20	20-30	>30

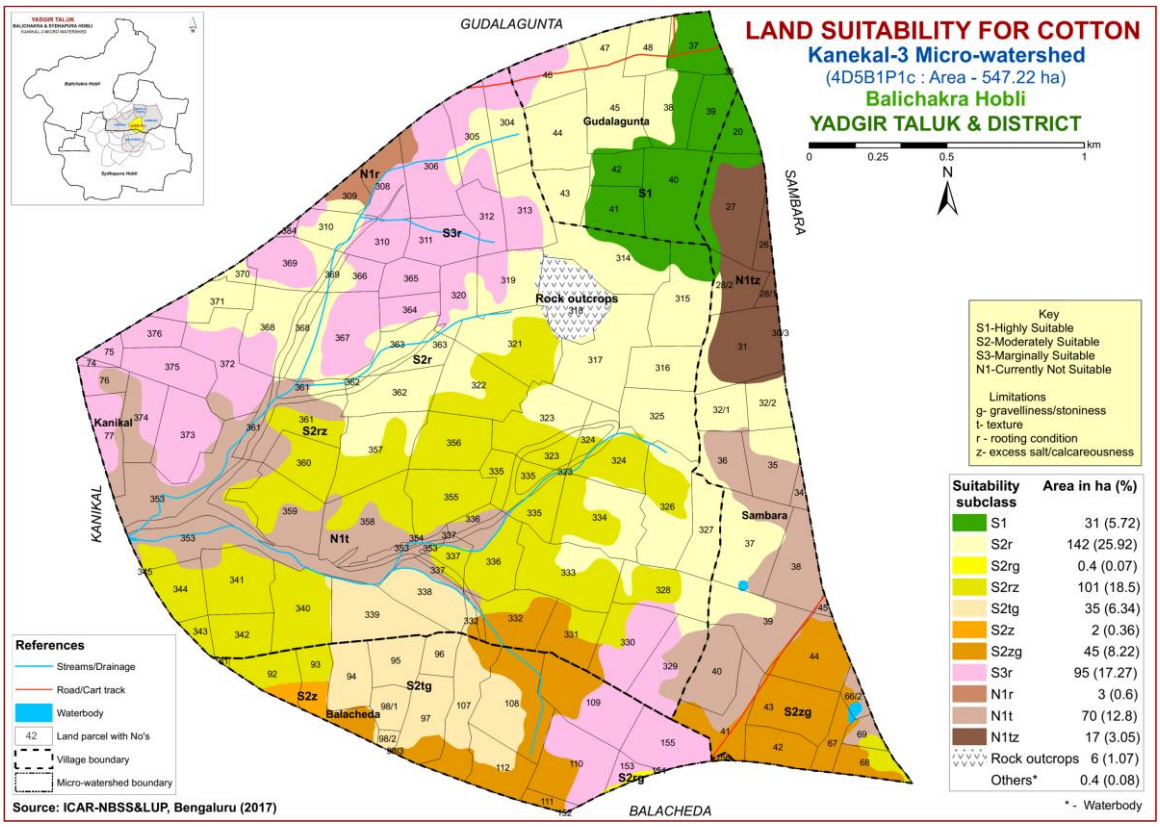


Fig. 7.7 Land Suitability map of Cotton

7.8 Land Suitability for Bengal gram (*Cicer aerativum*)

Bengal gram is one of the most important pulse crop grown in about 9.39 lakh ha area in Bijapur, Raichur, Kalaburgi, Dharwad, Belgaum and Bellary districts. The crop requirements for growing Bengal gram (Table 7.8) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing Bengal gram 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 Crop suitability criteria for Bengal gram

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	90-100	70-90	<70
Soil drainage	class	Well drained	Mod. to well drained; imperfectly drained	Poorly drained; excessively drained	Very Poorly drained
Soil reaction	pH	6.0-7.5	5.5-5.7, 7.6-8.0	8.1-9.0;4.5-5.4	>9.0
Surface soil texture	Class	l,scl,sil,cl,	sicl, sic, c	sl, c>60%	
Soil depth	cm	>75	51-75	25-50	<25
Gravel content	% vol.	<15	15-35	>35	
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	>2.0	
Sodicity (ESP)	%	<10	10-15	>15	

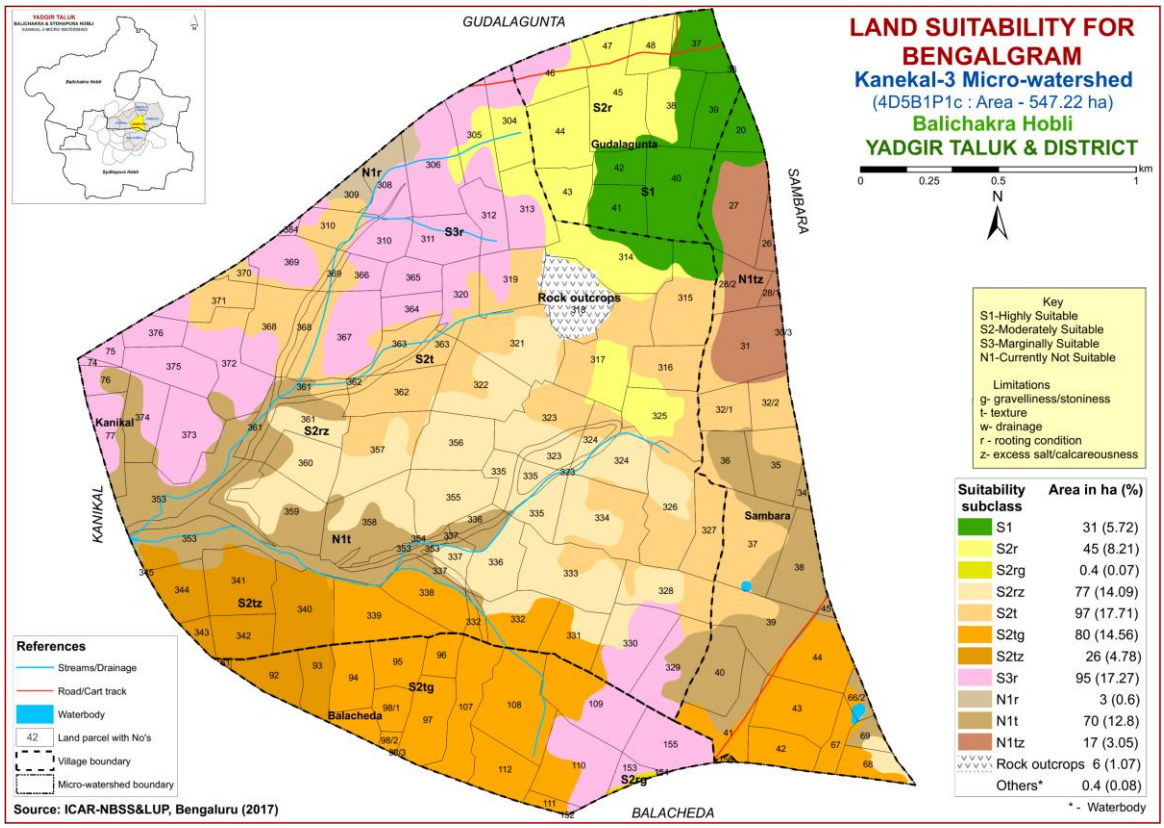


Fig. 7.8 Land Suitability map of Bengal gram

A small area of about 31 ha (6%) is highly (Class S1) suitable for growing bengal gram and are distributed in the northern part of the microwatershed. Major area of about 325 ha (59%) is moderately suitable (Class S2) for growing bengalgram and are distributed in all parts of the microwatershed. They have minor limitations of gravelliness, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 95 ha (17%) and are distributed in the northwestern, western, central and southeastern part of the microwatershed. They have moderate limitation of

rooting depth. Not suitable (Class N1) lands occur in an area of 90 ha (16%) and are distributed in the northwestern, central, western, southeastern and northeastern part of the microwatershed with severe limitations of rooting depth, texture and calcareousness.

7.9 Land Suitability for Chilli (*Capsicum annuum)*

Chilli is one of the most important fruit and spice crop grown in about 0.42 lakh ha in Karnataka State. The crop requirements for growing chilli (Table 7.9) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing chilli was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.9.

In Kanekal-3 microwatershed no highly (Class S1) suitable lands available for growing chilli. Major area of about 373 ha (62%) is moderately suitable (Class S2) for growing chilli and are distributed in all parts of the microwatershed. They have minor limitations of drainage, texture, calcareousness, gravelliness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 165 ha (30%) and are distributed in the northwestern, western, southwestern, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth and texture. Not suitable lands occur in a very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

Table 7.10 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, sic,c(m/k)	c(ss), ls, s	
Soil depth	cm	>75	50-75	25-50	<25
Gravel content	%vol.	<15	15-35	35-60	>60
Salinity (ECe)	dsm^{-1}	<1.0	1.0-2.0	2.0-4.0	<4
Sodicity (ESP)	%	<5	5-10	10-15	

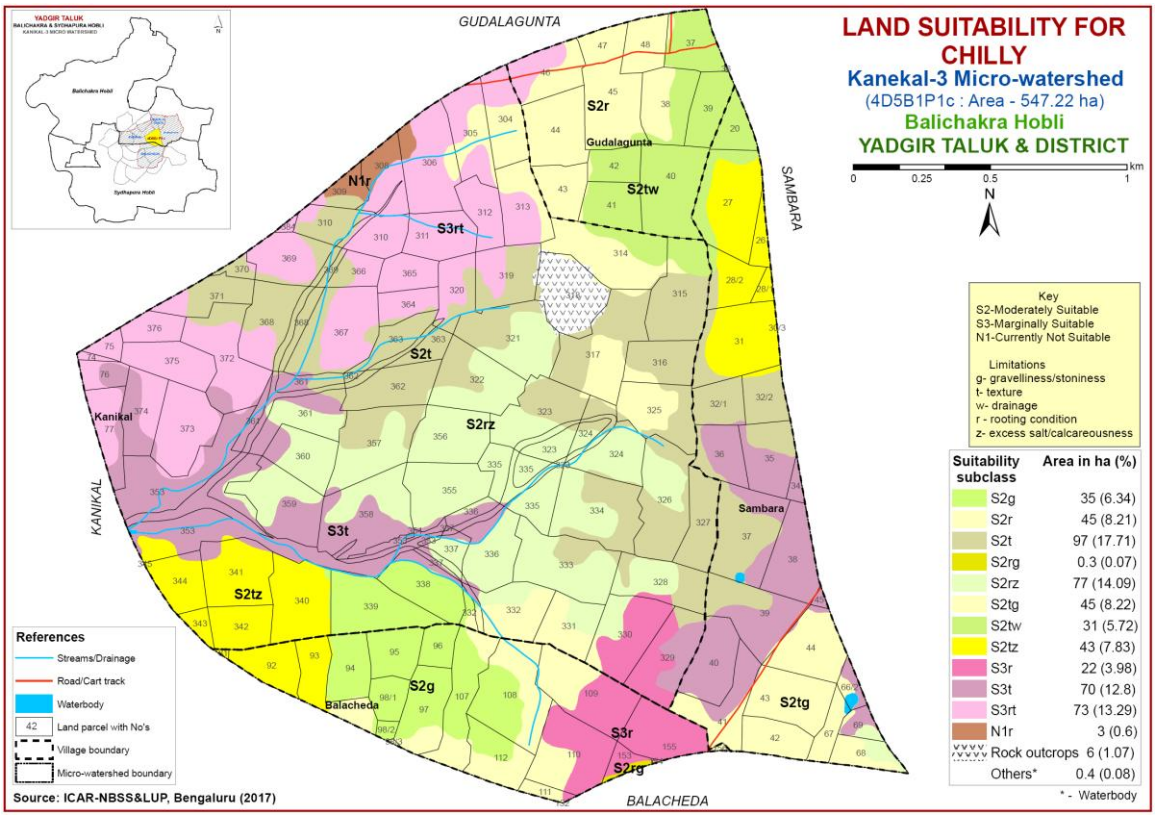


Fig 7.9 Land Suitability map of Chilli

7.10 Land Suitability for Tomato *(Lycopersicon esculentum)*

Tomato is one of the most important fruit crop grown in about 0.61 lakh ha covering almost all the district of the state. The crop requirements for growing tomato (Table 7.10) 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 geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.10.

In Kanekal-3 microwatershed the highly (Class S1) suitable lands for growing tomato occupy an area of 97 ha (18%) and are distributed in the eastern, central and western part of the microwatershed. The moderately suitable (Class S2) lands cover an area of about 245 ha (45%) and occur in the major part of the microwatershed. They have minor limitations of calcareousness, gravelliness and rooting depth. The marginally suitable (Class S3) lands cover an area of about 196 ha (36%) and occur in all parts of the microwatershed. They have moderate limitations of texture, drainage and rooting depth. Not suitable (Class N1) lands occur in a very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with sever limitation of rooting depth.

Table 7.11 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	Poorly drained	V. poorly drained
Nutrient availability	Texture	Class	l, sl, cl, scl	sic,sicl,sc,c(m/k)	c (ss), ls	s
	pH	1:2.5	6.0-7.3	5.5-6.0 7.3-8.4	8.4-9.0	>9.0
	$CaCO_3$ in root zone	%	Non calcareous	Slightly calcareous	Strongly calcareous	
Roting 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

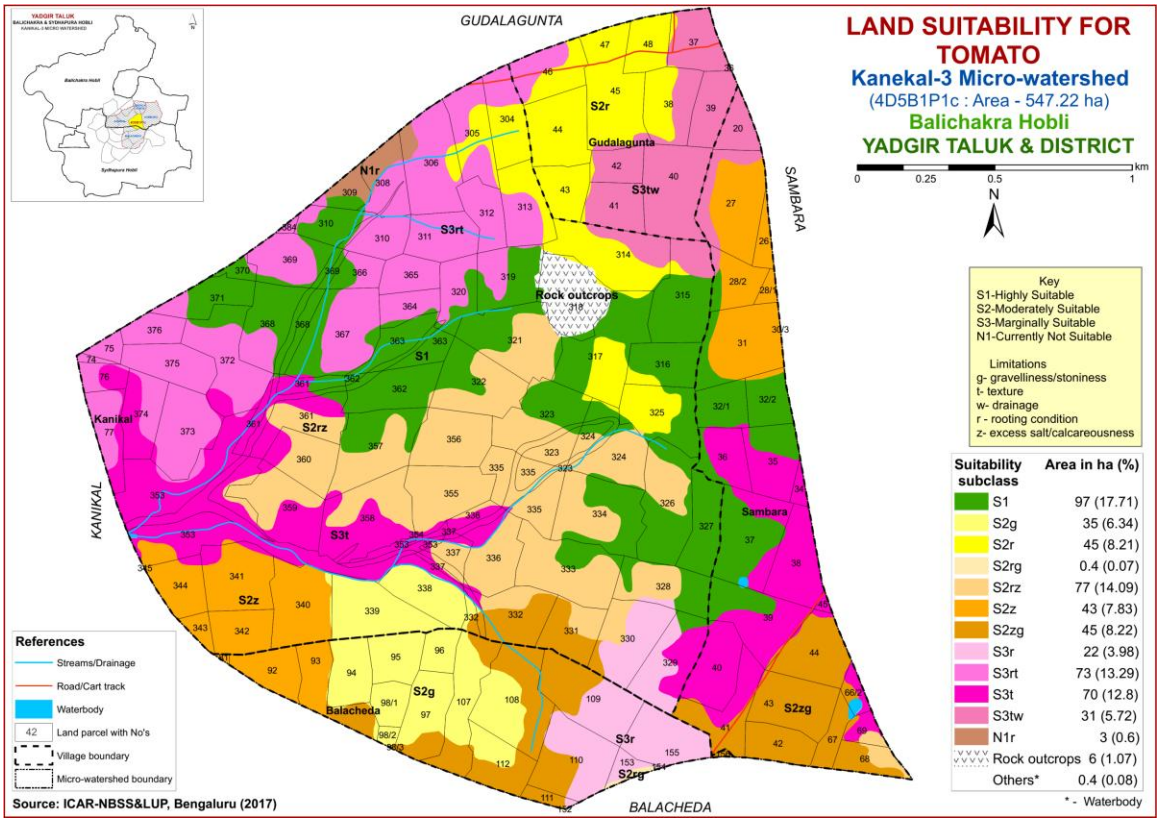


Fig 7.10 Land Suitability map of Tomato

7.11 Land Suitability for Drumstick (*Moringa oleifera*)

Drumstick is one of the most important vegetable crop grown in about 2403 ha in the state. The crop requirements for growing drumstick (Table 7.11) 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 7.11.

Table 7.12 Crop suitability criteria for Drumstick

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

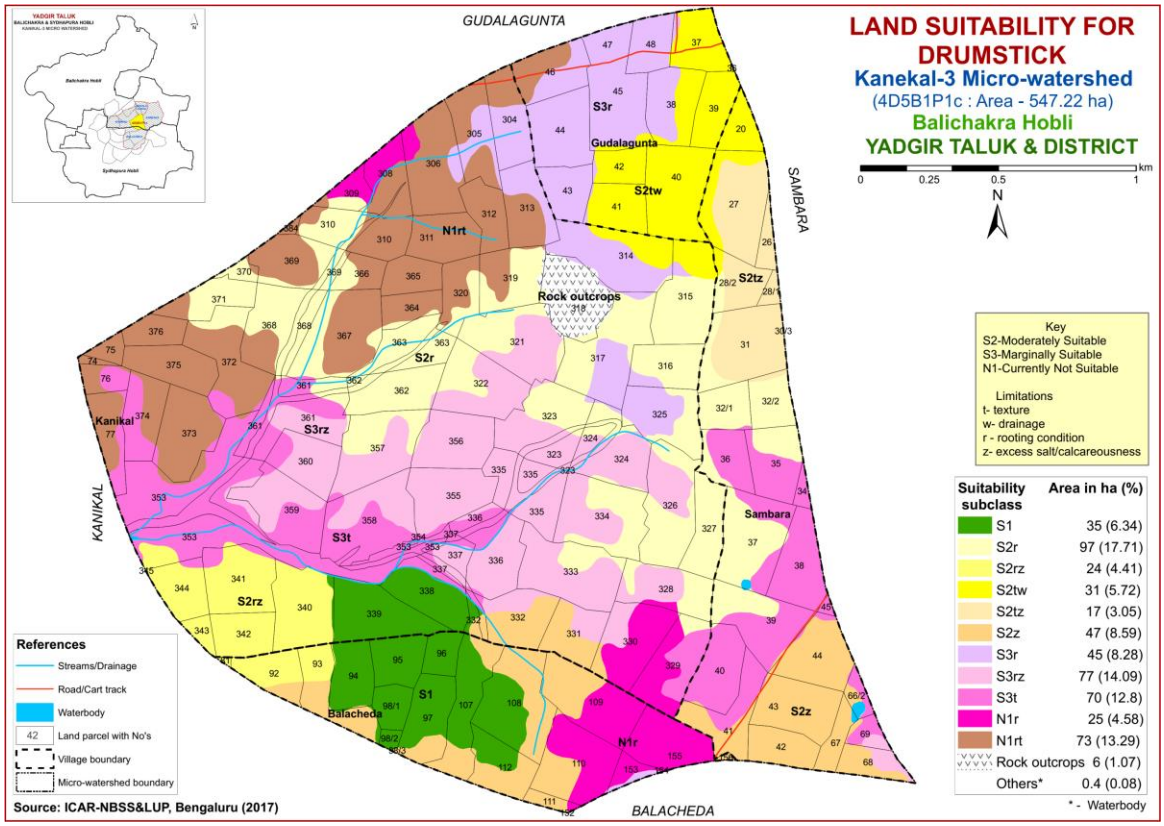


Fig 7.11 Land Suitability map of Drumstick

In Kanekal-3 microwatershed the highly (Class S1) suitable lands for growing drumstick occur in an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Major area of about 216 ha (39%) is moderately suitable (Class S2) for drumstick and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, texture, calcareousness and drainage. An area of about 192 ha (35%) is marginally suitable (Class S3) for growing drumstick and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture

and calcareousness. An area of about 98 ha (18%) is not suitable (Class N) for growing drumstick and are distributed in the northwestern, western, central and southern part of the microwatershed. They have severe limitations of rooting depth and texture.

7.12 Land Suitability for Mulberry (*Morus nigra*)

Mulberry is one of the important leaf crop grown for rearing silk worms in about 1,66,000 ha area in all the districts of the state. The crop requirements for growing mulberry (Table 7.12) 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 7.12.

In Kanekal-3 microwatershed the highly (Class S1) suitable lands for growing mulberry occur in an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. An area of about 168 ha (31%) is moderately suitable (Class S2) for growing mulberry and are distributed in all parts of the microwatershed. They have minor limitations of calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy maximum area of about 240 ha (44%) and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, calcareousness, drainage and texture. Not suitable (Class N1) lands occur in an area of 98 ha (18%) and are distributed in the northwestern, western, central and southern part of the microwatershed with severe limitations of rooting depth and texture.

Table 7.13 Crop 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

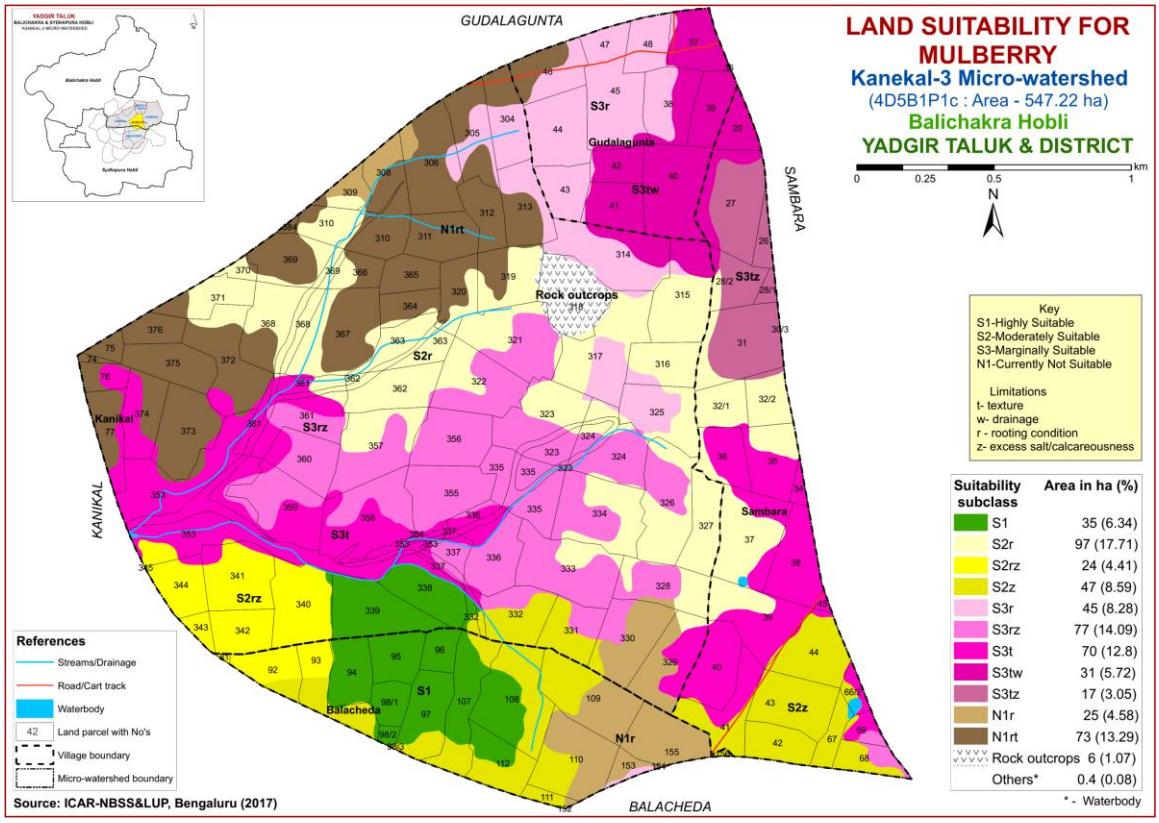


Fig 7.12 Land Suitability map of Mulberry

7.13 Land Suitability for Mango (*Mangifera indica*)

Mango is one of the most important fruit crop grown in about 173080 ha in all the districts of the State. The crop requirements for growing mango (Table 7.13) 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 geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.13.

Highly suitable (Class S1) lands for growing mango occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Moderately suitable (Class S2) lands occupy 47 ha (9%) and are distributed in the southeastern and southern part of the microwatershed. An area of about 171 ha (31%) is marginally suitable (Class S3) for growing mango and are distributed in all parts of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Not suitable lands (Class N) occupy maximum area of about 288 ha (53%) and are distributed in the major part of the microwatershed. They have severe limitations of rooting depth and calcareousness.

Table 7.14 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 imperf. drained	Poor drained	V.poorly drained
	Water table	M	>3	2.50-3.0	2.5-1.5	<1.5
Nutrient availability	Texture	Class	Sc, l, sil, cl	Sl, sc, sic, l, c	C (<60%)	C (>60%),
	pH	1:2.5	5.5-7.5	7.6-8.55.0-5.4	8.6-9.0 4.0-4.9	>9.0 <4.0
	OC	%	High	medium	low	
	$CaCO_3$ in root zone	%	Non calcareous	<5	5-10	>10
Rooting conditions	Soil depth	cm	>200	125-200	75-125	<75
	Gravel content	% vol.	Non gravelly	<15	15-35	>35
Soil toxicity	Salinity	dS/m	Non saline	<2.0	2.0-3.0	>3.0
	Sodicity	%	Non sodic	<10	10-15	>15
Erosion	Slope	%	<3	3-5	5-10	

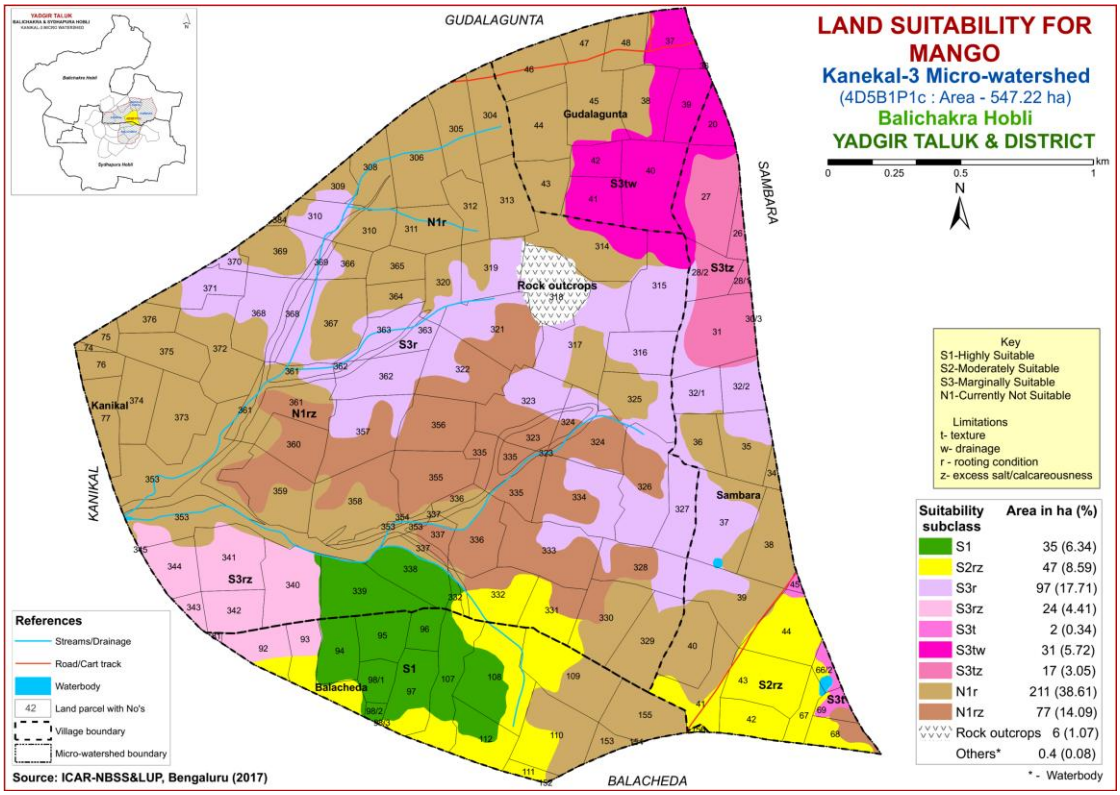


Fig. 7.13 Land Suitability map of Mango

7.14 Land Suitability for Sapota (*Manilkara zapota*)

Sapota is one of the most important fruit crop grown in about 29373 ha in almost all the districts of the state. The crop requirements for growing sapota (Table 7.14) 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 geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.14.

Highly suitable (Class S1) lands for growing sapota occur in an area of 35 ha (6%) and distributed in the southern part of the microwatershed. Moderately (Class S2) suitable lands occupy an area of 185 ha (34%) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, texture, calcareousness and gravelliness. Major area of about 223 ha (41%) is marginally suitable (Class S3) for growing sapota and are distributed in the major part of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Not suitable lands (Class N) occupy an area of about 98 ha (18%) and are distributed in the northwestern, central, western and southeastern part of the microwatershed. They have severe limitation of rooting depth.

Table 7.15 Crop suitability criteria for Sapota

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

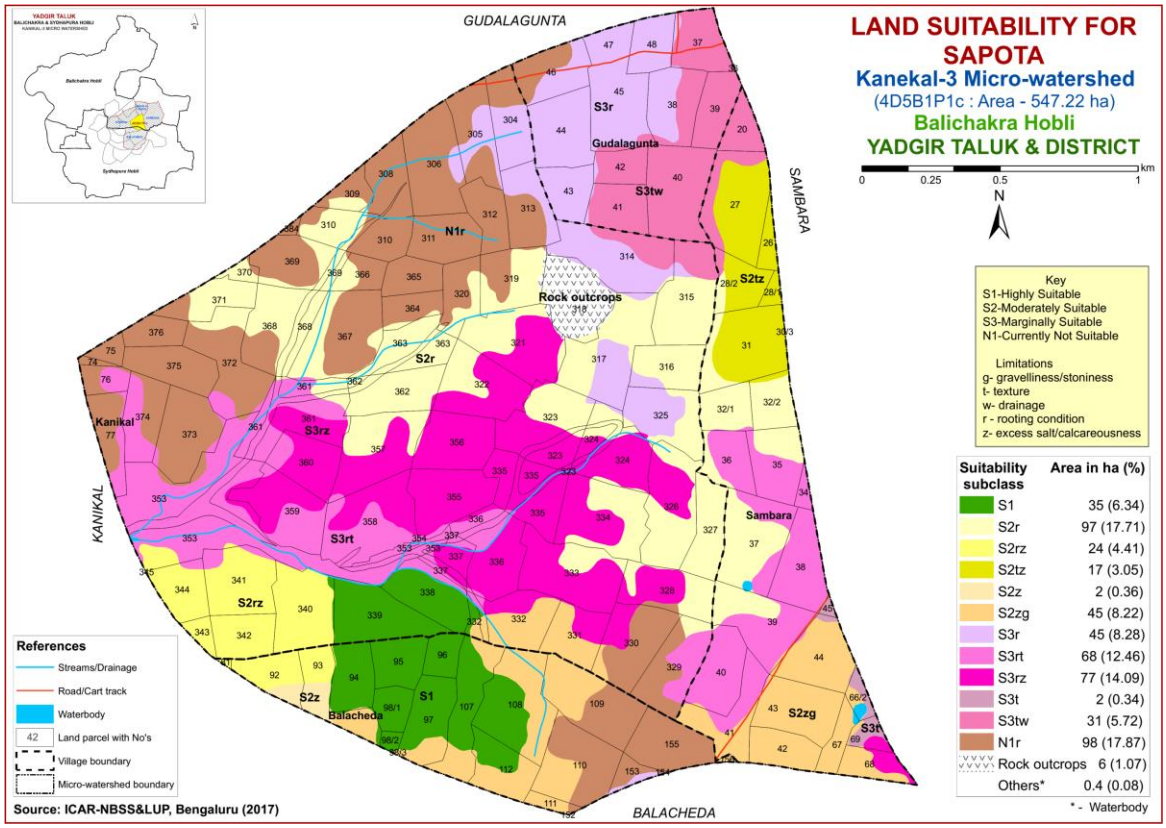


Fig. 7.14 Land Suitability map of Sapota

7.15 Land Suitability for Guava (*Psidium guajava*)

Guava is one of the most important fruit crop grown in about 6558 ha in the State of Raichur, Dharwad, Belgaum, Kalaburgi, Bijapur, Bidar, Bellary, Chitradurga, Bangalore, Kolar, Chikkaballapur and Chamarajnagar districts. The crop requirements for growing guava (Table 7.15) 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 geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.15.

Highly suitable (Class S1) lands occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Moderately suitable (Class S2) lands occupy 185 ha (34%) and are distributed in all parts of the microwatershed. They have minor limitations of rooting depth, texture and calcareousness. Major area of about 223 ha (41%) is marginally suitable (Class S3) for growing guava and are distributed in the major part of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Not suitable lands (Class N) occupy an area of about 98 ha (18%) and are distributed in the northwestern, western, central and southeastern part of the microwatershed. They have severe limitations of rooting depth and texture.

Table 7.16 Crop suitability criteria for Guava

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

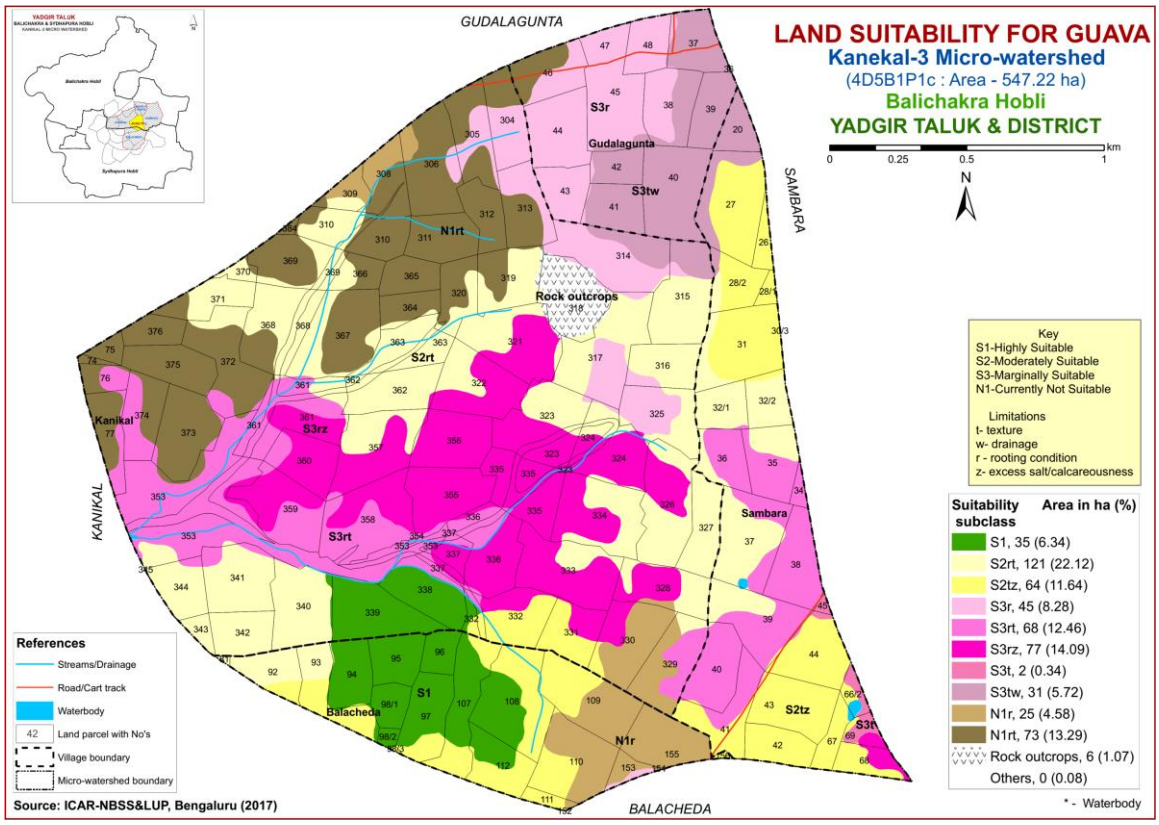


Fig 7.15 Land Suitability map of Guava

7.16 Land Suitability for Pomegranate (*Punica granatum*)

Pomegranate is one of the most important fruit crop commercially grown in about 18488 ha in Karnataka in an area of about 0.16 lakh ha mainly in Bijapur, Bagalkot, Koppal, Gadag and Chitradurga districts. The crop requirements for growing pomegranate (Table 7.16) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing pomegranate was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.16.

In Kanekal-3 microwatershed the highly (Class S1) suitable lands for growing pomegranate occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Major area of about 216 ha (39%) is moderately suitable (Class S2) for pomegranate and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, texture, calcareousness and drainage. An area of about 192 ha (35%) is marginally suitable (Class S3) for growing pomegranate and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. An area of about 98 ha (18%) is not suitable (Class N) for growing pomegranate and are distributed in the northwestern, western and southeastern part of the microwatershed. They have severe limitation of rooting depth.

Table 7.17 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		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	
	pH	1:2.5	5.5-7.5	7.6-8.5	8.6-9.0	
Rooting conditions	Soil depth	cm	>100	75-100	50-75	<50
	Gravel content	% vol.	nil	15-35	>35	
Soil toxicity	Salinity	ds/m	Nil	<9	>9	<50
	Sodicity	%	nil			
Erosion	Slope	%	<3	3-5	5-10	

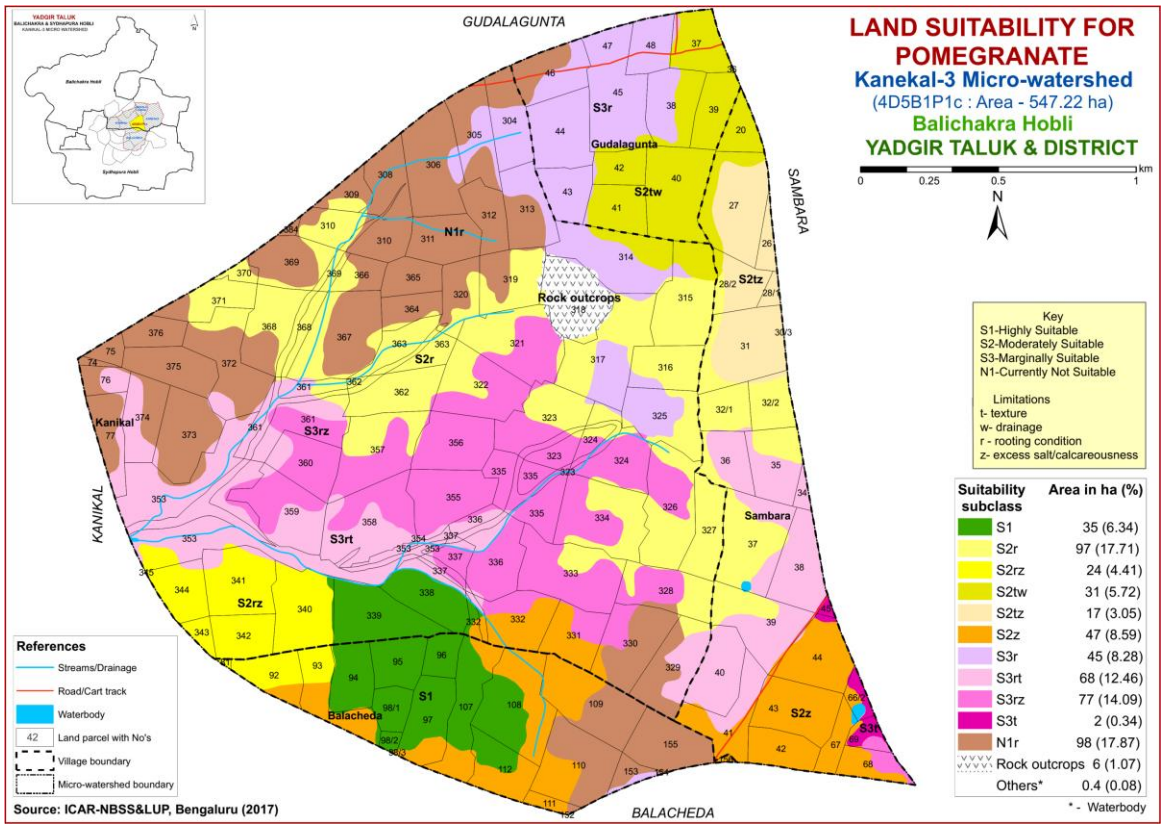


Fig 7.16 Land Suitability map of Pomegranate

7.17 Land Suitability for Jackfruit (*Artocarpus heterophyllus*)

Jackfruit is one of the most important fruit crop grown in 5368 ha in almost all the districts of the state. The crop requirements for growing jackfruit (Table 7.17) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jackfruit was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.17.

Highly suitable (Class S1) lands occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Moderately suitable (Class S2) lands occur in an area of 168 ha (31%) and are distributed in the all parts of the microwatershed. They have minor limitations of rooting depth, calcareousness and gravelliness. Major area of about 240 ha (44%) is marginally suitable (Class S3) for growing jackfruit and are distributed in the major part of the microwatershed. They have moderate limitations of texture, drainage, calcareousness and rooting depth. Not suitable lands (Class N) occupy an area of about 98 ha (18%) and are distributed in the northwestern, western and southeastern part of the microwatershed. They have severe limitations of rooting depth and texture.

Table 7.18 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	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	-

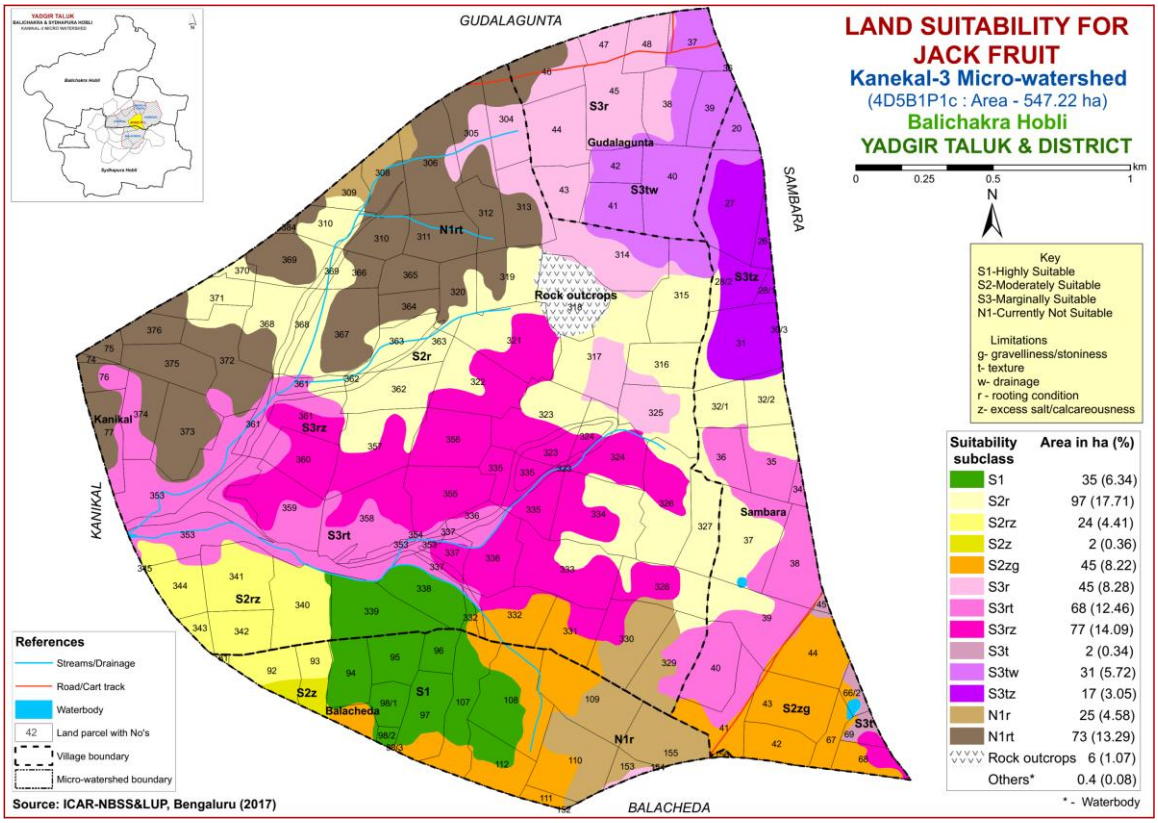


Fig 7.17 Land Suitability map of Jackfruit

7.18 Land Suitability for Jamun (*Syzygium cumini*)

Jamun is one of the most important fruit crop grown in almost all the districts of the state. The crop requirements for growing jamun (Table 7.18) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing jamun was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.18.

In Kanekal-3 microwatershed the highly suitable (Class S1) lands for growing jamun occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. An area of about 95 ha (17%) is moderately suitable (Class S2) for jamun and is distributed in the northern, southeastern and southern part of the

microwatershed. They have minor limitations of texture, rooting depth, calcareousness and drainage. Maximum area of about 313 ha (57%) is marginally suitable (Class S3) for growing jamun and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. An area of about 98 ha (18%) is not suitable (Class N) for growing jamun and are distributed in the northwestern, western and southeastern part of the microwatershed. They have severe limitations of rooting depth and texture.

Table 7.19 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

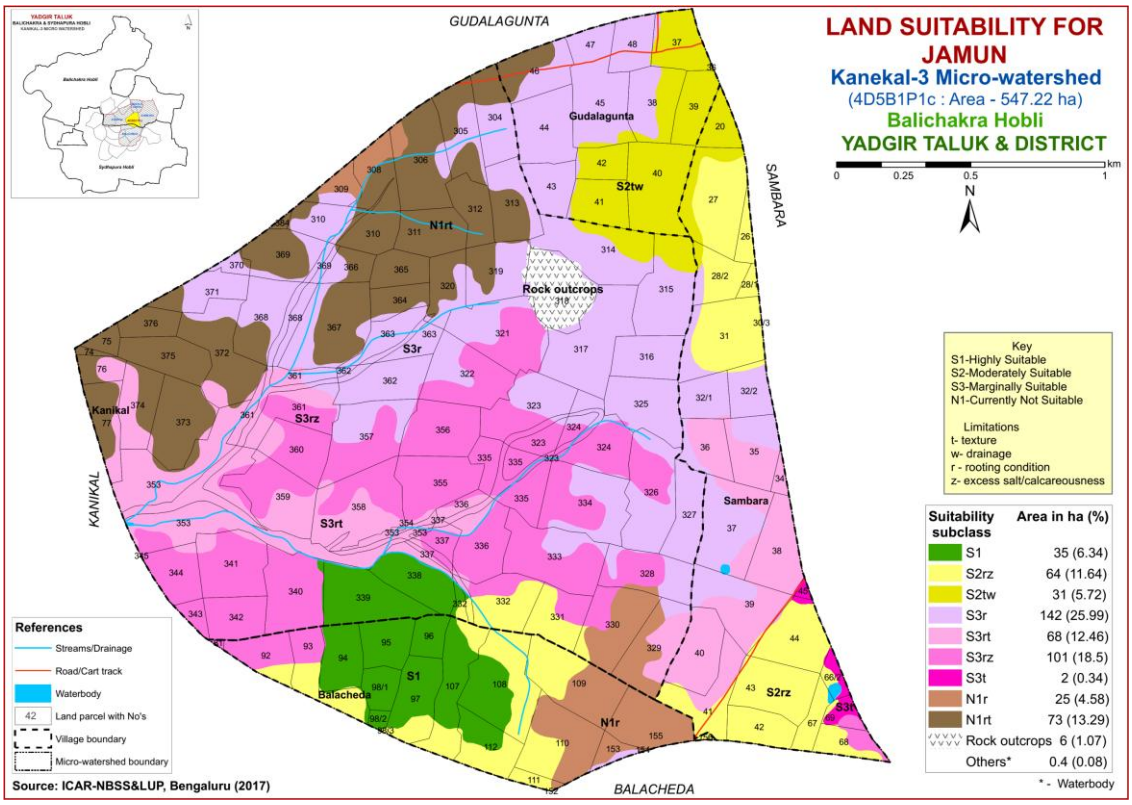


Fig 7.18 Land Suitability map of Jamun

7.19 Land Suitability for Musambi (*Citrus limetta*)

Musambi is one of the most important fruit crop grown in an area of 5446 ha in almost all the districts of the state. The crop requirements for growing musambi were matched with the soil-site characteristics and a land suitability map for growing musambi was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.19.

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing musambi occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Major area of about 216 ha (39%) is moderately suitable (Class S2) for musambi and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness, texture and drainage. An area of about 192 ha (35%) is marginally suitable (Class S3) for growing musambi and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. An area of about 98 ha (18%) is not suitable (Class N) for growing musambi and are distributed in the northwestern, western and southeastern part of the microwatershed. They have severe limitation of rooting depth.

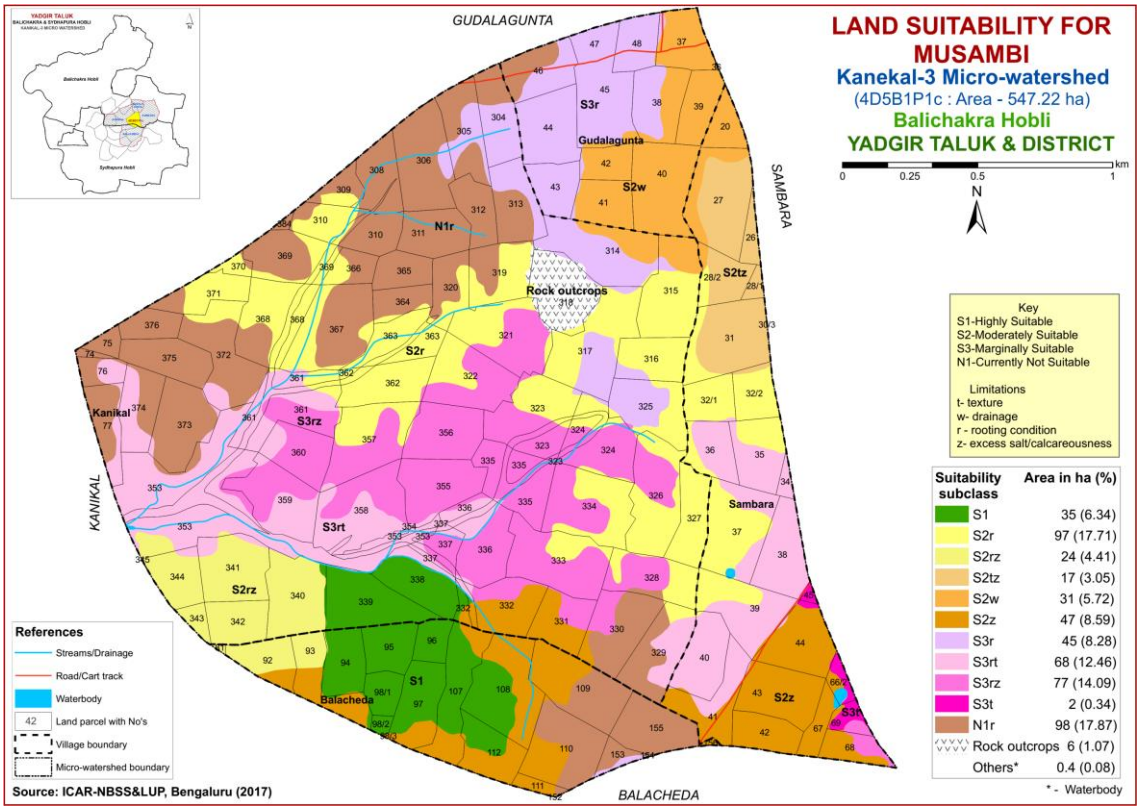


Fig 7.19 Land Suitability map of Musambi

7.20 Land Suitability for Lime (*Citrus sp*)

Lime is one of the most important fruit crop grown in 11752 ha in almost all the districts of the state. The crop requirements for growing lime (Table 7.19) 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 is given in Figure 7.20.

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing lime occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Major area of about 216 ha (39%) is moderately suitable (Class S2) for lime and is distributed in the major part of the microwatershed. They have minor limitations of rooting depth, calcareousness, gravelliness and drainage. An area of about 192 ha (35%) is marginally suitable (Class S3) for growing lime and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. An area of about 98 ha (18%) is not suitable (Class N) for growing lime and are distributed in the northwestern, western and southeastern part of the microwatershed. They have severe limitation of rooting depth.

Table 7.20 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	Temp. 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%)	s, ls
	pH	1:2.5	6.0-7.5	5.5-6.4,7.6-8.0	4.0-5.4, 8.1-8.5	<4.0,>8.5
	$CaCO_3$ in root zone	%	Non calcareous	Upto 5	5-10	>10
Rooting condition	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	

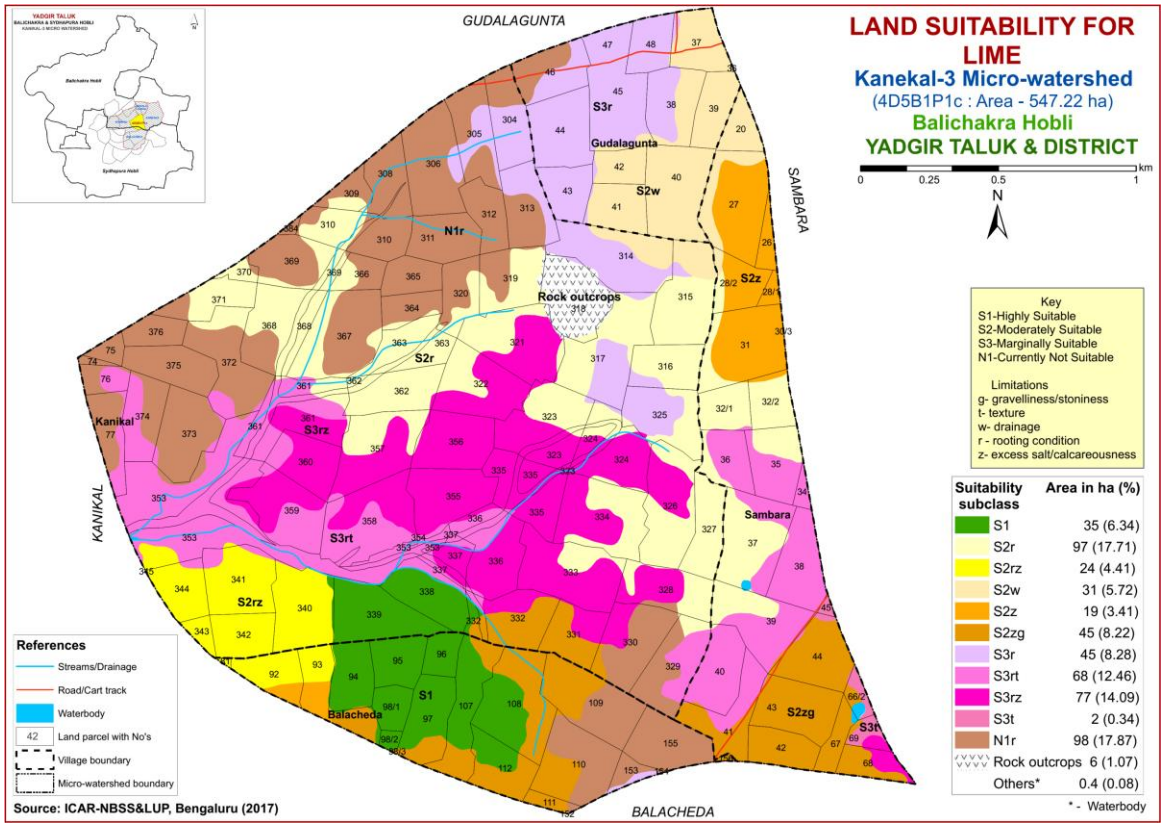


Fig 7.20 Land Suitability map of Lime

7.21 Land Suitability for Cashew (*Anacardium occidentale)*

Cashew is one of the most important plantation nut crop grown in an area of about 70552 ha in almost all the districts. The crop requirements for growing Cashew (Table 7.20) 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 is given in Figure 7.21.

Highly suitable (Class S1) lands for growing cashew occupy an area of 35 ha (6%) and are distribute in the southern part of the microwatershed. Moderately suitable (Class S2) lands occupy 121 ha (22%) and are distributed in the eastern, central, western and southwestern part of the microwatershed. They have minor limitations of rooting depth and texture. Major area of about 209 ha (35%) is marginally suitable for cashew and are distributed in the major part of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Not suitable (Class N1) lands for growing cashew occur in 176 ha (32%) in all parts of the microwatershed. They have severe limitations of rooting depth, texture, drainage and calcareousness.

Table 7.21 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	

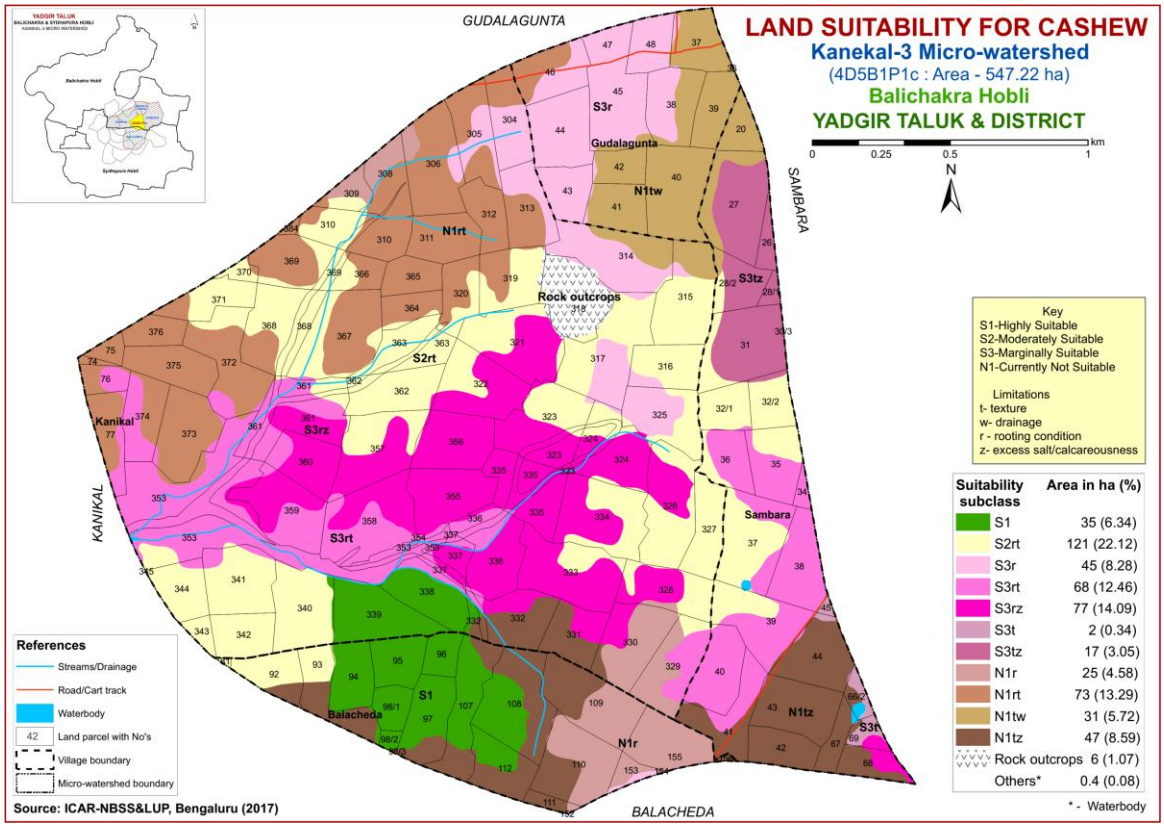


Fig 7.21 Land Suitability map of Cashew

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

Custard apple is one of the most important fruit crop grown in 1426 ha in almost all the districts of the state. The crop requirements for growing custard apple (Table 7.21) 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 is given in Figure 7.22.

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing custard apple occupy an area of 132 ha (24%) and are distributed in the eastern, central, western and southern part of the microwatershed. Major area of about 224 ha (41%) is moderately suitable (Class S2) for growing custard apple and are distributed in the major

part of the microwatershed. They have minor limitations of drainage, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 182 ha (33%) and are distributed in all parts of the microwatershed. They have moderate limitations of rooting depth, texture and calcareousness. Not suitable (Class N1) lands occupy a very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed.

Table 7.22 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	

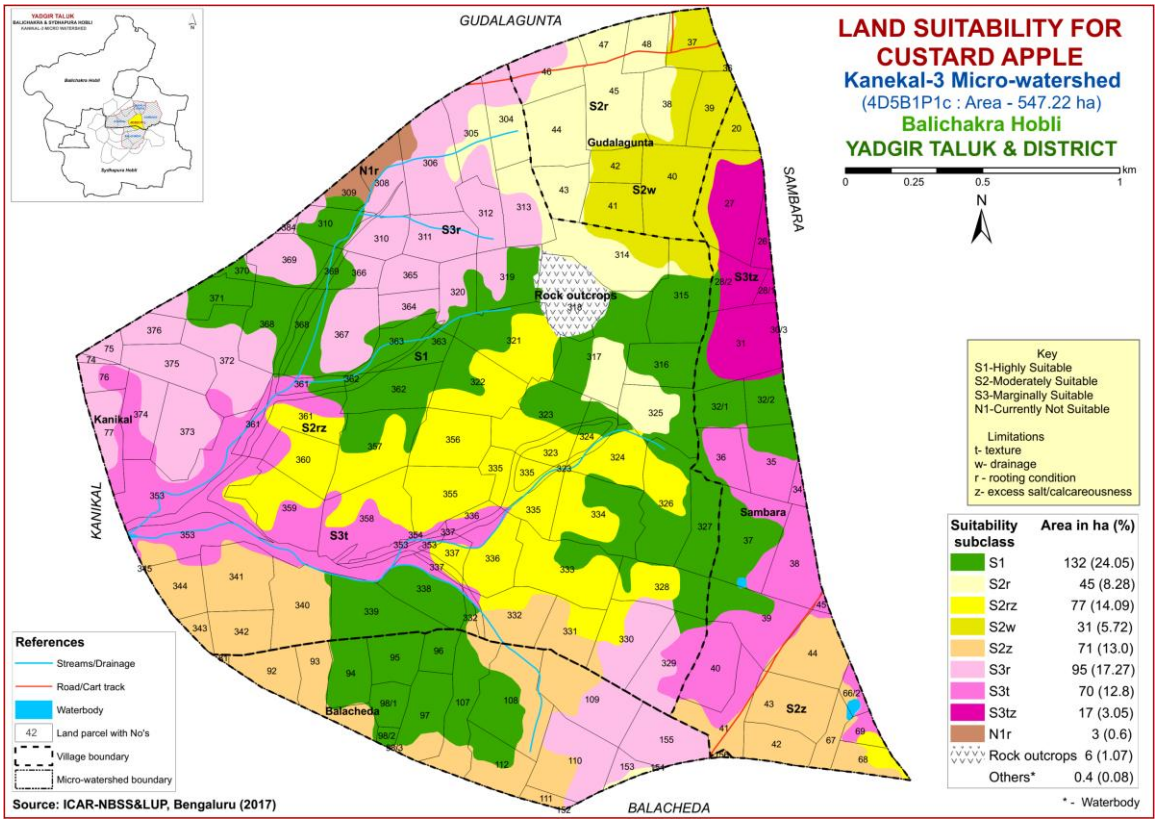


Fig 7.22 Land Suitability map of Custard Apple

7.23 Land Suitability for Amla (*Phyllanthus emblica*)

Amla is one of the most important medicinal and fruit plant grown in 151 ha in almost all the districts of the state. The crop requirements for growing amla (Table 7.22) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing amla was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.23.

Table 7.23 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

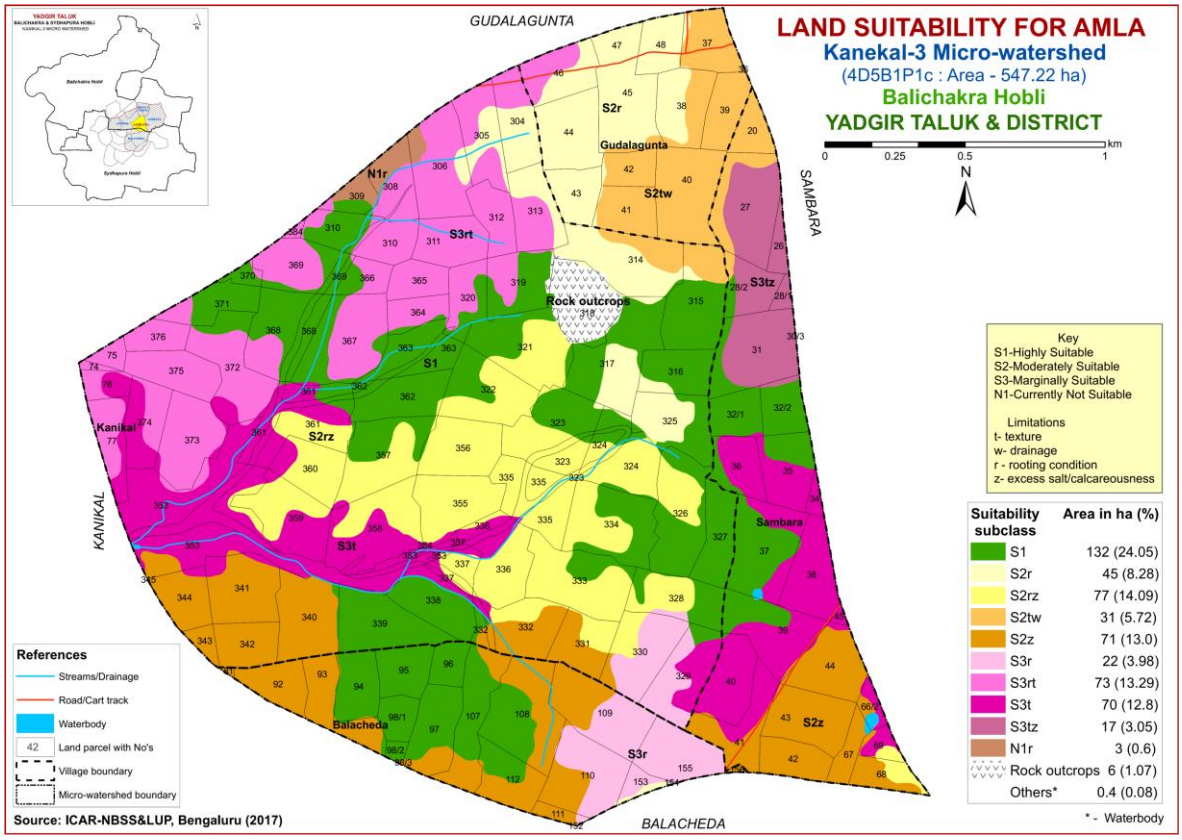


Fig 7.23 Land Suitability map of Amla

In Kanekal-3 microwatershed, the highly (Class S1) suitable lands for growing amla occupy an area of 132 ha (24%) and are distributed in the eastern, central, western and southern part of the microwatershed. Major area of about 224 ha (41%) is moderately

suitable (Class S2) for growing amla and are distributed in the major part of the microwatershed. They have minor limitations of drainage, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 182 ha (33%) and are distributed in all part of the microwatershed. They have moderate limitations of rooting depth, calcareousness and texture.

7.24 Land Suitability for Tamarind (*Tamarindus indica*)

Tamarind is one of the most important spice crop raised in 14897 ha in all the districts of the state. The crop requirements for growing tamarind (Table 7.23) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing tamarind was generated. The area extent and their geographic distribution of different suitability subclasses in the microwatershed is given in Figure 7.24.

Highly suitable (Class S1) lands for growing tamarind occupy an area of 35 ha (6%) and are distributed in the southern part of the microwatershed. Moderately suitable (Class S2) lands occur in 95 ha (17%) and are distributed in the northern, eastern, southern and southeastern part of the microwatershed. An area of about 123 ha (22%) is marginally suitable (Class S3) for growing tamarind and are distributed in the western, central, eastern and southwestern part of the microwatershed. They have moderate limitations of texture, calcareousness and rooting depth. Not suitable lands (Class N1) occupy maximum area of about 289 ha (53%) and are distributed in the major part of the microwatershed. They have severe limitations of rooting depth, texture and calcareousness.

Table 7.24 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	<50
	Gravel content	% vol.	<15	15-35	35-60	60-80
Erosion	Slope	%	0-3	3-5	5-10	>10

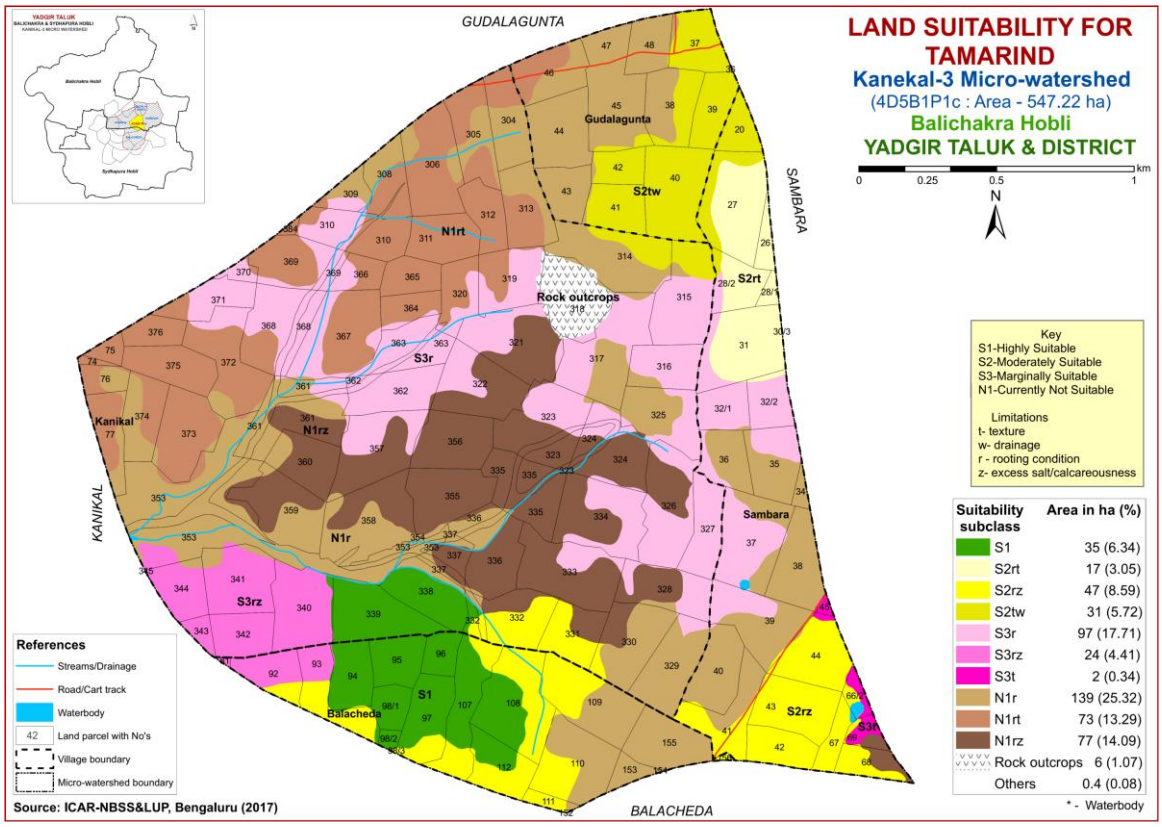


Fig 7.24 Land Suitability map of Tamarind

7.25 Land suitability for Marigold (*Tagetes sps.)*

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 for growing marigold (Table 7.24) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing marigold was generated. The area extent and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.25.

In Kanekal-3 microwatershed, there are no lands that are highly (Class S1) suitable for growing marigold. Major area of about 373 ha (68%) is moderately suitable (Class S2) for growing marigold and are distributed in the major part of the microwatershed. They have minor limitations of drainage, gravelliness, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 165 ha (30%) and are distributed in the northwestern, western, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth and texture. Not suitable lands (Class N1) occupy a very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

Table 7.25 Land suitability criteria for Marigold

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

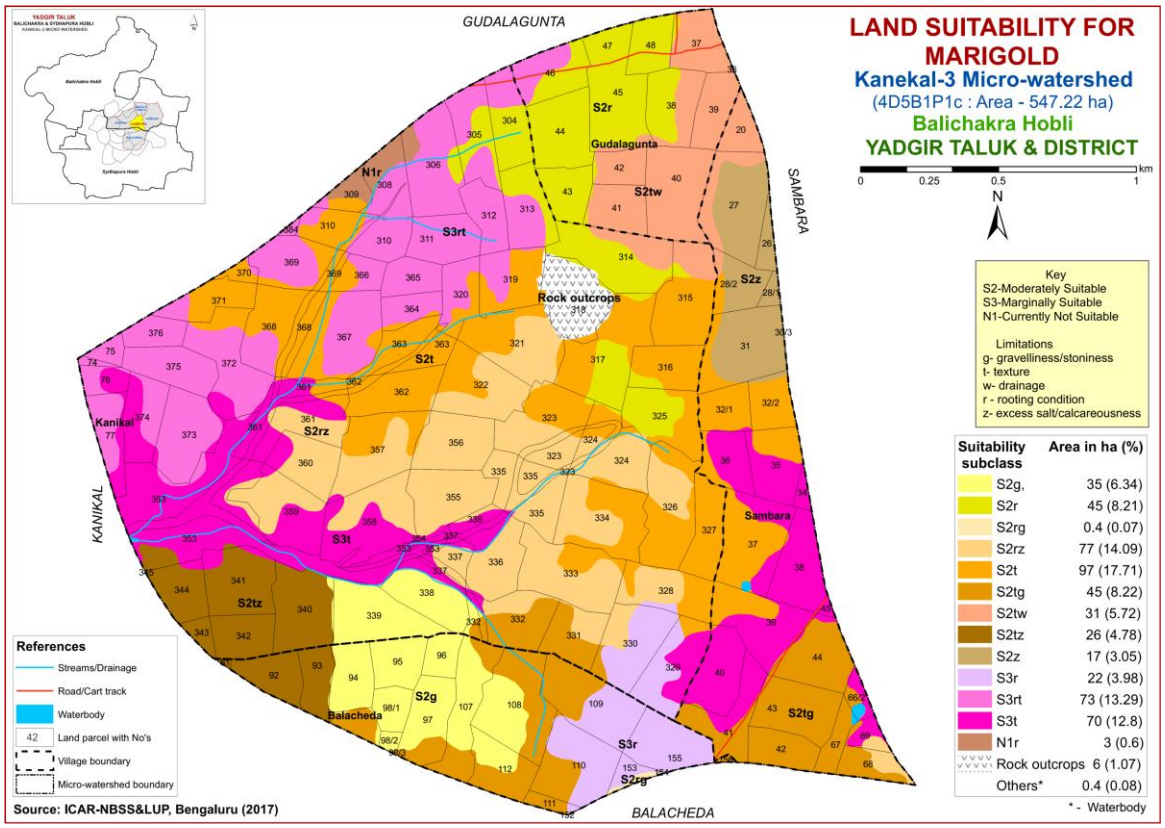


Fig. 7.25 Land Suitability map of Marigold

7.26 Land suitability for Chrysanthemum (*Dendranthema grandiflora*)

Chrysanthemum is one of the most important flower crop grown in an area of 4978 ha in almost all the districts of the State. The crop requirements for growing chrysanthemum (Table 7.25) were matched with the soil-site characteristics (Table 7.1) and a land suitability map for growing chrysanthemum was generated. The area extent

and their geographical distribution of different suitability subclasses in the microwatershed is given in Figure 7.26.

Table 7.26 Land suitability criteria for Chrysanthemum

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

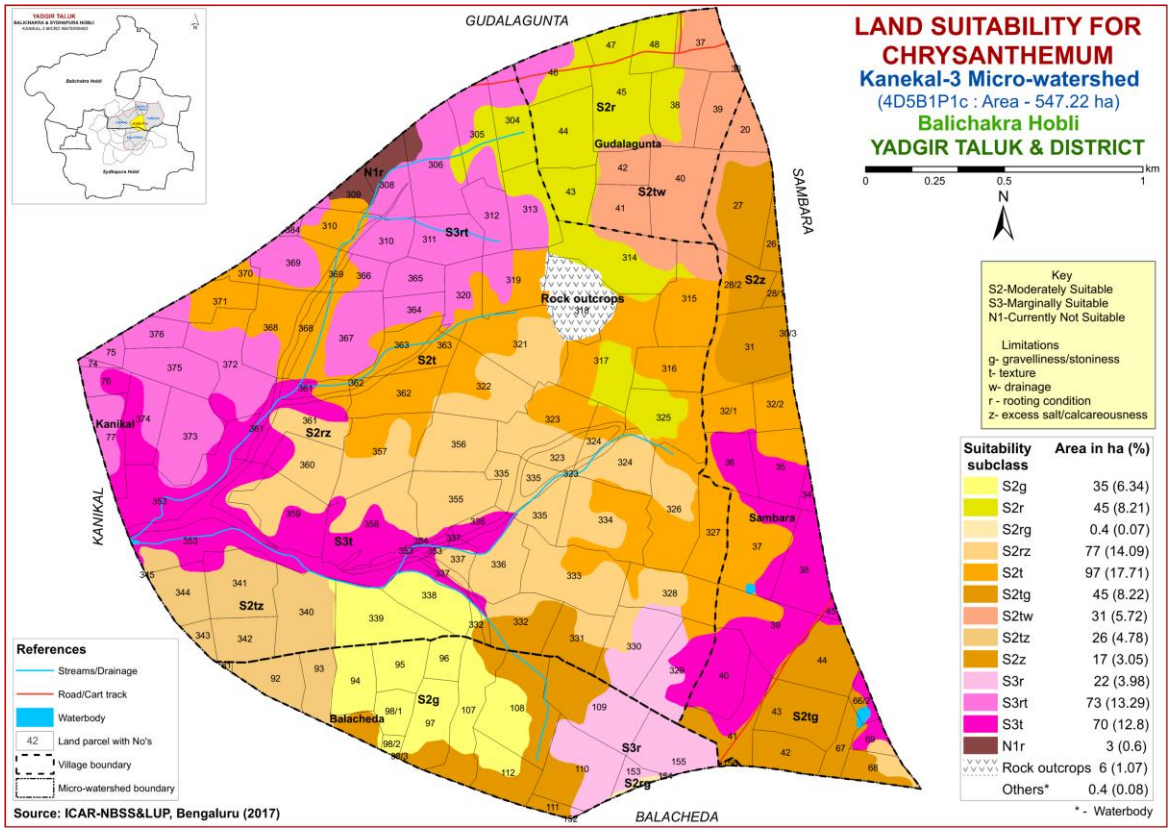


Fig. 7.26 Land Suitability map of Chrysanthemum

In Kanekal-3 microwatershed, there are no lands that are highly (Class S1) suitable for growing chrysanthemum. Major area of about 373 ha (68%) is moderately suitable (Class S2) for growing chrysanthemum and are distributed in the major part of

the microwatershed. They have minor limitations of drainage, gravelliness, texture, calcareousness and rooting depth. Marginally suitable lands (Class S3) occupy an area of about 165 ha (30%) and are distributed in the northwestern, western, central and southeastern part of the microwatershed. They have moderate limitations of rooting depth and texture. Not suitable lands (Class N1) occupy a very small area of 3 ha (1%) and are distributed in the northwestern part of the microwatershed with severe limitation of rooting depth.

7.27 Land Management Units (LMU)

The 18 soil map units identified in Kanekal-3 microwatershed have been grouped into seven 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.7.27) has been generated. These Land Management Units are expected to behave similarly for a given level of management.

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

LMU NO.	Soil Map Unit number	Soil Map Units	Soil and site characteristics
1	65,44,45,38,41	BMDiB2g1 GDGbB2 GDGbB3g1 BLCiB2 PGPiB2	Moderately deep to very deep, red sandy clay to sandy clay loam soils, slopes 1-3%, moderate to severe erosion and non gravelly to gravelly (<15-35%)
2	50,62	BGDbB2 BMNmB2	Deep to very deep, black clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)
3	42	YDRcB2	Deep, black loamy sand to sandy loam soils, slope 1-3%, moderate erosion and non gravelly (<15%)
4	25,26,29,31	DPLcB2 DPLiB2 YLRcB2g1 YLRiB2	Moderately shallow, red clayey soils, slopes 1-3%, moderate erosion and non gravelly to gravelly (<15-35%)
5	11,13	SBRcB2 SBRiB2	Moderately shallow, black loamy sand soils, slopes 1-3%, moderate erosion and non gravelly (<15%)
6	9	VNKcB2	Shallow, red clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)
7	1,5	BDPiB2 BDLiB2	Very shallow to shallow, black clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)

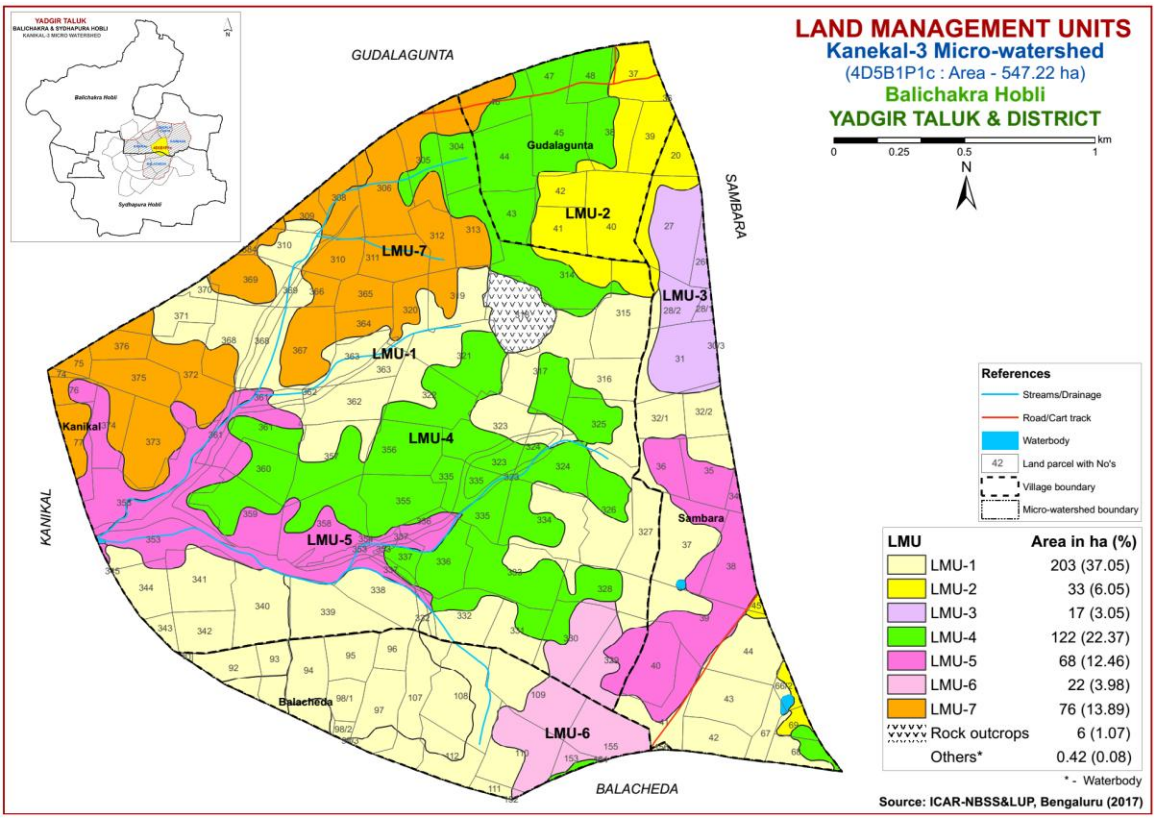


Fig. 7.27 Land Management Units (LMU) map of Kanekal-3 microwatershed

7.28 Proposed Crop Plan for Kanekal-3 Microwatershed

After assessing the land suitability for the 26 crops, a 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 26 crops. The resultant proposed crop plan is presented in Table 7.26.

Table 7.27 Proposed Crop Plan for Kanekal-3 Micro-watershed

Proposed Land use Class	Soil Map Units	Survey Number	Soil characters	Field Crops	Horticulture Crops	Suitable Interventions
1	65. BMDiB2g1 44.GDGbB2 45. GDGbB3g1 38.BLCiB2 41. PGPiB2	**Balacheda:**107,108,111,112,152,156,81,92,93,94,95,96,97,98/1,98/2,98/3 **Kanikal:**315,316,317,319,326,327,331,332,334,338,339,340,341,342,343,344,345,362,363,368,370,371 **Sambara:**32/1,32/2,37,41,42,43,44,67,68	Moderately deep to very deep, red sandy clay to sandy clay loam soils, slopes 1-3%, moderate to severe erosion and non gravelly to gravelly (<15-35%)	Maize, Sorghum, Groundnut, Redgram, Bajra	**Fruit crops:** Sapota, Guava, Jackfruit, Musambi, Pomegranate, Jamun, Lime, Tamarind, Amla, Custard apple, **Vegetables:** Tomato, Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Drip irrigation, mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)
2	50.BGDbB2 62.BMNmB2	**Gudalagunta:**36,37,39,40,41,42 **Sambara:** 20,45,66/2,69	Deep to very deep, black clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)	Sunflower, Sorghum, Cotton, Bengal gram, Safflower, Linseed, Bajra	**Fruit crops:** Mango**,** Pomegranate, Lime, Musambi, Tamarind, Jamun, Amla, Custard apple, **Vegetables:** Drumstick, Chilli, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, Mulching, suitable soil and water conservation practices
3	42. YDRcB2	**Sambara:**26,27,28/1,28/2,30/2,30/3,31	Deep, black loamy sand to sandy loam soils, slope 1-3%, moderate erosion and non gravelly (<15%)	Sorghum, Sunflower, Bajra	**Fruit crops:** Musambi, Pomegranate, Lime, Amla, Jamun, Custard apple, Tamarind, **Vegetables:** Drumstick, Coriander **Flowers:** Marigold, Chrysanthemum	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices

4	25. DPLcB2 26. DPLiB2 29. YLRcB2g1 31. YLRiB2	**Gudalagunta:**38,43,44,45,46,47,48 **Kanikal:**304,314,321,322, 323,324,325,328,333,335, 336,337,355,356,357,359, 360	Moderately shallow, red clayey soils, slopes 1-3%, moderate erosion and non gravelly to gravelly (<15-35%)	Maize, Sorghum, Groundnut, Bajra, Redgram	**Fruit crops:** Amla, Custard apple **Vegetables:** Tomato, Chilli **Flowers:** Marigold Chrysanthemum	Drip irrigation, mulching, suitable conservation practices (Crescent Bunding with Catch Pit etc)
5	11. SBRcB2 13. SBRiB2	**Kanikal:**353,354,358,361, 374 **Sambara:**34,35,36,38,39, 40	Moderately shallow, black loamy sand soils, slopes 1-3%, moderate erosion and non gravelly (<15%)	Groundnut, Bajra, Sorghum, Sunflower	**Vegetables:** Onion **Agri-Silvi-Pasture:** Custard apple, Amla**,** Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra*	Application of FYM, Biofertilizers and micronutrients, drip irrigation, mulching, suitable soil and water conservation practices
6	9. VNKcB2	**Balacheda:**109,110,153,154,155 **Kanikal:** 329,330	Shallow, red clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)	Horsegram, Bajra	**Agri-Silvi-Pasture:** Custard apple, Amla Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra*	Use of short duration varieties, sowing across the slope and split application of nitrogen fertilizers
7	1.BDPiB2 5. BDLiB2	**Kanikal:**305,306,308,309, 310,311,312,313,320,364, 365,366, 367,369,372,373, 375,376,384,74,75,76,77	Very shallow to shallow, black clayey soils, slopes 1-3%, moderate erosion and non gravelly (<15%)	-	**Agri-Silvi-Pasture:** -Hybrid Napier, *Styloxanthes hamata*, Glyricidia, *Styloxanthes scabra*	Use of short duration varieties, 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 characteristics of a healthy soil are

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

Characteristics of Kanekal-3 Microwatershed

- The soil phases with sizeable area identified in the microwatershed belonged to the soil series of PGP (97 ha), DPL (77 ha), BDL (73 ha), YLR (49 ha), GDG (46 ha), BMD (35 ha), BMN (31 ha), SBR (28 ha), BLC (24 ha), YNK (22 ha), YDR (17 ha), BDP (3 ha) and BGD (2 ha).
- As per land capability classification, entire area comes under arable land category (Class II, III and IV). The major limitations identified in the arable lands were soil and erosion.
- On the basis of soil reaction, about 306 ha (56%) area is neutral (pH 6.5-7.3) followed by slightly alkaline (pH 7.3-7.8) soils in 114 ha (26%). An area of about

88 ha (16%) is moderately alkaline (pH 7.8-8.4) in reaction. Small area of about 3 ha (1%) is slightly acidic (pH 6.0-6.5) in reaction. Thus, about 56 per cent of the soils in the microwatershed are neutral 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 moderately 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 – 5kg/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. Entire area of the microwatershed is suffering from either moderate or severe erosion. These areas need immediate soil and water conservation and other land husbandry practices for restoring soil health.

Dissemination of Information and Communication of Benefits

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

technologies such as Cellular phones and the Internet, which can be much more effective in reaching the younger farmers.

Inputs for Net Planning (Saturation Plan) and Interventions needed

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

1. Soil and Water Conservation Treatment Plan 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 (Saturation Plan) 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 may be adopted.
- **Gravelliness:** More gravel content is favourable 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 Kanekal-3 microwatershed.
- **Organic Carbon:** In about 172 ha (31%) area, the OC content is medium (0.5-0.75%) and about 369 ha (67%) area high (>0.75%). In the areas of medium OC, it 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 cost 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 172 ha area where OC is less than 0.5-0.75%. 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**: In 113 ha (21%) area, the available phosphorus is low, an area of about 344 ha (63%) it is medium and an area of about 84 ha (15%) is high in available phosphorus in the microwatershed. Hence for all the crops, 25% additional P-needs to be applied, where it is low or medium in available phosphorus.
- **Available Potassium:** Available potassium is low in 25 ha (5%), medium in 505 ha (92%) area of the microwatershed. Hence, in all these plots, for all crops, additional 25 % potassium may be applied. It is high in 11 ha (2%) area of the microwatershed.
- **Available Sulphur:** Available sulphur is a very critical nutrient for oilseed crops. It is low in 376 ha (69%) area of the microwatershed and medium in 165 ha (30%).These areas need to be applied with magnesium sulphate or gypsum or Factamphos (p) fertilizer (13% sulphur) for 2-3 years for the deficiency to be corrected.
- **Available Boron:** It is low in 285 ha (52%) area of the microwatershed and medium in 210 ha (38%). For all these areas, sodium borate @ 10 kg/ha needs to be applied. High in an area of about 47 ha (9%) in the microwatershed.
- **Available iron:** It is deficient in 61 ha (11%) area and it is sufficient in 480 ha (88%) area in the microwatershed. To manage iron deficiency, iron sulphate @ 25 ka/ha needs to be applied.
- **Available Zinc:** Entire area is deficient in available zinc. Application of zinc sulphate @25kg/ha is to be followed.

Soil alkalinity: The microwatershed has 232 ha area with soils that are alkaline in reaction. 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.

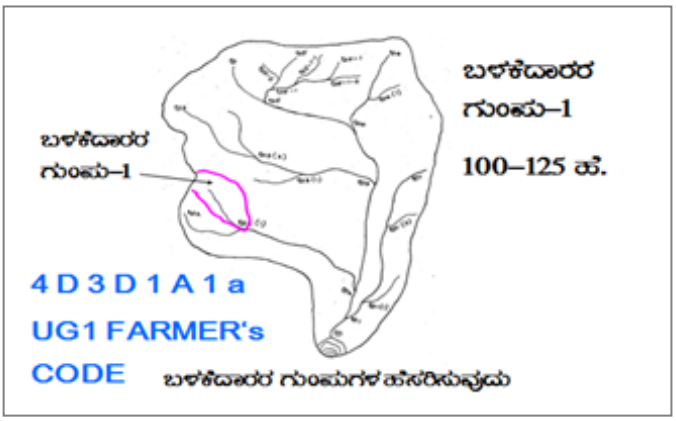
Land Suitability for various crops: Areas that are highly, moderately, marginally suitable and not suitable for growing various crops are indicated. Along with the suitability, various constraints that are limiting the productivity are also indicated. For example, in case of cotton, gravel content, rooting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

Chapter 9

SOIL AND WATER CONSERVATION TREATMENT PLAN

For preparing soil and water conservation treatment plan for Kanekal-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 needs to be collected.

Steps for Survey and Preparation of Treatment Plan

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

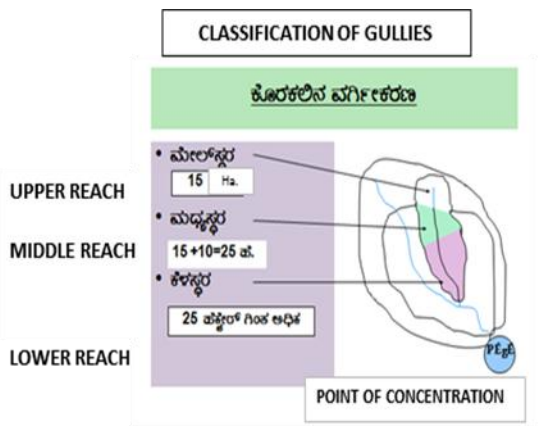
- Naming of user groups and farmers
- Identification of arable and non arable lands
- Identification of drainage lines and gullies
- Identification of non treatable areas
- Identification of priority areas in the arable lands
- Treatment plan for arable lands
- Location of water harvesting and recharge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

9.1 Treatment Plan

The treatment plan recommended for arable lands is briefly described below

9.1.1 Arable Land Treatment

A. BUNDING

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

Measurement of Land Slope

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

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

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

Note: (i) The above intervals are maximum.

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

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

Section of the Bund

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

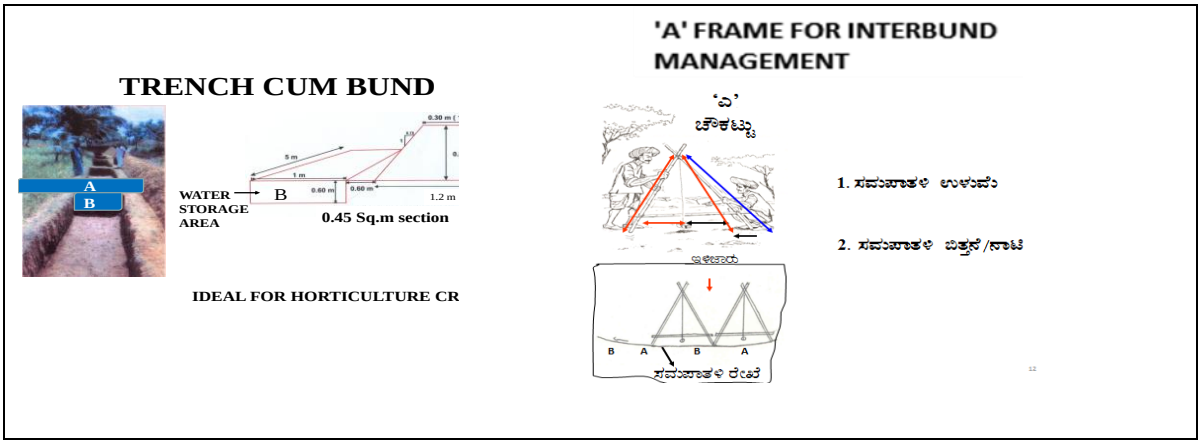
Recommended Bund Section

Top width (m)	Base width (m)	Height (m)	Side slope (Z:1;H:V)	Cross section (sq m)	Soil Texture	Remarks
0.3	0.9	0.3	01:01	0.18	Sandy loam	Vegetative bund
0.3	1.2	0.3	1.5:1	0.225	Sandy clay	
0.3	1.2	0.5	0.9:1	0.375	Red gravelly soil	
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. Water Ways

- Existing waterways are marked on the cadastral map (1:7920 scale) and their dimensions are recorded.
- Considering the contour plan of the MWS, additional waterways/ modernization of the existing ones can be thought of.
- 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 drainage lines (gullies/ *nalas/ hallas*) and existing structures are marked to the scale and storage capacity of the existing water bodies are documented.

b) The drainage line will be demarcated into Upper Reach, Middle Reach and Lower Reach.
c) Considering the Catchment, *Nala* bed and bank conditions, suitable structures are decided.
d) Number of storage structures (Check dam/ *Nala* bund/ Percolation tank) will be decided considering the commitments and available runoff in water budgeting and quality of water in the wells and site suitability.
e) Detailed 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 earthen checks in the natural water course. Location and design details are given in the Manual.

9.2 Recommended Soil and Water Conservation Measures

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

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

A map (Fig. 9.1) showing soil and water conservation plan with one kind of conservation structure recommended has been prepared, which shows the spatial distribution and extent of area. Major area of about 350 ha (64%) requires Trench cum Bunding and 191 ha (35%) requires Graded Bunding.

The conservation plan prepared may be presented to all the stakeholders including farmers and after including their suggestions, the conservation plan for the microwatershed may be finalised in a participatory approach.

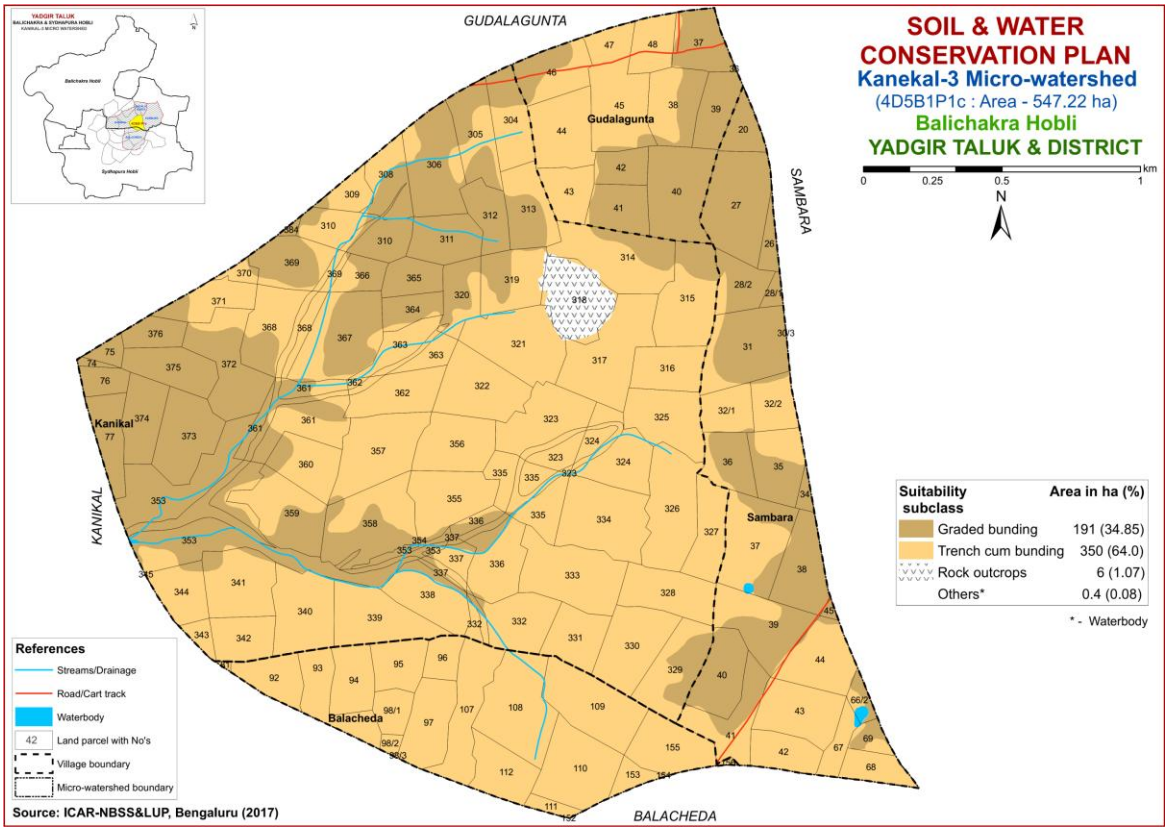


Fig. 9.1 Soil and Water Conservation Plan map of Kanekal-3 Microwatershed

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 and field bunds for growing annual and perennial crops. The method of planting these trees is given below.

It is recommended to open 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

Kanikal-3 Microwatershed

Soil Phase Information

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Kanikal	74	0.29	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	75	0.97	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Graded bunding
Kanikal	76	1.67	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIIes	Graded bunding
Kanikal	77	3.4	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy+Redgram (Pd+Rg)	Not Available	IIIes	Graded bunding
Kanikal	304	4.39	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	305	4.85	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIIes	Graded bunding
Kanikal	306	7.06	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIIes	Graded bunding
Kanikal	308	3.7	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIIes	Graded bunding
Kanikal	309	1.88	BDPiB2	LMU-7	Very shallow (<25 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IVs	Trench cum bunding
Kanikal	310	5.3	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Graded bunding
Kanikal	311	4.08	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	312	3.07	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Jowar (Gn+Jw)	Not Available	IIIes	Graded bunding
Kanikal	313	4.68	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Jowar (Gn+Jw)	Not Available	IIIes	Graded bunding
Kanikal	314	7.75	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Jowar+Redgram (Ct+Jw+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	315	6.95	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	316	3.96	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	317	8.4	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	318	5.8	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Not Available	Rock outcrops	Rock outcrops
Kanikal	319	4.92	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	320	3.25	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	321	7.4	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Groundnut (Ct+Gn)	Not Available	IIes	Trench cum bunding
Kanikal	322	6.34	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Kanikal	323	6.88	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Trench cum bunding
Kanikal	324	5.49	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	325	5.5	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	326	7.39	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	327	4.01	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	328	5.08	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	329	5.79	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Kanikal	330	6.13	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Kanikal	331	3.95	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Kanikal	332	5.18	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Groundnut (Gn)	Not Available	IIIes	Trench cum bunding
Kanikal	333	7.69	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	334	7.65	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	335	5.08	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy+Redgram (Pd+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	336	5.78	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	337	1.51	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Trench cum bunding
Kanikal	338	4.83	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	339	6.11	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	340	6.19	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	341	5.91	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	342	3.45	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	343	0.97	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	344	3.5	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	345	0	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	353	17.99	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Grassland (Gl)	Not Available	IIes	Graded bunding

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Kanikal	354	0.04	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Graded bunding
Kanikal	355	5.7	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Paddy (Pd)	Not Available	IIes	Trench cum bunding
Kanikal	356	5.28	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	357	7.09	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	358	8	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Graded bunding
Kanikal	359	6.23	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	360	4.2	DPLiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	361	6.54	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Graded bunding
Kanikal	362	4.54	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	363	3.97	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	364	2.29	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	365	2.59	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	366	2.01	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Graded bunding
Kanikal	367	8.06	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Graded bunding
Kanikal	368	5.97	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Kanikal	369	4.91	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Groundnut (Ct+Gn)	Not Available	IIIes	Graded bunding
Kanikal	370	0.79	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Trench cum bunding
Kanikal	371	3.41	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Kanikal	372	6.91	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Graded bunding
Kanikal	373	5.84	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIIes	Graded bunding
Kanikal	374	4.08	SBRiB2	LMU-5	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIes	Graded bunding
Kanikal	375	4.24	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Graded bunding
Kanikal	376	2.16	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Redgram (Gn+Rg)	Not Available	IIIes	Graded bunding
Kanikal	384	0.25	BDLiB2	LMU-7	Shallow (25-50 cm)	Sandy clay	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut+Paddy (Gn+Pd)	Not Available	IIIes	Graded bunding

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Balacheda	81	0.11	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Groundnut (Ct+Gn)	Not Available	IIes	Trench cum bunding
Balacheda	92	3.27	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIes	Trench cum bunding
Balacheda	93	4.27	BLCiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIes	Trench cum bunding
Balacheda	94	3.6	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar (Jw)	Not Available	IIes	Trench cum bunding
Balacheda	95	3.26	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Balacheda	96	1.89	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Balacheda	97	4.8	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Balacheda	98/1	1.98	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Balacheda	98/2	0.48	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Not Available (NA)	Not Available	IIes	Trench cum bunding
Balacheda	98/3	0.06	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Not Available (NA)	Not Available	IIIes	Trench cum bunding
Balacheda	107	5.75	BMDiB2g1	LMU-1	Very deep (>150 cm)	Sandy clay	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton+Redgram (Ct+Rg)	Not Available	IIes	Trench cum bunding
Balacheda	108	8.14	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Not Available (NA)	Not Available	IIIes	Trench cum bunding
Balacheda	109	6.99	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Balacheda	110	6.78	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Balacheda	111	0.86	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	No crop (Nc)	Not Available	IIIes	Trench cum bunding
Balacheda	112	4.04	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	No crop (Nc)	Not Available	IIIes	Trench cum bunding
Balacheda	152	0	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	No crop (Nc)	Not Available	IIIes	Trench cum bunding
Balacheda	153	1.22	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Balacheda	154	0.03	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Trench cum bunding
Balacheda	155	4.85	VNKcB2	LMU-6	Shallow (25-50 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Groundnut (Gn)	Not Available	IIIes	Trench cum bunding
Balacheda	156	0.13	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	No crop (Nc)	Not Available	IIIes	Trench cum bunding
Gudalagunta	36	0.03	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Gudalagunta	37	3.93	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi+Cotton(Rg+Ct)	Not Available	IIes	Graded bunding
Gudalagunta	38	4.96	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi+Cotton(Rg+Ct)	Not Available	IIes	Trench cum bunding

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Gudalagunta	39	3.32	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Graded bunding
Gudalagunta	40	7.25	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Graded bunding
Gudalagunta	41	3.56	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Graded bunding
Gudalagunta	42	2.38	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Graded bunding
Gudalagunta	43	3.17	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Trench cum bunding
Gudalagunta	44	5.59	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Trench cum bunding
Gudalagunta	45	6.39	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Ragi+Cotton(Jw+Rg+Ct)	Not Available	IIes	Trench cum bunding
Gudalagunta	46	4.51	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi(Rg)	Not Available	IIes	Trench cum bunding
Gudalagunta	47	1.94	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Ragi+Cotton(Rg+Ct)	Not Available	IIes	Trench cum bunding
Gudalagunta	48	3	YLRiB2	LMU-4	Moderately shallow (50-75 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Jowar+Ragi+Cotton(Jw+Rg+Ct)	Not Available	IIes	Trench cum bunding
Sambara	20	2.18	BMNmB2	LMU-2	Very deep (>150 cm)	Clay	Non gravelly (<15%)	Very high (>200 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Graded bunding
Sambara	26	1.17	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	27	8.02	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	28/1	0.63	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Cotton (Ct)	Not Available	IIes	Graded bunding
Sambara	28/2	3.29	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	30/2	0	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	30/3	0	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	31	7.56	YDRcB2	LMU-3	Deep (100-150 cm)	Sandy loam	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	32/1	2.92	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Trench cum bunding
Sambara	32/2	2.94	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Trench cum bunding
Sambara	34	0.59	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Graded bunding
Sambara	35	4.65	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	36	3.51	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	37	7.54	PGPiB2	LMU-1	Moderately deep (75-100 cm)	Sandy clay	Non gravelly (<15%)	Low (51-100 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Trench cum bunding

Village	Survey No.	Total Area (ha)	Soil Phase	LMU	Soil Depth	Surface Soil Texture	Soil Gravelliness	Available Water Capacity	Slope	Soil Erosion	Current Land Use	Wells	Land Capability	Conservation Plan
Sambara	38	5.03	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Groundnut+Cotton (Rg+Gn+Ct)	Not Available	IIes	Graded bunding
Sambara	39	6.31	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	40	4.65	SBRcB2	LMU-5	Moderately shallow (50-75 cm)	Sandy loam	Non gravelly (<15%)	Very low (<50 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Graded bunding
Sambara	41	4.89	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Not Available (NA)	Not Available	IIIes	Trench cum bunding
Sambara	42	3.17	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram+Cotton (Rg+Ct)	Not Available	IIIes	Trench cum bunding
Sambara	43	5.54	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Sambara	44	5.19	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram+Cotton (Rg+Ct)	Not Available	IIIes	Trench cum bunding
Sambara	45	0.26	BGDbB2	LMU-2	Deep (100-150 cm)	Loamy sand	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram (Rg)	Not Available	IIes	Graded bunding
Sambara	66/2	1.11	BGDbB2	LMU-2	Deep (100-150 cm)	Loamy sand	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Cotton (Rg+Ct)	Not Available	IIes	Graded bunding
Sambara	67	1.78	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram (Rg)	Not Available	IIIes	Trench cum bunding
Sambara	68	2.47	GDGbB3g1	LMU-1	Deep (100-150 cm)	Loamy sand	Gravelly (15-35%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Severe	Redgram+Jowar (Rg+Jw)	Not Available	IIIes	Trench cum bunding
Sambara	69	1.31	BGDbB2	LMU-2	Deep (100-150 cm)	Loamy sand	Non gravelly (<15%)	Medium (101-150 mm/m)	Very gently sloping (1-3%)	Moderate	Redgram+Jowar (Rg+Jw)	Not Available	IIes	Graded bunding

Appendix II

Kanikal-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
Kanikal	74	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	75	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	76	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	77	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	304	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	305	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	306	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	308	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	High (> 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	309	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	High (> 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	310	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	High (> 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	311	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	312	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	313	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	314	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	315	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	316	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	317	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	318	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops
Kanikal	319	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	320	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	321	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	322	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	323	Moderately alkaline	Non saline	High (>0.75	Medium (23 -	Medium (145	Low (<10	Low (< 0.5	Sufficient	Sufficient (>	Sufficient	Deficient (<

Village	Survey No.	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
		(pH 7.8 – 8.4)	(<2 dsm)	%)	57 kg/ha)	- 337 kg/ha)	ppm)	ppm)	(> 4.5 ppm)	1.0 ppm)	(> 0.2ppm)	0.6 ppm)
Kanikal	324	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	325	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	326	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	327	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	328	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	329	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	330	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	331	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	332	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	333	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	334	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	335	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	336	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	337	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	338	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	339	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	340	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	341	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	342	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	343	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	344	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	345	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	353	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	354	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	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
Kanikal	355	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	356	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	357	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	358	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	359	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	360	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	361	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	362	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	363	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	364	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	365	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	366	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	367	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	368	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	369	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	370	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	371	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	372	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	373	Moderately alkaline (pH 7.8 – 8.4)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	374	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	375	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	376	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Kanikal	384	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	81	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	92	Slightly alkaline (pH	Non saline	Medium (0.5	High (> 57	Medium (145	Low (<10	Medium (0.5	Sufficient	Sufficient (>	Sufficient	Deficient (<

Village	Survey No.	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
		7.3 – 7.8)	(<2 dsm)	- 0.75 %)	kg/ha)	- 337 kg/ha)	ppm)	- 1.0 ppm)	(> 4.5 ppm)	1.0 ppm)	(> 0.2ppm)	0.6 ppm)
Balacheda	93	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	94	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	95	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	96	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	97	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	98/1	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	98/2	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	98/3	Slightly acid (pH 6.0 – 6.5)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	107	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	108	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	109	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	110	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	111	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	112	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	152	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	153	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	154	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	155	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	High (> 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Balacheda	156	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	36	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	37	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	38	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	39	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	40	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	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
Gudalagunta	41	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	42	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	43	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	44	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Deficient (< 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	45	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	46	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	47	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Gudalagunta	48	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	20	Slightly alkaline (pH 7.3 – 7.8)	Non saline (<2 dsm)	Medium (0.5 - 0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	26	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	27	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	28/1	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	28/2	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	30/2	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	30/3	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	31	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Low (< 0.5 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	32/1	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	32/2	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	34	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	35	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	36	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Low (<10 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	37	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	38	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	39	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	40	Neutral (pH 6.5 –	Non saline	High (>0.75	Medium (23 -	Medium (145	Medium (10	High (> 1.0	Sufficient	Sufficient (>	Sufficient	Deficient (<

Village	Survey No.	Soil Reaction	Salinity	Organic Carbon	Available Phosphorus	Available Potassium	Available Sulphur	Available Boron	Available Iron	Available Manganese	Available Copper	Available Zinc
		7.3)	(<2 dsm)	%)	57 kg/ha)	- 337 kg/ha)	- 20 ppm)	ppm)	(> 4.5 ppm)	1.0 ppm)	(> 0.2ppm)	0.6 ppm)
Sambara	41	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Medium (145 - 337 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	42	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	43	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	44	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	45	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Low (< 23 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	High (> 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	66/2	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	67	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	68	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)
Sambara	69	Neutral (pH 6.5 – 7.3)	Non saline (<2 dsm)	High (>0.75 %)	Medium (23 - 57 kg/ha)	Low (< 145 kg/ha)	Medium (10 - 20 ppm)	Medium (0.5 - 1.0 ppm)	Sufficient (> 4.5 ppm)	Sufficient (> 1.0 ppm)	Sufficient (> 0.2ppm)	Deficient (< 0.6 ppm)

Appendix III

Kanikal-3 Microwatershed

Soil Suitability Information

Village	Survey No.	Mango	Maize	Sapota	Sorgham	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Redgram	Amla	Jackfruit	Custard apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulbery
Kanikal	74	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	75	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	76	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	77	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	304	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Kanikal	305	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	306	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	308	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	309	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r	N1r
Kanikal	310	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	311	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	312	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	313	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	314	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Kanikal	315	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	316	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	317	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	318	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops	Rock outcrops
Kanikal	319	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	320	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	321	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	322	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	323	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	324	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	325	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Kanikal	326	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	327	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	328	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	329	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Kanikal	330	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Kanikal	331	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Kanikal	332	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Kanikal	333	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	334	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	335	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	336	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	337	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	338	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1

Village	Survey No.	Mango	Maize	Sapota	Sorgham	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Redgram	Amla	Jackfruit	Custard apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulbery
Kanikal	339	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Kanikal	340	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	341	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	342	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	343	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	344	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	345	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Kanikal	353	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Kanikal	354	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Kanikal	355	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	356	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	357	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	358	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Kanikal	359	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	360	N1rz	S2rz	S3rz	S2rz	S3rz	S2rz	N1rz	S3rz	S2rz	S3rz	S3rz	S2rz	S3rz	S2rz	S3rz	S3rz	S3rz	S2rz	S2rz	S2rz	S2rz	S2rz	S3rz	S2rz	S3rz	S3rz
Kanikal	361	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Kanikal	362	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	363	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	364	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	365	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	366	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	367	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	368	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	369	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	370	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	371	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Kanikal	372	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	373	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	374	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Kanikal	375	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	376	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Kanikal	384	N1r	S3rt	N1r	S3r	N1rt	S3r	N1rt	N1r	S3r	N1r	S3rt	S3rt	N1rt	S3r	N1rt	N1rt	N1r	S3rt	S3rt	S3rt	S3rt	S3rt	N1r	S3rt	N1rt	N1rt
Balacheda	81	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Balacheda	92	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Balacheda	93	S3rz	S2z	S2rz	S2z	S2rt	S2rz	S3rz	S2rz	S2tz	S2rz	S2rz	S2z	S2rz	S2z	S2rt	S3rz	S2rz	S2tz	S2tz	S2z	S2tz	S2tz	S2rz	S2z	S2rz	S2rz
Balacheda	94	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	95	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	96	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	97	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	98/1	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	98/2	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1
Balacheda	98/3	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Balacheda	107	S1	S2g	S1	S2tg	S1	S2tg	S1	S1	S2tg	S2g	S2tg	S1	S1	S1	S1	S1	S1	S1	S2g	S2g	S2g	S2g	S1	S1	S1	S1

Village	Survey No.	Mango	Maize	Sapota	Sorgham	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Redgram	Amla	Jackfruit	Custard apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulbery
Balacheda	108	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Balacheda	109	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Balacheda	110	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Balacheda	111	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Balacheda	112	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Balacheda	152	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Balacheda	153	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Balacheda	154	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Balacheda	155	N1r	S3r	N1r	S3r	N1r	S3r	N1r	N1r	S3r	N1r	S3r	S3r	N1r	S3r	N1r	N1r	N1r	S3rt	S3r	S3r	S3r	S3r	N1r	S3r	N1r	N1r
Balacheda	156	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Gudalagunta	36	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	37	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	38	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	39	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	40	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	41	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	42	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Gudalagunta	43	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	44	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	45	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	46	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	47	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Gudalagunta	48	N1r	S2r	S3r	S2r	S3r	S2r	N1r	S3r	S2r	S3r	S3r	S2r	S3r	S2r	S3r	S3r	S3r	S2r	S2r	S2r	S2r	S2r	S3r	S2r	S3r	S3r
Sambara	20	S3tw	S3tw	S3tw	S2w	S3tw	S1	S2tw	S2w	S1	S2w	S2tw	S2tw	S3tw	S2w	N1tw	S2tw	S2w	S3tw	S2tw	S3tw	S2tw	S2tw	S2tw	S2tw	S2tw	S3tw
Sambara	26	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	27	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	28/1	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	28/2	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	30/2	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	30/3	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	31	S3tz	S3tz	S2tz	S3tz	S2tz	N1tz	S2rt	S2z	N1tz	S3tz	S2tz	S3tz	S3tz	S3tz	S3tz	S2rz	S2tz	S2tz	S2tz	S2z	S2z	S2z	S2tz	S2z	S2tz	S3tz
Sambara	32/1	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Sambara	32/2	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Sambara	34	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	35	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	36	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	37	S3r	S1	S2r	S1	S2rt	S2r	S3r	S2r	S2t	S2r	S2r	S1	S2r	S1	S2rt	S3r	S2r	S2t	S2t	S1	S2t	S2t	S2r	S1	S2r	S2r
Sambara	38	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	39	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	40	N1r	S3t	S3rt	S3t	S3rt	N1t	N1r	S3rt	N1t	S3t	S3t	S3t	S3rt	S3t	S3rt	S3rt	S3rt	S3t	S3t	S3t	S3t	S3t	S3rt	S3t	S3t	S3t
Sambara	41	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Sambara	42	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Sambara	43	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z

Village	Survey No.	Mango	Maize	Sapota	Sorgham	Guava	Cotton	Tamarind	Lime	Bengalgram	Sunflower	Redgram	Amla	Jackfruit	Custard apple	Cashew	Jamun	Musambi	Groundnut	Chilly	Tomato	Marigold	Chrysanthemum	Pomegranate	Bajra	Drumstick	Mulbery
Sambara	44	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Sambara	45	S3t	S3t	S3t	S3t	S3t	N1t	S3t	S3t	N1t	N1t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S2t	S3t	S3t
Sambara	66/2	S3t	S3t	S3t	S3t	S3t	N1t	S3t	S3t	N1t	N1t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S2t	S3t	S3t
Sambara	67	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Sambara	68	S2rz	S2zg	S2zg	S2zg	S2tz	S2zg	S2rz	S2zg	S2tg	S2zg	S2zg	S2z	S2zg	S2z	N1tz	S2rz	S2z	S2tz	S2tg	S2zg	S2tg	S2tg	S2z	S2z	S2z	S2z
Sambara	69	S3t	S3t	S3t	S3t	S3t	N1t	S3t	S3t	N1t	N1t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S3t	S2t	S3t	S3t

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 Kanikal 3 micro-watershed in Yadgir taluk and district is located in between $16^0 35'$ – $16^0 36'$ North latitudes and 77^0 18' – $77^0 20'$ East longitudes, covering an area of about 547.22 ha, bounded by Gudalagunta, Samabara, Kanikal and Balacheda villages. Agro Ecological Sub Region (AESR) 6.2: Central and Western Maharashtra Plateau and North Karnataka Plateau and North Western Telangana Plateau, hot moist semi-arid ESR with shallow and medium loamy to clayey black soil (medium and deep clayey Black soil as inclusion), medium to high AWC and LGP 120-150 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: *The socio-economic outputs for the Kanikal 3 micro-watershed in Yadgir taluk and district are presented here.*

Social Indicators;

- *Male and female ratio is 55.6 to 44.4 per cent to the total sample population.*
- *Younger age 18 to 50 years group of population is around 55.7 per cent to the total population.*
- *Literacy population is around 39.8 per cent.*
- *Social groups belong to SC/ST is around 13.0 per cent.*
- *Wood is the source of energy for a cooking among 100 per cent.*
- *About 39.1per cent of households have a yashaswini health card.*
- *Majority of farm households (26.1 %) are having MGNREGA card for rural employments.*
- *Dependence on ration cards through public distribution system is around 100 per cent.*
- *Swatch bharath program providing closed toilet facilities around 17.4 per cent.*
- *Rural migration to unban centre for employment is prevalent among 2.3 per cent of farm households.*
- *Women participation is decisions making are around 39.2 per cent of were found.*

Economic Indicators;

- *The average land holding is 12.6 ha indicates that majority of farm households are belong to large farmers. The dry land account for 91.8 % and irrigated land 5.8 % of total cultivated land of sample farmers.*
- *Agriculture is the main occupation among 4.4 per cent and Agriculture is the main and non agriculture labour is predominant subsidiary occupation for 91.3 per cent.*
- *The average value of domestic assets is around Rs.31009 per household. Mobile and television are mass popular mass communication media.*
- *The average farm assets a value is around Rs.72963 per household, about 36.1 per cent of sample farmers are owing plough.*
- *The average livestock value is around Rs.20721 per livestock; about 77.8 per cent of household are having livestock.*
- *The average per capita food consumption is around 891.9 grams (2030 kilo calories) against national institute of nutrition (NIN) recommendation at 827 gram. Around 60.9 per cent of sample farmers are consuming more than the NIN recommendation.*
- *The annual average income is around Rs 40315 per household. About 8.7 per cent of farm households are below poverty line.*
- *The per capita monthly expenditure is around Rs 2333.9 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 1768.9 per ha/year. The total cost of annual soil nutrients is around Rs.956979 per year for the total area of 547.2 ha.*
- *The average value of ecosystem service for food grain production is around Rs 9011/ ha/year). Per hectare food production services is maximum in onion (Rs. 8287) followed by sorghum (Rs. 7408), redgram (Rs.6098), cotton (Rs. 5411), maize (Rs. 2465), green gram (Rs. 2258) and groundnut (Rs.1307).*
- *The average value of ecosystem service for fodder production is around Rs 2961/ ha/year). Per hectare fodder production services is maximum in maize (Rs. 4482) followed by sorghum (Rs. 2964), groundnut (Rs.2477) and paddy (Rs.1919).*
- *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 green gram (Rs.70127) followed by sorghum (Rs.56464), red gram (Rs.52576), cotton (Rs.42847), maize (Rs.32384) groundnut (Rs.29424), and onion (Rs.10078).*

Economic Land Evaluation;

- *The major cropping pattern is red gram (50.6%) followed by groundnut (15.5 %), cotton (7.9 %), maize (6.5 %), paddy (9.3 %), green gram (4.6 %), onion (1.8 %) and sorghum (3.7%).*
- *In Kanikal 3 micro watershed, major soil are soil of alluvial landscape of Badiyala (BDL) series are having shallow soil deep cover around 13.2 % of area. On this soil farmers are presently growing cotton (15.4%), maize (46.2 %), groundnut (23.1%) and red gram (15.4 %). Soil of granite and granite gneiss landscape of Sambara (SBR) series are having moderately shallow soil deep cover around 12.5 % of area. On this soil farmers are presently growing red gram (40.7 %), cotton (7.4 %), groundnut (29.6 %), paddy (14.8 %) and green gram (7.4 %). Baddeppalli (BDP) series are having moderately soil deep cover around 0.6 % of area. Yalleri (YLR) series are having moderately shallow soil deep cover around 8.9% of area. On this soil farmers are presently growing. Cotton (10.9 %), groundnut (14.5 %), paddy (7.2 %) and red gram (60.2 %), Pogalapur (PGP) series are having moderately deep soil deep cover around 17.7 % of area. On this soil farmers are presently growing paddy (25.9%) and red gram (22.2 %), groundnut (29.6 %). Yadgir (YDR) series are having Deep soil deep cover around 3.9 % of area. On this soil farmers are presently growing maize (28.6%) paddy (21.4%) and red gram (50.0 %). Bhimanahalli (BMN) series are having very deep soil deep cover around 5.7 % of area. On this soil farmers are presently growing red gram (70.0%) and sorghum (30.0 %) on Belagundi (BGD) series are having Deep soil deep cover around 0.3 % of area. On this soil farmers are presently growing cotton (42.9), paddy (28.6%) and red gram (28.6%). Balichakra (BCL) series are having moderately deep soil deep cover around 4.4 % of area. On this soil farmers are presently growing red gram, Bomraldoddi (BMD) series are having Very deep soil deep cover around 6.3 of area. On this soil farmers are presently growing green gram. Gundedagi (GDG) series are having moderately soil deep cover around 8.5 % of area. On this soil farmers are presently growing green gram. Vanakanahalli (VNK) series are having shallow soil deep cover around 3.9 % of area. On this soil farmers are presently growing groundnut (25.0 %) and redgram (75.0 %). Duppali (DPL) series are having moderately shallow soil deep cover around 14.1 % of area. On this soil farmers are presently growing groundnut (4.8%), onion (4.8 %), paddy (4.8%) and red gram (85.7%).*
- *The total cost of cultivation and benefit cost ratio (BCR) in study area for groundnut ranges between Rs.75191/ha in DPL soil (with BCR of 1.02) and Rs.25460ha in BDL soil (with BCR of 1.52).*
- *In cotton the cost of cultivation range between Rs 52541/ha in SBR soil (with of 1.06) and Rs.24517/ha in BGD soil (with BCR of 1.34).*

- *In green gram the cost of cultivation range between Rs. 46066/ha in PGP soil (with BCR of 1.07) and Rs. 22949/ha in GDG and BMD soil (with BCR of 1.0).*
- *In maize cost of cultivation range between is Rs.53030/ha in YLR soil (with BCR of 1.14) and Rs.20504 in BDL soil (with BCR of 1.28).*
- *In red gram cost of cultivation range between is Rs 52680/ha in DRL soil (with BCR of 1.14) and Rs. 9514/ha in DPL soil (with BCR of 1.3).*
- *In paddy cost of cultivation in DPL soil is Rs.53387/ha (with BCR of 1.6) and PGP soil in Rs.30141/ha (with BCR of 1.29) and onion cultivation in DPL soil is Rs 62108/ha (with BCR of 1.13).*
- *The land management practices reported by the farmers are crop rotation, tillage practices, fertilizer application and use of Farm Yard Manure (FYM). Due to higher wages farmer are following labour saving strategies is not prating soil and water conservation measures. Less ownership of livestock limiting application of FYM.*
- *It was observed soil quality influences on the type and intensity of land use. Fertilizer applications are deeper soil to maximize returns.*

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 maize (34.8 to 72.8%), cotton (32.5to 66.3 %), red gram (2.4 to 79.8 %), groundnut (0 to 7.4 %), paddy (12 to 67.8%) and green gram (0 to 6.7 %).*

Chapter 2

INTRODUCTION

Sujala 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 rained agriculture, innovative and science based approaches and strengthened institutions and capacities. The project is implemented in 11 districts of Bidar, Vijayapura, Gulbarga, Yadgir, Koppal, Gadag, Raichur, Davanagere, Tumkur, Chikkamangalur and Chamarajanagar which have been identified by the Watershed Development Department based on rainfall water and socio-economic conditions. The project will be implemented over six years and linked with the centrally financed IWMP.

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

Objectives of the study

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

Chapter 3

METHODOLOGY

Study area

Agro-Climatic Zone 2: North-eastern Dry Zone: The total geographic area of this zone is about 1.76 M ha covering 8 taluks of Gulbarga district and 3 taluks of Raichur. Net cultivated area in the zone is about 1.31 M ha of which about 0.09 M ha are irrigated. The mean elevation of the zone is 300-450 m MSL. The main soil type is deep to very deep soil with small pockets of shallow to medium black soil. The zone is cropped predominantly during rabi due to insufficient rainfall (465-785 mm). The principal crops grown are jowar, bajra, oilseeds, pulses, cotton and sugarcane.

The Kanikal-3 micro-watershed (Yadgir taluk, Yadgir district) is located in between $16^0$35' – $16^0$36' North latitudes and 77^0 18' – $77^0$20' East longitudes, covering an area of about 547.22 ha, bounded by Gudalagunta, Samabara, Kanikal and Balacheda villages. **Agro Ecological Sub Region (AESR) 6.2:** Central and Western Maharashtra Plateau and North Karnataka Plateau and North Western Telangana Plateau, hot moist semi-arid ESR with shallow and medium loamy to clayey black soil (medium and deep clayey Black soil as inclusion), medium to high AWC and LGP 120-150 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 (ALPES) (Figure 2).

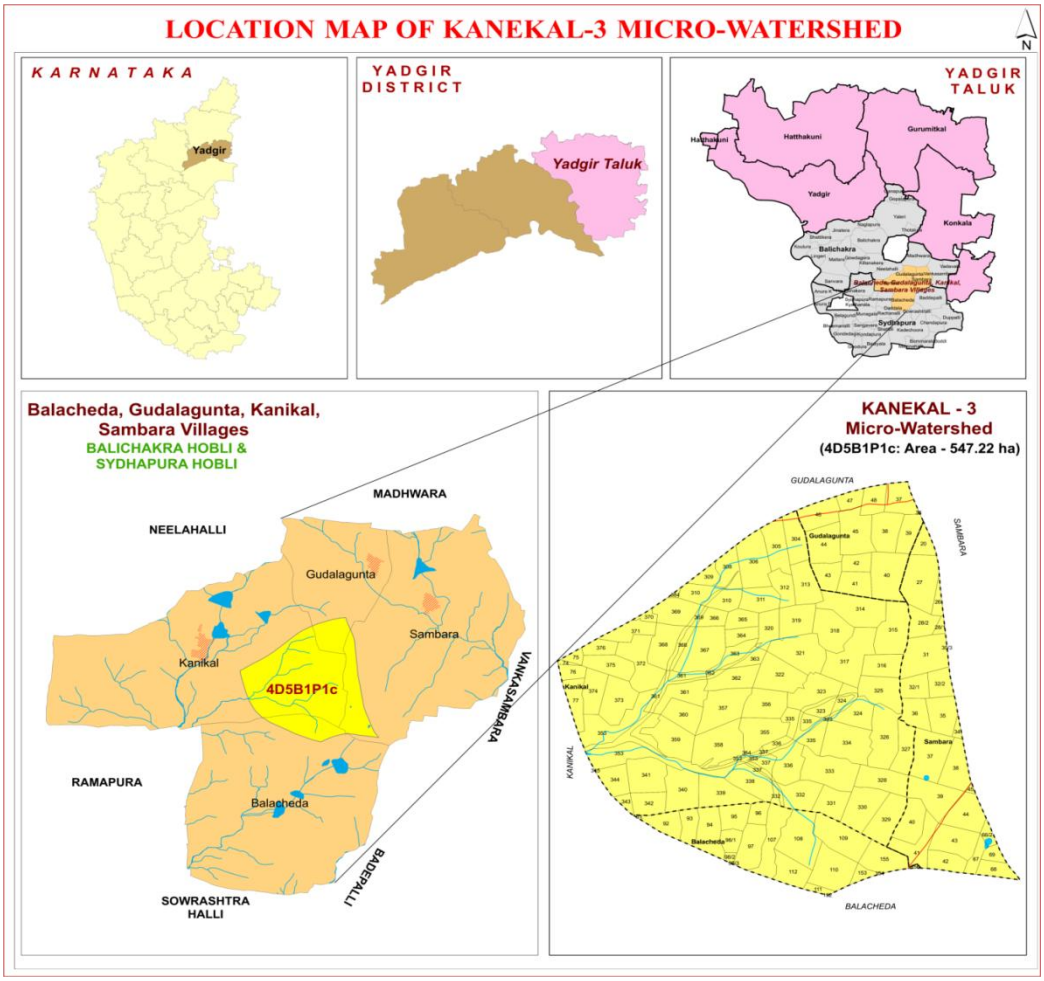

Figure 1: Location of study area

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 of 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 .

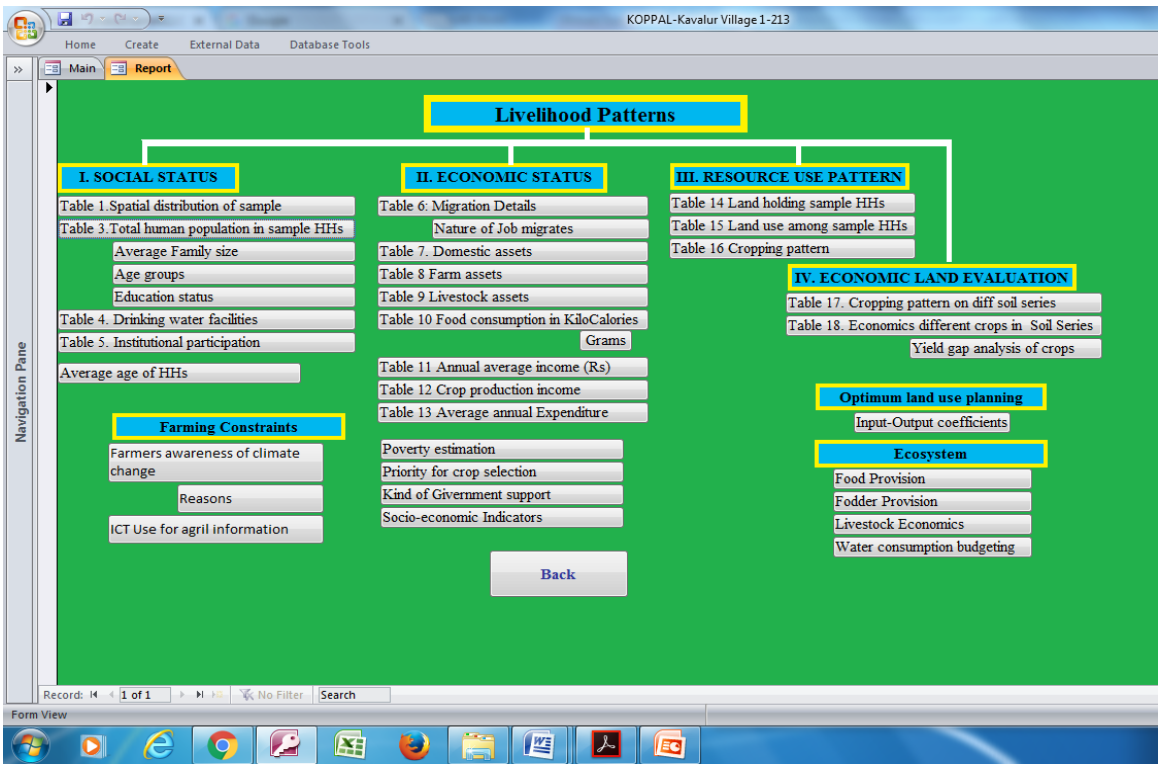

Figure 2: ALPES FRAMEWORK

The sample farmers were post classified in to marginal and small (0.00 to <=2 ha), medium and semi medium (>2 to <=10 ha) and large (>10 ha). 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

1. Collect the Soil Map Units (SMU) / Land Use Type (LUT) with soil fertility analysis.
2. Integrate the erosion rates per SMU/LUT.
3. Estimate the nutrients lost per tone of soil erosion for each SMU/LUT.
4. Estimate the value of soil nutrients lost per ton of soil erosion for each SMU/LUT by taking the market price of soil nutrients.

Chapter 4

RESULTS AND DISCUSSIONS

The main purpose to characterise the socio-economic systems in the watershed is to identify the existing production constraints and propose the potential/alternate options for agro-technology transfer and for bridging the adoption and yield gap. The demographic information shows that the household population dynamics encompasses the socioeconomic status of the farmer. For a rural family, the household size should be optimal to earn a comfortable livelihood through farm and non-farm wage earning. The Total number of population in watershed area was 133, out of which 55.6 per cent were males and 44.4 per cent females. Average family size of the households is 5.7. 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 18 to 30 years (29.3 %) followed by 0 to18 years (30.8 %), 30 to 50 years (26.4 %) and more than 50 years (13.5 %). 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 60.2 per cent of respondents were illiterate and 39.8 per cent literate (Table 1).

Table 1: Human population among sample households in Kanikal 3 Microwatershed

Particulars	**Units**	**Value**
Total human population in sample HHs	Number	133
Male	% to total Population	55.6
Female	% to total Population	44.4
Average family size	Number	5.7
Age group		
0 to 18 years	% to total Population	30.8
18 to 30 years	% to total Population	29.3
30 to 50 years	% to total Population	26.4
>50 years	% to total Population	13.5
Average age	Age in years	30.5
Education Status		
Illiterates	% to total Population	60.2
Literates	% to total Population	39.8
Primary School (<5 class)	% to total Population	12.0
Middle School (6- 8 Class)	% to total Population	7.5
High School (9- 10 Class	% to total Population	10.5
Others	% to total Population	9.8

The ethnic groups among the sample farm households found to be 43.5per cent belonging to Other Backward Castes (OBC) followed by 43.5per cent belonging to General Castes, Schedule Casts (SC) of 4.3 per cent and only 8.7 per cent belong to Schedule Tribes (ST) (Table 2 and Figure 3). About 100 per cent of sample households are using fire wood as source of fuel for cooking. All the sample farmers are having

electricity connection. About 39.1 per cent are sample households having health cards. Only 26.1 % are having MNREGA job cards for employment generation. About 100 per cent of farm households are having ration cards for taking food grains from public distribution system. About 17.4 per cent of farm households are having toilet facilities.

Table 2: Basic needs of sample households in Kanikal 3 Microwatershed

Particulars	**Units**	Value
Social groups		
SC	% of Households	4.3
ST	% of Households	8.7
OBC	% of Households	43.5
Others	% of Households	43.5
Types of fuel use for cooking		
Fire wood	% of Households	100
Energy supply for home		
Electricity	% of Households	100
Number of households having Health card		
Yes	% of Households	39.1
No	% of Households	60.9
MGNREGA Card		
Yes	% of Households	26.1
No	% of Households	73.9
Ration Card		
Yes	% of Households	100
No	% of Households	0.0
Households with toilet		
Yes	% of Households	17.4
No	% of Households	82.6
Drinking water facilities		
Tube well	% of Households	91.3
Tank	% of Households	8.7

Collected on the source of drinking water in the study area is presented in Table 2. Majority of the sample respondents are having tube well source for water supply for domestic purpose (91.3 %) and 8.7 per cent was tank.

The data on migration in Kanikal 3 micro-watershed is given in Table 3. It indicated that around 2.3 per cent of samples households were migrated. The average distance travelled for seeking employment is 300 km and for purpose is job.

Table 3: Migration details among the sample households in Kanikal 3 Microwatershed

Particulars	**Value**
% of households showing migration	2.3
% of persons migrating	8.7
No. of months migrated in a year	10
Average Distance of migration(Km)	300
Nature of job (%)	
Job/wage/work	100

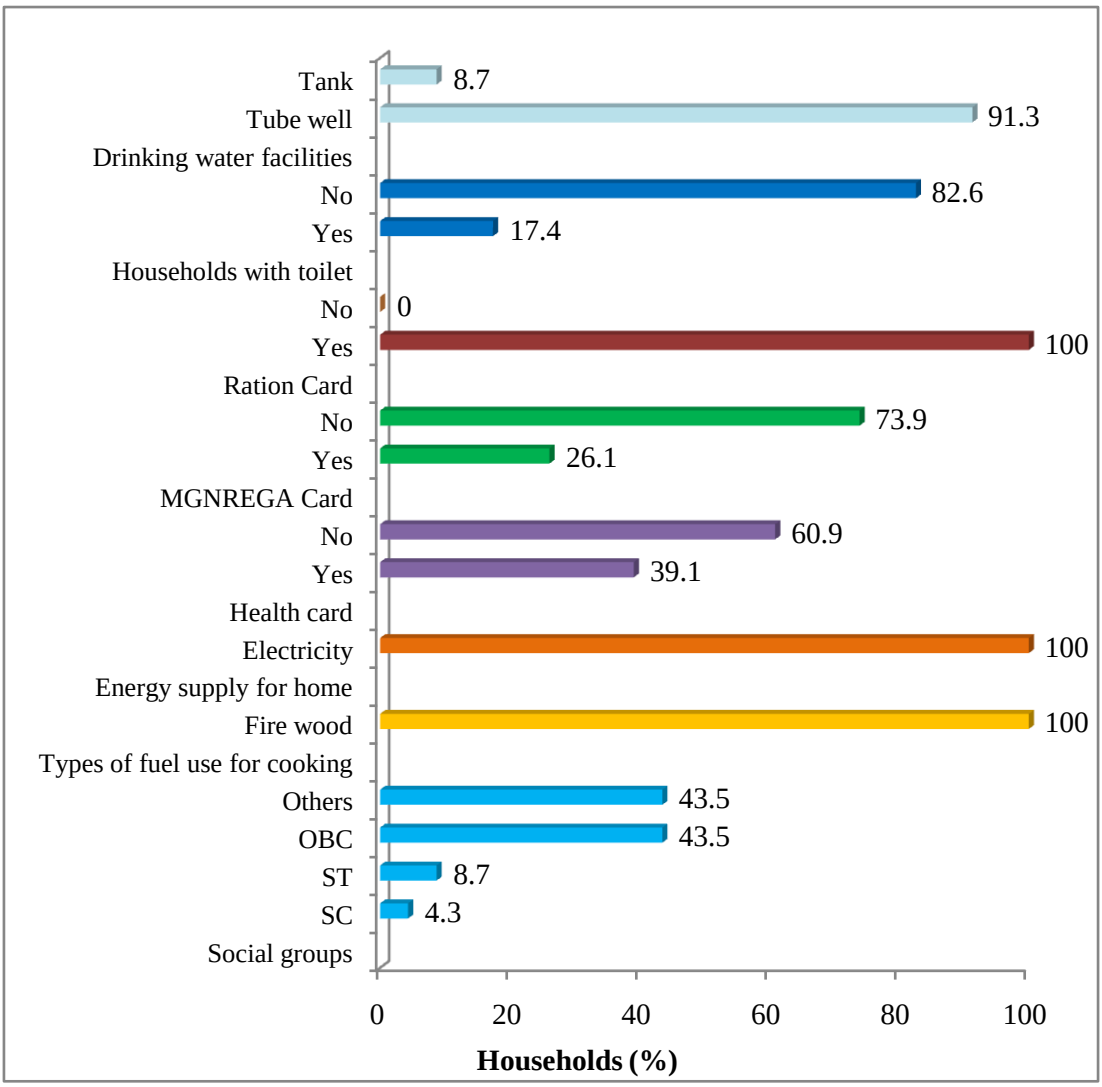

Figure 3: Basic needs of sample households in Kanikal 3 Microwatershed

The occupational pattern (Table 4) among sample households shows that agriculture is the main occupation around 4.4 per cent of farmers followed by subsidiary occupations like Non Agricultural labour (91.3 %), private service (2.9 %) and 1.4 per cent of the households are Non agriculture labour as main occupation and private service as a subsidiary occupation.

Table 4: Occupational pattern in sample households in Kanikal 3 Microwatershed

Occupation		**% to total population**
Main	**Subsidiary**	
Agriculture	Agriculture Labour	4.4
	Non Agriculture Labour	91.3
	Private service	2.9
Non Agriculture Labour	Private service	1.4
Grand Total		100
Family labour availability		**(Man days/ month)**
Male		81.2
Female		49.0
Total		130.2

The important assets especially with reference to domestic assets were analyzed and are given in Table5 and Figure 4. The important domestic assets possessed by all categories of farmers are mobile phones (100 %) followed by television (56.5 %), motorcycle (43.4 %), mixer/grinder (8.7 %), auto (8.7%), land line phone (4.3 %) and tempo (8.7 %). The average value of domestic assets is around Rs.31009 per households (Table 5).

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

Particulars	% of households	Average value in Rs
Mixer/grinder	8.7	2000
Mobile phone	100	3000
Motorcycle	43.4	41400
Television	56.5	7666
Landline phone	4.3	3000
Tempo	8.7	120000
Auto	8.7	40000
Average value	31009	

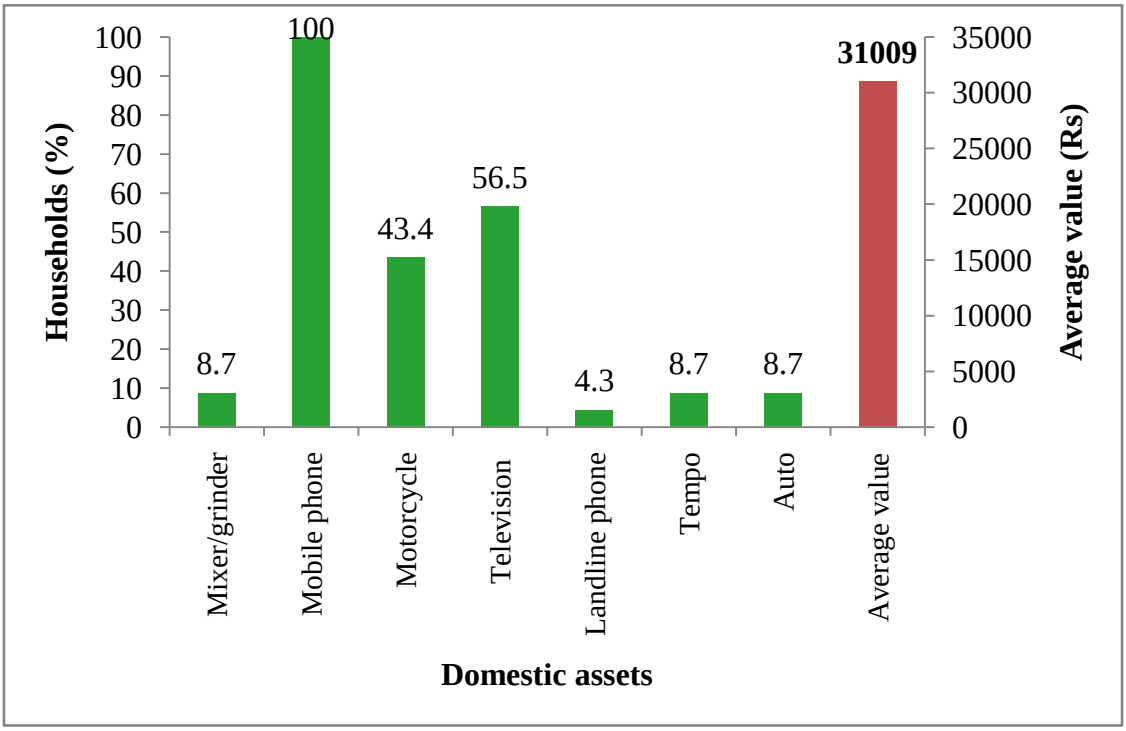

Figure 4: Domestic assets among the sample households in Kanikal 3 Microwatershed

The most popularly owned farm equipments were plough, cattle shed; pump sets, chaff cutter, bullock cart, sprayer, weeder and thresher. Plough and bullock cart were commonly present in all the sampled farmers; these were primary implements in agriculture. The per cent of households owned plough (65.2%), bullock cart (60.8 %), sprayer (39.1 %), weeder (13.0%), tractor (4.3 %), power tiller (4.3%) and thresher (4.3%) was found highest among the sample farmers. The average value of farm assets is around Rs.72963 per households (Table 6 and Figure 5).

Table 6: Farm assets among samples households in Kanikal 3 Microwatershed

Particulars	% of households	Average value in Rs
Bullock cart	60.8	52857
Irrigation Pump	8.7	8750
Plough	65.2	7000
Seed Cum Fertilizer Drill	13.0	27666
Sprayer	39.1	101444
Weeder	13.0	4166
Power Tiller	4.3	35000
Thresher	4.3	3500
Tractor	4.3	1000000
Average value	72963	

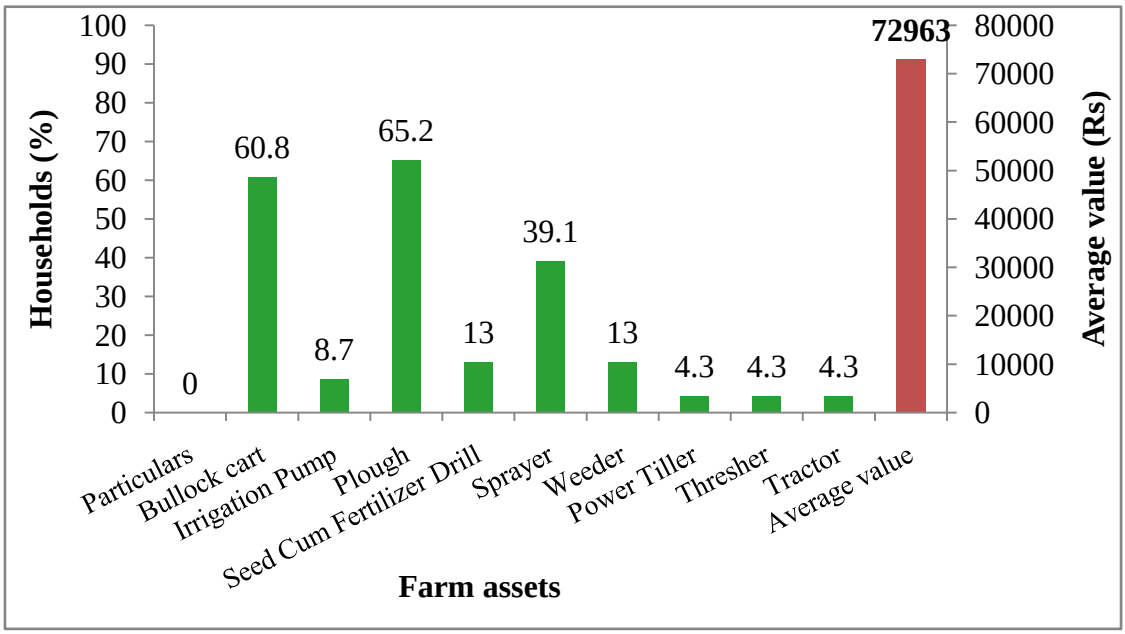

Figure5: Farm assets among samples households in Kanikal 3 Microwatershed

Livestock is an integral component of the conventional farming systems (Table 7and Figure 6). The highest livestock population is bullocks (28.0 %) followed by milching buffalos were around 28.0 per cent, local dry cow (14.0 %), dry buffalos (12.0 %), local milching cow (6.0 %), goats (6.0%), poultry (2.0 %) and sheep's (4.0 %). The average livestock value was Rs. 20784.

Table 7: Livestock assets among sample households in Kanikal 3 Microwatershed

Particulars	% of livestock population	Average value in Rs
Local Dry Cow	14.0	17571
Local Milching Cow	6.0	11666
Dry Buffalos	12.0	20000
Milching Buffalos	28.0	27857
Bullocks	28.0	76428
Goats	6.0	3500
Sheep's	4.0	6250
Poultry	2.0	3000
Average value	20784	

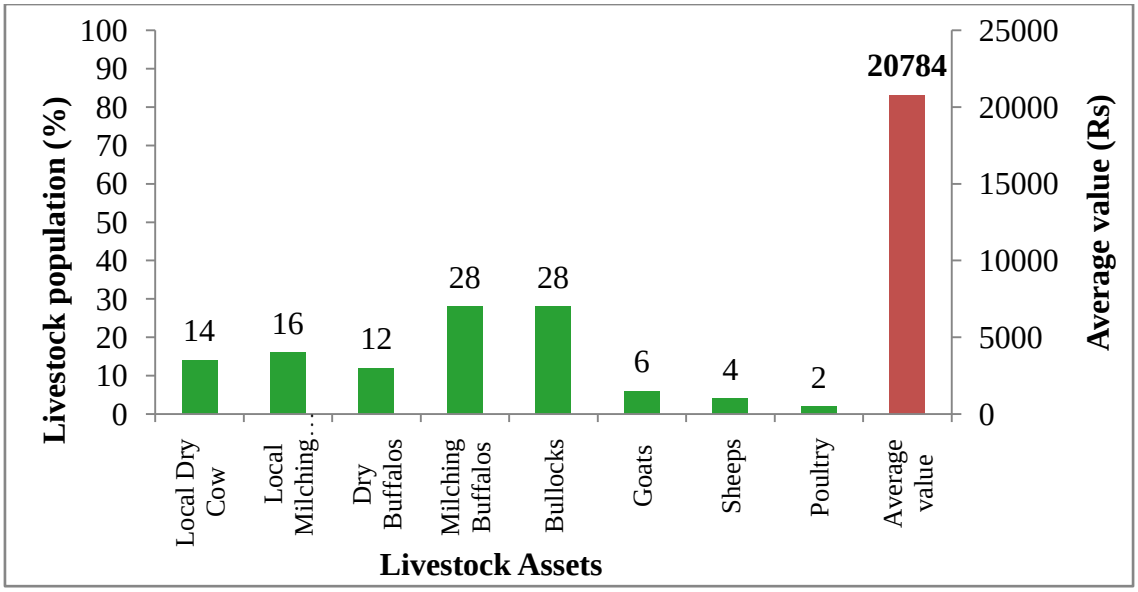

Figure 6: Livestock assets among sample households in Kanikal 3 Microwatershed

Average Milk produced in sample households is 301.1 litters/ annum. Among the farm households, sorghum, groundnut and paddy are the main crops for domestic food and fodder for animals. About 3750 kg/ha of average fodder is available per season for the livestock feeding (Table 8).

Table 8: Milk produced and fodder availability of sample households in Kanikal 3 Microwatershed

Particulars	
Name of the Livestock	**Ltr./Lactation/animal**
Local Milching Cow	316.6
Milching Buffalos	285.7
Average Milk produced	301.1
Fodder produces	**Fodder yield (kg/ha.)**
Sorghum	1250
Groundnut	7500
Paddy	2500
Average fodder availability	3750
Livestock having households (%)	87.7
Livestock population (Numbers)	107

A woman participation in decision making is in this micro-watershed is presented in Table 9. About 4.4 per cent of women participation in local organisation activates, 52.2 per cent women earning for her family requirement and 39.2 per cent of women taking decision in her family and agriculture related activities.

Table 9: Women empowerment of sample households in Kanikal 3 Microwatershed

% to Grand Total

Particulars	**Yes**	**No**
Women participation in local organization activities	4.4	95.6
Women elected as panchayat member	0	100
Women earning for her family requirement	52.2	47.8
Women taking decision in her family and agriculture related activities	39.2	60.8

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 is consumed by sample farmers which accounted for 1280.3 kcal per person. The other important food items consumed was pulses 166.4 kcal followed by vegetable cooking oil 192.3 kcal, milk 78.9 kcal, Egg 234 kcal, vegetables 29.6 kcal and meat 48.5 kcal. In the sampled households, farmers were consuming less (2030 kcal) than NIN- recommended food requirement (2250 kcal).

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

Particulars	NIN recommendation (gram/ per day/ person)	Present level of consumption (gram/ per day/ person)	Kilo Calories /day/person
Cereals	396.0	376.6	1280.3
Pulses	43.0	48.5	166.4
Milk	200.0	121.3	78.9
Vegetables	143.0	123.4	29.6
Cooking Oil	31.0	33.7	192.3
Egg	0.5	156.0	234.0
Meat	14.2	32.3	48.5
Total	**827.7**	**891.9**	**2030.0**
Threshold of NIN recommendation		827 gram*	2250 Kcal*
% Below NIN		0.0	0.0
% Above NIN		100.0	100

Note: * day/person

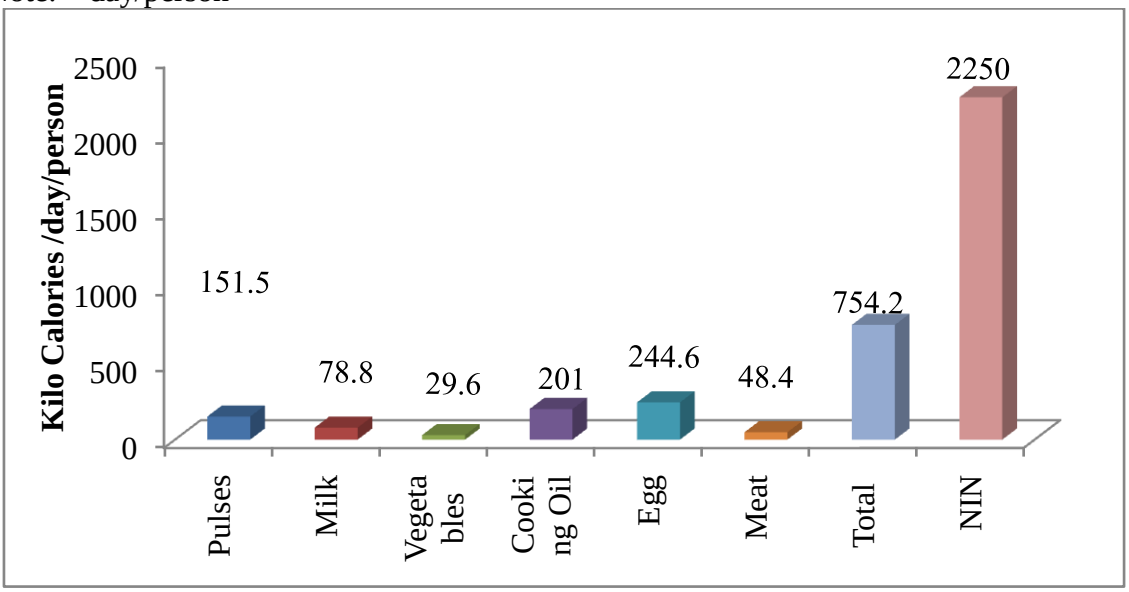

Figure 7: Per capita daily consumption of food among the sample farmers in Kanikal 3 Microwatershed

Annual income of the sample HHs: The average annual household income is around Rs 40315. Major source of income to the farmers in the study area is from crop production (Rs 17233) followed by livestock (Rs. 20721). The income from Non farm income was very low at Rs.2360. The monthly per capita income is Rs.580, 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 Kanikal 3 Microwatershed

Particulars	**Income ***
Nonfarm income (Rs)	2360 (4.2)
Livestock income (Rs)	20721(47.8)
Crop Production (Rs)	17233 (100)
Total Annual Income (Rs)	**40315**
Average monthly per capita income (Rs)	580
Threshold for Poverty level (Rs 975 per month/person)	
% of households below poverty line	8.7
% of households above poverty line	91.3

* Figure in the parenthesis indicates % of Households

The average annual expenditure of farm households indicated that farmers in the study area spend highest on Health (Rs. 59130) followed by food, education, clothing, social and function. Now a day's 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.2333.9 and about 8.7 per cent of farm households are below poverty line and 91.3 per cent of farm households are above poverty line (Table 12 and Figure 8).

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

Particulars	**Value in Rupees**	**Per cent**
Food	57123	35.3
Education	6696	4.1
Clothing	12391	7.7
Social functions	26609	16.4
Health	59130	36.5
Total Expenditure (Rs/year)	161949	100.0
Monthly per capita expenditure (Rs)	2333.9	

Land holding: Total sample households are 23 and total area cultivated by them is 291.1 ha. The average land holding of sample HHs is 12.6 ha. Large number of sample HHs (8) belong to small size group with an average holding size of 0.9 ha followed by medium farmers (8) with an average holding size of 3.1 ha and a large farmer (8) with a average land holding size of 32.5 ha (Table 13)

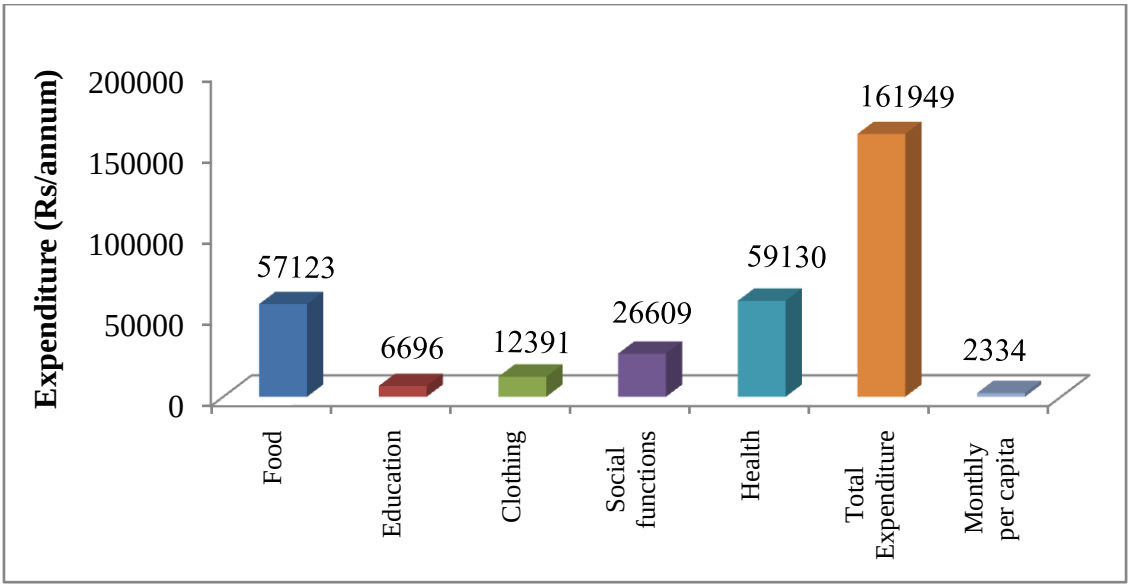

Figure 8: Average annual expenditure of sample HHs in Kanikal 3 Microwatershed

Table 13: Distribution of land holding among the sample households in Kanikal 3 Microwatershed

Particulars	Units	Values
Small farmers		
Total Sample HHs in number	Number	7
Total Land Holding	ha	6.3
Average Total land holding	ha	0.9
Medium farmers		
Total Sample HHs in number	Number	8
Total Land Holding	ha	24.8
Average Total land holding	ha	3.1
Large farmers		
Total Sample HHs in number	Number	8
Total Land Holding	ha	259.9
Average Total land holding	ha	32.5
Pooled farmers		
Total Sample HHs in number	Number	23
Total Land Holding	ha	291.1
Average Total land holding	ha	12.6

Land use: The total land holding in the Kanikal 3 micro-watershed is 291.1 ha (Table 15). Of which 267.0 ha is dry land and 17.0 ha is irrigated land. The average land holding per household is worked out to be 12.6 ha. The total land out of fallow land was 2.47 per cent (7.0 ha).

Table 14: Land use among samples households in Kanikal 3 Microwatershed

Particulars	Per cent	Area in ha
Irrigated land	5.8	17.0
Dry Land	91.7	267.0
Fallow Land	2.5	7.0
Total land holding	100	291.1
Average land holding	12.6	

In the micro-watershed, the prevalent present land uses under perennial plants are neem trees (63.8 %) followed by coconut (12.0 %), mango (7.2 %) and peeple tree (Arali) (4.8%), lime (3.6 %), baniyan tree (2.4 %), pongamia and jalli each are (1.2 %) (Table15).

Table 15: Number of trees/plants covered in sample farm households in Kanikal 3 Microwatershed

Particulars	Number of Plants/trees	Per cent
Banyan tree(Alada)	2	2.4
Coconut	10	12.0
Jalli	1	1.2
Lime	3	3.6
Mango	6	7.2
Neem Trees	53	63.9
Peeple Tree(Arali)	4	4.8
Pongamia	1	1.2
Tamarind	3	3.6
Grand Total	83	100

The land use decisions are usually based on experience of farmers, tradition, expected profit, personal preferences, resources and social requirements. The present dominant crops grown in dry lands in the study area were by red gram (50.4 %) followed by groundnut (9.8 %), cotton (7.9 %), maize (2.8 %), paddy (4.6 %), green gram (4.6 %) and onion (1.8 %) which is taken during Kharif and maize (3.7%), paddy (4.6%), groundnut (5.6 %) and sorghum (3.7 %), during Rabi season respectively. The cropping intensity was 121.5 per cent (Table 16 and Figure 9).

Table 16: Present cropping pattern and cropping intensity in Kanikal 3 Microwatershed

% to Grand Total

Crops	Kharif	Rabi	Grand Total
Red gram	50.4		50.6
Groundnut	9.8	5.6	15.5
Cotton	7.9		7.9
Maize	2.8	3.7	6.5
Paddy	4.6	4.6	9.3
Green gram	4.6		4.6
Onion	1.8		1.8
Sorghum		3.7	3.7
Grand Total	82.24	17.7	100
Cropping intensity (%)	121.5		

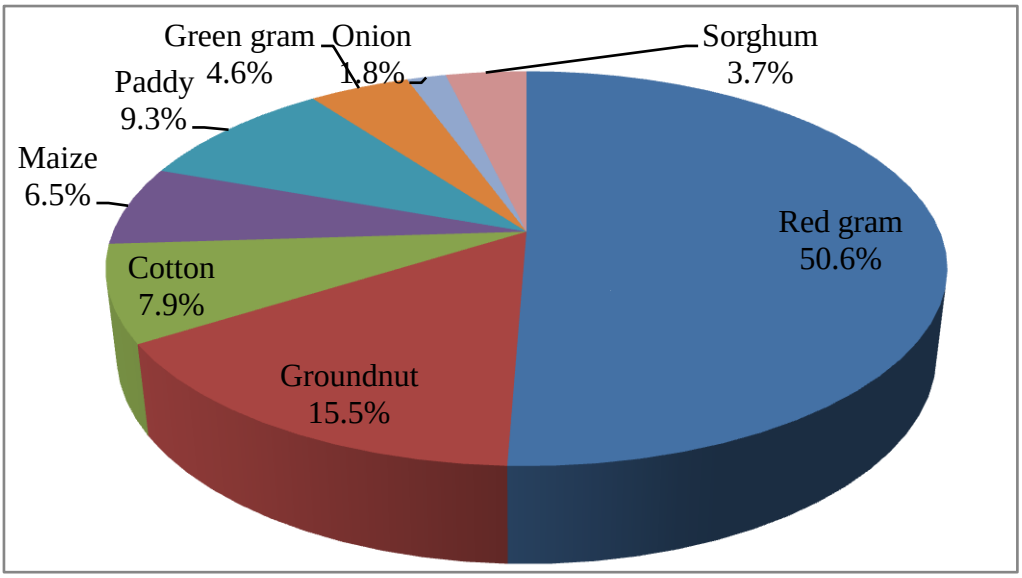

Figure 9: Present cropping pattern in Kanikal 3 Microwatershed

Economic land evaluation

In Kanikal 3 micro-watershed, 13 soil series are identified and mapped (Table 17). The distribution of major soil series are Pogalapur covering an area around 97 ha (17.7 %) followed by Duppali 77 ha (14.1 %), Badiyala 73 ha (13.3 %),Yalleri 49 ha (8.9%), Gondedagi 46 ha (8.6%), Bomraldoddi35 ha (6.3 %), Bhimanahalli 31 ha (5.7 %), Sambara 28 ha (12.5%), Balichakra24 ha (4.4 %),Vanakanahalli 22 ha (3.9%), Yadgir 17ha (3.9%), Baddeppalli 3 ha (0.6) and Belagundi 2 ha (0.4%)

Table 17: Distribution of soil series in Kanikal 3 Microwatershed

Sl. No	Soil series	Area in ha (%)
1	Baddeppalli (BDP)	3 (0.6)
2	Badiyala (BDL)	73 (13.2)
3	Belagundi (BGD)	2 (0.3)
4	Balichakra (BLC)	24 (4.4)
5	Bomraldoddi (BMD)	35 (6.3)
6	Bhimanahalli (BMN)	31 (5.7)
7	Duppali (DPL)	77 (14.1)
8	Gondedagi (GDG)	46 (8.5)
9	Pogalapur (PGP)	97 (17.7)
10	Sambara (SBR)	28 (12.5)
11	Vanakanahalli (VNK)	22 (3.9)
12	Yadgir (YDR)	17 (3.9)
13	Yalleri (YLR)	49 (8.9)
Total		**547.2**

Present cropping pattern on different soil series are given in Table 18. Crops grown on Badiyala soil are cotton, groundnut maize and red gram. Cotton, groundnut, green gram, and paddy on Sambara soil are grown. Maize, red gram, cotton and groundnut are grown on Baddeppalli soil. Cotton, groundnut, paddy, maize and red gram on Yalleri soil are grow. Cotton, groundnut, green gram, paddy and red gram on

Pogalapur soil are grow. Maize, paddy and red gram on Yadgir soil are grow. Red gram and sorghum on Bhimanahalli soil are grow. Cotton, paddy, red gram on Belagundi soil can grow Red gram on Balichakra, Green gram on Bomraldoddi, Groundnut, paddy, onion and red gram on Gundedagi soil is grow and groundnut and red gram on Vanakanahalli soil are grow.

Table 18: Cropping pattern on major soil series in Kanikal 3 Microwatershed

(Area in per cent)

Soil series	Soil Depth	Crops	Dry		Irrigated		Grand Total
			Kharif	Rabi	Kharif	Rabi	
BDL	Shallow (25-50 cm)	Cotton	15.4	0	0	0	15.4
		Groundnut	0	0	23.1	0	23.1
		Maize	0	46	0	0	46.2
		Redgram	15.4	0	0	0	15.4
VNK	Shallow (25-50 cm)	Groundnut	25	0	0	0	25
		Redgram	12.5	0	62.5	0	75
DPL	Moderately shallow (50-75 cm)	Groundnut	0	0	4.8	0	4.8
		Onion	0	0	4.8	0	4.8
		Paddy	0	0	4.8	0	4.8
		Redgram	85.7	0	0	0	85.7
SBR	Moderately shallow (50-75 cm)	Cotton	7.4	0	0	0	7.4
		Green gram	7.4	0	0	0	7.4
		Groundnut	22.2	7.4	0	0	29.6
		Paddy	0	0	0	15	14.8
		Redgram	40.7	0	0	0	40.7
YLR	Moderately shallow (50-75 cm)	Cotton	10.9	0	0	0	10.9
		Groundnut	0	15	0	0	14.5
		Maize	7.2	0	0	0	7.2
		Paddy	0	0	7.2	0	7.2
		Redgram	60.2	0	0	0	60.2
BLC	Moderately deep (75-100 cm)	Redgram	133.3	0	0	0	133.3
PGP	Moderately Deep (75-100 cm)	Cotton	14.8	0	0	0	14.8
		Green gram	7.4	0	0	0	7.4
		Groundnut	22.2	7.4	0	0	29.6
		Paddy	11.1	0	0	15	25.9
		Redgram	22.2	0	0	0	22.2
BGD	Deep (100-150 cm)	Cotton	42.9	0	0	0	42.9
		Paddy	0	0	0	29	28.6
		Redgram	28.6	0	0	0	28.6
GDG	Deep (100-150 cm)	Green gram	100	0	0	0	100
YDR	Deep (100-150 cm)	Maize	0	29	0	0	28.6
		Paddy	0	0	21.4	0	21.4
		Redgram	50	0	0	0	50
BMN	Very deep (>150 cm)	Redgram	70	0	0	0	70
		Sorghum	0	30	0	0	30
BMD	Very deep (>150 cm)	Green gram	100	0	0	0	100

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 19).

Table 19: Alternative land use options for different size group of farmers (Benefit Cast Ratio) in Kanikal 3 Microwatershed

Soil Series	Small Farmers	Medium Farmers	Large Farmers
BDL	Redgram (1.5)	Cotton (1.5) ,Groundnut(1.8), Maize (2.7)	
VNK	Redgram (1.2)	Groundnut(1.1),Redgram(1.3)	
DPL	Groundnut (1.8), Onion (1.1)		Paddy(1.6) Redgram(2.3)
SBR		Cotton(1.1),Redgram (1.1), Green gram (1.1),Paddy (1.1), Groundnut(1.1),	
YLR	Redgram (1.1)		Cotton(1.1), Groundnut (1.1), Maize(1.08), Paddy(1.05), Redgram(1.02)
BLC			Redgram(1.6)
PGP		Green gram(1.07), Paddy(1.1), Groundnut(1.1) Redgram (1.2)	Cotton (1.3), Paddy (1.3),Redgram (1.09)
BGD		Cotton (2.2),Paddy (1.8), Redgram (1.1)	
GDG	Green gram (1.1)		
YDR			Maize (1.17), Paddy (1.18), Redgram (1.11)
BMN			Redgram (1.1),Sorghum (1.2)
BMD	Green gram (1.1)		

The productivity of different crops grown in Kanikal 3 micro-watershed under potential yield of the crops is given in Table 20 to 20c

The data on cost of cultivation and benefit cost ratio (BCR) of different crops is given in Tables 20 to 20 c. The total cost of cultivation in study area for groundnut ranges between Rs.75191/ha in DPL soil (with BCR of 1.02) and Rs.25460/ha in BDL soil (with BCR of 1.52), cotton range between Rs 52541/ha in SBR soil (with of 1.06) and Rs.24517/ha in BGD soil (with BCR of 1.34), green gram range between Rs. 46066/ha in PGP soil (with BCR of 1.07) and Rs. 22949/ha in GDG and BMD soil (with BCR of 1.0), maize cost of cultivation range between is Rs.53030/ha in YLR soil (with BCR of 1.14) and Rs.20504 in BDL soil (with BCR of 1.28), red gram range between is Rs 52680/ha in DRL soil (with BCR of 1.14) and Rs. 9514/ha in DPL soil (with BCR of 1.3), paddy cultivation in DPL soil is Rs.53387/ha(with BCR of 1.6) and PGP soil in Rs.30141ha (with BCR of 1.29) and onion cultivation in DPL soil is Rs62108/ha (with BCR of 1.13).

Table 20: Economic land evaluation and bridging yield gap for different crops in Kanikal 3 micro-watershed

Particulars	BDL(25-50 cm)				VNK(25-50 cm)		DPL(50-75 cm)			
	Cotton	Groundnut	Maize	Redgram	Groundnut	Redgram	Groundnut	Onion	Paddy	Redgram
Total cost (Rs/ha)	50744	25460	20504	36736	39511	40820	75191	62108	53387	9514
Gross Return (Rs/ha)	57551	38697	26347	44460	40014	53723	77064	70395	85462	12350
Net returns (Rs/ha)	6807	13237	5842	14727	503	12903	1873	8287	32075	2836
B:C	1.13	1.52	1.28	1.21	1.01	1.27	1.02	1.13	1.60	1.30
Farmers Practices (FP)										
FYM (t/ha)	2.5	2.5	4.2	0.0	2.5	2.3	0.0	0.0	0.0	0.3
Nitrogen (kg/ha)	69.3	69.3	69.3	80.0	90.0	86.7	120.0	120.0	83.0	83.0
Phosphorus (kg/ha)	38.3	38.3	38.3	57.5	61.8	60.3	86.3	86.3	44.7	44.7
Potash (kg/ha)	0.0	0.0	0.0	0.0	4.3	2.8	0.0	0.0	0.0	0.0
Grain (Qtl/ha)	12.5	8.3	16.7	10.0	12.5	10.0	15.0	37.5	50.0	2.8
Price of Yield (Rs/Qtl)	4660	4500	1500	4500	3000	4667	5000	1900	1700	4500
Soil test based fertilizer Recommendation (STBR)										
FYM (t/ha)	12.5	7.5	7.5	7.5	7.5	7.5	7.5	30.0	9.9	7.5
Nitrogen (kg/ha)	112.5	18.8	75.0	18.8	18.8	20.8	18.8	93.8	75.0	18.8
Phosphorus (kg/ha)	93.8	62.5	62.5	50.0	37.5	37.5	50.0	50.0	62.5	62.5
Potash (kg/ha)	75.0	25.0	25.0	25.0	25.0	25.0	25.0	75.0	50.0	25.0
Grain (Qtl/ha)	18.5	9.0	57.5	13.8	9.0	13.8	9.0	225.0	56.8	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)										
FYM (%)	80.0	66.7	44.4	100.0	66.7	68.9	100.0	100.0	100.0	96.3
Nitrogen (%)	38.4	-269.6	7.6	-326.7	-380.0	-316.0	-540.0	-28.0	-10.6	-342.6
Phosphorus (%)	59.1	38.7	38.7	-15.0	-64.7	-60.9	-72.5	-72.5	28.4	28.4
Potash (%)	100.0	100.0	100.0	100.0	83.0	88.7	100.0	100.0	100.0	100.0
Grain (%)	32.5	7.4	71.0	27.3	-38.9	27.3	-66.7	83.3	12.0	79.8
Value of yield and Fertilizer (Rs)										
Additional Cost (Rs/ha)	14457	5957	4965	6935	3493	3815	5190	29590	11566	7734
Additional Benefits (Rs/ha)	28053	3000	61250	16875	-10500	17500	-30000	356250	11560	49375
Net change Income (Rs/ha)	13597	-2957	56285	9940	-13993	13685	-35190	326660	-6	41641

To be contained...

Table 20a: Economic land evaluation and bridging yield gap for different crops in Kanikal 3 Microwatershed

Particulars	SBR(50-75 cm)					YLR(50-75 cm)				
	Cotton	**Greengram**	**Groundnut**	**Paddy**	**Redgram**	**Cotton**	**Groundnut**	**Maize**	**Paddy**	**Redgram**
Total cost (Rs/ha)	52541	46066	41159	32878	46176	48312	39716	53030	46859	33015
Gross Return (Rs/ha)	55575	49400	44048	39366	51593	55575	45078	60515	53105	40318
Net returns (Rs/ha)	3034	3334	2890	6488	5416	7263	5361	7485	6246	7302
B:C	1.06	1.07	1.07	1.20	1.11	1.15	1.13	1.14	1.13	1.20
Farmers Practices (FP)										
FYM (t/ha)	6.3	5.0	3.3	3.8	4.5	3.3	1.3	2.5	3.8	1.6
Nitrogen (kg/ha)	76.9	125.2	125.2	125.2	117.1	74.7	74.7	74.7	74.7	83.6
Phosphorus (kg/ha)	72.4	110.9	110.9	110.9	104.5	73.4	73.4	73.4	73.4	79.9
Potash (kg/ha)	2.4	0.0	0.0	0.0	0.4	15.1	15.1	15.1	15.1	13.5
Grain (Qtl/ha)	12.5	12.5	10.4	18.8	13.4	12.5	10.0	37.5	25.0	5.6
Price of Yield (Rs/Qtl)	4500	4000	4000	2045	4406	4500	4500	1500	2000	4067
Soil test based fertilizer Recommendation (STBR)										
FYM (t/ha)	12.5	7.5	7.5	9.9	7.5	12.5	7.5	7.5	9.9	7.5
Nitrogen (kg/ha)	112.5	9.8	18.8	75.0	18.8	112.5	18.8	75.0	75.0	18.8
Phosphorus (kg/ha)	93.8	25.0	50.0	50.0	52.1	84.4	56.3	56.3	56.3	55.2
Potash (kg/ha)	75.0	25.0	25.0	50.0	25.0	75.0	25.0	25.0	50.0	25.0
Grain (Qtl/ha)	18.5	6.3	9.0	56.8	13.8	18.5	9.0	57.5	56.8	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)										
FYM (%)	50.0	33.3	55.6	62.0	40.1	73.3	83.3	66.7	62.0	78.1
Nitrogen (%)	31.6	-1183.8	-567.6	-66.9	-524.7	33.6	-298.2	0.4	0.4	-346.0
Phosphorus (%)	22.8	-343.7	-121.8	-121.8	-100.6	13.0	-30.5	-30.5	-30.5	-44.8
Potash (%)	96.9	100.0	100.0	100.0	98.4	79.9	39.7	39.7	69.8	46.2
Grain (%)	32.5	-100.0	-15.7	67.0	2.4	32.5	-11.1	34.8	56.0	59.4
Value of yield and Fertilizer (Rs)										
Additional Cost (Rs/ha)	9071	-2165	709	3848	15	11302	5022	4447	6077	4220
Additional Benefits (Rs/ha)	27090	-25000	-5667	77812	1428	27090	-4500	30000	63600	33209
Net change Income (Rs/ha)	18019	-22835	-6376	73965	1413	15788	-9522	25553	57523	28989

To be contained...

Table 20b: Economic land evaluation and bridging yield gap for different crops in Kanikal 3 Microwatershed

Particulars	BLC (75-100 cm)	PGP (75-100 cm)					BGD Deep (100-150 cm)		
	Redgram	Cotton	Greengram	Groundnut	Paddy	Redgram	Cotton	Paddy	Redgram
Total cost (Rs/ha)	17641	26627	46066	41159	30141	52680	24517	40846	43317
Gross Return (Rs/ha)	24700	27788	49400	44048	38292	59998	32933	49647	54414
Net returns (Rs/ha)	7059	1160	3334	2890	8151	7318	8416	8801	11097
B:C	1.40	1.04	1.07	1.07	1.29	1.14	1.34	1.22	1.26
Farmers Practices (FP)									
FYM (t/ha)	0.0	1.3	5.0	3.3	3.3	4.1	2.5	2.5	5.0
Nitrogen (kg/ha)	51.3	54.4	125.2	125.2	108.8	108.8	86.9	86.9	86.9
Phosphorus (kg/ha)	57.5	57.5	110.9	110.9	98.6	98.6	74.5	74.5	74.5
Potash (kg/ha)	0.0	0.0	0.0	0.0	0.0	0.0	3.5	3.5	3.5
Grain (Qtl/ha)	5.0	6.3	12.5	10.4	18.3	14.4	8.3	37.5	12.5
Price of Yield (Rs/Qtl)	5000	4500	4000	4000	2044	4312	4000	1300	4406
Soil test based fertilizer Recommendation (STBR)									
FYM (t/ha)	7.5	12.5	7.5	7.5	9.9	7.5	12.5	9.9	7.5
Nitrogen (kg/ha)	25.0	112.5	9.8	18.8	75.0	18.8	112.5	75.0	18.8
Phosphorus (kg/ha)	50.0	93.8	28.1	56.3	57.7	57.7	93.8	62.5	62.5
Potash (kg/ha)	25.0	75.0	25.0	25.0	50.0	25.0	93.8	62.5	31.3
Grain (Qtl/ha)	13.8	18.5	6.3	9.0	56.8	13.8	18.5	56.8	13.8
% of Adoption/yield gap (STBR-FP) / (STBR)									
FYM (%)	100.0	90.0	33.3	55.6	66.9	44.9	80.0	74.7	33.3
Nitrogen (%)	-105.0	51.6	-1183.8	-567.6	-45.1	-480.5	22.8	-15.8	-363.3
Phosphorus (%)	-15.0	38.7	-294.4	-97.2	-70.9	-70.9	20.5	-19.2	-19.2
Potash (%)	100.0	100.0	100.0	100.0	100.0	100.0	96.2	94.3	88.7
Grain (%)	63.6	66.3	-100.0	-15.7	67.8	-4.9	55.0	34.0	9.1
Value of yield and Fertilizer (Rs)									
Additional Cost (Rs/ha)	7355	15042	-2028	984	5405	985	12958	7888	1708
Additional Benefits (Rs/ha)	43750	55215	-25000	-5667	7871	-2903	40747	25090	5508
Net change Income (Rs/ha)	36395	40173	-22972	-6651	7336	-3887	27789	1722	3799

To be contained...

Table 20c: Economic land evaluation and bridging yield gap for different crops in Kanikal 3 Microwatershed

Particulars	GDG(100-150 cm)	YDR(100-150 cm)			BMD(>150 cm)	BMN(>150 cm)	
	Greengram	Maize	Paddy	Redgram	Greengram	Redgram	Sorghum
Total cost (Rs/ha)	22949	22584	34208	24847	22949	19484	23158
Gross Return (Rs/ha)	23053	26861	35980	26440	23053	22190	33530
Net returns (Rs/ha)	104	4278	1772	1593	104	2706	10372
B:C	1.00	1.19	1.05	1.06	1.00	1.14	1.45
Farmers Practices (FP)							
FYM (t/ha)	2.5	2.5	2.5	1.8	2.5	0.8	1.3
Nitrogen (kg/ha)	60.4	64.2	64.2	64.2	60.4	72.1	72.1
Phosphorus (kg/ha)	45.4	58.1	58.1	58.1	45.4	49.5	49.5
Potash (kg/ha)	7.1	9.9	9.9	9.9	7.1	12.5	12.5
Grain (Qtl/ha)	5.8	15.6	20.8	7.9	5.8	5.3	18.8
Price of Yield (Rs/Qtl)	4000	1500	1700	3406	4000	4200	1650
Soil test based fertilizer Recommendation (STBR)							
FYM (t/ha)	7.5	7.5	9.9	7.5	7.5	7.5	7.5
Nitrogen (kg/ha)	13.0	75.0	75.0	18.8	13.0	21.9	56.9
Phosphorus (kg/ha)	18.8	62.5	62.5	62.5	18.8	50.0	40.0
Potash (kg/ha)	25.0	25.0	50.0	25.0	25.0	25.0	40.0
Grain (Qtl/ha)	6.3	57.5	56.8	13.8	6.3	13.8	18.8
% of Adoption/yield gap (STBR-FP) / (STBR)							
FYM (%)	66.7	66.7	74.7	76.2	66.7	89.3	83.3
Nitrogen (%)	-364.7	14.5	14.5	-242.1	-364.7	-229.6	-26.8
Phosphorus (%)	-142.2	7.1	7.1	7.1	-142.2	1.1	-23.6
Potash (%)	71.7	60.5	80.3	60.5	71.7	49.9	68.7
Grain (%)	6.7	72.8	63.3	42.9	6.7	61.1	0.0
Value of yield and Fertilizer (Rs)							
Additional Cost (Rs/ha)	3616	5628	8508	5667	3616	6369	6201
Additional Benefits (Rs/ha)	1667	62813	61143	20071	1667	35290	0
Net change Income (Rs/ha)	-1949	57185	52636	14404	-1949	28921	-6201

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 20 to 20 c. There is a huge gap between FYM application by farmers and recommended FYM in all the crops across the soil. There is a larger yield gap in crops grown across different soil series. Adequate knowledge about recommended package of practices is the pre-requisite for their use in cultivation of crops. It is a fact that, recommended practices are major contributing factors to yield. Inadequate knowledge about recommended practices leads to their improper adoption. Strengthening of extension services by concerned agency is required to increase adoption of recommended cultivation practices and ultimately reducing the gap. By adopting soil-test fertiliser recommendation, there is scope to increase yield and income to a maximum of Rs326660 in onion and a minimum of Rs1413 in red gram cultivation.

Table 21: Estimation of onsite cost of soil erosion in Kanikal 3 Microwatershed

Particulars	Quantity(kg)		Value (Rs)	
	Per ha	Total	Per ha	Total
Organic matter	261.6	141516	1647.9	891554
Phosphorus	0.3	162	13.1	7137
Potash	1.6	877	32.4	17544
Iron	0.1	55	4.9	2659
Manganese	0.2	115	58.3	31559
Cupper	0.0	6	5.8	3154
Zinc	0.0	2	0.2	88
Sulpher	0.1	77	5.6	3065
Boron	0.0	5	0.4	219
Total	263.9	142816	1768.9	956979

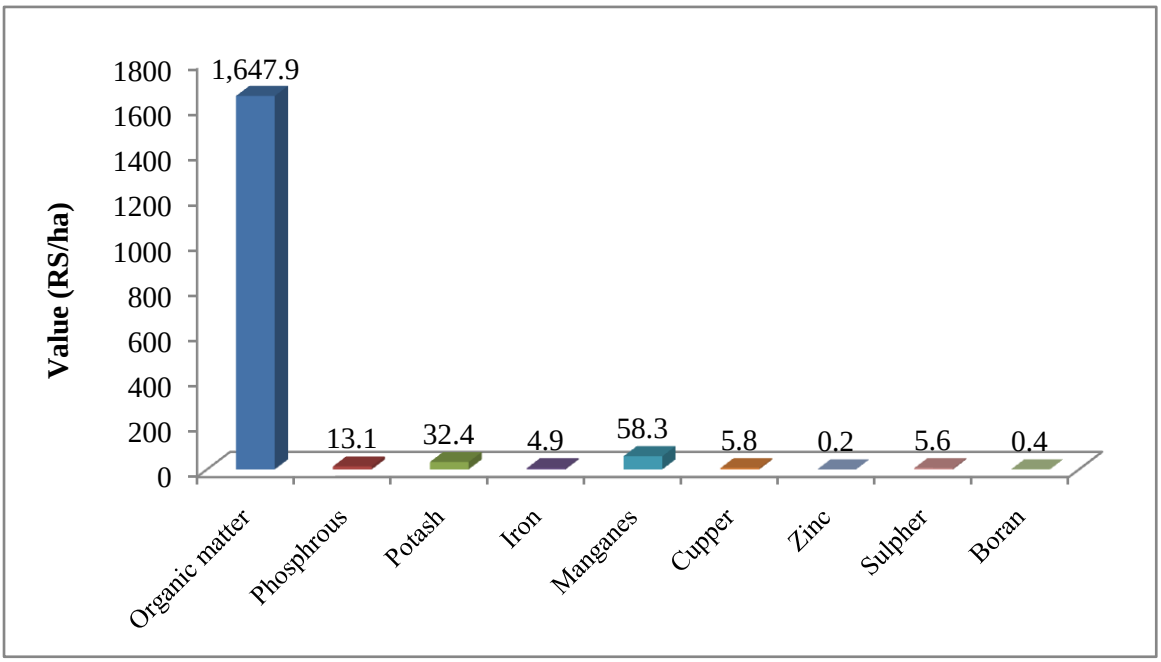

Figure 10: Estimation of onsite cost of soil erosion in Kanikal 3 Microwatershed

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 21 and Figure 10. The average value of soil nutrient loss is around Rs 1768.9 per ha/year. The total cost of annual soil nutrients is around Rs. 956979 per year for the total area of 547.22 ha.

The average value of ecosystem service for food grain production is around Rs 9011/ ha/year (Table 22 and Figure 11). Per hectare food production services is maximum in onion (Rs. 8287) followed by sorghum (Rs. 7408), redgram (Rs.6098), cotton (RS. 5411), maize (Rs. 2465), green gram (Rs. 2258) and groundnut (Rs.1307).

Table 22: Ecosystem services of food grain production in Kanikal 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	Maize	5.7	26.5	1500	39752	37287	225313	2465
	Sorghum	3.2	18.5	1650	30566	23158	99000	7408
Pulses	Greengram	4.0	10.2	4000	40618	38360	164444	2258
	Redgram	43.7	9.7	4344	41956	35858	1834170	6098
Oil seeds	Groundnut	12.1	10.6	4115	43527	42220	528669	1307
Vegetables	Onion	0.4	37.1	1900	70395	62108	28500	8287
Commercial crops	Cotton	6.9	10.6	4443	47254	41842	325227	5411
Grand Total		76.1	12.3	3880	47618	38607	3623947	9011

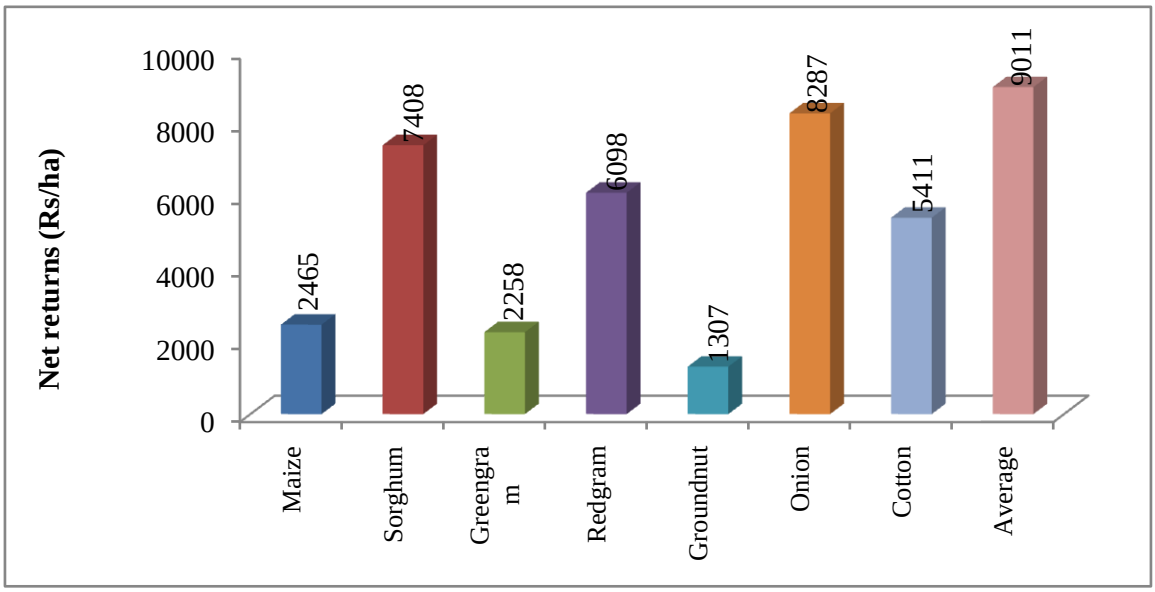

Figure 11: Ecosystem services of food grain production in Kanikal 3 Microwatershed

The average value of ecosystem service for fodder production is around Rs.2961/ ha/year (Table 23). Per hectare fodder production services is maximum in maize (Rs. 4482) followed by sorghum (Rs.2964), groundnut (Rs.2477) and paddy (Rs.1919).

Table 23: Ecosystem services of fodder production in Kanikal 3 Microwatershed

Production items	Crops	Area in ha	Yield (Qtl/ha)	Price (Rs/Qtl)	Total Returns (Rs)	Net Returns (Rs/ha)
Cereals	Maize	5.7	3.4	1300	25404	4482
	Paddy	8.5	1.5	1295	16317	1919
	Sorghum	3.2	2.5	1200	9600	2964
Oil seeds	Groundnut	12.1	2	1262	30083	2477
Grand Total		29.5	2.4	1264	20351	2961

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 24 and Figure 12) in green gram (Rs.70127) followed by sorghum (Rs.56464), red gram (Rs.52576), cotton (Rs.42847), maize (Rs.32384) groundnut (Rs.29424), and onion (Rs.10078).

Table 24: Ecosystem services of water supply in Kanikal 3 Microwatershed

Crops	Yield (Qtl/ha)	Virtual water (cubic meter) per ha	Value of Water (Rs/ha)	Water consumption (Cubic meters/Qtl)
Cotton	10.6	4284.7	42847	402.9
Greengram	10.2	7012.7	70127	690.6
Groundnut	10.6	2942.4	29424	278.2
Maize	26.5	3238.4	32384	122.2
Onion	37.1	1007.8	10078	27.2
Redgram	9.7	5257.6	52576	544.4
Sorghum	18.5	5646.4	56464	304.8
Grand Total	12.3	4533.0	45330	369.4

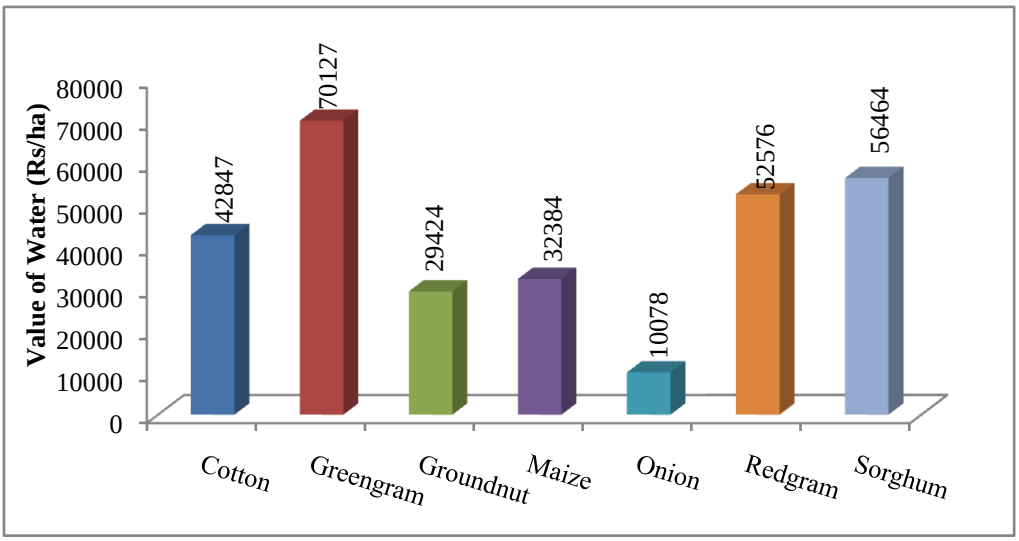

Figure 12: Ecosystem services of water supply in Kanikal 3 Microwatershed

The main constraints in farming is climate change particularly decline in rainfall and increasing temperature. Framers reported that they are not getting timely support/extension services from the concerned development department (Table 25).

Table 25: Farming constraints related land resources of sample households in Kanikal 3 Microwatershed

Particulars	Per cent
Farmers awareness of climate change	
Yes	0
No	100
Perception on climate change	
Decrease in rainfall	0.0
Increase in temperature	0.0
Availability agricultural technology information	
Yes	0
No	100

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